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**(Gen. et sp nov.)**

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# THE VERTEBRATES OF THE ADIRONDACK REGION,

NORTHEASTERN NEW YORK.

BY

CLINTON HART MERRIAM, M. D.

[SECOND INSTALMENT, CONCLUDING THE MAMMALIA.]

Most of the Biographies comprised in this Volume were read before the Linnæan Society of New York at different times during the winter of 1883–84.

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## CHAPTER II.—Concluded.

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### CARIACUS VIRGINIANUS (Bodd.) Gray.

*Common Deer; Virginia Deer; Red Deer; White-tailed Deer.*

Deer are at present so abundant in most parts of the Adirondacks that they outnumber all the other large mammals together, and this in spite of the fact that during the present century alone hundreds of them have perished of cold and starvation, hundreds have been killed by wolves and panthers, and thousands by their natural enemy, man. And there is every reason to believe that if proper game laws are enforced, their numbers will not materially decrease.

This beautiful and graceful animal, by far the fleetest of our mammalia, roams over all parts of the Wilderness, being found high upon the mountain sides, as well as in the lowest valleys and river bottoms. It frequents alike the densest and most impenetrable thickets, and the open beaver meadows and frontier clearings. During the summer season, which is here meant to apply to the entire period of bare ground, loosely reckoning, from the first of May to the first of November, its food consists of a great variety of herbs, grasses, marsh and aquatic plants, the leaves of many deciduous trees and shrubs, blueberries, blackberries, other fruits that grow within its reach; and, largely, of the nutritious beech-nut. While snow covers the ground, which it commonly does about half the year, the fare is necessarily restricted; and it is forced to subsist chiefly upon the twigs and buds of low deciduous trees and shrubs, the twigs and foliage of the arbor vitæ hemlock, and balsam, and a few mosses and lichens. In winters succeeding a good yield of nuts the mast constitutes its staple article of diet, and is obtained by following the beech ridges and pawing up the snow beneath the trees.

When the first warm winds of approaching spring uncover here and there in the beaver meadows small spots and narrow strips of ground between the snowdrifts, the new marsh grass is found already sprouted, and its tender blades afford the Deer a tempting change from the dry twigs and tough lichens that constitute its winter fare.*

From this time until the latter part of September much of their sustenance is procured in the immediate vicinage of water. After the snow has left the forests and the new vegetation has fairly started, they gradually work back into the woods, but return again in early June to feed upon marsh plants and grasses, and wade or even swim to procure the lily-pads and other aquatic plants that thrive in the shallow water near by. During June, July, and August hundreds of Deer visit the water-courses of this Wilderness every night, and retire at break of day to the deep recesses of the forest.

It has been stated that they do this to rid themselves of black flies and mosquitoes, but a little reflection will suffice to show the absurdity of this assertion. For nowhere in the entire Wilderness are these insect pests so abundant and annoying as on the marshes and in the immediate neighborhood of lakes and streams. And since it is rare to find a Deer above his thighs in water, the fallacy of this supposition is apparent. The fact is, that, for the sake of obtaining the plants that grow in such situations, they submit to the annoyance of swarms of insects most of which they would escape did they remain amid the mountain fastnesses. It is true, however, that Deer, particularly at the South, do sometimes enter water when not in search of food, and sink to such a depth that little save the nostrils and eyes remain in sight; but whether this is done for the riddance of insects,

* I was particularly struck with this fact on the 29th April, 1882, while crossing from Big Moose Lake to Lake Terror, in company with Dr. F. H. Hoadley. Here, along the banks of a sluggish stream which was still bordered with ice eight to ten inches in thickness, we observed fresh green grass already over an inch and a half high in small bare spots between snowdrifts two and three feet in depth. The same day we saw a Deer standing on a mass of ice and snow on the shore of Lake Terror, doubtless in search of food.

or for the refreshing effects of the bath, is an open question, and for my part I incline to the latter view. Mr. E. L. Sheppard tells me that he has on two occasions seen Deer enter the water and immerse themselves until almost the entire body disappeared from view, and this when not "skulking," or endeavoring to elude an enemy. The Rev. John Bachman once witnessed this diversion and described it in these words: "We recollect an occasion, when on sitting down to rest on the margin of the Santee river, we observed a pair of antlers on the surface of the water near an old tree, not ten steps from us. The half-closed eye of the buck was upon us; we were without a gun, and he was, therefore, safe from any injury we could inflict upon him. Anxious to observe the cunning he would display, we turned our eyes another way, and commenced a careless whistle, as if for our own amusement, walking gradually towards him in a circuitous route, until we arrived within a few feet of him. He had now sunk so deep in the water that an inch only of his nose, and slight portions of his prongs were seen above the surface. We again sat down on the bank for some minutes, pretending to read a book. At length we suddenly directed our eyes towards him, and raised our hand, when he rushed to the shore, and dashed through the rattling canebrake in rapid style."*

Early in September our Deer begin to desert the water courses, and before cold weather sets in there is a marked decrease in their numbers in the localities which a short time previously were their favorite feeding grounds. The reason is apparent: the marsh grasses have matured and are now dry; the tender aquatic plants near shore have mostly withered and decayed; and the lily-pads and pickerel weed, cut down by September frosts, no longer remain to tempt their appetites. They retire, therefore, to the higher ground in the forest, which still affords them abundant subsistence.†

* Quadrupeds of North America, vol. II, 1851, p. 223.

† The largest and best conditioned Deer I ever saw was a magnificent buck that Dr. F. H. Hoadley shot at Big Moose Lake, October 31, 1881. Its stomach was full, containing a quantity of

A large number of the Adirondack lakes are heavily bordered with a dense frontage of arbor vitæ (here called "white cedar"), which so overhangs the water that the lower limbs barely clear the surface. Around many of these lakes all the lower branches, up to a certain height, are dead, so that on viewing the shore one is struck with the strange appearance of a sharp cut line, about the height of a man's head, extending partly, or entirely, around the lake. Above it the dense foliage presents an almost continuous and unbroken front, impenetrable to the eye, while below it not a green sprig can be seen, the dead limbs and branches remaining in the form of a broad belt.

The cause of this phenomenon long remained a mystery, and many and amusing theories have been advanced for its explanation. It has been supposed that some unusual and unknown agency operated to produce a great overflow of these lakes, and that the present green line indicates the high-water mark of this unrecorded inundation, the branches below it having been killed by the water or ice. Were there no other reasons for disbelieving this hypothesis, its absurdity is demonstrated by the fact that on many of the larger lakes the line is confined to one side. The only other theory, so far as I am aware, that is worthy of refutation, was advanced by no less distinguished a gentleman than Mr. Verplanck Colvin, Superintendent of the Adirondack Survey. Mr. Colvin's theory is, that the snow which is blown off from the ice, on some of the larger lakes, and is sometimes piled in drifts in certain places along the borders, buries the lower limbs of the cedars; and he thinks that this snow "in some unfavorable season, becoming compact and icy, had killed the enclosed evergreen foliage."* The fallacy of this view is proven, I think, by the following facts: 1st, branches on the opposite or shore side of these very

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the leaves and stems of the "bunch berry" or dwarf cornel (*Cornus Canadensis*), a small amount of wintergreen (*Gaultheria procumbens*), and a few leaf-stems of the mountain ash (*Pyrus Americana*) while throughout the mass were scattered numbers of beech-nuts with the shucks on.

* Report of Adirondack Survey, 1880, p. 162.

trees are usually alive and green, which could hardly be the case were the drift theory true; 2d, the line is often most strongly marked on the shores of ponds that are too small, and too closely hemmed in by hills, to afford the wind a chance to drift the snow about their borders; and 3d, the foliage line is, in all instances where I have observed it, perfectly straight, and exactly parallel to the surface of the water, which could not possibly be the case were it caused by irregularly drifted snow.

Moreover, it is now an ascertained fact that the green line is a result of the wintering of Deer along the shores where it exists, and the evidence on this head may be summed up as follows: In the first place, it is absent from at least half of the cedar bordered lakes, and is only found, of recent origin, in localities where Deer are known to winter. On some of the larger lakes it is confined to one shore and sometimes to a single deep bay, while the cedars about the rest of the lake remain unmarred. Furthermore, it is a fact, which can be verified by any one willing to take the trouble, that where the Deer still winter in these places the snow which covers the ice is literally trodden down by them, a well beaten path follows closely the outline of the shore, and the stumps of newly broken branches may here and there be found. The height of the line shows the distance that a full grown Deer can reach when standing on the snow and ice. And finally, trustworthy witnesses affirm that they have observed the Deer standing on the ice in the act of browsing upon the low branches of cedars overhanging the lake. I regard all this evidence as conclusive.

Though Deer are generally spoken of as nocturnal, they are by no means strictly so, their habits, in this particular, being modified by the environment. In localities that are much frequented by man they keep their beds during the greater part of the day, and feed mostly by night; while in the remoter sections the reverse seems to be true.

The spot on which one lies to rest is called its bed. It is gener-

ally hidden in some thicket, under the low branches of an evergreen, or by the top of a fallen tree.*

They have no fear of water and, when pressed by wolves or dogs, take to it as a means of escape. They are excellent swimmers, moving with such speed that a man must row briskly to overhaul them. Even the young fawns swim well, and I once caught one alive that had been driven into the lake. It was in the spotted coat, and not more than three months old.†

The extraordinary sagacity of some of these animals, and the temerity, I might even say stupidity, of others is astonishing. As a general thing a Deer is always on the alert; his eyesight is good, his hearing acute, and his sense of smell developed to an unusual degree. Under ordinary circumstances he detects the whereabouts of man at a considerable distance, and even if abundant is seldom seen. At other times, particularly when feeding on the margin of a lake or river, if the wind is right he may be approached in broad daylight by aid of a boat, and will only raise his head from time to time, gazing at the intruder in a vacant sort of a way; but let the wind shift a trifle, so that he gets a whiff from the direction of the boat, and he is off in an instant. Along the borders of the Wilderness a Deer will sometimes join a group of cows or sheep at pasture, and follow them home within gunshot of the house. Not a few have met their death in this way.

During the deep snows of our severer winters Deer are apt to

* While on a snow-shoe-tramp from Big Otter to Big Moose lake, in January, 1883, I counted upwards of forty Deer beds—mere depressions in the snow. One only was in an exposed position, being in a little opening alongside a maple sapling. With this single exception, all were under the shelter of small spruce and balsam trees, the space between the bed and the overhanging branches, loaded down with ice and snow, being in most cases barely sufficient to admit the animal.

† In Forest and Stream for Dec. 6, 1883 (vol. XXI, no. 19, p. 362), occurs the following: "Deer at Sea.—Portland, Me., Nov. 29.—The British schooner Howard came in yesterday with one of Howard Knowlton's deer on board, which had been picked up about five miles out at sea. The animal escaped from the garden on Peak's Island last summer, and had not been seen since probably having kept in the woods at the lower end of the island. This is the biggest feat of capturing deer in the water on record."

congregate and remain in one locality till the food supply in the immediate vicinity is exhausted, when they move off to some other place. By working to and fro in search of browse the snow becomes much trampled, and pathways are beaten in various directions. These places are called yards, but they fall far short of the regular enclosures, walled in by deep snow, that we so often read about, and even see pictured under this head. They afford the much persecuted animals no shelter or protection, for if discovered by either the panther or the infamous "crust hunter," they become grave-yards for many. Mr. Verplanck Colvin, speaking of one he found on the south side of Seventh Lake Mountain, February 15, 1877, said: "It was impossible to estimate the number of Deer which had occupied this yard, as they had fled at our approach, plunging into the deep snow below. The ground of this central area resembled a sheep yard in winter, the forms of the Deer being plainly discernible in the beds of snow, in which they had slept, on every side.

"Here we were startled by the sight of the fresh tracks of a panther or cougar, which evidently made his home in this abode of plenty; and shortly thereafter we found the body of a Deer freshly killed, and shockingly torn and mutilated. The guides were now all excitement, and followed the cougar's trail eagerly. In less than thirty minutes a shout announced that he had been encountered, and rushing forward to the southern front of the plateau I came upon the monstrous creature, coolly defiant, standing at the brow of a precipice on some dead timber, little more than twenty feet from where I stood. Quickly loading the rifle, I sent a bullet through his brain, and as the smoke lifted, saw him struggling in the fearful convulsions of death, till finally precipitated over the cliffs he disappeared from sight in the depths below." *

It is stated by several writers that the Deer delights in destroying snakes. Dr. Harlan thus speaks of this proclivity:—

* Report of Adirondack Survey, 1880, pp. 159–160.

"This species displays great enmity towards the rattlesnake, which enemy they attack and destroy with singular dexterity and courage; when the Deer discover one of these reptiles, they leap into the air to a great distance above it, and descend with their four feet brought together, forming a solid square, and light on the snake with their whole weight, when they immediately bound away; they return and repeat the same manœuvres until their enemy is completely destroyed." *

*Antlers.*

The branching and gracefully curved antlers which adorn the heads of the bucks, and contribute so largely to the elegant appearance of the animal, are shed and renewed every year. Their growth is so rapid that the full size is usually reached in about three months, and they fall off about four months afterward. They are first seen with us, as a rule, about the middle of May, appearing as soft, dark-colored and rapidly elongating vascular excrescences. They harden from below upwards, and by the time the growth is complete all but the tips is well ossified. The soft, skin-like material, called the velvet, with which they are covered, now begins to peel off in irregular strips and shreds, and by the early part or middle of September the horns are generally clean. The velvet does not come away of itself, but is rubbed and scraped off against shrubs and small trees, as if the antlers itched at the period of maturity. The Hon. Judge Caton, of Ottawa, Illinois, whose facilities for observation in this field have rarely been equalled, makes the following statement, which will, by many, be received with surprise: "The evidence, derived from a very great multitude of observations, made through a course of years, is conclusive that nature prompts the animal to denude its antlers of their covering, at a certain period of its growth, while yet the blood has as free access to that covering as it ever had."†

* Fauna Americana, 1825, p. 242.

† The Antelope and Deer of America. By John Dean Caton, LL. D., 1877, p. 172.

*Seasonal Changes in Pelage.*

Descriptions of the pelages of our mammals do not fall within the scope of the present work; but the seasonal changes in the coat of the Deer have so much to do with its life history that a brief glance at the distinctive features of these changes is necessary. Our Deer shed their coats twice each year, in June and September; and, from the general appearance of the pelage, are said to be in the *red* coat in summer, and in the *blue* or *gray* coat during the rest of the year. The *gray* is merely the *blue* after it has become old and worn, for in maturing it loses the handsome blue appearance that characterizes the first few weeks of its growth. These seasonal changes are not confined to color alone, for there is an equally radical difference in the length and texture of the hair. In summer it is fine and short, and lacks the wavy look that is always noticeable at other times. In winter it is long and coarse, has a crinkled appearance, and the individual hairs are so large and light that the animal will float in water.*

Judge Caton, whose spacious Deer parks and carefully recorded observations have contributed so largely to our knowledge of this species, has published the most accurate, detailed, and complete account of the changes of pelage, that has ever appeared in print. From his extended remarks upon this subject I quote the following brief passages: "The change from the summer to the winter coat is gradual, the new displacing the old by dislodging the hairs promiscuously, till they become so thin that the new coat is seen through the old. This is not simultaneous over the whole animal, for the neck and shoulders may be clothed entirely with the new dress, while the old still prevails on the thighs and rump; or the winter coat may have replaced the old on the back, while the belly still shows only the summer pelage. When the winter has replaced

* It must not be forgotten, however, that Deer are commonly poor in summer, and fat in autumn and early winter. Hence, the later in the season the more nearly will the specific gravity of the animal approach that of water. Consequently, a much smaller amount of buoyant material will suffice to float the animal in October and November, than in July, August, and September.

the summer garb, the hairs are short, fine, and soft; but they rapidly grow in length and diameter, and undergo the changes of color peculiar to the species. At first they lie down smoothly, but presently the diameter becomes so great, that they force each other up to a more vertical position, or at right angles to the skin. As the diameters increase, the cavities within enlarge and become filled with a very light pith, and they become brittle and lose their elasticity, so that the integrity of the walls is destroyed when sharply bent, and they remain in the given position."*

The exact period of shedding and of renewal of the coat varies somewhat from year to year; and it does not always take place at the same time in all the Deer of the region, during the same season. It evidently depends in great measure, if not wholly, upon the condition of the animal at the time of the moult, and this is determined mainly by the way the Deer wintered. After severe winters many are poor and ill conditioned, and they do not put on the *red* coat till late in June, or even till the first of July,—the *blue* being correspondingly delayed. If, on the other hand, the winter has been a mild one, and the supply of beech-nuts large, the Deer have probably wintered well, and come out fat and healthy in the spring. In this case they shed the old *gray* coats early, and the *red* may be seen covering a large part of the animal by the middle of June, or even earlier. These Deer assume the *blue* coat very early, and the change may be well advanced by the last of August.

Deer rut in November, the season commonly extending from the latter part of October till the first week in December. As this period approaches, the necks of the bucks become enormously enlarged,† and their whole demeanor is changed. Instead of treading cautiously through the forest they now rush wildy about, tracking the does

* Antelope and Deer of America, pp. 126–127.

† As early as the last week in October I measured the neck of a buck that was 30 inches (762mm) in circumference, only ten inches behind the ears. The maximum development is attained about the middle of November.

by the scent; and when two or more bucks meet, fierce conflicts ensue. In these engagements their antlers sometimes become interlocked, so that the combatants cannot free themselves, and both must inevitably perish. My father has a set of locked horns that were found, with the carcasses attached, frozen in the ice on Pine Creek, in Lewis County, several winters ago. The body of the larger buck was in fair condition, while that of the smaller was much emaciated, showing that the larger and more powerful had succeeded in forcing his adversary's head to one side so that he could browse a little.

Audubon and Bachman state that they once saw three pairs of horns thus interlocked. What a wretched trio this must have been, slowly starving in the midst of plenty!

At this season the bucks not only fight amongst themselves, but occasionally attack man, and more than one unfortunate person has been gored to death by them. In battle they make use of their horns, and also of the fore feet, whose sharp hoofs are capable of inflicting terrible wounds. I was once sitting quietly on a log in a Deer park when a buck approached, and, making a sudden spring, dealt me such a powerful blow on the head, with the hoofs of his fore feet, as to render me unconscious. No sooner was I thrown upon the ground than the vicious beast sprang upon me, and would doubtless have killed me outright had it not been for the intervention of a man who rushed at him with a club and finally drove him off. Both my father and myself have been knocked flat upon the ground by being struck in the abdomen by the fore feet of a very harmless looking doe.

As a rule, two fawns are born at a time, one being the exception. Most of them are brought forth in May, a few being dropped as early as the latter part of April, while others are postponed until the first week in June. They are at first spotted, the spots usually remaining about four months and disappearing in September, when both old and young change their coats. Before the moult takes place they may fairly be regarded as one of the most beautiful of North American

mammals, and their graceful and sprightly movements cannot fail to elicit admiration.

The clear white spots are set in a ground of rich bay, and the contrast is heightened, to use the language of Judge Caton, by the animal's "exceedingly bright eye, erect attitude, elastic movement, and vivacious appearance. . . . The highest perfection of graceful motion is seen in the fawn of but a month or two old, after it has commenced following its mother through the grounds. It is naturally very timid, and is alarmed at the sight of man, and when it sees its dam go boldly up to him and take food from his hand it manifests both apprehension and surprise, and sometimes something akin to displeasure. I have seen one standing a few rods away, face me boldly and stamp his little foot, in a fierce and threatening way, as if he would say: 'If you hurt my mother I will avenge the insult on the spot.' Ordinarily it will stand with its head elevated to the utmost; its ears erect and projecting somewhat forward; its eye flashing, and raise one fore foot and suspend it for a few moments, and then trot off and around at a safe distance with a measured pace, which is not flight, and with a grace and elasticity which must be seen to be appreciated, for it quite defies verbal description. A foot is raised from the ground so quickly that you hardly see it, it seems poised in the air for an instant and is then so quietly and even tenderly dropped, and again so instantly raised that you are in doubt whether it even touched the ground, and, if it did, you are sure it would not crush the violet on which it fell."*

Fawns are readily tamed, in fact become tame of themselves, if much handled, in an astonishingly short time; and I have known one to follow its keeper, and even bleat for him, when out of sight, within three or four days after its capture. At this tender age they display neither judgment nor common sense in the selection of food, devouring almost anything that falls in their way which they are able to swallow.

* Antelope and Deer of America, p. 155.

Bits of newspapers, old rags, and pieces of boots and shoes are seized and disposed of with as much apparent eagerness as bread and butter or lily-pads; and I once saw a fawn eat a box of chewing tobacco given it by an unprincipled visitor. It died next day.

The flesh of the Deer is juicy, tender, and well flavored, and is the most easily digested of meats. Its good qualities are too well known to require further comment.

The hide is put to a variety of uses, the most important, with us, being the manufacture of gloves and moccasins.

Our Deer are much larger than those of the South and Southwest, adult well-conditioned bucks averaging from 200 to 225 lbs. Avoirdupois in weight, and exceptionally large ones being much heavier. Hence the Adirondack Deer is more than double the size and weight of the same species in Florida.

I have taken great pains to ascertain, approximately, the number of Deer annually slain in this Wilderness, but with indifferent success. It is a low estimate to state that from five to eight hundred have been killed here yearly for the past ten years. How much longer their numbers can withstand this enormous drain is an open question.

On the 3d of July, 1609, Samuel de Champlain ascended the River Richelieu and entered the lake that now bears his name. In his narrative of this memorable journey he speaks thus of the animals found upon the island at the foot of the lake: "Here are a number of beautiful, but low islands filled with very fine woods and prairies, a quantity of game and wild animals, such as stags, deer, fawns, roebucks, bears, and other sorts of animals that come from the mainland to the said islands. We caught a quantity of them. There is also quite a number of Beavers, as well in the river as in several other streams which fall into it. These parts, though agreeable, are not inhabited by any Indians, in consequence of their wars." *

* Documentary History of New York, vol. III, p. 5.

Pennant says, that 25,027 hides were exported from New York and Pennsylvania in the sale of 1764. (Arctic Zoology, vol. I, 1792, p. 33.)

*Spike-Horn Bucks.*

The matter of "Spike-horn Bucks," though somewhat threadbare, deserves mention in this connection from the circumstance that the supposed variety was first described from the Adirondacks. In a note in the American Naturalist for December, 1869 (vol. III, No. 10, pp. 552–553), a writer observed that he had hunted in the Adirondacks for twenty-one years, and goes on to say: "About fourteen years ago, as nearly as I can remember, I first began to hear of Spike-horn Bucks. The stories about them multiplied, and they evidently became more and more common from year to year. About five years ago I shot one of these animals, a large buck with spike-horns, on Louis Lake. In September, 1867, I shot another, a three year old buck with spike-horns, on Cedar Lakes. These Spike-horn Bucks are now frequently shot in all that portion of the Adirondacks south of Raquette Lake. I presume the same is true north of Raquette Lake, but of this latter region I cannot speak from personal observation, having visited it only once.

"The spike-horn differs greatly from the common antler of the *C. Virginianus*. It consists of a single spike, more slender than the antler, and scarcely half so long, projecting forward from the brow, and terminating in a very sharp point. It gives a considerable advantage to its possessor over the common buck. Besides enabling him to run more swiftly through the thick woods and underbrush (every hunter knows that does and yearling bucks run much more rapidly than the large bucks when armed with their cumbrous antlers [!]), the spike-horn is a more effective weapon than the common antler. With this advantage the Spike-horn Bucks are gaining upon the common bucks, and, may, in time, entirely supersede them in the Adirondacks. Undoubtedly the first Spike-horn Buck was merely an accidental freak of nature. But his spike-horns gave him an advan-

tage, and enabled him to propagate his peculiarity. His descendants, having a like advantage, have propagated the peculiarity in a constantly increasing ratio, till they are slowly crowding the antlered Deer from the region they inhabit." *

The foregoing note contains several inaccuracies of statement, and the writer's deductions are wholly erroneous. It was very justly criticised by Mr. W. J. Hays in the *Naturalist* for May, 1870 (pp. 188–189). Further remarks and discussions may be found in the same Journal, vol. IV, pp. 442–443, 762–763; and vol. V, pp. 250–251. The subject is now well understood, and the Hon. Judge Caton has presented the facts of the case with such accuracy and conciseness that I cannot do better than transcribe his own words:—

"It has long been a prevalent opinion among hunters, and to some extent has been adopted by naturalists, that a race of common Deer, the adults of which have antlers without branches, have established themselves in the northeastern part of the United States and in Canada, whence they are driving out the prong-antlered bucks.

"This is a matter of the greatest scientific importance, and I have taken pains to investigate it to my satisfaction, and am entirely convinced that it is a popular error, founded upon incomplete observations. The *spike bucks* found in the Adirondacks are all yearling bucks with their first antlers. The universal testimony, so far as I have been able to gather it, is, that they are smaller than the average of the prong-antlered bucks, and that their spikes vary in length

* The above passage fell under the ever-searching eye of that eminent naturalist and indefatigable collector of facts, the late and much lamented Charles Darwin, whose massive intellect and exhaustive researches have revolutionized Natural Science and mark a new era in the progress of knowledge. Mr. Darwin, misled by this account, part of which he quotes in his masterly work on the Descent of Man, remarks upon it as follows: "A critic has well objected to this account by asking, why, if the simple horns are now so advantageous, were the branched antlers of the parent-form ever developed? To this I can only answer by remarking, that a new mode of attack with new weapons might be a great advantage, as shown by the case of the *Ovis cycloceros*, who thus conquered a domestic ram famous for his fighting power. Though the branched antlers of a stag are well adapted for fighting with his rivals, and though it might be an advantage to the prong-horned variety slowly to acquire long and branched horns, if he had to fight only with others of the same kind, yet it by no means follows that branched horns would be the best fitted for conquering a foe differently armed." (Descent of Man, New York, 1875, p. 513.)

from eight inches, or ten inches at the very utmost, down to two or three inches in length. It is only the largest of these that any have claimed to be adults. It is very easy for a hunter to say, and even believe that he has killed deer with spikes ten inches long, but did he actually measure them, and make a note of the fact, with time and place, describing its appearance, and take and note the measurements of the animal, or did he preserve the head, so that he could carefully examine it, after the excitement of the chase was over, or so that he could submit it to the examination of others? . . . . .

"Continued observations upon the young deer in my parks have enlightened me much on this subject. For several years, I really persuaded myself that I had the true spike-antlered bucks, and set myself to carefully note their peculiarities, and fondly believed that I was about to add an important chapter to scientific knowledge. But these careful and continued observations soon undeceived and disappointed me. By marking the spike buck of one year, which was as large as one feeding by its side having two or three tines on each antler, I found the next year that his antlers were also branched, and my spike-antlered buck had become a fine specimen of the ordinary kind. And then the early fawn of the year before, dropped from a fully adult vigorous doe, which had furnished him plenty of milk, had now grown to the size of a medium adult, and had fine spike-antlers, resembling in all things his older brother of the preceding year now bearing the pronged antlers. And so I anxiously pursued my observations for a number of years, ever looking in vain for a second antler without prongs. Without this certain means of knowledge, I should have believed that those large spike-antlered bucks were more than yearlings and nearly adult. It is true the dentition might have undeceived me, but this I could not ascertain while the animal was alive, and this test has probably been rarely examined and carefully studied by those hunters who believe they have killed adult deer with spike antlers. I feel quite sure that they had not the means of accurately determining the true ages of the wild deer which they

had killed; and what I have already stated may serve to show how very liable all are to be misled in relation to a point, upon a certain knowledge of which the whole question depends." *

The only exception, that has come to my knowledge, to the rule that Spike-horn bucks are always yearlings, is a case that fell under the observation of Mr. E. L. Sheppard: A very old buck, with much gray about its head, was killed in Queer Lake about ten years ago. In addition to its extreme age, it had but three legs and was, consequently, ill-conditioned, having been unable to procure sufficient food. It carried a pair of spike-horns which differed from those of yearling bucks in being much thicker at the base, rougher, more warty, and deeply wrinkled for some distance above the burr. This apparent exception is an illustration of two general laws: (*a*) that in extreme age there is a tendency for certain parts to revert to a condition resembling that of early life; and (*b*) that ill-nourished bucks bear stunted and more or less imperfect horns. It is a well-known fact that the largest, handsomest, and most perfect antlers come from middle-aged Deer that have wintered well and are in fine condition; while the few-pronged and unsymmetrical ones are grown by young or very old animals, or by those that have been wounded or from other cause are poor and ill-conditioned.†

All yearlings do not have true spike-horns, and, if the term be made to include all unbranched antlers, I am strongly of the opinion that two-year old bucks sometimes grow them. I have a pair of unbranched antlers that are curved both inward and forward, and are of exceptional length, the separate horns measuring respectively ten and a half and eleven inches (or 267 and 279mm.) over the curve, and

* Antelope and Deer of America, pp. 231–232.

† Through the kindness of the well-known guide, Mr. E. L. Sheppard, I possess a specimen of unusual interest that well illustrates this point. The buck, which was an adult, was killed at Big Moose Lake, September 10, 1880, and its horns are imperfect, asymmetrical, and very scraggy. The animal was lank and thin, and was found to be a cripple. Its left humerus had once been broken and the fragments had united at a right angle, so that the fore-leg was directed forward, and the shortening of the humerus was so great (its greatest length being less than six and a half inches, or, exactly, 164mm.) that the foot could not be made to touch the ground.

seven and a half and eight inches (190 and 203mm.) in a straight line from the base of the burr to the tip. The longest horn presents a slight enlargement, three inches from the tip, along its upper and posterior border, the greatest thickness of which is three-quarters of an inch (19mm.), thus indicating the point where a prong ought to have grown. I take it that these are the horns of a two-year old, but have no means of determining this very important question. I also have two other pairs of horns from young Deer, that are smaller than those just described and yet one horn of each pair is forked. Whether they came from yearlings or two-year olds I will not venture to decide.

In my opinion the term spike-horn should be limited to the straight and true spike that is known to be characteristic of the yearling buck.

Does sometimes, though rarely, have horns, and they are usually of the "spike" pattern, only more incurved than those of the bucks, and they are apt to be more or less imperfect and unsymmetrical. They are generally covered with the velvet, no matter at what season taken, in this respect resembling those of castrated bucks. Does that bear antlers do not commonly bear young, though they are not always barren.*

### *The Chase.*

An account of the different ways of hunting the Deer on the plains and prairies of the West, in the canebrakes and swamps of the South, and in other sections remote from the region under consideration, however interesting, does not fall within the scope of the

* Alonzo Wood, Esq., one of the most experienced and competent guides in the Adirondacks, has kindly presented me with a very beautiful pair of spike antlers that were taken from a doe which was killed at Second Lake of North Branch about the first of September, 1876. They are deeply curved, symmetrical, and covered with a very dense coat of "velvet," the individual hairs of which are of unusual length. The measurements of these antlers are as follows:

| | | |
|---|---|---|
| From burr to tip, | in a straight line, | 6 in. (152 mm.) |
| " | " around curve, | 8¼ " (210 " ) |
| Distance between tips, | | 4¼ " (108 " ) |
| " | antlers at curve, | 6¼ " (159 " ) |

present work ; hence the methods practised in the Adirondacks will alone be described.

There are three principal ways in which Deer are hunted in this Wilderness, namely : by *floating*, by *driving* (hounding), and by *still-hunting*.

*Floating* consists in paddling up to a Deer, at night, with a light called a *jack* fastened above the bow of the boat, and so arranged that it casts the whole light ahead, leaving the boat and contents in exaggerated darkness. The *jack* of our ancestors (used even within the brief period of my own recollection), was a very simple affair, constructed where occasion required. It consisted of a torch, or sometimes a tallow candle, fastened upon a piece of bark, and backed by a bark reflector. This rude illuminator was attached to a stick, three or four feet long, that stood upright in the bow. The stick, or standard of the primitive jack, still remains, and now supports a lantern which is closed in on three sides so that all the light shall be thrown in front. Some sort of a reflector is generally used to concentrate and project the rays to a greater distance. Sometimes the light is fastened to the hat.

Two people constitute a floating party, and the *modus operandi* is as follows : The sportsman sits on the front seat, with his legs tucked under the bow in a position that is, at the start, anything but agreeable, and becomes distressingly uncomfortable as hour after hour drags slowly on. He dare not move lest the noise thus made should alarm the Deer. The guide sits in the stern and must be expert with the paddle, for it is his duty to propel the boat steadily and noiselessly within easy range of the wary Deer.

The locality is usually selected in the day-time, and is generally some marsh-bordered bay, abounding in lily-pads, or a similar place along the banks of a sluggish stream On nearing the feeding ground not a word is spoken, not even in a whisper, and the hunters strain eye and ear to discover the whereabouts of the quarry. The light is turned in such a way that it covers the shore as the boat

glides silently on, for the Deer may be gazing at it from the bank, standing motionless and silent. Indeed, he is often seen, not more than a couple of boat lengths away, before any sound has forewarned them of his presence.

Bright moonlight nights are undesirable because the animal can then detect the outline of the boat, and is apt to take to the woods without delay.

Let us note the course of events in an ordinary floating expedition, premising only that the sportsman is somewhat of a novice. Unless there is direct water communication between the camp and the place selected for the hunt, the party eat an early supper and set out at once in order to reach the spot before the gathering darkness obscures the way. The guide, placing the boat upon his sturdy shoulders, takes the lead, following some old trail or blazed line, or, if the spot be unfrequented, finds his way by certain features of mountain or valley that are familiar landmarks to his practised eye. The sportsman follows, carrying the *jack* and gun, as well as a bottle of tar oil for protection against insects.

The start is well timed, for the outlines of near objects have already become indistinct, and the shades of dusk are fast blending the dim forms of the evergreens, transforming the coniferous forest into a uniform mass of darkness, when they emerge upon the open shore of a small and shallow lake and launch the canoe in its black but unruffled water. Night is upon them, and with it the flies and mosquitoes. Tar oil is applied freely to face and hands, the jack is lit and placed, and they step quietly into the boat and move noiselessly off,—the sportsman on the front seat, his overcoat buttoned up to his chin, and his feet crowded uncomfortably under the bow, one on each side of the jack-stick; the guide astern, silently plying his paddle. The nearest marsh-bordered bay is soon reached, and as the light skims along the bank, falling in turn upon clumps of bushes, old logs and stumps, and the dark cone-like forms of the young spruce and balsams, the sportsman's

expectation is at its highest pitch; he feels his heart beat faster and faster, and grasps his gun tighter and tighter, imagining that each fantastic shadow will show the white tail of a retreating buck. The suspense is of short duration, for this feeding-ground is passed without so much as the sound of a moving branch to indicate the presence of any animal larger than the flies that swarm about his head. Now comes a pull of half a mile before the next ground is reached, which would afford the sportsman ample time to compose himself, were it not for the armies of pestiferous flies and mosquitoes that demand, and receive, his undivided attention. The bottle of tar oil is produced, and a thorough smearing grants temporary respite. No sooner is this accomplished than the next favorable shore for Deer is fast appearing over the port bow. Another ten minutes of breathless suspense and they turn again into the open lake. A close listener might have detected a half suppressed sigh of submission to the inevitable, from the fore part of the boat, but no other sound disturbs the unbroken silence of the night. The third swampy bay is reached and passed, with like result. A council ensues, in a low whisper, and it is decided to run up the inlet, a marshy stream averaging less than a boat's length in width. Having arrived at its mouth they proceed very slowly, for good feed abounds on both banks, and a Deer may be surprised at any moment. Presently a noise is heard ahead: it is vague and indefinite, but evidently something moving. The boat comes nearer; the noise ceases; it is heard again. The sight is strained to penetrate the bushes along the shore, but nothing is discovered. Hark! something dripping in the water; the eyes are lowered, and there, on a log that projects into the stream, almost within reach from the bow, is seen the form of a large porcupine, lazily eating lily-pads and gazing stupidly at the light. The sportsman is tempted to fire, but controls his disgust and says nothing. A bend in the tortuous channel is passed, and another, and,—*splash*, *splash*, *splash*: it is the unmistakable sound of a

Deer wading in the creek. Then all is still again. Is the animal standing in the water looking at the light, or has he stepped out upon the bank? The sportsman hears the faint ripple of water against the bow as the boat moves swiftly on; he is conscious that the hat is rising on his head; his heart beats louder and louder, and he feels it knocking violently against his ribs. The boat is slackened and the light made, in turn, to cover both shores. Moments seem like hours, and the flies are entirely forgotten. But what has become of the game? Inadvertently the gun rubs against the jack-stick when, simultaneously, is heard the sharp shrill whistle of a startled buck, from behind a bush to the right, and the fading sound of crackling branches announce his disappearance in the forest.

The flies now seem worse than ever, and so they really are, for the boat is passing through their very headquarters, and the bright light attracts them to the spot. Continuing the course up the sluggish stream it is some time before anything occurs to divert the sportsman's attention from these tormenting insects, which constantly get into the eyes, nose, and mouth, till, harassed, exasperated, and well nigh distracted, he applies his only remedy, the tar oil, so freely that he soon feels it trickling slowly down his aching back. The cramped position of his legs and feet is actually painful, and his back "seems as if it would break." The hour is past midnight, his lids are heavy, and he has almost determined to request the guide to turn back when a loud plunge alongside the boat gives him a sudden start and elicits the involuntary exclamation: "what's that?" forgetting for the moment the necessity of silence. "Nothing but a muskrat," calmly replies the guide in a whisper. "Muskrat? hum!" he retorts in a tone of incredulity, but says no more.

Another hour passes wearily away. The inlet, which is here so narrow and shallow as scarely to admit the boat, is crossed by a fallen tree that bars farther progress. The return voyage becomes

very monotonous, and finally even the flies fail to keep up the excitement. The drowsy hunter nods, his eyes close, and his head hangs heavily upon his breast. Suddenly an owl, on a low limb overhead, utters one of his loudest and most startling cries. The affrighted sportsman cocks both barrels of his gun, expecting to detect the crouching form of a panther preparing for the fatal spring. On being assured of the harmless nature of his imaginary foe he cannot suppress a groan of mortification and disgust while he endeavors to regain his equanimity. Beads of cold sweat mingle with the oil upon his forehead as he solemnly and silently vows that floating is a diversion into which he will never again be beguiled. He feels chilly, and wonders if this is really a sample of Adirondack sport, or if his guide has been playing him a trick. While his mind is occupied with these meditations they have reached the lake, and the guide, anxious not to return empty-handed, has put the boat into a shallow bay and is working it slowly ahead amongst the lily-pads. The sportsman, now too cold to sleep, feels the boat slacken its headway and stop. He wonders if the guide has dropped off in a doze and is about to turn and investigate when the word "shoot," uttered in a low whisper, falls upon his ears. He doesn't see anything to shoot, but on looking more closely, discovers, partly hidden behind a bush, the form of a Deer, as motionless as a statue, gazing inquiringly at the light. Raising the gun nervously to his shoulder he fires. A desperate leap, a wild plunge ahead, a heavy fall, and a noble buck lies dead upon the bank.

*Driving* consists in chasing a Deer with hounds, and killing it, if possible, when it takes to water. A Deer is not much afraid of a dog, and when the latter commences to bay on the track does not start off at once, but waits till sure that the hound is really chasing it. It then moves away at a brisk pace, rapidly distancing its pursuer, and is apt to run several miles, circling through valleys and over hills, before taking to water. If now a stream of any

size is reached, the animal is liable to wade for a considerable distance in order to throw the dog off the scent. It then stops to listen, and if after a while the dog again finds the track, will generally take a pretty straight course for some neighboring lake, and swim it in order to rid itself of the annoyance of being followed. Instead of swimming, it sometimes skulks in shallow water near shore, and in this way baffles the dog.

The details of the hunt having been arranged over night, the participants proceed, soon after daylight, to their respective posts, while the guide puts out the dogs. If the lake about which the hunt centres is a large one, two or more men are stationed at different points to watch it, while the others make portages to adjacent lakes and ponds. The guide commonly starts several dogs, each on a separate track. Each watch-point is provided with a boat, and the hunters keep a sharp look-out, for the Deer is frequently so far ahead that it takes the water before the bay of the hound comes within hearing. If the game is a doe or fawn, and particularly if early in the season, the head alone is commonly seen above the surface, and at a distance it is likely to be mistaken for a duck. A buck swims higher, and the later the date the more of its body shows out of water. Deer killed in September generally sink, but after this month they usually float. This depends upon the state of the pelage; for when in the *red* coat they sink, while, on the contrary, when the *blue* coat, which grows very rapidly, is an inch in length, it will, as a rule, float the Deer that carries it, and this length is generally attained about the first of October.

When a Deer is seen swimming the lake, the hunter waits till it has gone far enough from shore to give him an opportunity to head it off, before launching his boat and starting in pursuit. By exercising a little caution and not hurrying too much, he is often able to approach within easy range without being observed; but, if the animal sights him or hears any suspicious noise, it swims so fast that unless in a large lake and some distance from shore, the

hunter has great difficulty in overtaking it. When a large buck is overtaken and unexpectedly finds that he is pursued, he suddenly turns toward the boat, with a look of mingled astonishment and horror, rises high out of water and snorts; then, facing about, makes a desperate, but usually fruitless, effort to escape.

In September it is not uncommon for a guide to drive the Deer about the lake till well nigh exhausted, and then catch and hold it by the tail, so that it will not sink, while the "sportsman" kills it!

In *driving*, a hunt ordinarily lasts seven or eight hours, and is apt to become a trifle monotonous, particularly for those who do not happen to see a Deer. It commonly has this advantage, however, that there are at this season (autumn) no flies to pester the watchman, who, if he can manage to keep warm, and has enough to eat, may maintain a tolerable degree of complacency.

*Still-hunting*, with us, consists in following a deer, by its tracks on the ground, and in attempting to overtake and shoot it, by daylight, in its home in the forest. It is sometimes, though rarely, practised by our most skilful still-hunters in summer and early autumn, after a recent rain has so moistened the surface that the foot-prints can be traced. But it is when the ground is covered with a few inches of newly fallen snow, in November and December, that this method of hunting is commonly resorted to. A rifle is the weapon usually employed.

In order that he may step as noiselessly as possible, the hunter lays aside his boots, covers his feet with several pairs of woolen stockings, and over them draws a pair of well-made buckskin moccasins. Starting early in the morning, he makes a circuit in search of fresh tracks, and if Deer are plenty, pays no attention to those of does and fawns, but proceeds till the track of a large buck is discovered. This he follows slowly and cautiously, taking care lest he tread on some dead branch or in any way make a noise that might alarm the wary Deer. The animal often takes

fright and makes off at full speed before it has been seen at all. This the hunter at once detects by the difference in the track, the long spaces between footprints plainly showing that it was on the run. He now throws off all restraint and strikes into a brisk pace, for the Deer is already likely to be several miles away, and whatever noise is made cannot possibly reach its distant ears. When the tracks indicate that the Deer has slackened its gait into a walk, and has, perhaps, commenced to browse a little, then it is time to advance again slowly and with great circumspection, for having been once alarmed, it is even more on the alert than usual, and can only be approached with the utmost care.

It not unfrequently happens that the Deer enters a swamp where several others are feeding, in which case the snow is apt to be so much cut up that it is impossible to follow the original track unless its size serves to distinguish it; and even then it may cross and recross its own path so many times as to bewilder the hunter, who must now do one of two things: either advance stealthily and noiselessly through the swamp, without regard to the footprints, hoping by chance to get a shot; or he must make a wide detour, circling around it, to see if the track he is after leads away in any direction. If it does not, he knows that the Deer is still in the swamp, and must return and attempt to find it. Appreciating the difficulty of the undertaking, he moves with great deliberation, his practised eye penetrating, at each step, every space and recess that the slight change of position brings in view. To the left he observes a prostrate maple, felled by the wind, and, knowing that Deer are fond of the kind of browse* it

* Deer greedily devour the lichens that adhere to the branches of trees that have long been dead, and the buds and twigs of those that were living when they fell. This fact is well-known to woodsmen, who invariably assert that if a tree falls during the night, tracks of Deer can always be found there next morning. And I have heard more than one old hunter affirm it to be his sincere belief that Deer know the cause of the noise produced by a falling tree, and, guided by the sound, at once set out in quest of the spot.

Mr. John Constable tells me that he once shot a Deer in the act of browsing upon the lichens that clung to a fallen tree-top. The animal was standing on its hind-legs, with its fore-feet resting upon a large limb, and was reaching up for the lichens.

affords, works cautiously toward it. The branches are reached but no live thing is seen, and his eyes are bent in other directions when,—*crash, crash*, under his very nose, and he is deluged with a shower of snow that, for the moment, completely blinds him. He may, or he may not, get his eyes open in time to catch a vanishing glimpse of the affrighted Deer, and, now that it is too late, discovers the bed of his would-be victim under the fallen tree-top, at his very feet.

The hunter rarely sees the whole outline of a Deer in still-hunting. The forests are so thick, and the evergreens so loaded with snow, that an object is not commonly visible at any great distance, and a part of the leg or a patch of hair constitute the target usually presented to his eye. He sometimes fires directly at what he sees, and sometimes "allows a trifle" aiming a little ahead or a little behind, as the case may be. If severely wounded, without being killed outright, the animal is generally left for several hours, or until the next day; for if pursued it would continue to run as long as its strength held out; while, on the other hand, if left alone it soon lies down and will probably never rise again. Judge Caton says: "But few animals will go so far and so fast, after receiving a mortal wound, as a Virginia Deer," * and I have myself followed a buck, shot through both lungs with a 44 calibre rifle-ball, more than a mile and a half through the woods!

In localities where Deer are abundant an expert still-hunter frequently kills two or three in a single day, but such hunts are very laborious, for the track often leads many miles, in a tortuous course, over hard-wood ridges, across stretches of spruce and hemlock, and through dense balsam and cedar swamps. It is a long distance to camp, but thitherward, at nightfall, the weary hunter wends his way. His course lies through a swamp in which the evergreens grow so near together that the eye is unable to penetrate farther than a few paces in any direction, and are so

* Loc. Cit., p. 383.

loaded with snow that the dark green of the few uncovered branches contrasts markedly with the uniform white of the tent-like cones from which they protrude. The silence is oppressive, and unbroken even by the sighing of the wind. The imagination, aided by the gathering shades of dusk, sees in this picture a primeval forest, amongst whose time-worn trunks stands the long deserted encampment of a bygone race. The well-preserved wigwams of spotless white, bleached by many winters, and pitched upon a floor of alabaster, mark the final bivouac of an unremembered nation.

Of the three methods of hunting heretofore considered, *driving* is the least sportsmanlike, and affords the Deer the smallest chance of escape. It requires neither skill nor cunning on the part of the executioner; for patience, and a very ordinary amount of common sense, are the only essentials. It has this advantage, however, that the Deer, if wounded at all, is almost certain to be killed outright,—which cannot be said of the other methods.

*Floating* requires one of the actors to be expert in the use of the paddle, and is really quite an exciting diversion. This is partly because it can only be practised by night, and partly because each change of position of the boat, and each curve and bend of the shore brings new objects into the limited field of vision, keeping the expectation in a state of acute tension. But after all, when the novelty has worn off, one cannot help realizing that it is like carrying a lantern, any dark night, through a frontier pasture, and shooting the first unlucky cow that chances to stand in the path.

In *still-hunting*, on the other hand, the hunter is thrown entirely upon his own resources, and it is the only method of taking the Deer in this Wilderness that requires any particular skill or labor on his part. The guide is here superfluous, unless it be to string up the game and find the shortest way to camp when the hunt is over. Still-hunting tends to toughen the muscles, to sharpen the

vision, to quicken the hearing, and to impart to the whole system a glow of health and vigor. It calls into play the exercise of functions that are apt to be neglected by the student and man of business, and inspires the lover of nature with a zeal and enthusiasm not easily extinguished.

In addition to the three foregoing legitimate (!) methods of hunting the Deer, there are sometimes practised here two other ways of killing—I might better say butchering—that are too despicable even to be spoken of without a feeling of shame. They are: by means of *licks*, and by *crusting*.

A *lick* is a place where salt is put,* and the supply from time to time replenished. The Deer, being exceedingly fond of salt, after having once discovered the place, repair to it with great regularity. When they have visited the lick nightly for some little time, which is ascertained by examining the ground round about for tracks, the murderous pot-hunter, armed with a double-barrelled gun loaded with buck-shot, secretes himself at dusk behind some convenient covert, or in a neighboring tree, and in silence awaits the approach of his unsuspecting victim.

*Crusting* is a method of destruction that is still more unfair and atrocious than that just described, and is only practised by the most worthless and depraved vagabonds. It depends, fortunately, upon a condition of the deep snows that is usually of short duration, and rarely occurs save in the months of February and March. When the snow averages four or five feet in depth on the level, a thaw, followed by a freeze, converts the surface into a stiff crust which renders the Deer very helpless. Taking advantage of this state of things, the crust-hunters sally forth. Their snow-shoes enable them to skim lightly over the surface, whilst the poor Deer

* The only natural deer-lick in the Adirondacks, so far as I am aware, is thus spoken of by Mr. Colvin: "I observed in a moist place a deposit of marly clay, a rare thing in this region. What was most interesting, however, was the fact that this was a natural deer-lick, many places showing where the Deer had licked the clay, possibly obtaining a trifle of potash, alumina, and iron, derived from sulphates from decomposing pyrites." (Report of the Adirondack Survey, 1880, p. 193.)

are unable to move except by the greatest effort, and are soon exhausted. They sink to their bellies at every plunge, the sharp hoofs cutting through the frozen crust, which lacerates their slender legs till the tracks are stained with blood. The cruel foe is upon them, and well do they realize that the struggle is for life. Every muscle is strained to the utmost in the frantic effort to escape, but in vain. Every leap tells bitterly on the fast-waning strength, and they soon sink in the snow, breathless and with heaving sides. Their large liquid eyes are turned toward their brutal pursuers, as if to implore mercy, but none is given. All share a like fate—they are butchered in cold blood.

### *Deer Protection.*

For many years an army of hardy lumbermen, wood-choppers, and bark-peelers has been steadily at work, together with its concomitant devastating fires, in making progressive and disastrous inroads upon the ill-fated forests of the Adirondacks. Much of the proper borders of the region, long since stripped of timber, present to the eye a desolate and barren waste, whose present irregular boundaries are still contracting with ominous rapidity.

New saw-mills, pulp-mills, and numerous other manufacturing establishments that consume vast quantities of wood, are constantly being erected; and, as if this were not enough, it is possible that before the snows of another winter cover the earth, a railroad will pierce the very heart of this grand Wilderness.

It augurs ill for the Deer when the footprints of the panther or wolf are found near its winter quarters, but the cold steel tracks of the iron horse admonish us of the presence of a tenfold more insidious and subtle foe; for the railroad not only brings the Deer's greatest enemy, man, into its immediate haunts, but destroys and carries off the forests that constitute its home. Hence it naturally follows that unless the region is early converted into a State Preserve, which, unfortunately, seems hardly probable, the laws that

heretofore sufficed to enable this animal to hold its own, will soon prove inadequate. Therefore, the subject of Deer Protection becomes one that claims earnest and thoughtful consideration from our sportsmen and hunters, and demands intelligent and judicious legislation.

The present law was a fairly good one at the time of its enactment, but it has ceased to meet existing conditions; that it will prove ineffectual against the demands of the rapidly increasing occupancy and destruction of the forests, requires no great perspicacity to foretell.

There are two weak points in the law as it now stands: 1st, the open season is too long by at least a month; and 2d, there is no limit put to the number of Deer that a party, or an individual, may kill during this period. The season begins with the month of August, and when the weather is propitious more than a hundred boats are nightly engaged in *floating*, on the various watercourses of the Adirondacks. Now it is an undisputed fact that, by this method of hunting, more than twice as many does as bucks are killed, and that a large percentage of those fired at are wounded, and escape into the woods to die. It is also a fact that, as a rule, each doe has two fawns, and that fawns deprived of their mother's milk before the first of September usually die. Hence the appalling truth becomes apparent, that for every twenty-five Deer secured by floating, at least fifty (and probably a much larger number) must be destroyed! Therefore it seems proper that the season should not open before the first of September. The second weak point in the law is also a vital one. It is notorious that during the past two years many hundreds of Deer have been slaughtered over and above the number necessary to keep the parties killing them supplied with venison. In parts of Canada, and in the State of Maine, the law sets a limit to the number of moose, caribou, and Deer that may be killed by an individual or camp during a given period, and I see no reason why a similar

law might not be enacted and enforced in our own State with like good results.

## NOTES ON EXTERMINATED AND EXTINCT UNGULATES.

NOTE 1.—It is not many years since the Moose (*Alce Americanus*) was a favorite object of pursuit in the Adirondacks, from which region it was exterminated, as nearly as I can ascertain, about the year 1861.

Dr. DeKay, in his Zoology of New York, said of these animals: "They are yet numerous in the unsettled portions of the State, in the counties of Essex, Herkimer, Hamilton, Franklin, Lewis, and Warren; and since the gradual removal of the Indians, they are now (1841) believed to be on the increase . . . . The Moose furnishes an excellent material from its hide for moccasins and snow-shoes. The best skin is obtained from the bull Moose in October, and usually sells for four dollars. They were formerly so numerous about Raquet Lake, that the Indians and French Canadians resorted thither to obtain their hides for this purpose; and hence we have the origin of the name of that lake, the word *raquet* meaning *snow-shoes*. They still exist in its neighborhood."

The Moose is a huge animal, the adult males often standing six feet in height at the shoulders, and exceeding a thousand pounds in weight, Evidence of its former presence here may still be seen in various parts of the Wilderness, where the long scars of its "peelings" yet remain. These commonly consist of small soft or swamp maples (*Acer rubrum* L.) and striped maples (*A. Pennsylvanicum* L.) from which the bark has been stript, from a short distance above the ground to the height of eight or even ten feet. This bark, together with the branches of the same tree, and several kinds of browse, constitute its principal food in winter. In summer it feeds also upon marsh grasses and aquatic plants, notably upon the roots of the pond lily.

In the fall of 1853 Thoreau met an Indian, named Tahmunt Swasen, in the forests near Moosehead Lake, Maine, who told him that he had hunted Moose in the Adirondacks in New York, but that they were more plentiful in the Maine woods.*

Concerning the abundance of the Moose in the Adirondacks subsequent to 1850, and its final disappearance from the region, I have taken great pains to solicit information, both through private inquiry and correspondence, and publicly through the medium of *Forest and Stream.* The result of this investigation, in which I have been greatly aided by Dr. Frederick H. Hoadley, is a deluge of individual opinion and conflicting statement, together with a meagre amount of positive information of a strictly reliable character.

Early in March, 1851, Mr. John Constable and his brother Stevenson killed two Moose near the head of Independence Creek, in Herkimer County. They killed their last Moose in March, 1856, west of Charley's Pond, in Hamilton County. Mr. Constable writes me: "I never recur to those hunts with any satisfaction, for much as I enjoyed at the time the tramp of more than a hundred miles on snow-shoes, the camping in the snow, the intense excitement of the search and pursuit, I must ever regret the part I have taken unwittingly in exterminating this noble animal from our forests. Were I younger, I would assist in reinstating them, as the plan is perfectly feasible. In the early years of my still-hunting, moose were quite numerous, and I rarely, if ever, failed to see signs of their peelings or their tracks."

In the year 1852 or 1853 the well-known guides, Alonzo Wood and Ed. Arnold, killed two Moose and found a third dead, back of Seventh Lake Mountain, in Hamilton County.

Dr. J. H. Guild writes me from Rupert, Vermont, that a Moose was killed at or near Mud Lake, in the Lower Saranac region, in 1856.

* The Maine Woods. By Henry D. Thoreau, Boston, 1864, p. 141.

In July of the same year (1856) Ed. Arnold killed a Moose at Nick's Lake; and in the following spring a man named Baker killed another in the same vicinity.

One evening during the summer of 1858 a Moose strayed into the Wood's garden at Raquette Lake, but was not shot.

The Hon. Horatio Seymour, ex-Governor of the State of New York, killed a huge bull Moose in the forest North of Joc's Lake. Its head and horns may now be seen at his farm in Deerfield, N. Y.

The Governor writes me: "It was a very large animal and was disposed to charge upon our party; but for our dog it might have made us trouble. The snow was very deep and covered with a crust. The dog could run upon this while the Moose sunk through it. This enabled the dog to worry the animal and turn its attention away from our party." He does not remember the year in which it was killed.

In July, 1861, the artist Mr. A. F. Tait, and Mr. James B. Blossom, both of New York, were camped on Constable Point, Raquette Lake. One night about the middle of the month, while floating on Marion River, Mr. Tait wounded a Moose, but did not kill it. On the 25th of the month, about four o'clock in the afternoon, Mr. Blossom shot and killed a dry cow Moose on South Inlet.

The measurements of this animal, taken by Mr. Blossom at the time and on the spot, are:

| | |
|---|---|
| Length, | 7 feet, 1 inch. |
| Height (at shoulder), | 6 feet, 1 inch. |
| Head, | 2 feet, 2 inches. |
| Ears, | 1 foot. |
| Girth, | 5 feet, 4 inches. |
| Fore leg, | 3 feet, 5 inches. |
| Hind leg (hip bone to hoof), | 5 feet, 5 inches. |

Early in August of the same year (1861) the hunter William Wood killed a bull calf near the place where Mr. Tait had wounded

his Moose. It had a broken jaw, was very lean, and was unquestionably the animal wounded by Mr. Tait.

In *Forest and Stream* for April 2d, 1874 (p. 116), Mr. Edw. Clarence Smith states that a cow Moose was killed on Marion River (East Inlet of Raquette Lake) during the summer of 1861. He says that it was shot by a guide by the name of Palmer from Long Lake, while feeding upon lily-pads, about three o'clock in the afternoon; and that "the persons present were Isaac Gerhart, lawyer; Mr. Burgin, Rev. Augustus Smith, now settled in West Philadelphia, and the undersigned, all residents of Philadelphia." In response to interrogations, Mr. Smith writes me that this Moose was killed in the month of August. Mr. Smith had also the kindness to address a letter of inquiry, in my behalf, to Isaac Gerhart, Esq., a member of the party. Mr. Gerhart's reply is so full of interesting details that I make no apology for publishing the greater part of it *verbatim*. He writes: "I should say the Moose was shot about the end of the second week in August, 1861, at the mouth of the East Inlet of Raquette Lake, on whose shore, about four miles distant, we then had a camp. We had been up this inlet, your correspondent calls it Marion River—a name I cannot recall,—for a day's trout fishing. You and your brother [Rev. H. Augustus Smith] and guide were in one boat; Burgin, a guide, and I in another. We, as usual, 'tho' on fishing bent,' still had our trusty guns, lest some chance game should find us unprepared. At its mouth the Inlet was bordered on either hand by a thickly wooded shore, terminating on the south side in a short promontory, round the end of which a sloping shore curved off to the southwest. Off this sloping shore grew in the water a border of lily-pads, perhaps a hundred feet wide, and about half as far from the edge of the water the shore became bold and thickly wooded. We were rowing steadily down, the bottoms of our boats covered with finny spoils. I was in the bow of the foremost boat, when, as we came abreast of the end of the promontory, I caught sight of the monster

up to her belly in water, cropping the tender lily-shoots. I shall never forget the confusing impression the sight made upon me. In my mind the Moose was always associated with imposing antlers, such as I had seen in the pictured and stuffed specimens which had all been of males; but this uncouth creature had only immense ears, which, though its head was below the humped shoulders, still towered above them. I felt that it must be game because of the complete wildness of the surroundings; and yet it seemed so suggestive of an exaggerated caricature of a jackass, that the idea passed across my mind that there might be some clearing in the neighborhood to which it belonged. I do not think my guide's impressions were any more coherent than mine, for, although he was a year or two past his majority and had been born and bred in the woods, he had never seen a Moose. Meanwhile, profiting by our confusion of ideas, Madame Moose had 'slewed around' in the water, with a view to making for the friendly shelter of the woods, when your boat came within view of the creature and your guide shouted 'Moose! Moose!' which had the effect of clearing up my ideas instantaneously. In the twinkling of an eye I had lodged in front of her shoulder the contents of my gun—not 'bird shot,' as you suggest, but 'buck-cartridge' consisting of over a dozen buck-shot enclosed in a wire frame, making a load that 'carried' very closely, and made a hole in her at that short range of not over fifty yards, that would doubtless, after one of those long runs for which these animals are famous when fatally wounded, have ended her career. My shot lent impetus to her progress toward shore. Then Burgin fired some shot (I think No. 6) into her and she emerged from the water. The two guides, first ours and then yours,[*] each put a rifle ball into her, and she fell heavily to rise no more. She doubtless had a spouse somewhere in the neighborhood, for a party who had been after her for

* Mr. Smith writes me: "The shot that brought her to the ground was fired by our guide, one *Palmer* of Long Lake, son of old Palmer, the original settler on Long Lake."

a week had killed a Moose-calf near by that was too young to have left its parents, and claimed to have found tracks of both the old ones. We lived on her tenderloin—after getting her to camp under great difficulties—for about a week.

"On our way out of the region, whence we made our exit at the First Saranac Lake, we stopped at Bartlett's on Round Lake, which appeared to be a famous and extensive rendezvous for hunters and guides; and on the register there we recorded conspicuously opposite our names our notable, albeit fortuitous, achievement.[*] I think we recorded it as weighing about 800 lbs. and standing about seven feet high in the hump. The derisive incredulity which this entry evoked was only silenced by the production of the hide, which we had brought with us."

No credence is to be given to the report, widely circulated by the press, that a Moose has during the past winter been seen near the Ox-bow on Moose River, in the Woodhull Lake region.

NOTE 2.—That the American Elk or Wapiti (*Cervus Canadensis*) was at one time common in the Adirondacks there is no question. A number of their antlers have been discovered, the most perfect of which that I have seen is in the possession of Mr. John Constable. It was found in a bog on Third Lake of Fulton Chain, in Herkimer County.

Dr. DeKay (Zool. N. Y., Part I, 1842, pp. 120–121) speaks of a specimen consisting of "a portion of a pair of horns attached to a fragment of skull," which was "dug up near the mouth of the Raquet River in this State, near the forty-fifth parallel of latitude. It bears a label in the handwriting of Dr. Mitchill, purporting that it

* Upon the receipt of the above letter, early in October, 1883, I hoped to ascertain the exact date of the killing of this Moose, and at once wrote to Mr. Bartlett, asking if he would consult his old register and send me a copy of the entry here referred to. Unfortunately, his reply has not yet been received. [Since the above went to press I have learned of Mr. Bartlett's death.]

belonged to the *C. tarandus*, or Rein-deer." * Dr. DeKay appends a table of measurements which clearly indicates that the antler in question was that of our common Elk, though he regarded it as pertaining to the fossil Elk. He mentions another antler, of a younger animal, which "was thrown out by a plow on Grand Isle," in Lake Champlain, and deposited in the Museum of the University of Vermont.

Dr. C. C. Benton, of Ogdensburg, has several specimens, more or less complete. The circumference of the largest at the burr is twelve and one half inches; immediately below the burr ten inches. These specimens were discovered at Steel's Corners in St. Lawrence County.

Mr. Calvin V. Graves, of Boonville, N. Y., has two sections of Elk horns that were "ploughed up in an old beaver meadow in Diana," Lewis County.

When the species was exterminated here is not known. Dr. DeKay, writing in 1842, states: "The stag is still found in the State of New York, but very sparingly, and will doubtless be extirpated before many years. Mr. Beach, an intelligent hunter on the Raquet, assured me that in 1836, he shot at a stag (or as he called it, an elk), on the north branch of the Saranac. He had seen many of the horns, and described this one as much larger than the biggest buck (*C. virginianus*), with immense long and rounded horns, with many short antlers. His account was confirmed by another hunter, Vaughan, who killed a stag at nearly the same place. They are found in the northwestern counties of Pennsylvania, and the adjoining counties of New York. In 1834, I am informed by Mr. Philip Church, a stag was killed at Bolivar, Allegany County. My informant saw the animal, and his description corresponds exactly with this species." †

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* This specimen is probably the source of Professor Dana's statement. "Remains of the *Reindeer* have been found on Racket River," New York (Dana's Geology, 2d Ed., 1875, p. 568.) I have been unable to find a trustworthy record of the Reindeer or Caribou from this region.

† Zoology of New York, Part I, Mammalia, 1842, p. 119.

I do not regard the above account of Messrs. Beach and Vaughan as trustworthy, for the reason that I have never been able to find a hunter in this wilderness, however aged, who had ever heard of a living Elk in the Adirondacks.

NOTE 3.—It is also worthy of remark that wild horses, larger than our domesticated stock, once roamed the borders of this region. Dr. C. C. Benton, of Ogdensburg, has shown me several fossil molar teeth of *Equus major* that were exhumed at Keenes Station near the Oswegatchie Ox Bow in Jefferson County. I have compared them with the corresponding teeth in an immense dray-horse, and find them much larger.

NOTE 4.—It is hard for us to realize that huge Elephants, in the wild state, ever moved their ponderous bodies over this northern Wilderness; but the fact is incontestibly proved by the discovery of their remains on both sides of the Adirondacks. Dr. Zadock Thompson tells us that a fossil Elephant was found in a muck bed in the township of Mt. Holly, Vermont, (in the Green Mountains,) at an elevation of 1415 feet, in the year 1848.*

A tusk measuring five feet nine inches in length, over the curve, was found, September 20, 1877, in a marl bed about a mile west of the village of Copenhagen in Lewis County. It was purchased for the State Cabinet by Dr. Franklin B. Hough, who described it in the Lowville Times. Whether this tusk belonged to an Elephant or a Mastodon has not been determined.

* Appendix to Thompson's Vermont, 1853, pp. 14–15. Dr. Leidy refers this specimen to *Elephas Americanus* (Proc. Acad. Nat. Sci., Phila., VII, 392).

Order INSECTIVORA. Family TALPIDÆ.

## CONDYLURA CRISTATA Linnæus.

*Star-nosed Mole.*

The Star-nosed Mole is a common animal along the outskirts of the Adirondacks, where it seems to manifest a predilection for moist situations, being usually found in low ground and in the neighborhood of streams. Its food consists almost wholly of the earthworm, and of various insects which it discovers in its meanderings through the soil. In general, its habits are much like those of the Shrew Mole, though it does not, apparently, make as extensive excavations, and the "mole hills" along the lines of its galleries are larger.

In gardens and ploughed ground they often work so near the surface that a ridge of loose earth is upheaved along the course of their tunnels. In meadows and pasture lands, on the contrary, the galleries are not marked by surface ridges, for the simple reason that they cannot readily force their way through the tough sod, but excavate their burrows immediately beneath. Late in the autumn, when the ground becomes frozen to the depth of two or three inches, the Moles sink their galleries into the soft earth below, and as winter advances they doubtless continue to deepen them sufficiently to avoid the frozen ground. Thus both Moles and earthworms escape the severe temperature of our northern winter by withdrawing below the depth to which the frost penetrates. It sometimes happens here that a period of severe cold sets in before much snow has fallen, in which case the ground becomes frozen to the depth of two feet or more. But this state of things is not apt to continue, for advancing winter is almost certain to bring with it a large amount of snow, which, as is well known, keeps out the cold and dissipates the frost already in the earth. I have known the ground to be frozen for two feet below the surface when a fall of about four feet of snow took place. Within two weeks afterward

the ground thawed and the surface became moist and mellow though the temperature remained low. Indeed, it is not uncommon for fresh green grass to spring up under the heavy covering which Dame Nature spreads over her northern possessions in winter; and residents of cold countries often avail themselves of the protection afforded by seemingly inhospitable snow banks.

There is a low and somewhat wet piece of ground bordering a small creek near my home in Lewis County. During and after every heavy rain, and for a considerable period in spring and fall, this creek overflows its banks and a large part of the surrounding flat is converted into a swamp. Star-nosed Moles have been common here ever since I can remember, their hills dotting the surface in various directions. In the fall of 1883 a colony of them were exceedingly active in one part of this flat and their mounds could be counted by hundreds over an area a few acres in extent. For the double purpose of procuring specimens, and of ascertaining if more species than one were concerned in these excavations, I determined to trap some of the animals, and was joined in the undertaking by Dr. A. K. Fisher.

This species, as well as Brewer's and the Shrew Mole, may be trapped by taking advantage of the habit of removing obstacles from the primary galleries, which are always kept in repair. A snare of fine wire or horse hair made to surround the runway, and connected with a bit of stick that protrudes into the burrow and liberates a small springpole when moved, is the best device for their capture with which I am acquainted. The traps made by us consisted of a small strip of board with a bow or hoop set in each end, to keep the wire loops in place, and so arranged that the Mole is equally apt to be taken from whichever direction he comes. During the latter part of October and first of November we set half a dozen traps of this description, visiting them twice daily until November 13th, when a fall of six inches of snow and the freezing of the ground suspended operations for a few days. The

weather moderated on the 19th and 20th, and the number of traps set was increased to fifteen. These were also visited both morning and evening and all were kept in good order. A large proportion of them were sprung almost every morning, and others were plastered up with mud in such a way that they could not spring. In fact, on an average, fully twenty traps would be sprung to every Mole secured. I think the springpoles used at first were too weak, and that a few Moles escaped by forcing themselves through the wire loops. But after stiffening the poles we still failed to secure more than a small number of Moles in comparison with the number of traps sprung. Although the traps remained set till the 28th of November, when the ground again became frozen and covered with snow, we secured but nine specimens in all. Eight were of the Star-nosed variety, while the other was a Brewer's Mole (*Scapanus Breweri*). During the same period three more Brewer's Moles were caught on a side hill near by.

Dr. Fisher is of opinion that the Moles, in repairing their galleries, often push a quantity of earth ahead of them in the direction of the mounds, and that this springs the trap before the Mole has arrived at the loop. In a large number of cases this is a very reasonable explanation of the failure to catch the animal, for the traps are frequently found packed full of earth. In other cases they dig around the trap, while occasionally a new burrow is excavated directly beneath it. Whatever else they may do, they invariably plaster over with mud any exposed part of the trap that may appear in the gallery; and they sometimes bury the whole affair by upheaving a hill directly over it.

The exact method by which the little mounds called "mole hills" are produced has long been a matter of earnest inquiry, and I am glad to be able to contribute important testimony upon this point. Repeated critical examinations of the hills themselves in different soils, and occasional observations made at the time of their upheaval, have convinced me that, when in dry earth, it is impossible

to arrive at any positive knowledge of the way in which they are made. All that one sees during their formation in dry soil is the upheaval of a quantity of loose earth from a central point, which point speedily becomes indistinguishable as the mound increases in size, the only observable phenomenon consisting in a little heap of dirt every particle of which seems to be in motion, as it steadily approaches completion. The rapidity with which so much earth is thrown up is one of the most perplexing things about it; and the peculiar motion of the mass leads to the notion that it is traversed by galleries and that the Mole is at work within it and not beneath the surrounding ground. On making a section of the mound, however, it is found to contain no cavity unless it be a mere tubular extension of the gallery, and this is absent in more than half the hills examined. On opening the gallery beneath, no chamber or tortuous excavation is discovered, and the fact at once becomes apparent that so much earth as constitutes the hill could not possibly have been obtained from the excavation in its immediate vicinity, and must therefore have been brought from a distance. Just how it was conveyed to and forced through the orifice leading into the hill I have until recently been at a loss to comprehend, but the opportunity to examine some freshly made mounds in a wet pasture of rich loam or mould has cleared up the mystery.

These new mounds consisted wholly of compact cylindrical masses of damp earth, having very much the appearance of Bologna sausages, and measuring from three to five inches in length by one and a half to two in diameter. It was noticeable that the size of each was greater than that of the hole in the sod through which it had been discharged, which circumstance shows that it must have been subjected to considerable pressure during expulsion. On handling these masses they readily broke up, transversely, into a number of more or less parallel discs, or lamellæ, each of which bore evidence of having been powerfully compressed. On exposure to the air they soon lost their cylindrical form and crumbled, so that

it is only under peculiarly favorable circumstances that they are to be found at all. They are never present in any but newly made mounds in wet mucky soil. Hence it is perfectly clear that the earth of which the mounds are composed is brought to and extruded through the hole intended for this purpose by being *pushed ahead* of the animal. In being thus crowded along it becomes compressed and moulded to the burrows. How the Mole always manages to force it through the hole he has prepared for it, instead of pushing it into the continuation of the gallery beyond, is by no means so evident. In a great many cases one arm of the gallery curves up into the mound so that the plugs would naturally follow this passage, but in other cases the canal leading to the mound is given off vertically and nearly at a right angle to the runway, while occasionally it commences as a horizontal offshoot, thence sloping upward to the mound.

As the main galleries from time to time require repairs, the superabundant earth is usually disposed of by crowding it up through the old mounds, which sometimes, though rarely, contain a tubular or oval cavity continuous with the holes. Thus, after a rain or frost by which the galleries have been injured, it often happens that many of the old mounds on the lines of the primary runways will be found to have been reopened and the fresh earth which has been removed in making the necessary repairs may be seen on them.

Audubon and Bachman criticise Godman's statement concerning the abundance of this species in certain localities, remarking: "We have sometimes supposed that he might have mistaken the galleries of the common Shrew Mole for those made by the Star-nose, as to us it has always appeared a rare species in every part of the Union."* My experience agrees with that of Dr. Godman, for I have frequently observed this species in large colonies, and with us it is certainly one of the commonest Moles.

* Quadrupeds of North America, 1851, vol. II, pp. 141–142.

Audubon and Bachman observe: "In a few localities where we were in the habit, many years ago, of obtaining the Star-nosed Mole, it was always found on the banks of rich meadows near running streams. The galleries did not run so near the surface as those of the common Shrew Mole. We caused one of the galleries to be dug out, and obtained a nest containing three young, apparently a week old. The radiations on the nose were so slightly developed that until we carefully examined them we supposed they were the young of the Common Shrew Mole. The nest was spacious, composed of withered grasses, and situated in a large excavation under a stump. The old ones had made their escape, and we endeavoured to preserve the young; but the want of proper nourishment caused their death in a couple of days." * The only nest that I ever found was about two feet below the surface, in clay soil, and under a stump. It was composed of grass, and from it a passage led to a vegetable garden near by.

The same authors assert that "it avoids cultivated fields, and confines itself to meadows and low swampy places." † That this is not always the case I have positive proof, for I have caught a number of them in our garden. By following the ridge of loose earth that marks their progress, and quickly sinking a spade directly in their path, a few inches in advance of the moving earth, I have often turned them out upon the surface. They pass through the rich, soft soil of a garden bed with such rapidity that my spade has sometimes cut them in two, though aimed several inches in advance of the moving earth.

The precise function of the curious disc of tentacle-like papillæ on the snout has not as yet been positively determined, though it is highly probable that it serves as a delicate organ of touch to aid the animal in discovering the worms and insects that constitute its prey.

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* Ibid., pp. 141–142. † Ibid., pp. 141–142.

One March, many years ago, when sliding down hill on the crust (the snow then being over three feet in depth) Dr. C. L. Bagg and I observed at different times several dark objects which at a distance looked like little balls of fur. On coming nearer we discovered that these apparently round objects were Star-nosed Moles, trying to bore through the icy crust. They had evidently been moving about on the surface till alarmed by our approach, when, having wandered away from the holes through which they came up, they at once set to work to perforate the crust, but, owing to its unusual hardness, did not succeed in time to make good their escape. We captured two or three and brought them home.

The reason that they are not more often seen here in winter is easily explained. They do not at any time travel much upon the surface, and even when thus engaged their sense of hearing is so acute that they detect the approach of an enemy while yet at a distance, and disappear at once into the snow. All winter long one sees upon the snow many small footprints, that are designated, collectively, as mice, mole, and shrew tracks. I can distinguish, with considerable confidence, those of *Hesperomys*, *Blarina*, and *Sorex*, but who will venture to affirm that he can name the species that makes each of the others?

The tail of this species becomes enormously enlarged during the rutting season, which circumstance led Dr. Harlan to describe a specimen taken during this period as a distinct species, which he named *Condylura macroura.** I have taken specimens as late as the middle of November whose tails measured 12mm. (.47 in.) in diameter. When in this swollen condition there is a marked constriction at the base, which causes the tail to appear as if strangulated. Two or more litters are produced each season.

The scent glands of this animal secrete a thick creamy material of a greenish yellow color that has a powerful and very disagree-

* Fauna Americana, 1825, p. 39.

able odor, which at certain seasons becomes exceedingly rank and nauseous.

## SCALOPS AQUATICUS (Linn.) Fischer.

*Shrew Mole.*

This species is not common about the borders of the Adirondacks, and is seldom if ever found within the evergreen forests, though it sometimes finds the way to the frontier settler's garden.

Its specific name, *aquaticus*, like many others in Zoological nomenclature, has been unfortunately chosen and has no bearing on the habits of the animal; for not only is the Shrew Mole not known voluntarily to swim, but in the selection of its haunts it shows no preference for the vicinity of water, but manifests rather a contrary tendency.

Its home is underground, and its entire lifetime is spent beneath the surface. Its food consists almost wholly of earth-worms, grubs, ants, and other insects that live in the earth and under logs and stones It is almost universally regarded as an enemy to the farmer, and is commonly destroyed whenever opportunity affords; for, notwithstanding the fact that it subsists upon insects that injure the crops, it is nevertheless true that, in the procurement of these, it disfigures the garden paths and beds, by the ridges and little mounds of earth that mark the course of its subterranean galleries, and loosens and injures many choice plants in its probings for grubs amongst their roots.

The strength of the Shrew Mole is simply prodigious, for an animal of its diminutive size, and the speed with which it forces itself through the ground is marvellous. Audubon and Bachman, speaking of one they had in confinement, state: "We afterwards put the Mole into a large wire rat-trap, and to our surprise saw him insert his fore-paws or hands, between the wires, and force them apart sufficiently to give him room to pass out through them at once, and

this without any great apparent effort." * Dr. Godman also tells us that one which he had "in a basket on the mantlepiece of a parlour made its escape, and fell to the hearth; apparently it sustained little injury by the fall, but hurried on until it reached the wall, where it began to travel round the room. Whenever its course was impeded by the feet of the chairs, which were of large size, it would not go round them, but wedging itself between them and the wall, pushed them with apparent ease far enough to obtain a free passage, and it thus continued to move several in succession. What was more astonishing, it passed in a similar manner behind the legs of a small mahogany breakfast-table, and pushed it aside in the same way it had done the chairs, finally hiding itself behind a pile of quarto volumes, more than two feet high, which it also moved out from the wall." † Now I have made a pile, just two feet high, of quarto volumes, and find that to move it on a smooth, painted floor requires a force of eighteen pounds (Avoirdupois), and on a carpet, of twenty-two pounds. In order to display a degree of strength proportionate to the difference in weight of the two, a man would have to exert a push pressure of twelve thousand pounds!

Its nest is commonly half a foot or more below the surface, and from it several passages lead away in the direction of its favorite foraging grounds. These primary passages gradually approach the surface, and finally become continuous with, or open into, an ever increasing multitude of tortuous galleries, which wind about in every direction, and sometimes come so near the surface as barely to escape opening upon it, while at other times they are several inches deep. Along the most superficial of these horizontal burrows the earth is actually thrown up, in the form of long ridges, by which the animal's progress can be traced. The distance that they can thus travel in a given time is almost incredible. Audubon and Bachman state that they have been known, in a single night after a rain, to

* Quadrupeds of North America, vol. I, 1846, pp. 85–86.

† American Natural History, by John D. Godman, M. D., vol. I, 1842, p. 64.

excavate a gallery several hundred yards in length; and I have myself traced a fresh one nearly one hundred yards. The only method by which we can arrive at a just appreciation of the magnitude of this labor is by comparison; and computation shows that in order to perform equivalent work a man would have to excavate, in a single night, a tunnel thirty-seven miles long, and of sufficient size to easily admit of the passage of his body.

In following the galleries of the Shrew Mole one finds a number of little hills of loose earth, each measuring from four to six inches in height, and eight to ten in diameter. They are usually in groups, a few feet apart, but are sometimes isolated. Lawns and flower beds are often disfigured by them in a few hours, for a large number are sometimes thrown up in a surprisingly short space of time. "I have often examined these eminences," writes Dr. Godman, "and have never been able fully to understand how they are formed; a slight motion is observed at the surface, and presently this loose earth is seen to be worked up through a small orifice, whence, falling on all sides, by its accumulation the hills just mentioned are produced. It seems to be brought from some distance, for on breaking up the gallery, it was evident that more earth had been thrown out than could have been removed in excavating the immediately adjoining portions of the burrow. In one instance I have seen the shrew-mole show the extremity of its snout from the centre of one of these loose hills, where it had come at mid-day, as if for the purpose of enjoying the sunshine, without exposing its body to the full influence of the external air." *

I have many times observed small areas, several square yards in extent, particularly in meadow-land, where the ground was fairly covered with mole-hills, and so cut up with their galleries that in walking over it one was sure to break through the surface. It seems reasonable to suppose that the animal discovers, in these places, an

* Loc. cit., p. 62.

abundance of some favorite food—perhaps a colony of grubs feeding upon the roots of the grass.

When the Shrew Mole encounters a rock, or an old log or stump, in the course of his subterranean wanderings, instead of avoiding it, he takes great pains to burrow beneath, making extensive excavations in contact with its under surface. The reason is obvious, for he knows as well as we do that in such places are to be found many earth-worms, slugs, ants with their eggs, and other tender insects.

It is not probable that the remoter secondary galleries are traversed more than a few times, for the animal makes new ones every day; but the primary passages which lead to the nest are in constant use, and are always kept in repair. In this connection Dr. Godman, whose biography of this species is the most complete and accurate we possess, observes: "It is remarkable how unwilling they are to relinquish a long frequented burrow; I have frequently broken down or torn off the surface of the same burrow for several days in succession, but would always find it repaired at the next visit. This was especially the case with one individual whose nest I discovered, which was always repaired within a short time, as often as destroyed. It was an oval cavity, about six or seven inches in length by three in breadth, and was placed at about eight inches from the surface in a stiff clay. The entrance to it sloped obliquely downwards from the common gallery, about two inches from the surface; three times I entirely exposed this cell by cutting out the whole superincumbent clay with a knife, and three times a similar one was made a little beyond the situation of the former, the excavation having been continued from its back part. I paid a visit to the same spot two months after capturing its occupant, and breaking up the nest, all the injuries were found to be repaired, and another excavated within a few inches of the old one. Most probably numerous individuals, composing a whole family, reside together in these extensive galleries." He further says: "Shrew-moles are most active early in the morning, at mid-day, and in the evening; after rains they are particularly busy

in repairing their damaged galleries, and in long continued wet weather we find that they seek the high grounds for security. The precision with which they daily come to the surface at twelve o'clock is very remarkable, and is well known in the country. In many instances when we have watched them, they appeared exactly at twelve, and at this time only have we succeeded in taking them alive, which is easily done by intercepting their progress with a spade, broad blade, &c., and throwing them on the surface." *

Audubon and Bachman discourse as follows upon the feeding habits of one they had in confinement: "When this Mole was fed on earth-worms (*Lumbricus terrenus*), as we have just related, we heard the worms crushed in the strong jaws of the animal, with a noise somewhat like the grating of broken glass, which was probably caused by its strong teeth gnashing on the sand or grit contained in the bodies of the worms. These were placed singly on the ground near the animal, which after smelling around for a moment turned about in every direction with the greatest activity, until he felt a worm, when he seized it between the outer surface of his hands or fore-paws, and pushed it into his mouth with a continually repeated forward movement of the paws, cramming it downward until all was in his jaws. Small sized earth-worms were dispatched in a very short time; the animal never failing to begin with the anterior end of the worm, and apparently cutting it as he eat, into small pieces, until the whole was devoured. On the contrary, when the earth-worm was of a large size, the Mole seemed to find some difficulty in managing it, and munched the worm sideways, moving it from one side of its mouth to the other. On these occasions the gritting of its teeth, which we have already spoken of, can be heard at a distance of several feet. . . . . Although this species, as we have seen, feeds principally on worms, grubs, &c., we have the authority of our friend Ogden Hammond, Esq., for the following example either

* Loc. cit., pp. 63–64, 65.

of a most singular perversity of taste, or of habits hitherto totally unknown as appertaining to animals of this genus, and meriting a farther inquiry. While at his estate near Throg's Neck, on Long Island Sound, his son, who is an intelligent young lad, and fond of Natural History, observed in company with an old servant of the family, a Shrew Mole in the act of swallowing, or devouring, a common toad—this was accomplished by the Mole, and he was then killed, being unable to escape after such a meal, and was taken to the house, when Mr. Hammond saw and examined the animal, with the toad partially protruding from its throat. This gentleman also related to us some time ago, that he once witnessed an engagement between two Moles, that happened to encounter each other, in one of the *noon-day* excursions, this species is so much in the habit of making. The combatants sidled up to one another like two little pigs, and each tried to root the other over, in attempting which, their efforts so much resembled the manner of two boars fighting, that the whole affair was supremely ridiculous to the beholder, although no doubt to either of the bold warriors, the consequences of an overthrow would have been a very serious affair; and the conqueror, would vent his rage upon the fallen hero, and punish him severely with his sharp teeth. We have no doubt these conflicts generally take place in the love season, and are caused by rivalry, and that some 'fair Mole' probably rewards the victor." *

Farther on, the same authors observe: "We had an opportunity on two different occasions of examining the nests and young of the Shrew Mole. The nests were about eight inches below the surface, the excavation was rather large and contained a quantity of oak leaves on the outer surface, lined with soft dried leaves of the crab-grass (*Digitaria sanguinalis*). There were galleries leading to this nest, in two or three directions. The young numbered in one case, five, and in another, nine.

* Quadrupeds of North America, vol. I, 1846, pp. 85–86, 87–88.

"Our kind friend, J. S. Haines, Esq., of Germantown, near Philadelphia, informed us that he once kept several Shrew Moles in confinement for the purpose of investigating their habits, and that having been neglected for a few days, the strongest of them killed and ate up the others; they also devoured raw meat, especially beef, with great avidity." *

*Explanation of Erroneous Notions Concerning the Food of the Mole.*

It is unfortunate (for the Mole, at any rate) that the farmers and gardeners still cling to the mistaken notion that the Mole eats the roots of vegetables and other plants. In support of this view they affirm that they have followed the galleries of these animals along rows of garden plants and have found some of the roots gnawed entirely off, and others more or less injured. Granted; but this is circumstantial and presumptive evidence only, and is negatived by the facts hereinafter related. The truth of the matter is this: The Mole follows the row of plants in order to obtain the insects that gather in the rich soil about their roots, and doubtless occasionally injures a few by loosening the earth around them, or possibly even by scratching them in his efforts to procure the grubs.

Presently a field mouse (*Arvicola*) comes along and discovers the gallery of the Mole. It is just the right size, or perhaps a trifle large, so he enters without delay and is delighted to find that it leads directly to his favorite articles of diet, the roots of garden vegetables. It is this abundant and destructive pest that does the mischief, while the poor Mole gets the credit of it, and very likely loses his head in consequence.

As bearing upon this subject I quote from the pen of Samuel Woodruff, Esq., some evidence that may fairly be regarded as conclusive. Mr. Woodruff commences by stating that he had always supposed the Mole to be herbivorous, and now that the contrary had been asserted, determined to prove the matter by actual experiment,

* Ibid., p. 90.

as soon as he could obtain a subject. Having finally procured "a full grown, healthy, and vigorous mole" of this species, he goes on to say: "I confined him in a wooden box about two feet square, placing on the bottom six or eight inches depth of earth, and before him a potato, a beet, a carrot, a parsnip, turnip, and an apple.

"Early next morning I found him exceedingly languid, and apparently exhausted, barely able to turn himself over when placed on his back. All the vegetables remained whole—none having been bitten. I then presented him the head and whole neck of a fowl, with the feathers on; he instantly seized it, and fed upon it with great avidity. I found him the next morning, plump, strong and active—nothing left of the head and neck of the fowl, except the beak, part of the skull, and bones of the neck, the latter being gnawed and stripped of all the flesh. I then left him with a whole chicken about the size of a quail. The next day, I found upon examination, nothing left of the chicken, with the exception of the beak, wing feathers, and a few of the larger bones. I then treated him to the head, neck, and entrails of another fowl. He first devoured the entrails, and after that, the head and neck, with the exceptions as stated in the first instance. Satisfied with this course, I changed his regimen on the evening of the 17th, from flesh to cheese, with the addition of potato boiled with meat; the animal was then full and vigorous. The next morning I found him dead—the cheese and potatoes as I had left them, none of which had been eaten. The belly and sides of the mole were much contracted and depressed.

"During the whole time of his confinement, he had been well supplied with water and ice. The whole of the vegetables put into the box remained unbitten.

"The result of this experiment has removed from my mind all doubts respecting the character and habits of this singular animal . . . . it is clearly not herbivorous, and may be truly ranked among carnivorous animals." *

* American Journal of Science and Arts, vol. XXVIII, No. 1, pp. 169-170.

## SCAPANUS AMERICANUS (Bartram, MS.) Coues. *

*Hairy-tailed Mole; Brewer's Mole.*

I have secured a number of examples of this species from the borders of the Wilderness, but have not observed it within the coniferous forests. Specimens have been taken in the garden, where it excavates long and tortuous burrows, often marked upon the surface by crumbling ridges of earth.

Its habits, so far as I am aware, resemble those of its nearest relative, the shrew mole (*Scalops aquaticus*), except that its mounds do not contain a chamber and surface opening, and its galleries are usually made a little deeper. Like this species it is most common in dry meadow lands, while the star-nose is usually found in moist or swampy places. It is much more common here than the shrew mole, and is evidently a more northern animal. It is not known to indulge in the little "noon-day excursions" which, as already related, are characteristic of the last-named species.

In a wet meadow where Dr. Fisher and I caught eight star-nosed moles in October and November, 1883, we procured but one Brewer's Mole It was taken in the following manner: A section of stove pipe, the lower end of which had been closed with a tight-fitting board, was sunk along the line of a gallery to such a depth that its upper edge was on a level with the floor of the runway. The surface opening was covered over with a piece of rubber cloth to exclude the light. For some time the moles worked around this pitfall without tumbling in, to prevent which operation Dr. Fisher arranged a pair of wings or leads (strips of boards), placing their inner ends flush with the pipe. The Moles now adopted a new mode of procedure and filled the pipe with dirt so that they might pass over it with impunity. It was left in this condition for some days and then

* In the *American Naturalist* for March, 1879 (pp. 189–190), Dr. Coues refers this species, which is generally known as *S. Breweri*, to *Talpa Americana* (Bartram, MS.) Harlan. This conclusion is corroborated by Dobson in his Monograph of the Insectivora (Part II, London, June 1883, pp. 134–135).

the dirt was quietly removed. Within twenty-four hours a large and handsome Brewer's Mole was found in the pipe.

The modification of structure that adapts this animal to its peculiar mode of life affords a most remarkable example of animal specialization. The conical head, terminating in a flexible cartilaginous snout, and unincumbered with external ears or eyes to catch the dirt, constitutes an effective wedge in forcing its way through narrow apertures; the broad and powerful hands, whose fingers are united nearly to their very tips and armed with long and stout claws, supply the means by which the motive power is applied, and serve to force the earth away laterally to admit the wedge-like head; while the apparent absence of neck, due to the enormous development of muscles in connection with the shoulder-girdle, the retention of the entire arm and forearm within the skin, the short and compact body, and the covering of soft, short, and glossy fur, tend to decrease to a minimum the frictional resistance against the solid medium through which it moves. In fact, it presents a most extraordinary model of a machine adapted for rapid and continued progress through the earth.

The mole does not, and cannot, *dig* a hole, in the same sense as other mammals that engage in this occupation, either in the construction of burrows or in the pursuit of prey. When a fox or a woodchuck digs into the ground, the anterior extremities are brought forward, downward, and backward, the plane of motion being almost vertical: while the Mole, on the other hand, in making its excavations, carries its hands forward, outward, and backward, so that the plane of motion is nearly horizontal. The movement is almost precisely like that of a man in the act of swimming, and the simile is still closer from the fact that the Mole brings the backs of his hands together in carrying them forward, always keeping the palmar surfaces outward and the thumbs below. Indeed, when taken from the earth and placed upon a hard floor, it does not tread upon the palmar aspect of its fore-feet, as other animals do, but runs along on the sides of its thumbs, with the broad hands turned up edgewise.

Prof. Baird was the first to add the Hairy-tailed Mole to the fauna of New York State. In the Report of the Regents on the Condition of the State Cabinet of Natural History, 1862, he says: "This species of Mole, although not mentioned by DeKay in the State Natural History, is in reality very abundantly to be met with in the northern part of the State, and apparently to the exclusion of the more southern species with white naked tail, *S. aquaticus*. Its burrows are very different from those of the latter species; being at a considerable distance beneath the surface, with heaps of loose earth thrown up at intervals over the gallery, without any kind of entrance whatever." *

Dr. Harlan thus described the habits of this species, which he supposed identical with the common mole of Europe: "Subterraneous, affecting light and cultivated soils; changing locality according to atmospherical variations; seeking elevated regions during the rainy seasons; excavating long galleries which all communicate with each other, parallel to the surface of the soil, and at moderate depths; elevating the earth into what are denominated *mole-hills*; excavating with their hands, and raising the earth with their head; feeding on worms, insects, roots, bulbs of colchicum, &c.; entering in rut early in the spring, and bringing forth twice annually, four or five at a birth, between the months of March and August; raising their young with the greatest tenderness; forming their nests of leaves, in a spacious chamber, the vault of which is supported by pillars, and which is situated in a manner to be sheltered from inundations." †

But it must be remembered that Dr. Harlan confounded this animal with the European Mole (*Talpa Europæa*), and it is possible that the above is in part compiled from accounts of that species.

* Fifteenth Annual Report of the Regents of the University of the State of New York, on the Condition of the State Cabinet of Natural History, 1862, p. 13.

† Fauna Americana, 1825, p. 44.

## Family SORICIDÆ.

### BLARINA BREVICAUDA (Say) Baird.

*Short-tailed Shrew.*

The Short-tailed Shrew is, I presume, the most abundant of the insectivorous mammals that occur in the Adirondack Mountains, and is found alike in the dense coniferous forests of the interior, and the cleared and settled districts of the surrounding region.

It seeks its food both by day and by night; and, although the greater part of its life is doubtless spent underground, or at least under logs and leaves, and amongst the roots of trees and stumps, it occasionally makes excursions upon the surface, and I have met and secured many specimens in broad daylight.

It subsists upon beechnuts, insects, earth-worms, slugs, sow-bugs, and mice, and can in no way be considered as other than a friend to the farmer. Its burrows are so small that their presence near the roots of plants could hardly prove injurious.

In the selection of its haunts it seems to show a preference for the neighborhood of half-decayed logs, under and within which much of its food is procured. It is also pretty sure to find and undermine old planks and boards that have been left on the ground, and I have captured it under a stone walk. While it is common on the dry ground immediately bordering swamps and streams, I have never known it either to enter the water, or to cross over wet places. It does not appear to be as abundant in those portions of the forest that are covered exclusively with coniferous evergreens, as in the vicinity of hard-wood ridges and groves. This is probably due, partly to the nature of the food supply, and partly to its fondness for travelling under the layer of dead and decomposing leaves that covers the ground in our deciduous forests.

The rigors of our northern winters seem to have no effect in diminishing its activity, for it scampers about on the snow during the severest weather, and I have known it to be out when the thermome-

ter indicated a temperature of –20 Fahr. (–29 C.). It makes long journeys over the snow, burrowing down whenever it comes to an elevation that denotes the presence of a log or stump, and I am inclined to believe that at this season it must feed largely upon the chrysalides and larvæ of insects, that are always to be found in such places.

The eyes of the Shrew are distinctly visible in the living animal, not being covered by the integument, as is the case with some of the moles. Still, the sight is very much restricted, and is, I think, limited almost to the power of discriminating light from darkness. On the other hand, the hearing is exceedingly acute, and tactile sensibility is highly developed.

Mr. John Morden, of Hyde Park, Ontario, has recently published, in the *Canadian Sportsman and Naturalist*, an article "On the Mole." He states that in a trap set for mice he found, at one time, a Shrew and two white-footed mice (*Hesperomys leucopus*), one of the latter being dead and about half eaten. He goes on to say: "The evening of that same day, the mole was placed in an old laundry boiler and the entire dead mouse given to it, which by morning was entirely eaten, bones and all, except the hair. We then gave the mole a large rat just killed, when it at once proceeded to eat out its eyes, and by 4 o'clock next afternoon one side of the rat's head, bone, together with the brains, were eaten, and strange to say, the mole looked no larger . . . . Our curiosity was aroused to know by what means a mole or shrew could kill mice which were larger than itself; so four large meadow mice being procured, they were placed in the boiler with the mole, which as soon as it met a mouse, showed fight, but the mouse knocked it away with its front feet and leaped as far away as it could. The mole from the first seemed not to see very plainly and started around the boiler at a lively rate, reaching and scenting in all directions with its long nose, like a pig that has broken into a back yard and smells the swill barrel. The mice seemed terror-stricken, momentarily rising on their hind legs, looking for

some place to escape, leaping about squeaking in their efforts to keep out of the way of the mole which pursued them constantly. The mole's mode of attack was to seize the mouse in the region of the throat. This it did by turning its head as it sprang at the mouse, at the same time uttering a chattering sound. The mice would strike at, and usually knock the mole away with their front feet, but if the latter got a hold of the mouse, it would then try to bite, and they would both tumble about like dogs in a fight. The little chap at last attacked one mouse and kept with it, and in about ten minutes had it killed; but even before it was dead the mole commenced eating its eyes and face. About ten minutes later the mole had devoured all the head of the mouse and continued to eat. I have captured and caged several moles this winter and they all display the same untiring greedy nature. According to my observations the little mammal under consideration eats about twice or three times its own weight of food every 24 hours and when we consider that their principal food consists of insects, it is quite bewildering to imagine the myriads one must destroy in a year." *

Upon reading the above very interesting observations, I immediately wrote to Mr. Morden for a specimen of the "mole" in question. It was kindly sent me and proved to be an unusually large Short-tailed Shrew (*Blarina brevicauda*).

I had not previously known that the Shrew was a mouse-eater, and hence determined to repeat Mr. Morden's experiments. Therefore, having caught a vigorous, though undersized Shrew, I put him in a large wooden box and provided him with an ample supply of beechnuts, which he ate eagerly. He was also furnished with a saucer of water, from which he frequently drank. After he had remained two days in these quarters, I placed in the box with him an uninjured and very active white-footed mouse. The Shrew at the time weighed 11.20 grammes, while the mouse, which was a

* Canadian Sportsman and Naturalist, vol. III, Nos. XI & XII, December, 1883 [not published till February, 1884], p. 283.

large adult male, weighed just 17 grammes. No sooner did the Shrew become aware of the presence of the mouse than he gave chase. The mouse, though much larger than the Shrew, showed no disposition to fight, and his superior agility enabled him, for a long time, easily to evade his pursuer, for at a single leap he would pass over the latter's head and to a considerable distance beyond. The Shrew labored at great disadvantage, not only from his inability to keep pace with the mouse, but also, and to a still greater extent, from his defective eyesight. He frequently passed within two inches (31 mm.) of the mouse without knowing of his whereabouts. But he was persistent, and explored over and over again every part of the box, constantly putting the mouse to flight. Indeed, it was by sheer perseverance that he so harassed the mouse, that the latter, fatigued by almost continuous exertion, and also probably weakened by fright, was no longer able to escape. He was first caught by the tail; this proved a temporary stimulant, and he bounded several times across the box, dragging his adversary after him. The Shrew did not seem in the least disconcerted at being thus harshly jerked about his domicil, but continued the pursuit with great determination. He next seized the mouse in its side, which resulted in a rough and tumble, the two rolling over and over and biting each other with much energy. The mouse freed himself, but was so exhausted that the Shrew had no difficulty in keeping alongside, and soon had him by the ear. The mouse rolled and kicked and scratched and bit, but to no avail. The Shrew was evidently much pleased and forthwith began to devour the ear. When he had it about half eaten-off the mouse again tore himself free; but his inveterate little foe did not suffer him to escape. This time the Shrew clambered up over his back and was soon at work consuming the remainder of the ear. This being satisfactorily accomplished, he continued to push on in the same direction till he had cut through the skull and eaten the brains, together with the whole side of the head and part of the shoulder. This completed his first meal, which occupied not quite

fifteen minutes after the death of the mouse. As soon as he had finished eating I again placed him upon the scales and found that he weighed exactly 12. grammes—an increase of .80 gramme.

The Shrew was half an hour in tiring the mouse, and another half hour in killing him. But it must be remembered that he was not fully grown, and was doubtless, on this account, longer in capturing and killing his victim than would have been the case had he been an adult. Still, it is clear that a Shrew could never catch mice on open ground. His small size, however, enables him readily to enter their holes and to follow them to their nests and the remotest ramifications of their burrows, where, having no escape, he can slay them with fearful certainty.

The eagerness with which my Shrew pursued the mouse placed in his box, and the persistency and success with which he directed his attempts to destroy the latter by eating into its head, clearly shows that this was not his first exploit in that direction. And the fact that Mr. Morden's Shrews, in Ontario, Canada, acted in the same manner proves that the habit is not of local origin. Therefore, it is reasonable to infer that the Short-tailed Shrew preys largely upon mice, and is, consequently, of great economic value to the farmer. Indeed, after the skunk, I am inclined to assign him the first place amongst those of our mammals that are beneficial to the agriculturist.

The Shrews that I have had in confinement have been kept in a large box, the bottom of which was well covered with earth and dead leaves, fresh from the woods. Water was given them in a saucer, which they soon discovered and drank freely. They were exceedingly active, but always moved on a walk or trot, or by short springs, never proceeding in a series of leaps. Whenever I approached the box they would run about with their heads thrown up, sniffing the air in various directions, and starting spasmodically at the slightest noise. When angry, they utter a shrill, chattering cry.

I have one alive at the present time. When first put in the box he gathered all the leaves and rootlets into one corner, constructing

a rough nest, to which he always retires when he wants to rest. He is very fond of beechnuts and thrived when fed exclusively on them for more than a week. One evening, not long ago, I put a handful of beechnuts in his water saucer. He soon found them and carried them off. Part he buried in a hole under the saucer, part under his nest, and the rest in an excavation near one corner of the box. This certainly looks as if the animal was in the habit of hoarding for winter. In opening the nuts he invariably commences at the small end, and, after biting a little hole there, strips off one side as neatly as it can be done with a penknife. If left without food for a few hours he will eat corn from the cob, beginning at the outside of the kernel, but it is very clear that he does not relish this fare. He will also eat Indian meal and oats when other food is not at hand. Slugs and earth worms he devours with avidity, always starting at one end, and manipulating them with his fore-paws. But of the various kinds of food placed before him he shows an unmistakable preference for mice—either dead or alive.

The late Robert Kennicott, in a valuable paper upon "The Quadrupeds of Illinois Injurious and Beneficial to the Farmer," contributed the following to the life-history of this little-known mammal:—

"I have several times kept specimens in captivity for a day or two, though they always died by the end of that time, despite my care. While alive, the minute black eye is distinctly seen and always open; but, though the sense of sight may be possessed in the dark, it certainly is not used in the full light. Upon waving different objects before one, or thrusting my finger or a stick close to its face, no notice was taken of it whatever; but if I made any noise near by, it always started. If the floor were struck, or even the air disturbed, it would start back from that direction. I observed no indication that an acute sense of smell enabled it to recognize objects at any considerable distance; but its hearing was remarkable. An exceedingly delicate sense of touch was exhibited by the whiskers, and if, after irritating a shrew, I placed a stick against it, in even the most

gentle manner, the animal would instantly spring at it. I could see that, in running along the floor, it stopped the moment its whiskers touched anything; and often, when at full speed, it would turn aside just before reaching an object against which it seemed about to strike, and which it certainly had not seen. Unless enraged by being teazed, it endeavored to smell every new object with which its whiskers came in contact, turning its long flexible snout with great facility for this purpose.

"My caged specimens, both male and female, exhibited great pugnacity. When I touched one several times with a stick, it would become much enraged, snapping and crying out angrily. When attacked by a meadow-mouse (*Arvicola scalopsoides*) confined in a cage with it one fought fiercely; and though it did not pursue its adversary when the latter moved off, neither did it ever retreat; but the instant the mouse came close, it sprang at him, apparently not guided in the least by sight. It kept its nose and whiskers constantly moving from side to side, and often sprang forward with an angry cry, when the mouse was not near, as if deceived in thinking it had heard or felt a movement in that direction. In fighting, it did not spring up high, nor attempt to leap upon its adversary, as the mouse, but jerked itself along, stopping firmly, with the fore-feet well forward, and the head high. On coming in contact with the mouse, it snapped at him, and, though it sometimes rose on its hind-feet in the struggle, I did not observe that it used its fore-feet as weapons of offence, like the arvicolæ. Its posture, when on guard, was always with the feet spread and firmly braced, and the head held with the snout pointing upwards, and the mouth and chin forward, in which position its eyes would have been of no use, could it have seen. The motions of this animal, when angry, are characterized by a peculiar firmness; the muscles appear to be held very rigid, while the movements are made by quick energetic jerks. Short springs, either backward, forward, or sidewise, appear to be made with equal readiness.

"This shrew is quite active as well as strong; the snout and head are powerful, and seem to be much used in burrowing; the tough cartilaginous snout received no injury from the rough edge of a pane of glass, under which that of a caged specimen was forcibly thrust in endeavoring to raise it. When liberated, upon a smooth floor, it runs rapidly, without ever leaping, placing only the toes on the surface; though in moving slowly the whole tarsi of the hind-feet are brought down. By placing an ear of corn, over 2 inches in diameter, at the edge of the room, and chasing a shrew towards it by striking the floor behind the animal, I have seen one several times spring over it, apparently without great effort; but if not much frightened, it would always go round objects an inch high, running close along them, as it did beside the wall, invariably feeling its way. One would never leave the side of the wall to run across the room, and would always run round the side of its cage, rather than go across the middle. When hurt or irritated, it uttered a short, sharp, tremulous note, like *zee-e*, and, when it was much enraged, this note became longer, harsher, and twittering, like that of some buntings or sparrows. Sometimes, a short, clear cry was uttered, the voice calling to mind that of the common mink (*Putorius vison*), but softer and lower." *

Professor E. D. Cope published the following note "On a Habit of a Species of Blarina" in the American Naturalist for August, 1873 (vol. VII, No. 8, pp. 490–491): "I recently placed a water-snake (*Tropidonotus sipedon*) of two feet in length, in a fernery which was inhabited by a shrew, either a large *Blarina Carolinensis* or a small *B. talpoides*. The snake was vigorous when placed in the case in the afternoon and bit at everything within reach. The next morning the glass sides of his prison were streaked with dirt and other marks, to the height of the reach of the snake, bearing witness to his energetic efforts to escape. He was then lying on the earthen floor, in

* Report of the Commissioner of Patents for the Year 1857. Agriculture. 1858. pp. 95–96.

an exhausted state, making a few ineffectual efforts to twist his body, while the *Blarina* was busy tearing out his masseter and temporal muscles. A large part of the flesh was eaten from his tail, and the temporal and masseter muscles and eye of one side, were removed, so that the under jaw hung loose. The temporal was torn loose from the cranium on the other side, and as I watched him the *Blarina* cut the other side of the mandible loose, and began to tear the longicolli and rectus muscles. His motions were quite frantic, and he jerked and tore out considerable fragments with his long anterior teeth. He seemed especially anxious to get down the snake's throat (where some of his kin had probably 'gone before'), and revolved on his long axis, now with his belly up, now with his sides, in his energetic efforts. He had apparently not been bitten by the snake, and was uninjured. Whether the shrew killed the snake is of course uncertain, but the animus with which he devoured the reptile gives some color to the suspicion that he in some way frightened him to exhaustion."

The Shrew is rarely eaten by birds or beasts of prey, but is usually left where killed, which fact is doubtless due to the offensive odor from its scent glands. That it is sometimes eaten appears from the fact that a disgorged pellet from some bird of prey, found in the Catskills by Mr. E. P. Bicknell and Dr. A. K. Fisher, contained the recognizable remains of this species.*

The Short-tailed Shrew is readily taken in an ordinary mouse-trap, baited with meat, set near the mouth of a burrow. I have caught many in this way.

I am not aware that anything has been published relating to its breeding habits, and the only facts that I can contribute are in regard to the time when its young are produced. On the 22d of April, 1878, I found a couple of these Shrews under a plank-walk near my museum. They proved to be male and female, and the latter contained young which, from their size, would probably have been born

* Bicknell in Trans. Linn. Soc., vol. I, 1882, p. 122.

early in May. Another female, caught near the same place, April 21, 1884, contained five large embryos which would certainly have been born within ten days. They weighed, together, 4.20 grammes. I procured a half-grown young, February 10, 1884, which must have been born late in the fall. Hence two or three litters are probably produced each season. The young born in autumn do not breed in the spring following, as I have demonstrated by repeated dissections of both sexes.

## SOREX COOPERI Bachman.

*Cooper's Shrew.*

This diminutive Shrew, the smallest known mammalian inhabitant of the Adirondacks, is quite common in most parts of the region, but much more abundant some years than others. Its food is supposed to consist wholly of insects and their larvæ, and the carcasses of animals that chance throws in its way.

Like its congeners, it manifests a predilection for the immediate vicinage of old logs and stumps, and its holes can frequently be found, both in summer and winter, in these places, and about the roots of trees.

Underground life does not appear to be as attractive to it as to its relatives, the moles, yet it avoids too much exposure and commonly moves, by night and by day, under cover of the fallen leaves, twigs, and other *debris* that always cover the ground in our northern forests.

The Naturalist well knows that, however cautiously he may walk, the stir of his footstep puts to flight many forms of life that will reappear as soon as quiet is restored; therefore, in his excursions through the woods, he waits and watches, frequently stopping to listen and observe. While thus occupied it sometimes happens that a slight rustling reaches his ear. There is no wind, but the eye rests upon a fallen leaf that seems to move. Presently another stirs and perhaps a third turns completely over. Then something evanescent,

like the shadow of an embryonic mouse, appears and vanishes before the retina can catch its perfect image. Anon, the restless phantom flits across an open space, leaving no trace behind. But a charge of fine shot, dropped with quick aim upon the next leaf that moves, will usually solve the mystery. The author of the perplexing commotion is found to be a curious sharp-nosed creature, no bigger than one's little finger, and weighing hardly more than half a dram.* Its ceaseless activity, and the rapidity with which it darts from place to place, is truly astonishing, and rarely permits the observer a correct impression of its form.

Whenever a tree or a large limb falls to the ground, these Shrews soon find it, examining every part with great care, and if a knot-hole or crevice is detected, leading to a cavity within, they are pretty sure to enter, carry in materials for a nest, and take formal possession. Hence their homes are not infrequently discovered and destroyed by the wood-chopper.

They are sometimes found in meadows, and I remember killing eleven in one day, several years ago, under hay-cocks that had been standing a few days in the rain.

Not only are these agile and restless little Shrews voracious and almost insatiable, consuming incredible quantities of raw meat and insects with great eagerness, but they are veritable cannibals withal, and will even slay and devour their own kind. I once confined three of them under an ordinary tumbler. Almost immediately they commenced fighting, and in a few minutes one was slaughtered and eaten by the other two. Before night one of these killed and ate its only surviving companion, and its abdomen was much distended by the meal. Hence in less than eight hours one of these tiny wild beasts had attacked, overcome, and ravenously consumed two of its own species, each as large and heavy as itself! The functions of digestion, assimilation, and the elimination of waste are performed with wonderful rapidity, and it seems incomprehensible that they should

* The largest specimen I have recently examined from this region weighed 2.85 grammes.

be able to procure sufficient animal food to sustain them during our long and severe winters; indeed, I incline to believe that their diet is more comprehensive than most writers suppose, and that they feed upon beechnuts and a variety of seeds, and possibly roots as well, though I confess that I have no direct evidence to adduce in support of this supposition.

## SOREX PLATYRHINUS (DeKay) Linsley.

*Broad-nosed Shrew.*

This species, which was first described by Dr. DeKay, from a specimen taken in this State, is not rare in the Adirondacks, though I do not think it is as plentiful here as *Sorex Cooperi*, which it much resembles in habits.

Its diminutive size does not exempt it from the attacks of predatory birds, for, in April, 1882, I shot, at Morse Lake, a Canada Jay whose stomach contained the remains, including the under jaw, of a Shrew which seemed to be of the present species. I have also taken it at Big Moose Lake.

The individual from which Dr. DeKay's description was drawn, was captured "at Tappan, Rockland county, in the cellar of a dwelling-house, having taken up its abode between the stones of the foundation. It was exceedingly agile; and when excited, emitted a shrill, twittering squeak. It ate greedily of fresh meat, but died in the course of a few days. Through the politeness of my friend, the Rev. J. H. Linsley of Elmwood Place, Connecticut, I had an opportunity of examining another specimen, which was obtained from a log in the forest in winter, near Stratford. According to Mr. Linsley, it weighed 47 grains." * Prof. Baird mentions a specimen that weighed but 37 grains. †

* Zoology of New York. Part I, 1842, p. 23.

† Pacific Rail Road Reports, vol. VIII, 1857, p. 26.

Order CHIROPTERA. Family VESPERTILIONIDÆ.

## ATALAPHA CINEREA (Beauvois) Peters.

*Hoary Bat.*

This species, which differs from the red bat in its much larger size, as well as in coloration, is not rare in the Adirondacks, and I have taken it both in the interior and along the western border of the region.

The Hoary Bat can be recognized, even in the dusk of evening, by its great size, its long and pointed wings, and the swiftness and irregularity of its flight. It does not start out so early as our other bats, and is consequently much more difficult to shoot. The borders of woods, water courses, and roadways through the forest are among its favorite resorts, and its nightly range is vastly greater than that of any of its associates. While the other species are extremely local, moving to and fro over a very restricted area, this traverses a comparatively large extent of territory in its evening excursions, which fact is probably attributable to its superior power of flight.

Imagine for the moment, sympathetic reader, that you are an enthusiastic bat hunter, and have chanced to visit some northern forest where this handsome species occurs. The early evening finds you, gun in hand, near the border of a lonely wood. The small bats soon begin to fly, and in the course of fifteen or twenty minutes you may have killed several, all of which prove to be the silver-haired species (*Vesperugo noctivagans*). The twilight is fast fading into night, and your eyes fairly ache from the constant effort of searching its obscurity, when suddenly a large bat is seen approaching, perhaps high above the tree-tops, and has scarcely entered the limited field of vision when, in swooping for a passing insect, he cuts the line of the distant horizon and disappears in the darkness below. In breathless suspense you wait for him to rise, crouching low that his form may be sooner outlined against the dim light that still lingers in the northwest, when he suddenly shoots by, seemingly as big as an owl,

within a few feet of your very eyes. Turning quickly you fire, but too late! He has vanished in the darkness. For more than a week each evening is thus spent, and you almost despair of seeing another Hoary Bat, when, perhaps, on a clear cold night, just as the darkness is becoming too intense to permit you to shoot with accuracy and you are on the point of turning away, something appears above the horizon that sends a thrill of excitement through your whole frame. There is no mistaking the species—the size, the sharp, narrow wings, and the swift flight serve instantly to distinguish it from its nocturnal comrades. On he comes, but just before arriving within gunshot he makes one of his characteristic zig-zag side-shoots and you tremble as he momentarily vanishes from view. Suddenly he reappears, his flight becomes more steady, and now he sweeps swiftly toward you. No time is to be lost, and it is already too dark to aim, so you bring the gun quickly to your shoulder and fire. With a piercing, stridulous cry, he falls to the earth. In an instant you are stooping to pick him up, but the sharp grating screams, uttered with a tone of intense anger, admonish you to observe discretion. With delight you cautiously take him in your hand and hurry to the light to feast your eyes upon his rich and handsome markings. He who can gaze upon a freshly killed example without feelings of admiration is not worthy to be called a naturalist. From its almost boreal distribution, and extreme rarity in collections, the capture of a specimen of the Hoary Bat must, for some time to come, be regarded as an event worthy of congratulation and record. Although I have been fortunate enough to shoot fourteen, I would rather kill another to-day than slay a dozen deer. During the past season Dr. A. K. Fisher, Walter H. Merriam, and myself shot nineteen specimens of this elegant species in and near the western border of the Adirondacks. It is not to be imagined, however, that the procurement of this extensive series (extensive for so rare an animal) was an easy task. Scarcely a suitable evening passed, throughout the entire season, that was not devoted to bat hunting. From the middle of June to the middle of July, when there

is nearly an hour of twilight, the silver-haired and little brown bats begin to fly shortly after eight o'clock, but the present species is seldom seen till half an hour later, and those we killed were commonly shot about 9 P. M. As the season advances and the evenings become shorter, all bats, of course, appear proportionately earlier. On the 3d of August I shot *Atalapha cinerea* at eight o'clock, and on the 8th of October at precisely 6 o'clock—three hours earlier than the same species was killed during the first part of July.

In warm evenings it was not to be seen at all, and I have never observed it when the temperature was above 15° C. (59° F.). It was most often seen when the thermometer ranged from 10° to 12° C. (50° to 53.6° F.). Assuming that the species does not leave its hiding-place when the temperature is above 15° or 16° C. it might be supposed that it would suffer for food if there were several successive warm evenings. But it must be remembered that the coolest part of the twenty-four hours is just before daylight, and throughout the northern regions inhabited by this species there are few days when the temperature does not fall to 15° C. in the early morning. Moreover, it is well known that most bats are as active just before daylight as in the evening. Hence, if the evenings are too warm for its comfort, it would almost always be enabled, by the falling temperature, to sally forth at some later hour of the night.

The Hoary Bat occurs about the Red River settlement in British America, and Dr. Richardson obtained it at Cumberland House on the Saskatchewan, in lat. 54° N.* Robert Kennicott procured it in the Hudson's Bay Company's territory, farther north than any other species of bat has been taken. It is a summer resident of high latitudes, its southern limit in the east coinciding, apparently, with that of the Canadian Fauna. In the west it has been taken in Arizona and New Mexico, but only, so far as I am aware, at considerable altitudes. In the fall and early winter isolated indi-

* Fauna Boreali Americana, vol. I, 1829, p. 1.

viduals have been procured from localities so far to the southward of its usual habitat that I am constrained to believe it a migratory species. William Cooper mentions a specimen that was killed, "in the month of November, near the hights of Weehawken, in New Jersey;"* DeKay says that he "noticed two flying about quite actively shortly before noon" on the 12th of December, 1841 (locality not mentioned, but presumably Long Island, N. Y.);† Zadock Thompson secured one that was taken alive at Colchester, Vermont, about the last of October, 1841;‡ and Mr. E. P. Bicknell took one from an overhanging branch at Riverdale-on-the-Hudson, New York, September 30th, 1878.§ Dr. A. K. Fisher has never taken it at Sing Sing, New York, where he has shot several hundred bats in summer, though he is confident that he saw a single individual there on the evening of October 1st, 1883.

Nothing whatever appears to be known of the breeding habits of the Hoary Bat. On the evening of the 30th of June last (1883) Dr. A. K. Fisher shot a large female (measuring 422mm. in spread of wings) at my home in Lewis County. It had already given birth to its young, and each of its four mammæ bore evidence of having recently been nursed. That the species ruts about the first of August there can be no reasonable doubt, for I saw more of them from the 30th of July till the 6th of August than I have seen in all before and since, and twelve adult specimens killed during that brief period were all males. They were not feeding, but were rushing wildly about, evidently in search of the females. Many flew so high as to be entirely out of range though directly overhead. The only young I have ever seen was shot here, August 6th, 1883, by Walter H. Merriam. It was nearly full grown

* Researches on the Cheiroptera of the United States, Annals Lyceum Natural History, N. Y., 1837, p. 56.

† Zoology of New York. Part 1, 1842, p. 8.

‡ Natural and Civil History of Vermont, 1842, p. 25.

§ Mr. Bicknell writes me that "it was met with about sunrise, hanging at a height of about six feet, in a young tree in an opening near the border of a wood."

(measuring 400mm. in extent) and differed from the adults chiefly in being a little lighter colored.

Zadock Thompson, in his paper upon the mammals of Vermont, speaks thus of this species: "The only Vermont specimen, which I have examined, and that from which the preceding description was drawn, was sent me alive by my friend, David Reed, Esq., of Colchester. It was taken at his place in Colchester, the latter part of October, 1841, and was kept alive for some time in a large willow basket with a flat cover of the same material. On opening the basket, he was almost invariably found suspended by his hind claws from the central part of the cover. When the basket was open, he manifested little fear, or disposition to fly, or get away, during the day time, but in the evening would readily mount on the wing and fly about the room, and on lighting always suspended himself by his hind claws with his head downward. He ate fearlessly and voraciously of fresh meat when offered to him, but could not be made to eat the common house fly." *

The hour at which bats leave their retreats to begin their nocturnal excursions is governed, first, by the latitude, longitude, and altitude of the locality, and the time of the year; and, second, by the character of the sky (whether clear or overcast), and the exposure—those living along the southern and eastern borders of woodlands, and in dark ravines, appearing earlier than those whose hiding-places face the setting sun. In other words, the time at which bats appear depends solely upon the *degree* of darkness.

Hence it follows that their nightly exodus, in a given locality, does not take place at a fixed period after the disappearance of the sun; for, during the first part of October, in this latitude, the darkness is as great half an hour after sunset as it is an hour after three months earlier. Therefore, in estimating the exact hour at which bats are to be expected at any stated date, it is necessary not only to consider the time the sun sets, but also to take into account the

* Natural and Civil History of Vermont, 1842, p. 25.

duration of the twilight. Moreover, in the same locality, the several species do not commence to fly at the same hour, for each seems to await a particular and different degree of darkness. The Hoary Bat is one of the last to appear, and for this reason its capture is the most difficult. In Lewis County, during the latter part of June, it does not start out (excepting in deep forests and dark valleys) till about 8.45 P. M., or a full hour after sunset; while in the early part of October I have killed it at 6 P. M., or just half an hour after sundown. The following table is calculated to illustrate the above remarks :—

*Times of evening appearances of Atalapha cinerea at Locust Grove, New York, at different dates in 1883.*

| Date. | Sunset. | First Bat Seen. | Time after Sunset. |
|---|---|---|---|
| June 30, | 7.42 o'clock. | 8.45 o'clock, | 63 minutes. |
| July 9, | 7.38 " | 8.30 " | 52 " |
| July 31, | 7.21 " | 8.10 " | 49 " |
| Aug. 3, | 7.17 " | 8.00 " | 43 " |
| Aug. 21, | 6.52 " | 7.30 " | 38 " |
| Oct. 8, | 5.30 " | 6.00 " | 30 " |

## ATALAPHA NOVEBORACENSIS (Erxleben) Peters.

*Red Bat; New York Bat.*

This species ranks among the least common bats of the area under consideration. I have shot it here as late as October 12th (1883).

Excepting the hoary bat it is the most beautiful of its tribe, being clad in a thick coat of soft, glossy fur of a bright golden-red color, varying somewhat in shade, and tipped to a greater or less extent with silvery white. This coloration serves, at a glance, to distinguish it from all its associates.

The Red Bat generally makes its appearance earlier in the evening than the other species, evidently fancying the dusk of

twilight more than the increased darkness of advancing night; and I have killed it even on a cloudy afternoon, while flying to and fro in pursuit of insects, near the border of a hard-wood grove. I have found several of them asleep, in the day-time, hanging by their thumb-nails to small twigs or leaf-stems within easy reach. When thus suspended they are, at a little distance, easily mistaken for dead leaves, or the cocoons of some large moth.

"In most portions of the United States, the Red Bat is one of the most abundant, characteristic, and familiar species, being rivalled in these respects by the little Brown Bat alone. It would be safe to say that, in any given instance of a bat entering our rooms in the evening, the chances are a hundred to one of its being either one or the other of these two species. The perfect noiselessness and swiftness of its flight, the extraordinary agility with which it evades obstacles—even the most dexterous strokes designed for its capture—and the unwonted shape, associated in popular superstition with the demons of the shades, conspire to revulsive feelings that need little fancy to render weird and uncanny."*

As illustrating the devoted attachment of the mother for her young, Dr. Godman quotes the following circumstance from Mr. Titian Peale: "In June, 1823, the son of Mr. Gillespie, keeper of the city square, caught a young red Bat, (*Vespertilio Nov-Eboracensis*, L.) which he took home with him. Three hours afterwards, in the evening, as he was conveying it to the Museum in his hand, while passing near the place where it was caught, the mother made her appearance, followed the boy for two squares, flying around him, and finally alighted on his breast, such was her anxiety to save her offspring. Both were brought to the Museum, the young one firmly adhering to its mother's teat. This faithful creature lived two days in the Museum, and then died of injuries received from

* Drs. Coues and Yarrow in their "Monographic Essay" on North American Chiroptera, published in chap. II, vol. V, Report upon Explorations and Surveys West of the One Hundredth Meridian, in charge of Lieut. G. M. Wheeler, 1875, p. 89.

her captor. The young one, being but half grown, was still too young to take care of itself, and died shortly after." *

Like our other bats, this species frequently hibernates in vast assemblages; and in regions remote from civilization each colony usually occupies a rocky cavern or hollow tree; in inhabited districts they often take up quarters in the ruin of some deserted building, particularly of structures composed of stone and brick. Dr. Godman publishes a letter from Prof. Jacob Green, of Princeton, containing an account of the presence and actions of a host of this species in a cave that he visited November 1st, 1816. The letter runs as follows: "I this day visited an extensive cavern about twelve miles south of Albany, N. Y. I did not measure its extent into the mountain, but it was at least three or four hundred feet. There was nothing remarkable in this cave, except the vast multitudes of Bats which had selected this unfrequented place, to pass the winter. They did not appear to be much disturbed by the light of the torches carried by our party, but, upon being touched with sticks, they instantly recovered animation and activity, and flew into the dark passages of the cavern. As the cave was, for the most part, not more than six or seven feet in height, they could very easily be removed from the places to which they were suspended, and some of the party, who were behind me, disturbed some hundreds of them at once, when they swept by me in swarms to more remote, darker, and safer places of retreat. In flying through the caves they made little or no noise; sometimes upon being disturbed in one place they flew but a few yards and then instantly settled in another, in a state of torpor apparently as profound as before. These Bats, in hibernating, suspend themselves by the hinder claws, from the roof or upper part of the cave; in no instance did I observe one along the sides. They were not promiscuously scattered, but were collected into groups or clusters, of some hundreds, all in close contact. On holding a candle within a

* American Natural History. By John D. Godman. Vol. I, 1842, p. 42.

few inches of one of these groups, they were not in the least troubled by it: their eyes continued closed, and I could perceive no signs of respiration. On opening the stomach of one of these Bats, it was found entirely empty; the species, I believe, was the *V. Noveboracensis.*" *

The young of this species continue to nurse till at least a month old. I shot a female on the 31st of July (1883) whose udders still contained milk, and whose long nipples were much drawn out. A week later (Aug. 7th), I killed a full grown young flying over the same meadow.

## VESPERUGO SEROTINUS FUSCUS (Schreber) Dobson.

*Dusky Bat; Carolina Bat.*

Professor Baird has taken this species at Westport, in Essex County, on the eastern border of the Adirondacks, and I have procured a single specimen in Lewis County, on the western side of the district; but it is unquestionably the rarest bat found within the limits of this region. It pertains to a more southern fauna.

In writing of the habits of the Carolina Bat, Dr. A. K. Fisher observes: "They are the last to make their appearance in the evening. In fact, when it gets so dark that objects are blended in one uncertain mass, and the bat hunter finds that he is unable to shoot with any precision, the Carolina Bats make their appearance as mere dark shadows flitting here and there while busily engaged in catching insects. We have to make a snap shot as they dodge in and out from behind the dark tree-tops, and are left in doubt as to the result until in the gloom we may perchance see our little black and tan, seemingly as interested in the result as we are, pointing the dead animal. This species is particularly fond of fields well surrounded by trees." †

* Ibid., pp. 48–49.

† Forest and Stream, vol. XVI, No. 25, July 21, 1881, p. 490.

The large membranous wings of the bat serve a double function: not only do they sustain the animal in a strong and rapid flight, enabling it to make quick and abrupt turns in the noiseless pursuit of its insect prey; but they are also sensitive to an extreme degree, constituting organs of touch of unusual delicacy. They thus enable the bat with a certainty that is little short of marvellous, to avoid the most inconspicuous objects that may lie in its way. On this point Dr. Godman remarks: "We have already glanced at the singular fact, that Bats have the power of directing their flight with perfect correctness, even when deprived of their sight. In 1793, Spallanzani put out the eyes of a Bat, and observed that it appeared to fly with as much ease as before, and without striking against objects in its way, following the curve of a ceiling, and avoiding, with accuracy, everything against which it was expected to strike. Not only were blinded Bats capable of avoiding such objects as parts of a building, but they shunned, with equal address, the most delicate obstacles, even silken threads, stretched in such a manner as to leave just space enough for them to pass with their wings expanded. When these threads were placed nearer together, the Bats contracted their wings, in order to pass between them without touching. They also passed with the same security between branches of trees placed to intercept them, and suspended themselves by the wall, &c., with as much ease as if they could see distinctly." (American Natural History, vol. I, pp. 42–43.)

Dr. Joseph Schöbl, of Prague, repeated these experiments, but instead of putting out the eyes he covered them with adhesive plaster.

"He has kept bats, thus treated, for a year alive in his room, and has entirely confirmed Spallanzani's results. To account for these phenomena, the wings of bats have been examined for peculiar nerve-endings, by Cuvier, Leydig, and Krause, but without any success. The author's discoveries are therefore quite new to science. The following is a short abstract of his results. The

bat's wing membrane consists of two sheets of skin, the upper derived from that of the back, the lower from that of the belly. The epidermic and Malpighian layers in each sheet remain separate, whilst the true skin is inseparably fused. In this fused medium layer are imbedded the muscles, nerves, vessels, etc., of the wing. . . . . The whole wing is covered, both on the upper and under surface, with extremely fine, sparsely scattered hairs. . . . Each hair sac has from two to seven sebaceous glands, according to the species, and one sweat gland opening into its sac. The two outer fibrous layers of the hair sac have no sharp line of demarcation to separate them from the surrounding connective tissue, but the inner or hyaline coat is highly developed, and, after being constricted beneath the hair bulb, widens out and encloses the sense-bodies (Tastkörperchen), one of which organs is connected with each hair.

"The nerves of the wings may be considered to consist of five layers, i. e., there is one occupying the centre of a transverse section of the wing, which gives off on each side of it four others, and these are successively finer and finer as they approach the opposite surfaces. The inner layer and the one immediately on each side of it, consist of nerve fibres with dark borders, the other layers of pale fibres only. The tastkörperchen are connected with the second layer. The fifth layer of finest fibres ends as a network between the innermost layer of cells of the Malpighian layer of the epidermis. The tastkörperchen are shaped like a fir-cone with a rounded apex turned inwards. They lie immediately below the root of the hair; and their core or central substance is formed of a prolongation of the cells forming the two root sheaths of the hair. Their length is 0.0259 and their breadth 0.0175mm. A nerve containing about six dark-edged fibres is distributed to each körperchen. Just before the nerve reaches this organ it splits into two, and three fibres pass to one side of it, three to the other. The fibres are then wound round the body so as to sheathe its cellular core. Dr.

Schöbl thinks it probable that the fibres on one side are continuous with those on the opposite side, and that there is thus a bipolar arrangement here. He attributes to the fine network of pale nerve fibres belonging to the fifth layer the appreciation of temperature, pain, &c.; to the tastkörperchen the highly exalted sense of touch. It is curious that both kinds of nerve endings are connected with the Malpighian layer of the skin." *

Rafinesque, that eccentric, irascible, and not over liberal naturalist, whose inaccurate and ambiguous descriptions of species have created so much confusion in many departments of Natural History, was once the guest of the illustrious Audubon. The event was the occasion of a somewhat ludicrous adventure, which Mr. Audubon thus graphically narrates: "When it was waxed late I showed him to the apartment intended for him during his stay, and endeavored to render him comfortable, leaving him writing material in abundance. I was indeed heartily glad to have a naturalist under my roof. We had all retired to rest. Every person I imagined was in deep slumber, save myself, when of a sudden I heard a great uproar in the naturalist's room. I got up, reached the place in a few moments, and opened the door, when, to my astonishment, I saw my guest running about the room naked, holding the handle of my favorite violin, the body of which he had battered to pieces against the walls in attempting to kill the bats, which had entered by the open window, probably attracted by the insects flying around his candle. I stood amazed, but he continued running round and round, until he was fairly exhausted; when he begged me to procure one of the animals for him, as he felt convinced they belonged to a new species." †

* American Naturalist, Vol. V, No. 3, May, 1871, pp. 174–175.

† Quoted in Allen's Monograph, pp. xvi–xvii.

## VESPERUGO NOCTIVAGANS (LeConte) Dobson.

*Silver-haired Bat; Silver-Black Bat.*

This is our commonest bat, far outnumbering all the other species together. I have killed it in various parts of the Wilderness, and during the past summer Dr. A. K. Fisher, Walter H. Merriam, and myself shot over one hundred and twenty-five in Lewis County, along the western border of the region.

Like many other bats, it has a decided liking for water ways, coursing up and down streams and rivers, and circling around lakes and ponds. In some places its habit of keeping directly over the water is very marked. At Lyon's Falls it is exceedingly abundant, particularly just below the falls. I have stood, gun in hand, on a point on the east bank of the river, and have seen hundreds passing and repassing, flying over the water, while during the entire evening not more than two or three strayed so far that if shot they would fall on the land. Several that were wounded and fell into the water, at a distance of fifteen or twenty feet from the bank, swam ashore. They swam powerfully and swiftly, for the current is here quite strong and would otherwise have carried them some distance down stream.

Next to water courses, the borders of hard-wood groves are the favorite haunts of the Silver-haired Bat. By standing close under the edge of the trees one sees many that at a little distance would pass unobserved. While searching for their insect prey they may be seen to dart in and out among the branches and to penetrate, in various directions, the dense mat of foliage overhead. They often pass within a few inches of one's face, and yet it is rare that a sound is heard from their delicate wings.* In the early dusk

* In localities where we had hunted bats for some time, Dr. Fisher and I have on several occasions heard a bat, when swooping overhead, produce a sound which was distinctly audible at a distance of several paces. But in each instance, if the bat rose against the clear western horizon, we saw the light shine through numerous perforations in its wings, and the noise was unquestionably produced by the whistling of the air through these shot holes.

the Silver-haired Bat emerges from its hiding-place.* After a few turns about the immediate neighborhood it generally takes a pretty direct course for water. I have seen it start from the summit of a high, densely-wooded hill, circle around for a few minutes, and then, keeping far above the tree-tops, sail leisurely toward a distant river till lost from sight in the valley below. And, standing on the banks of the large stream that winds along the foot of this hill, I have seen the bats flying over at a height of several hundred feet, all moving in the same direction—toward a more distant river.

Whether it remains abroad all night, or limits itself to comparatively brief excursions in evening and early morning, can only be conjectured. I am inclined to favor the latter view, for the reason that the greater number always disappear before the darkness becomes sufficiently intense to hide them from sight. Against this opinion it may be argued that, as night advances, the bats move on to other parts of the neighborhood; to which I can only reply, that it has never been my good fortune to discover their midnight haunts, though I have visited various sections of the country at all hours of the night, and frequently under the light of the full-moon. It is true that solitary individuals are occasionally met with later, but never in anything like the numbers that are to be seen in the early evening. The flight of this species is neither so rapid nor so irregular as that of the red or the hoary bat.

In Lewis County, the best locality for bats that I am acquainted with is near the junction of Sugar and Black Rivers. The numerous caves in the lime rock at this point afford them a multitude of hiding-places just suited to their liking, and they here have the additional advantage of close proximity to running water. The disproportionate abundance of the Silver-haired Bat to other

* Leaving out of consideration the red bat, which is not sufficiently common in the region under consideration to afford satisfactory data, the present species is the first to appear. When the evenings begin to shorten, after the end of June, it may be looked for about one minute earlier each night.

species is shown by the fact that of seventy specimens procured here, sixty-three were of this species, six were the little brown bat (*V. subulatus*), and amongst them all there was only a single red bat (*Atalapha Noveboracensis*).

The dissociation of the sexes is sometimes most remarkable. Out of eighty-five adult specimens killed in Lewis County during the past summer (1883) there was but a single male. Two other males were killed in the early autumn. Of thirty-two young killed during the same period there were nineteen males and thirteen females, showing that the disproportion does not exist at birth. I am at a complete loss to explain this enormous preponderance of females among the adults. At first, I was inclined to think that the sexes separated during the period of bringing forth and caring for the young, but, although we visited a number of different localities, we were never able to find the males. Thinking that they might not fly until early morning, I several times went out before daylight, but females only were killed.

Mr. Frank Hough tells me that when looking for young crows, some years ago, in the deep ravine that runs through the village of Lowville, in Lewis County, he espied a crow's nest in a large and densely-foliaged hemlock. On climbing the tree he found the nest to be an old one, and commenced tearing it in pieces, when, to his astonishment, he discovered thirteen young bats embedded in the sticks and litter of which it was composed. These bats were taken home and shown to several members of the family. Their eyes were not yet open. They were, of course, the progeny of a number of females, and *presumably* were of the species now under consideration, because it is by far the most common in the region. The young, generally two in number, are born about the first of July, and commence to fly when three weeks old.* Those

* Females killed during the latter part of June were heavy with young, but up to July 1st not one had given birth to its offspring. All that were killed after July 4th had already been in labor and were then suckling their young. Of three females shot June 30th, 1883, one contained but a single embryo, and the others, two each. All were nearly ready for extrusion and would doubtless

killed on the first evening of their appearance averaged 90mm. in length by 261mm. in stretch, but weighed only half as much as their parents. The adults average about 104mm. in length by 302mm. in stretch. When on the wing the young may be distinguished from the old by the weakness and hesitancy of their flight, rather than by the difference in size. The young are much more beautiful than the adults, and they alone possess the perfect silvery tips to the hairs from which the species derives its name. Even before going into winter quarters their soft silvery backs have given place to the grizzly coats that characterize the adults.

My esteemed friend, Mr. William Brewster, has kindly favored me with the following very interesting account of a colony of bats that he discovered during an ornithological excursion into the extensive coniferous forests of western Maine :—

"On June 18, 1880, I was searching for woodpecker's nests among the stubs that line the shores of Lake Umbagog, when I noticed a small ragged-looking hole about two feet above the water in a trunk that stood well out on the flooded meadows. I should hardly have turned aside to examine it had I not fancied that I saw something move at its entrance; accordingly, paddling to the spot, I struck the tree sharply with the butt of an axe. The blow was followed, not by the appearance of a woodpecker's or nuthatch's head, as I had expected, but by an outbreak of shrill squeaking sounds that seemed to come from every part of the interior. As

have been born within forty-eight hours. The single one, a male, weighed 1100 milligrammes, and measured 43mm. in length by 79mm. in extent; the cord measured 20mm., and the placenta 10x14mm. One of the other females contained twins, both of which were females; one of them weighed 1380 milligrammes, measuring 41mm. in length by 72mm. in stretch; cord 18mm.; placenta 9x14mm. The other weighed 1100 milligrammes, and measured 39x68mm.; cord 17mm.; placenta 8x13mm. That the young are brought forth in the southern part of the State at about the same date as with us is evidenced from the following. Dr. A. K. Fisher states that a female which he killed at Sing Sing, in Westchester County, June 24, 1881, "contained two young, well developed, and probably would have been delivered in a few days. The young each weighed 1,450 milligrammes. On removing the amnion the ears of one of the young bats became erect. The placenta of this species is different from that of the Little Brown Bat; instead of being circular it is elliptical, measuring 10 by 15 millimetres. The placentæ were attached to the posterior wall of the uterus near the summit of each cornu. The umbilical cord measured twenty millimetres in length." (Forest and Stream, Vol. XVI, No. 25, July 21, 1881. p. 490.)

nothing could be seen at the hole, I drove the blade of the axe through the thin shell a little below and pried off a large piece. The result was fairly startling, for in a twinkling the opening was filled with swarms of Bats which, for the space of several minutes, poured forth uninterruptedly in a solid, dusky stream. The majority took flight at once, making off over the Lake or in the direction of the nearest wooded shore, but dozens, in their haste, fell into the water or sought refuge in the boat where they scrambled about under the seats or attempted to climb my legs.

"After the rush was over I was astonished to find that the tree had been by no means emptied. Indeed, the squeaking sounds within continued almost unabated. Investigating further I discovered that although the trunk was hollow for nearly its entire length, there was a central core which touched the walls in places, thus dividing the interior into separate spaces or chambers connected with one another by numerous passages. The side that I had opened had been promptly vacated, but many of the occupants had probably crawled around into the other chamber instead of following their more impulsive companions. At least when this, their last refuge, was laid bare by another application of the axe, the torrent that rushed forth rendered the first exodus insignificant by comparison. In fact, as my guide remarked at the time, it seemed as if all the Bats of New England had congregated in that one tree. Of their total numbers I should not care to attempt any definite estimate, but there were certainly hundreds and probably thousands. All were adults, and all apparently of the same species, a small dark-colored one which, as you suggest, was probably *Vesperugo noctivagans* although as I preserved no specimens (a piece of negligence that I now deeply regret) I cannot be positive on this point.

"None of the guides or lumbermen to whom I told this experience had ever met with a similar colony, although it is not unusual for them to find single Bats, or small families, hibernating in the

hollow trees which are cut for firewood during winter. I may add that the season of 1880 was very backward in Maine, cold rains and occasional flurries of snow occurring with disagreeable frequency well into June."

The bat hunter has many difficulties to contend with. Night creeps upon him so insidiously that he is only made aware of its presence by the number of shots missed (which multiply with painful rapidity with the increasing darkness), and by the great trouble and loss of time experienced in finding the bats that fall to the ground. The temptation to linger as long as the bats can be distinctly seen is very great, but should be resisted if the hunter has any regard for his reputation as a wing shot. When two shots out of three are missed, it is time to go home. Moonlight evenings are also very misleading, but the novice soon learns to avoid such illusions. I believe that I could not average one bat for every dozen shots by the brightest moonlight. The greatest obstacle in bat shooting is the inability to calculate distance after early nightfall, objects invariably appearing much farther off than they really are. Thus, a bat is frequently fired at when supposed to be at proper range, when in reality it is so near that the shot have not time to scatter, and it is consequently either missed altogether or so blown to pieces as to be worthless. I have sometimes, after missing a bat with the first barrel, brought it down with the second, when it seemed so far away that I was surprised to find that my gun carried to so great a distance. On going to pick it up I have been still more astonished to find it within short range, rarely over seventy-five feet (22.86 metres) from the spot where I had stood. This deceptiveness in distance manifests itself in another embarrassing way, for in searching for the bat in this dim light one is almost certain to overestimate the distance at which it fell. Hence a well-trained dog, with a good nose, is of the greatest assistance.

The length of time that the fading light will permit of bat shooting in any single evening varies from a little over half an hour, to

less than ten minutes, according to the season. The loss of time, therefore, occasioned by searching for fallen bats is of the most serious consequence, and can only be overcome by the aid of a dog, or of an associate. In fact, the value of a willing assistant can scarcely be exaggerated. He stands a little to one side of the hunter and carefully notes the line in which a bat falls. The hunter likewise marks the direction, and as both advance simultaneously, the point of intersection of the two lines shows the exact position of the bat. A lantern with a good reflector is of some service, but too much reliance must not be placed upon it, and it should always be carried by the assistant, who, where bats are fairly abundant, may double the number of specimens secured.

The earliest date at which I have observed the Silver-haired Bat in the Black River Valley is the 26th of April (1884). It commenced to fly at about 7.20 P. M.

## VESPERTILIO SUBULATUS Say.

*Little Brown Bat.*

Next to the silver-haired bat, this is the commonest and most universally distributed species in the Adirondacks, so far as my observations extend. Professor Baird has taken the typical animal at Elizabethtown, and the form known as *lucifugus* at Westport. Dr. A. K. Fisher and Mr. Oliver B. Lockhart have killed it at Lake George, and Walter H. Merriam in Keene Valley, these localities being all upon the eastern slope of the mountains; and I have a specimen from Big Moose Lake in the interior, and have found it in considerable numbers at several places on the western side of the Wilderness.

In coloration, the young of the Little Brown Bat differs from its parents even more than does the young of the silver-haired species. An immature male which I shot August 15th, 1883, had attained the full dimensions of the adult, but was of an entirely

different color, its whole body being of a very pale yellowish-brown, almost inclining to gray on the belly.*

Mr. Figanierre E´ Morao, Minister Plenipotentiary from Portugal to the United States, published, some years ago, an account of a colony of bats that caused him great annoyance. This paper contains so much of interest that a few pertinent extracts from it are here introduced :—

"In the winter of 1859, having purchased the property known as Seneca Point, in the margin of the Northeast River, near Charlestown, in Cecil County, Maryland, we took possession of it in May of the next year. . . . Having been uninhabited for several years, it exhibited the appearance, with the exception of one or two rooms, of desolation and neglect. . . . The weather, which was beautiful, balmy and warm, invited us towards evening to out-door enjoyment and rest, after a fatiguing day of travel and active labor ; but chairs, settees, and benches were scarcely occupied by us on the piazza and lawn, when, to our amazement, and the horror of the female portion of our party, small black bats made their appearance in immense numbers, flickering around the premises, rushing in and out of doors and through open windows. . . . . Evening after evening did we patiently though not complacently watch this periodical exodus of dusky wings into light from their lurking-places. . . . Their excursions invariably commenced with the cry of the 'whippoorwill,' both at coming evening and at early dawn, and it was observed that they always

* Concerning the number of young produced at a birth, *et cetera*, by *Vespertilio subulatus*, Dr. A. K. Fisher writes. "Of ten pregnant females which we examined last June, 1880, each contained two young. Prof. Burt. G. Wilder (Pop. Sci. Mo., No. 42, p. 651) examined twenty females in June, 1874. Each contained two little bats, though Dr. C. C. Abbott states (Geology of New Jersey, Appendix, p. 752), that they bring forth a litter of three to five. We consider this number unusual, as all the specimens examined by us never contained more nor less than two. The abdomen of the female is not so prominent, but very much broadened, a fœtus developing in each horn of the uterus. The uterine walls at term are very thin, the entire organ weighing only about a centigramme. The placenta of this species is circular, measuring nine millimetres in diameter, the umbilical cord being twelve millimetres long. A young one taken from a female whose mammæ contained milk, weighed 1,350 milligrammes" (Forest and Stream, Vol. XVI, No. 25, July 21, 1880, p. 490.)

first directed their flight towards the river, undoubtedly to damp their mouse-like snouts, but not their spirits, for it was likewise observed that they returned to play hide-and-seek and indulge in all other imaginable gambols; when, after gratifying their love of sport and satisfying their voracious appetites (as the absence of mosquitoes and gnats testified) they would re-enter their habitation, again to emerge at the first signal of their feathered trumpeter. I thus ascertained one very important fact, namely, that the bat, or the species which annoyed us, ate and drank twice in twenty-four hours." After resorting to many ineffectual expedients in the vain attempt to rid his home of these multitudinous pests, he caused "all the holes, fissures in the wood-work, and apertures in the slating to be hermetically sealed with cement. This put a stop to their egress, but to avoid their dying by starvation and deprivation of water, which would much increase the annoyance by adding their dead to their living stench, I ordered apertures of about two feet square to be opened in the lathed and plastered partition on each side of the garret windows and also in the ceiling of every garret room; lastly, when the bat's reveille was sounded by the bugle of the whippoorwill, all the hands of our establishment, men and boys, each armed with a wooden implement (shaped like a cricket-bat), marched to the third floor 'on murderous deeds with thoughts intent'; a lighted lantern was placed in the middle of one of the rooms, divested of all furniture, to allure the hidden foe from their strongholds. After closing the window to prevent all escape into the open air, the assailants distributed themselves at regular distances to avoid clubbing each other, awaited the appearance of the bats, enticed into the room by the artificial light and impelled by their own natural craving. The slaughter commenced and progressed with sanguinary vigor for several hours, or until brought to a close by the weariness of dealing the blows that made the enemy bite the dust, and overpowered by the heat and closeness of the apartment. This plan succeeded perfectly. After

a few evenings of similar exercise, in which the *batteurs* became quite expert in the use of their weapon, every wielding of the wooden bat bringing down an expiring namesake, the war terminated by the extermination of every individual of the enemy in the main building. However there still was the cock-loft of the laundry, which gave evidence of a large population. In this case I had recourse to a plan which had been recommended, but was not carried out in regard to the dwelling-house. I employed a slater to remove a portion of the slating which required repairing. This process discovered some fifteen hundred or two thousand bats, of which the larger number were killed, and the surviving sought the barn, trees, and other places of concealment in the neighborhood.

"In the main building nine thousand six hundred and forty bats, from actual counting, were destroyed. . . . At the end of five years the odor has now nearly disappeared, being barely perceptible during a continuance of very damp weather." *

Order GLIRES. Family SCIURIDÆ.

## SCIUROPTERUS VOLUCELLA (Pallas) Geoffroy.

*Flying Squirrel.*

Two varieties of Flying Squirrel occur in the Adirondacks: the present form, confined mainly to the borders of the region, and a northern race, commonest in the elevated portions of the interior.

The subject of this sketch feeds upon a variety of nuts, seeds, and buds, and upon beetles and perhaps other insects, not hesitating to eat flesh when occasion offers. I have caught many in box-traps baited with beef, and have frequently known them to devour dead birds, the heads of which they particularly relish. Whether they prey upon the smaller species that roost in the forest I am unable to say, but their agility and their noiseless movements

* An Account of a Remarkable Accumulation of Bats. Smithsonian Annual Report for 1863 1864, pp. 407–409.

would enable them to capture the most wary with ease. Moreover the eagerness and avidity with which they seize and feast upon a dead bird placed within reach would indicate that they were not strangers to such a repast.* In confinement they will eat bird's eggs, not discarding the shells.

A more gentle, docile, and graceful animal than the Flying Squirrel does not exist, and though without anything striking in the way of color or markings, it is nevertheless one of the most beautiful of our mammals. The dense silky fur of an ashen-brown above and creamy white beneath, rivalling that of the chinchilla in glossy softness, and the large, prominent, and expressive eyes, together with its pretty ways, render it an attractive and justly esteemed pet.

Prof. F. H. King mentions the interesting circumstance that when an assortment of nuts was placed within reach of a Flying Squirrel which he had in confinement, it carried off all the acorns and hazel-nuts, but did not touch any of the others. These two kinds of nuts were the only ones that grew in the immediate neighborhood of the place where this squirrel was captured, but it was taken so young that it could never have seen any nuts prior to its confinement. Hence the case seems clearly one of inherited habit.†

Whether, in the region under consideration, this variety of the Flying Squirrel hibernates, I am unable to state with positiveness, though strongly of opinion that it does. It certainly remains in its nest during the severer weather of our winters.

Next to the bats, it is the most strictly nocturnal of our mammals, very rarely being seen abroad till after nightfall. He who quietly wanders through our groves and forests during the warm, still

* Prof. F. H. King, in his admirable and comprehensive treatise upon the Economic Relations of Wisconsin Birds, says: "In the spring of 1879, I placed the young of the Chipping Sparrow in the cage with a young pet flying squirrel (*Sciuropterus volucella*). The bird was seized with energy and killed but not eaten." (Geology of Wisconsin, Vol. I, 1883, p. 444.) The reason the bird was not eaten is hard to explain unless the squirrel was surfeited with food.

† Mr. E. P. Bicknell suggests that the squirrel may have selected the acorns and hazel-nuts because they were thinner-shelled than the others.

nights of summer and early autumn cannot but mark the myriads of sounds that betoken the presence and activity of animal life. The faint rustling of leaves, the pattering of light footsteps on the ground, the constant dropping of something from the trees, the springing back of a branch relieved from the weight of some animal, the sharp squeaking of unseen creatures, the lonesome note of a wakeful bird, the occasional low grating of teeth overhead, the bustle and chipper of something chasing something else up the trunk of a neighboring tree, the cry of distress as some bird or beast of prey seizes its unhappy victim;—these and numberless other noises, mostly vague and indescribable,—fill the air and bear evidence to the profusion of life. And yet the very multiplicity of sounds is confusing, and prevents the perception of those that are distinctive. To the ear accustomed to the whisperings of Nature many of these noises are recognized as easily as the voices of familiar friends. The shrew, the mouse, the bat, the chickaree, and the Flying Squirrel are almost sure to be present, and the latter is generally responsible for no small share of the perplexing sounds. His activity is intense, his sailing leaps frequent, his gambolings almost ceaseless, his sly chuckle and saucy scold are occasionally heard, and his dropping of beechnut shucks is sometimes well nigh continuous.

Audubon and Bachman narrate an interesting experience that no other naturalists seem to have been fortunate enough to witness. They say: "We recollect a locality not many miles from Philadelphia, where, in order to study the habits of this interesting species, we occasionally strayed into a meadow containing here and there immense oak and beech trees. One afternoon we took our seat on a log in the vicinity to watch their lively motions. It was during the calm warm weather peculiar to the beginning of autumn. During the half hour before sunset nature seemed to be in a state of silence and repose. The birds had retired to the shelter of the forest. The night-hawk had already commenced its low evening

flight, and here and there the common red bat was on the wing; still for some time not a Flying Squirrel made its appearance. Suddenly, however, one emerged from its hole and ran up to the top of a tree; another soon followed, and ere long dozens came forth, and commenced their graceful flights from some upper branch to a lower bough. At times one would be seen darting from the topmost branches of a tall oak, and with wide-extended membranes and outspread tail gliding diagonally through the air, till it reached the foot of a tree about fifty yards off, when at the moment we expected to see it strike the earth, it suddenly turned upwards and alighted on the body of the tree. It would then run to the top and once more precipitate itself from the upper branches, and sail back again to the tree it had just left. Crowds of these little creatures joined in these sportive gambols; there could not have been less than two hundred. Scores of them would leave each tree at the same moment, and cross each other, gliding like spirits through the air, seeming to have no other object in view than to indulge a playful propensity." *

The Flying Squirrel is the most highly specialized of the family to which it pertains, its whole structure pre-eminently fitting it for arboreal life. The peculiar tegumentary expansion along the sides enables it to make flying leaps that far exceed those of other squirrels; and the ease, grace, and rapidity with which it glides from tree to tree inspires the merest passer-by with wonder and admiration. Its ordinary mode of progression is by a series of alternate climbs and leaps. Upon reaching a tree the first act is to ascend, for, being unable to sail horizontally, it must attain a considerable elevation before venturing to leap to the next. Instead of moving off in this way when disturbed, it sometimes runs up into the topmost branches of the nearest tree, and, coiling itself into surprisingly small compass, remains motionless till the intruder has taken his departure.

* Quadrupeds of North America, Vol. I, 1846, p. 218.

The modifications of structure that adapt it to its habit of life are by no means so great as in the case of the mole or bat, and yet it is not less inseparably associated with an almost exclusively arboreal existence than are these others with the special conditions of their environment.

Flying Squirrels make their nests in the hollows of trees, frequently taking possession of deserted woodpecker's holes. They are easily aroused and driven out by hammering against the trunk. I have thus expelled the occupants of as many as half a dozen nests in a single day's hunt. Their progeny must be brought forth early in April, for on the 30th of April, 1878, Dr. C. L. Bagg and myself took three half-grown young from a woodpecker's hole, about fifteen feet above the ground, in a decayed stub. They did not seem at all frightened, but were tame and gentle from the beginning, and my sister and I kept two of them alive. At night they were excessively active and playful, but, unless disturbed, would sleep during the greater part of the day. They preferred to remain upon our persons, and one used to sleep in my pocket. At first it could jump but a short distance, and if placed upon a chair or table became very unhappy and would come to the edge nearest the place where I was standing and cry to be taken. If I extended my arm and approached it, the little creature, trembling with delight, would stand on its hind legs and leap upon my hand; thence, either running up my sleeve or down my neck, it would nestle in my bosom and sleep for hours, or until forcibly removed. Prof. F. H. King, in a recent communication, records an experience with the young of this species that calls to mind many of the actions and peculiarities of those that I have had. He says: "I have never known wild animals that became so perfectly familiar and confiding as these young squirrels did; and they seemed to get far more enjoyment from playing upon my person than in any other place, running in and out of pockets, and between my coat and vest. After the frolic was over they always esteemed it a great favor if

I would allow them to crawl into my vest in front and go to sleep there, where they felt the warmth of my body, and it was very rare indeed, during the first six months, that they failed to ask the privilege; indeed they came to consider themselves abused if turned out. When forced to go to sleep by themselves, the attitude taken was amusing, the nose was placed upon the table or other object it happened to be upon, and then it would walk forward over it, rolling itself up until the nose almost protruded from between the hind legs; the tail was then wrapped in a horizontal coil about the feet, and the result was an exquisite little ball of life in soft fur which it seemed almost sacrilegious to touch. If they escaped from the cage during the night, I was sure to be warned of the fact by their coming into the bed to roll themselves up close to my face or neck." *

The most extended account which I have seen of this animal's habits in confinement, is from the pen of Prof. Geo. H. Perkins, of the University of Vermont. He describes his interesting pets in the following language: "At dusk they begin to stir. Not all at once it would seem do they awake, for the material of the nest quivers and shakes for some time before the squirrel appears. When, however, they conclude that they are all ready, out pop their heads, each to be followed by the rest of the body, after a glance on all sides with the glistening black eyes; and now all drowsiness has disappeared and an activity more incessant and more intense than can be described takes its place. All night long, often with only the briefest rest now and then, these little animals are in vigorous motion, jumping, bounding, capering, running with ever-varying movement and astonishing energy. Everything they do is done with all their might. It would seem to any one watching them that the exercise of the first few minutes must wholly exhaust their powers, but, on the contrary, the more their muscles are used, the more capable of use they seem, and great as is the

* American Naturalist, Vol. XVII, No. 1, Jan. 1883, p. 39.

energy of their movements at first, they usually increase in vigor and speed until after midnight and scarcely grow less before morning. Nothing affords them so much gratification as a large wheel which is placed inside the cage. Into this wheel they jump whenever aught disturbs or pleases them, and even when quite hungry they often find it necessary to take a few turns before commencing their meal, after which exercise they draw themselves into a bunch with the tail over the back, after the manner of squirrels, and set briskly to work on the nut or other food they may have received. They are almost as fond of riding as of running, and work their passage by running till the wheel is in rapid motion and then clinging to its wires, and so are carried around and around, the pure white of the under side of the body contrasting prettily with the soft brownish-gray of the back and sides as each comes into view. When both are in the wheel one often rides while the other turns the wheel, the latter bounding over the other as each turn brings him around, and, no matter how rapidly the wheel turns, these movements are executed with perfect exactness and gracefulness. Being desirous of knowing with some degree of accuracy how rapidly the wheel moved, I made some experiments for that purpose and found that the usual rate of revolution was from sixty to over a hundred and twenty times a minute, and, as the wheel is forty-four inches in circumference, when its rate is the latter of the two numbers named, the squirrel turning it must travel four hundred and forty feet a minute, or about five miles an hour, a distance requiring a great many steps when they are so short as squirrels must take. The sides of the wheels are formed of spokes radiating as in any wheel, these spokes are only five inches apart at the circumference and of course constantly grow less toward the centre; yet through this narrow space which passes, when the wheel is at full speed, in the sixteenth of a second, they dart in and out with perfect ease. So quickly do they move that the eye can scarcely follow them; one instant a squirrel is in the

wheel running with all his might, and the next he is seated on a shelf at the opposite end of the cage, the wheel whirling behind him . . . . Though usually very quiet they are not always displeased with noise, if it be a lively one ; for instance, they drop a nut in the wheel and then as it rattles when the wheel moves they are highly delighted, sometimes more so than some of the other listeners. Once when a butternut thus became quite a trouble to me I removed it, but no sooner had I left the cage than they put it back and set it rattling louder than ever, leaping over it as it came near them and jumping about as if performing a war dance, and this they repeated over and over again till, finally, the nut was removed from the cage. Now and then the freak takes one or the other to leave the wheel altogether for several days, and in the meantime they relieve their over-buoyant feelings by executing a brilliant series of somersets with an agility and daring that would excite the envy of the most skilful acrobat. They always turn backward, going completely over and alighting almost exactly upon the spot from which they started. Now they run a few steps before going over and now stop and turn around as if a spit ran through the centre of the body on which it turned. These gyrations are often extremely ludicrous, especially, when turning side by side, they seem to be racing . . . . They are exceedingly inquisitive, prying into everything that comes in their way ; and, if watched and fearful lest they are to be interrupted, they assume a most impudent and reckless air, glancing out of one eye, and shaking their heads and sniffing every now and then for an instant, and then returning to their investigations with renewed energy, pulling away desperately at anything that can be laid hold of, and if anyone starts toward them to drive them away, they wait till the very last minute, when, with a twinkle of the eye, a toss of the head, and a jerk of the tail, they are off and across the room in a trice, perhaps stopping to chatter their disapproval of the whole proceeding as soon as safely out of reach . . . . When the actions of an animal are so suddenly varied, so

constantly changing and of such interest in all their phases as are those of the Flying Squirrel, a complete account can scarcely be given. Certainly it is not easy for words to represent the merry, rollicking, don't-care manner in which they do everything. Such a combination of earnestness and carelessness is seldom seen. For they are earnest about their work, and in emptying a box of nuts they seem to feel the great importance of their undertaking and the necessity of soberness and dignity in its execution, but yet one cannot help seeing that all this is but assumed for the occasion, for their eyes, and indeed their whole body, are all the time expressive of mischief, and the little rogues are never so sedate that they do not seem to be bubbling over with fun and to be ready at a moment's notice to engage in any mischief that may occur to their scheming little heads." *

An adult that I once had in captivity used to make a practice of leaping from the floor, or from some object in the room, to the top of my head, where it would scratch and dig as if searching for beechnuts.

The late Dr. Gideon B. Smith, of Baltimore, in a letter to Audubon and Bachman, speaks thus of these squirrels: "They are gregarious, living together in considerable communities, and do not object to the company of other and even quite different animals. For example, I once assisted in taking down an old martin-box, which had been for a great number of years on the top of a venerable locust tree near my house, and which had some eight or ten apartments. As the box fell to the ground we were surprised to see the great numbers of Flying Squirrels, screech-owls, and leather-winged bats running from it. We caught several of each, and one of the Flying Squirrels was kept as a pet in a cage for six months. The various apartments of the box were stored with hickorynuts, chestnuts, acorns, corn, &c., intended for the winter supply of food. There must have been as many as twenty Flying Squirrels in the box, as many bats, and we

* American Naturalist, Vol. VII, No. 3, March, 1873, pp. 133–139.

know there were six screech-owls. The crevices of the house were always inhabited by the squirrels. The docility of the one we kept as a pet was remarkable; although he was never lively and playful in the day-time, he would permit himself to be handled and spread out at the pleasure of any one. We frequently took him from the cage, laid him on the table or on one hand, and exposed the extension of his skin, smoothed his fur, put him in our pocket or bosom, &c., he pretending all the time to be asleep." *

## SCIUROPTERUS VOLUCELLA HUDSONIUS (Gmelin) Allen.

*Northern Flying Squirrel.*

The Northern Flying Squirrel is a common inhabitant of the elevated central area of the Adirondacks and is not particularly rare about the outskirts of the region, where I have found both varieties nesting in adjoining trees. Although this is much the larger of the two, and may also be distinguished by some peculiarities of coloration, individuals are sometimes met with that are more or less intermediate; still, I have yet to see the specimen that cannot at once be referred either to the one or the other.

The Northern Flying Squirrel is a hardier animal than its smaller relative, and remains awake and active during the whole of our long and severe winters. The mercury may indicate a temperature many degrees below zero, or snow may be falling in quantities sufficient to obstruct the vision, without seeming in any way to dishearten this merry adventurer. The last rays of the departing sun have scarcely disappeared from the western horizon before the sombre shades that mark the approach of winter night commence to gather about the snow-clad forest. Whether bright stars sparkle and shine through a frosty atmosphere, or heavy, leaden clouds overhang the scene, makes little difference to the Northern Flying Squirrel. He emerges from his warm nest, takes a hasty survey of the surroundings lest some wily

* Quadrupeds of North America, Vol. I, 1846, p. 220.

owl should lurk hard by, glides silently to a neighboring tree, and starts forthwith upon his nightly tour in quest of food and sport. Prompted either by hunger or curiosity, or by a combination of the two, he examines every unusual object with scrupulous care, and as one result is always getting into traps set for valuable fur—and this whether they are baited with mammal, bird, or fish. Indeed, the nature of the bait seems to be a matter of the most trivial consequence, as it often consists of red and Flying Squirrels that have previously been taken in the trap. Even in this case another Flying Squirrel is as likely to be the next thing caught as any animal in the Wilderness. Hence it happens that the trapper comes to look upon him as an unmitigated nuisance.

These handsome Squirrels are very fond of beechnuts, and during "nut years" feed largely upon them. They are thirsty creatures and in the early spring, when certain of the woodsmen are engaged in making maple sugar, many are found dead in the sap buckets—drowned in their efforts to obtain the sweet fluid.

They breed about a month later than their smaller relative. June 18th, 1883, Dr. A. K. Fisher and the writer found the nest of a Northern Flying Squirrel at West Pond, near Big Moose Lake. It was in the last year's nest of a three-toed woodpecker (*Picoides arcticus*) in a tamarack (*Larix Americana*) and the entrance hole faced the east, about ten feet above the ground. On cutting down the tree the nest was found to contain three nursing young, not yet one-third grown; they were estimated to be about a month old. They were fed on condensed milk diluted with water until we left the woods, and afterwards on fresh milk and vegetables. One of them grew very rapidly, attaining nearly two-thirds the size of its parent by the 10th of July, when it was accidentally killed. They all were perfectly tame and acted much like the young of the common Flying Squirrel (*S. volucella*) already described.

In searching the scanty literature relating to this animal, which has not previously been recorded from the State of New York, I have

been unable to find anything upon its habits excepting the following account of a female and young, narrated by Audubon and Bachman: "A brood of young of this species, along with the mother was kept in confinement by an acquaintance of ours, for about four months, and the little ones, five in number, were suckled in the following manner: the younglings stood on the ground floor of the cage, whilst the mother hung her body downwards, and secured herself from falling by clinging to the perch immediately above her head by her forefeet. This was observed every day, and some days as frequently as eight or ten times.

"The brood was procured as follows: a piece of partially cleared wood having been set on fire, the labourers saw a Flying Squirrel start from a hollow stump with a young one in her mouth, and watched the place where she deposited it, in another stump at a little distance. The mother returned to her nest, and took away another and another in succession, until all were removed, when the wood-cutters went to the abode now occupied by the affectionate animal, and caught her already singed by the fire, and her five young unscathed.

"After some time a pair of the young were given away to a friend. The three remaining ones, as well as the mother, were killed in the following manner:

"The cage containing them was hung near the window, and one night during the darkness, a rat, or rats (*Mus decumanus*), caught hold of the three young through the bars, and ate off all their flesh, leaving the skins almost entire, and the heads remaining inside the bars. The mother had had her thigh broken and her flesh eaten from the bone, and yet this good parent was so affectionately attached to her brood that when she was found in this pitiable condition in the morning, she was clinging to her offspring, and trying to nurse them as if they had still been alive." *

* Quadrupeds of North America, Vol. III, 1854, pp. 203–204.

## SCIURUS HUDSONIUS Pallas.

*Red Squirrel; Chickaree.*

The Red Squirrel is one of the commonest and best known of the mammalian inhabitants of the Adirondacks, being found in all parts of the Wilderness at all seasons of the year.

His diet is more varied than that of our other squirrels. In addition to nuts and acorns he feeds upon a variety of seeds and roots, the buds and leaf-stems of certain trees, several species of "toadstools" and other fungi, seeds from the cones of pines and spruces, fruits and berries of many kinds, beetles, birds' eggs, and even young birds. And in winter he does not look with disdain upon scraps of meat or fish that may have been left within his reach.

He is the most hilarious of the pre-eminently merry and frolicsome family to which he belongs, and his joyous and jubilant nature enables him to triumph over the sense of gloom that pervades the sombre coniferous forests of the North, rendering him cheerful and contented in the darkest and most impenetrable of our evergreen thickets. Indeed, it is this happy faculty of adapting himself and his modes of life to a diversity of surroundings that has permitted his wide dispersion, the present boundaries of his habitat being coextensive with those of the wooded portions of the northern part of our continent.*

The Chickaree combines qualities so wholly at variance, so unique, so incomprehensible, and so characteristic withal, that one scarcely knows in what light to regard him. His inquisitiveness, audacity, inordinate assurance, and exasperating insolence, together with his insatiable love of mischief and shameless disregard of all the ordinary customs and civilities of life, would lead one to suppose that he was little entitled to respect; and yet his intelligence, his untiring perseverance, and genuine industry, the cunning cleverness displayed in many of his actions, and the irresistible humor with which he does

* The species and its several geographical races are here spoken of collectively.

everything, command for him a certain degree of admiration. He is arrogant, impetuous, and conceited to an extreme degree, his confidence in his own superior capabilities not infrequently costing him his life. In fact, these contradictions in character and idiosyncrasies in disposition render him a psychological problem of no easy solution.

From earliest dawn till the setting sun has disappeared behind the distant hills, the Red Squirrel enlivens the silent solitude of the forest with his merry ways and saucy chatterings; and he may sometimes be discovered in the darkest hours of the night, stealing softly over the ground—bent, doubtless, on some errand of dubious propriety. Moonlight evenings he is often as active, though not so noisy, as during the day, and in early autumn he vies with the flying squirrel in nocturnal nut-husking exploits. Though an expert climber, delighting in long leaps from bough to bough, which he executes with grace and precision, he spends far more time on the ground than the other arboreal squirrels, sometimes even making his home in holes in the earth. Old logs, stumps, wood-piles, and brush-heaps are favorite places of resort, and, by excavating burrows beneath, he converts them into the securest of retreats. Our fences serve as highways upon which he travels from wood to wood, and the zig-zag rail fence in particular is one of the boons of his existence. It is his most frequented path, his playground, his race-course, and when pursued, his readiest means of escape. It is the step-ladder from which he leaps into the branches of neighboring trees, and the place where he meets his friends at all hours of the day. He frequently follows it to the farm-house and takes up his abode in the woodshed or other outbuilding, placing his nest between the ceiling and roof, or in some other equally out-of-the-way spot, whence he is with great difficulty dislodged.

He is the least wary of the squirrels, rarely taking the trouble to hide himself at the approach of man. In fact, on such occasions he usually assumes an aggressive attitude, chippers, shakes his tail in an

impudent and wholly uncalled-for manner, but takes care to keep just out of reach. This daring fearlessness is clearly the result of the fact that he is not worth the powder necessary for his destruction, and he is therefore tolerated, though an acknowledged nuisance. But there are times when his conduct becomes so scandalous that the shot-gun is brought out for his suppression. He is soon deeply impressed with the range and effect of this weapon, and, though many of his brothers may have perished before the warning was heeded, he now becomes, in this particular locality, the most circumspect of brutes. He scorns the thought of running away, but grows so vigilant, sly, and crafty that the farmer is put to his wit's end to devise means for his riddance.

His curiosity is almost as striking as his impudence, and more than once when I have been standing or sitting motionless in the forest he has approached nearer and nearer, eyeing me inquisitively, chippering, and shaking his tail, till finally he has jumped upon my person, to be off again in a trice. When sleeping on the ground in July, 1878, I was awakened, just at daybreak, by a noisy and excited chippering close at hand, but before my eyes were fairly open one of these mischievous imps alighted in my face. The surprise was common, and I must have started rather unceremoniously, for he sprang so suddenly to the nearest tree that the prints of his claws were visible for sometime after upon my forehead and nose.

Of all the annoyances that beset the trapper in this region, none compare with the Red Squirrel. Not only is he the most vexatious of all the animals that roam the Adirondack wilds, but he often proves a source of disaster to the fur dealer. From an overhanging limb he looks on with unfeigned interest while the trapper arranges the bait for the martin or fisher; but a moment later he has sprung the trap and is chippering with exulting derision at the result. He is often caught, it is true, but half a dozen others are always ready to take his place, and it affords little satisfaction to the hunter, on his lonely rounds through the snow-clad forest, to find a worthless

Squirrel in his trap, instead of the valuable fur for which it was set. But if, instead of consulting the hunter's interests, we take another view of the case, it is easy to see that the Chickaree is a good friend to the martin. He furnishes the latter with food of an exceptionally agreeable kind, and though it cost him his life, takes great pains to discover and spring the traps set for the martin's destruction.

He is not always to be found in equal numbers, but is influenced in a marked degree by the beechnut crop. In seasons when mast is plentiful there seems to be a Squirrel for every tree, bush, stump, and log in the entire Wilderness, besides a number left over to fill possible vacancies. When, on the other hand, the nut crop has been a failure, a corresponding diminution in the numbers of Squirrels is observable, and they are sometimes actually scarce.* Hence it is clear that while the diet of the Red Squirrel is varied, his staple commodity is the beechnut, the yield of which in any year determines his abundance in the succeeding winter and spring. That he migrates, on a small scale at least, is a fact concerning which there can be no reasonable doubt: on any other hypothesis we are at a loss to account for the suddenness of his increase and decrease over certain areas of large extent, and find it difficult to explain why he is sometimes met with in numbers swimming our lakes and rivers, always in one direction.

As might be inferred from the boreal distribution of this animal, he is the hardiest of our squirrels. Not only does he inhabit regions where the rigors of Arctic winter are keenly felt, but, refusing to hibernate, he remains active throughout the continuance of excessive

* To be more explicit: The yield of beechnuts was good in the fall of 1881. In October and November of that year I found Red Squirrels abounding in all parts of the region traversed—from the Black River Valley to the Saranacs and Tupper's Lakes. Dr. F. H. Hoadley, who spent the winter at Big Moose Lake, informs me that they continued in undiminished numbers throughout the months of January, February, and March, proving a serious grievance to the trapper. The next fall, that of 1882, the nut crop failed (as it always does here on the alternate years), and I found but few Red Squirrels in the Adirondacks in October and November. As the winter advanced they became less and less common, and in January I did not see a single one, and but two of their tracks, while on a snow-shoe tramp from Big Otter to Big Moose Lake.

cold. When fierce storms sweep over the land he retires to his nest, to appear again with the first lull of the wind, be the temperature never so low. I have many times observed him when the thermometer ranged from thirty to forty degrees below zero Centigrade (–22 to –40 F.), but could never see that he was inconvenienced by the cold. When running upon the snow he often plunges down out of sight, tunnels a little distance, and, reappearing, shakes the snow from his head and body, whisks his tail, and skips along as lightly and with as much apparent pleasure as if returning from a bath in some rippling brook during the heat of a summer's afternoon.

He possesses the rare and philosophical accomplishment of combining work with recreation, and sets about the performance of his self-imposed tasks with such roguish humor that it is a pleasure to watch him. In marked contrast to these free and happy habits is the stealth and sullenness that characterize the actions of some of the Carnivores, notably of the family Mustelidæ.

The Red Squirrel enjoys a game of "tag" even more than the average schoolboy, and one is often startled by a couple of them as they rush madly through the leaves, chasing each other hither and thither over the ground, up and down and around the trunks of trees, and in and out of hollow logs and stumps with a degree of recklessness that is astonishing to behold.

However frivolous the Red Squirrel may appear to the casual observer, he is, nevertheless, a most industrious animal. Unlike most of his associates, and many of our own species, he is not content with the enjoyment of present plenty, but takes pains to provide against a time of future need. When the summer has grown old, and the mellow days of early autumn cast a glow of color over the sumac and woodbine, the prudent Squirrel has commenced to gather the provision for his winter's use. Impatient to make sure his store, he does not wait for the nuts to ripen and fall, but cuts the stems by which they hang, till many lie scattered on the ground below. He then descends and collects them in a heap between, or near, the roots

of the trees; or, if he thinks them here too exposed, carries them directly to some hollow log or stump. Later in the season, when the mast is fully ripe, and the danger from mould is past, he fills the hollows of the limbs and trees about his nest, and often secretes reserve hoards in his burrows in the earth. In the evergreen forests he lays up large supplies of cones. I have seen him, even before the middle of September, engaged in gathering those of the white pine (*Pinus strobus*). At this early date he cuts the yet green cones from the branches, and, when a sufficient number have fallen, takes them to some hiding-place to ripen for his winter's fare. He eats the little buds that may be found scattered sparingly along the small branches of the spruce, and, in order to obtain them easily, bites off the terminal twigs and drags them back where the limb is large enough to allow him to sit comfortably on his haunches while feeding. Under single trees, both in the great forest and on our own lawn, I have found enough twigs to fill a bushel basket. The injury thus done is sometimes very extensive.

He is fond of a variety of fruits, and sometimes commits great havoc in the apple orchard. From his liking for mushrooms some would consider him an epicure, but in whatever light we regard this taste, it is a droll spectacle to see him drag a large "toadstool" to one of his storehouses. If the "umbrella" happens to catch on some stick or log and is broken from the stem, as is frequently the case, he is pretty sure to scold and sputter for a while, and then take the pieces separately to their destination.

Throughout the first half of June I have often observed a family of Red Squirrels feeding upon the winged seeds of a red or swamp maple (*Acer rubrum*), directly in front of my office window. They rarely came during the day, but in the evening both parents and five young were frequently seen on the tree at one time, and they commonly remained till it was so dark that I could no longer discern their outlines. In reaching down from the slender twigs to the drooping clusters of fruit they sometimes slipped and seemed

about to fall, but I never knew even one of the youngsters to lose his hold. On these occasions they were always silent. I have also seen them, in June, in the act of eating the leaf-stems of the sugar maple (*Acer saccharinum*), to which habit my attention was directed by observing the frequent dropping of green leaves to the ground.*

The propensity to suck the eggs and destroy the young of our smaller birds is the worst trait of the Red Squirrel, and is in itself sufficient reason for his extermination, at least about the habitations of man. I have myself known him to rob the nests of the red-eyed vireo, chipping sparrow, robin, Wilson's thrush, and ruffed grouse, and doubt not that thousands of eggs are annually sacrificed, in the Adirondack region alone, to gratify this appetite. Therefore, when abundant, as he always is during the springs that follow good nut years, his influence in checking the increase of our insectivorous birds can hardly be overestimated.

Dr. A. K. Fisher informs me that on three occasions he has known these Squirrels to destroy young robins. In the first instance he heard the old birds making a great outcry near his home at Sing Sing, and on going to ascertain the reason found a Red Squirrel in the act of devouring a young robin. A well-directed stone caused him to drop the bird, which was found with its head cut into and the brains eaten. One wing and both feet had also been eaten. The details of the other cases are much the same. In one instance the Squirrel returned several times to the nest and carried off all the young.†

* Mr. E. P. Bicknell writes me from his home at Riverdale, New York: "On our place they feed through the winter and early spring on the flower-buds of the white maple (*Acer dasycarpum*). Often several are to be seen perched among the leafless and bud-besprinkled branches about the top of one of these trees, scattering the snow below with fragments of the red buds and even entire twigs which later would have become sprays of blossoms and fruit."

† Dr. Edgar A. Mearns, in his valuable paper upon the Birds of the Hudson Highlands, states: "Among the Robin's worst enemies may be ranked the Red Squirrels (*Sciurus Hudsonius*), for, though their young are subject to the attacks of Crows, Jays, and particularly to the ravages of the Black Snake (*Bascanion constrictor*), yet none of these enemies inflict as much injury as the Squirrels, because, not only do they seek out and devour the eggs, but the young are also eaten."

I have long been aware that this animal was an occasional depredator of the poultry yard, and find, in a journal written twelve years ago, a note to the effect that a case had then come to my knowledge where one was caught in the act of killing both chickens and young ducks.

The Red Squirrel is a good swimmer, swimming rapidly and with much of the head, back, and tail out of water. On the 18th of August, 1874, I was paddling silently down a sluggish stream in the heart of the Adirondacks when a slight noise on the shore arrested my attention. A Squirrel soon appeared at the water's edge, but turned back upon perceiving the boat. The stream, which was about twenty feet (approximately 6 metres) in width, here flowed through an extensive marsh, the nearest tree being more than a hundred yards (nearly 100 metres) away. Surprised at seeing a Squirrel in such a place, I stopped the boat, holding fast to a few bushes on the opposite bank, and after remaining motionless a few moments had the satisfaction of seeing him return, climb out on a little bush, and swim across. Again, June 28th, 1878, while rowing on Brantingham Lake, in Lewis County, I saw a Red Squirrel swimming about midway between "the Point" and the main shore opposite. He was moving toward the Point, and, as I reached him, climbed up on the oar, ran over my back and legs, then along the gunwale, jumping ahead from the bow in the direction toward which he was swimming when first seen. On overtaking him he again came aboard and jumped ahead as before. This was

etc. (Bull. Essex Inst., X, 1878, p. 9.) Mr. John Burroughs says: "Nearly all the birds look upon it as their enemy and attack and annoy it when it appears near their breeding haunts. Thus, I have seen the pewee, the cuckoo, the robin, and the wood thrush pursuing it with angry voice and gestures. If you wish the birds to breed and thrive in your orchards and groves, kill every red squirrel that infests the place." (The Tragedies of the Nests, in The Century Magazine, Vol. XXVI, No. 5, Sept., 1883, p. 686.) Prof. F. H. King tells us that at Ithaca, New York, his attention was attracted by a pair of robins dashing wildly about the branches of an evergreen: "On examining the tree the nest of the birds was discovered, and just below it sat a Chickaree eating one of the Robin's eggs." (Geol. Wis., 1883, p. 443.) In *Forest and Stream* for November 17, and December 29, 1881, Mr. Bainbridge Bishop contributes much valuable testimony of a similar nature. Examples might be multiplied almost indefinitely, but enough has already been said to demonstrate that the Red Squirrel must be ranked among the worst enemies of our small birds.

done a number of times, the Squirrel gaining each time two or three boat's lengths, till finally he succeeded in reaching the shore. I have repeatedly been told by hunters and guides that they occasionally meet these Squirrels swimming various lakes and rivers in the Wilderness, and James Higby tells me that in June, 1877 he saw as many as fifty crossing Big Moose Lake, and that they were all headed the same way—to the north.

I am informed by Dr. A. K. Fisher that at the southern end of Lake George, in early autumn, it is sometimes an every-day occurrence to see Red Squirrels swimming across the lake, from west to east—never in the opposite direction. The chestnut grows abundantly on the eastern side of the lake, but it is comparatively scarce on the western, and these extensive migrations always take place in years when the yield of chestnuts is large.* Mr. Winslow C. Watson, in his History of Essex County, says: "The autumn of 1851 afforded one of these periodical invasions of Essex county. It is well authenticated, that the red squirrel was constantly seen in the widest parts of the lake [Lake Champlain], far out from land, swimming towards the shore, as if familiar with the service; their heads above water, and their bushy tails erect and expanded, and apparently spread to the breeze. Reaching land, they stopped for a moment, and relieving their active and vigorous little bodies from the water, by an energetic shake or two, they bounded into the woods, as light and free as if they had made no extraordinary effort."

Hawks and owls are the Squirrel's mortal enemies, often seizing him unawares; but his movements are so well timed that if he sees them coming he is almost certain to escape. When either

* A few Squirrels are occasionally seen crossing the lake when the nut-crop is only moderate In September, 1882, Mrs. Fisher was angling between Diamond Island and the west shore when a Red Squirrel swam to the boat and was lifted in by the tail. After resting a few minutes it ran out on an oar, jumped into the water and swam to the island (which is half a mile from the west shore), and thence, doubtless, to the chestnut groves on the eastern side of the lake.

of these birds is discovered perching on a limb near his home he invariably pesters it till it is glad to fly to some more congenial place.

He is sometimes caged and makes an intelligent but unruly and destructive pet.

In the choice of a site for his nest he does not limit himself to any fixed conditions, usually placing it in a hollow limb, sometimes in a hole in the ground, and occasionally in a hollow log. The young are generally born about the first of April, four to six constituting an average litter.

Where the climate is milder than it is in the Adirondack region the Red Squirrel often builds outside nests. Dr. A. K. Fisher writes me that he has found them about the southern end of Lake George, in Warren County; and that they are so common in Westchester County, New York, that "half a dozen may be in sight at one time in favorable localities. The nest is usually situated near the top of some evergreen, in the midst of a tangled grape-vine. Preference is given to the red cedar (*Juniperus Virginiana*), for the reason, probably, that this tree furnishes most of the material for the nest. It may occasionally be found in a deciduous tree. The nest, which is globular in shape, varies from two to three hundred millimetres in diameter. As a rule, the cavity is situated nearer the top than the bottom, thus making the roof thinner than the floor. At a little distance the entrance cannot be seen, for its borders fall together after the entrance or exit of the animal. The material generally used for the nest is the soft, silky bark of the red cedar. Sometimes that of the grape-vine, or the inner bark of the chestnut, is intermixed." Mr. W. L. Scott, of Ottawa, Canada, tells me that outside nests of the Red Squirrel are common as far north as that place; but it must be borne in mind that lower Ontario is Alleghanian in fauna, while the Adirondacks is Canadian.

## SCIURUS CAROLINENSIS LEUCOTIS (Gmelin) Allen.

*Gray Squirrel; Black Squirrel.*

The Gray Squirrel has no liking for forests of coniferous evergreens, and is, consequently, of extremely rare occurrence in the central area of the Adirondacks. He is common enough, however, in the hardwood groves along the borders of the region, varying in numbers from year to year according to the abundance or scarcity of the nut supply.*

The immortal Humboldt, in his *Ansichten der Natur*, asks: "Who is there that does not feel himself differently affected beneath the embowering shade of the beechen grove, or on hills crowned with a few scattering pines, or in the flowering meadow where the breeze murmurs through the trembling foliage of the birch? A feeling of melancholy, or of solemnity, or of light buoyant animation is in turn awakened by the contemplation of our native trees. This influence of the physical on the moral world—this mysterious reaction of the sensuous on the ideal, gives to the study of nature, when considered from a higher point of view, a peculiar charm which has not hitherto been sufficiently recognized." †

This meditation of Humboldt's leads me to suggest that causes which have exerted so marked an influence upon the dispersion, mental culture, and disposition of the various races of mankind have

* For more than forty miles the valley of the Black River extends along, and parallel to, the western border of the Adirondack region, and the fact is of local interest that this river valley constitutes, throughout a great part of its course, the dividing line between the area inhabited and that uninhabited by the Gray Squirrel. While this animal is abundant in the hardwood groves west of the river, it is of rare or casual occurrence on the eastern side. Many hunters and guides who have spent almost their whole lives in the Wilderness tell me that they have never seen a Gray Squirrel in the interior of the Adirondacks. In the course of their irregular migrations, however, isolated stragglers do sometimes occur there. James Higby informs me that he saw one near Copper Lake many years ago, and another near the old Arnold clearing. In September and early October, 1882, they invaded the region in unusual numbers. About the middle of September, of that year, E. L. Sheppard caught one that was swimming across 2d Lake, Fulton Chain, and a few days later one was seen in the water near the head of Big Moose Lake. Garrie Riggs caught one swimming in 4th Lake, Fulton Chain, about Sept. 25th; C. Wood saw one on the outlet of this lake, Wayne Bissell another on 2d Lake, and Ned. Ball killed one between Moose River and the Forge.

† Bohn's translation, 1850, p. 219.

not been inoperative in determining the distribution of many of our lower animals. Indeed, when nearly related species, having similar habits, and subsisting in the main upon the same kinds of food, are found inhabiting contiguous areas,—areas of equal altitude and subject to identical climatic conditions,—and we learn that these species are limited, so far as we can ascertain, solely by the character of the arboreous vegetation, we are forced to admit that influences other than those which have to do merely with the necessities of existence have played an important part in fixing the arbitrary and irregular boundaries of the places occupied by each. In the case of the present species it seems probable that the dark and sombre hues, the oppressive silence, and the imposing solitude of our evergreen forests impress it with a pervading sense of gloom and sadness against which its cheerful nature revolts. The red squirrel teems with such a superabundance of hilarity that he easily overcomes this feeling of oppression which his larger cousin is powerless to combat.

In sparsely populated districts that have long been settled, one sometimes finds, half-hidden among the trees, a neglected but time-honored mansion, near which a row of stately elms, extending from some neighboring wood to distant fields, leads the eye past clumps of scattered butternuts, beneath whose gnarled and spreading branches groups of grazing cattle seek shelter from the noonday sun. Here, in early autumn, a few joyous Squirrels gather at break of day to feast upon the yet green nuts. Following the line of elms they leap from tree to tree or run upon the zig-zag fence beneath, fairly revelling with delight; and long before the savory nuts are ripe, indeed when they have scarce attained their growth, the eager Squirrels haste to pluck them as they hang in heavy clusters from the boughs. While biting through the adhesive, staining velvet of the outer coat they sit perched upon their haunches, with a merry twinkle in the eye, but, not forgetting their exposed position, maintain a prudent silence.

Should some farmer's boy chance to pass near by, not a Squirrel

is to be seen from where he walks, for each one, clinging to a vertical branch or limb, constantly shifts its position so that it always keeps out of sight on the opposite side. Everything about this breakfast is thoroughly enjoyed—the early journey to the butternuts, the flying leaps from bough to bough amongst the summits of the lofty elms, the meal itself, and the bit of excitement attending the alarm and escape; each contributes its part toward the pleasure of the occasion. The repast over, the Squirrels do not linger here but hurry to their homes within the grove. The slanting sunbeam has pierced but not dispelled the drop of pearly dew upon the waving grass, when they are already well upon the way. One audacious adventurer, more courageous than the rest, steals down yonder tottering cross-fence to the orchard, quickly picks an apple from an overhanging branch, and rejoins his comrades ere they reach the wood. This haven once attained all constraint is cast aside and the cautious, silent, and circumspect Squirrels of a moment ago become the heedless, noisy, rollicking fellows that they really are. While chasing one another about the tree-tops they sometimes clear a distance of more than twenty feet (about 6 metres) in a single horizontal leap. And when at full speed they often stop short, clinging head downward to a smooth-barked beech, and utter their saucy, scolding cry—qua-qua-qua-qua-a, qua-qua-qua-qua-a-a, qua-qua-qua-qua-qua-a-a, qua-a-a-a, qua-a-a-a-a,—in an exasperating, impudent tone, keeping time, the while, with spasmodic contortions of the body and impertinent jerks and flourishes of the large and bushy tail. To observe their utter recklessness during these gambols one would suppose that nothing could be easier than to approach and shoot the entire troop. Never was man more mistaken. Despite their boisterous manners their eyes are always open and they are ever on the alert. Let some one try to get within gunshot and observe the result. His very approach seems to render them invisible. Those that were near their holes have disappeared within, and the others are hiding behind the trees upon which they were sporting when the

enemy appeared. As he advances they rotate slowly about the trunk, always keeping on the farther side, so that the body of the tree remains between them. Even if he knows that a Squirrel is on a certain tree it is doubtful if he gets a shot. A momentary glimpse of its ears or a part of its tail constitutes all he is likely to discover as he walks round the tree.

While watching a bird I once noticed what seemed to be a little tuft of hair protruding from the side of an ash sapling near by. On going nearer, I perceived the object to be the tip of a Gray Squirrel's tail. The animal was clinging vertically to the trunk, hugging it so closely that this bit of hair was the only part visible from the ground beneath, though where he lay the trunk was not four inches in diameter. Not wanting the Squirrel, I fired at the bird, and to my astonishment the former came tumbling headlong to the ground, almost at my very feet—an illustration of the effect of terror upon a sensitive animal. He did not tarry long, however, but in a twinkling was off and up another tree. One summer, several years ago, I surprised a Gray Squirrel on the ground in the edge of an open field, and chased him up a large hemlock that stood by itself in the clearing. Imagine my surprise to see him run out on a limb, fully eighty feet high, and leap to the ground, striking more than fifty feet from the base of the tree. Before I could reach the spot he had disappeared in the adjacent forest.

In winter, when the trees and branches are coated with ice, I have several times seen these Squirrels fall nearly a hundred feet, landing in the snow, but never knew one to be injured by the accident. But at such times they usually proceed with great caution and do not attempt to make leaps of any great length. In fact, during the continuance of extreme cold they do not venture out at all. My observations on this point are very full, and extend over a period of years. In winters that follow good yields of nuts they are usually well-conditioned, and seldom appear, in any numbers, when the temperature is below –8° C. (17.6° F.). It must be remembered, however, that

mild and open winters are likely to succeed "nut years" in this region, and that during these winters it is not common to have a continuance of very low temperature. The alternate winters, on the other hand, are generally severe. There are few if any nuts, and the Squirrels are none too fat when the heavy snows set in. They have laid up little or no provision in their holes in the trees, and consequently, since they do not hibernate for any great length of time, must often roam about in search of food when they would much prefer to remain coiled snugly in their nests. Under such circumstances they frequently come out, during continued cold, when the thermometer stands at ten degrees below zero C. (14° F.), but not during storms. They are occasionally met with when it is still colder, and I have seen a few individuals come to a place where corn was kept for them when the temperature was −19° C. (−2.2° F.), but only on mild days during protracted periods of low temperature. In this respect they differ markedly from their cousins, the red squirrels.

During the winters of deep snows and scarcity of food, my father has, for many years, kept a stock of corn and nuts within easy reach of the Squirrels, and but a short distance from the house. Knowing that they are always sure of finding a bountiful supply here, they repair to it with great regularity, coming daily except during stormy or very cold weather, often visiting it at times when their neighbors, in more remote portions of the wood, do not venture out at all. Sometimes as many as a dozen Grays and six or eight Blacks have been seen there at one time, running on the snow and feeding at the boxes and barrels within twenty feet (about 6 metres) from the dining-room window. While part of them remained on the boxes, others carried their nuts to a tree near by, eating one at a time and then returning for another. Some winters they became very tame, and while we were at breakfast inside, a few used to bring their nuts to the window and eat them there, perched on their haunches on the sill, with their handsome bushy tails cocked over their backs. When anyone went out of doors they commonly scampered off or ran up a

tree, yet several often remained and would allow a near approach without manifesting alarm. They were extremely fond of music (in the most comprehensive sense of the term), and it affected them in a peculiar manner. Some were not only fascinated, but actually spell-bound, by the music-box or guitar. And one particularly weak-minded individual was so unrefined in his taste that if I advanced slowly, whistling "*Just before the Battle, Mother*," in as pathetic a tone as I could muster for the occasion, he would permit me even to stroke his back, sometimes expressing his pleasure by making a low purring sound. This was a Gray, and I several times approached and stroked him as above described. I once succeeded in getting near enough to a Black to touch him, whereupon he instantly came to his senses and fled. When listening to music they all acted in very much the same way. They always sat bolt upright, inclining a little forward (and if eating a nut were sure to drop it), letting the fore-paws hang listlessly over the breast, and, turning the head to one side in a bewildered sort of a way, assumed a most idiotic expression.

Those who have observed the habits of this species in summer must have noticed their propensity for burying nuts just beneath the surface, in various parts of the woods. They do not, so far as I am aware, make a great accumulation in any one place, but dig a thousand little holes, plant a nut or two in each, scrape a few leaves over the spot and hurry off, as if afraid some one would discover the treasure. In winter this habit is almost equally marked, and the first thing a Squirrel thinks of after his hunger is satisfied is to secrete a portion of the food remaining at his disposal. In accomplishing this he tunnels into the snow in various directions, hiding some of the surplus provision in each excavation. Many persons who have observed this habit in summer regard it as an idle pastime, and question if the Squirrel ever finds the nuts again, knowing that he could never remember the exact positions of so many. But those who have kept tame Squirrels must have been struck with the remarkable certainty and quickness with which they detect the whereabouts of

nuts that are hidden from sight. A Squirrel will often scratch and gnaw at a tight box or drawer that he has never seen before, if a few nuts happen to be in the bottom of it. His sense of smell is very acute, enabling him to detect the presence of a nut at some little distance; hence, though he does not, of course, remember the exact spot where each one is buried under the leaves, he can, by moving carefully over the ground, discover a great many of them.

In summer, and in winter when the temperature is above the freezing point, Gray Squirrels are out in greatest numbers early in the morning and in the latter part of the afternoon; throughout the winter, except during thaws, they only appear for an hour or two in the warmest part of the day; and in very cold or stormy weather, as previously stated, they do not venture abroad at all.

This species is not nearly so plentiful along the outskirts of the Adirondacks as it was twelve or fifteen years ago, and it varies in abundance from year to year according to the condition of the nut crop. Beechnuts and butternuts are alone alluded to here because they are the prevailing nuts. All others are of such limited distribution in the area under consideration that they are unworthy of mention. The nut yield is bountiful here, with great regularity, on alternate years. This has been the case, without a single exception, for the past twelve years at least. My notes show that the beechnut crop was good in the autumns of 1871, 1873, 1875, 1877, 1879, 1881, 1883,—always on the odd years,—while on the alternate seasons it failed. And strange as it may at first sight appear, Squirrels are usually most numerous during the summer and early autumn of those years when there are few or no nuts. The reason is this: when the yield is large there is a noticeable influx of Squirrels from distant parts, and they, together with those that were here at the time, winter well, having an abundance of food, and breed here the following spring. During the summer and early autumn a multitude of young, now nearly full grown, mingle with the parent stock. Hence the species attains, at this time, its maximum in numbers·

But this is the year when the nut crop is a failure. Therefore, as the fall advances and they find that there is a scarcity of provision for the winter, many of them migrate—we know not where. Then come the October "Squirrel hunts"—a disgrace to the State as well as to the thoughtless men and boys who participate in them—and the number left to winter is deplorably small.

As the abundance of the Gray Squirrel in winter is governed by the supply of beechnuts, so is the presence, at this season, of its assailant, the red-headed woodpecker (*Melanerpes erythrocephalus*), determined by the same cause. I have elsewhere called attention to this fact, remarking that "with us a good Squirrel year is synonymous with a good year for *Melanerpes*, and *vice versa*." * Gray Squirrels, red-headed woodpeckers, and beechnuts were numerous during the winters of 1871–72, 1873–74, 1875–76, 1877–78, 1879–80, 1881–82, 1883–84, while during the alternate years the Squirrels and nuts were scarce, and the woodpeckers altogether absent.

Several years ago I published the following account of the way that these handsome birds sometimes harass the Squirrels: "In mid-winter (January, 1876) my attention was called, by the noise they made, to a pair of red-headed woodpeckers who were diving at something on one of the highest limbs of a large elm. A near approach showed the object of their malice to be a handsome Black Squirrel who had been unfortunate enough to excite their ire by climbing a tree in broad daylight. The Squirrel at first evaded their attacks from above by clinging to the under surface of the limb, and dodged their lateral shoots by a quick side shift, but this was temporary. The woodpeckers, realizing that they were not tormenting the Squirrel to their full satisfaction, alighted for a brief council, during which the Squirrel took occasion to commence a hasty retreat. But the birds were at him in an instant, this time changing their tactics; both dove together, the one following closely behind the other, so that as the Squirrel dodged the first he was sure to be struck by the

* Forest and Stream, Vol. XVII, No. 18, Dec. 1, 1881, p. 347.

second. The blows from their hard bills were so severe and so painful that the poor Squirrel had not been struck half a dozen times when he let go his hold and fell to the ground, but was off and up another tree before I could reach the spot. I witnessed a similar attack upon a Gray Squirrel (color-variety of the same species) last August, but this time the Squirrel succeeded in getting into a hollow limb. The time of year at which the above instances occurred precludes the possibility that the cause of the difficulty arose from an intrusion on the nesting-ground of the woodpeckers, for the first took place in midwinter, and the second after the young were fully fledged and had left the nest. Neither is it at all likely that the trouble was due to an old grudge which might have arisen from a habit, on the part of the Squirrel, of robbing the woodpeckers of their eggs, for the size of the animal is such as to prevent his ready entrance into the woodpecker's hole, and should he even succeed in getting in, he would doubtless pay the penalty with his eyes, if not his life."* At this time I was in ignorance of the cause of enmity between them, but was soon after enlightened on this point. While much the larger part of the beechnut crop falls to the ground after the first hard frosts, a few nuts remain on the trees throughout the winter. These the woodpeckers consider as their exclusive property, assailing and punishing all rivals with a valor, persistence, and severity, astonishing to behold. Now the Squirrels find it much more convenient to procure the nuts that still cling to the branches than to dig down through the snow in search of those that lie buried beneath. Therefore, it often happens that the woodpeckers, on coming to the grove to feed, discover that the Squirrels are there before them, stealing the scattered nuts. Their wrath knows no bounds, and they attack the intruders with such unmistakable earnestness and efficiency that the latter, unable to defend themselves, are glad of any haven to which they may escape. During the last five years I have witnessed these encounters over and over again, and am convinced

* Bull. Nutt. Ornith. Club, Vol. III, No. 3, July, 1878, pp. 125–126.

that the misunderstanding is wholly in regard to the possession of the nuts. The red-headed is the only species of woodpecker that I have seen quarrel with the Gray Squirrel.

On the 7th of November, 1879, I witnessed an exciting skirmish between a goshawk and a Gray Squirrel. The hawk dove repeatedly for the Squirrel, and as often did the latter evade him by quickly sliding around the trunk. He then chippered and scolded and shook his tail in the most aggravating manner imaginable. The hawk was much enraged, but finding himself unable to capture the object of his pursuit, finally alighted to wait till the Squirrel should venture on a limb—a proceeding which the latter wisely showed no inclination to attempt. I put an end to the affair by shooting the hawk. Audubon and Bachman state that the red-tailed hawks hunt them in pairs, thus rendering the capture of the helpless animal certain and easy.

The minor migratory movements of this species occur with more or less regularity from year to year, but on so small a scale as to escape general notice. They must not be confounded with the great migrations, not rare in former times, when these animals, actuated by some unknown influence, congregated in vast armies and moved over the land, crossing open prairies, climbing rugged mountains, and swimming lakes and rivers that lay in their path. Though hundreds, and sometimes thousands, perished by the way, the multitude moved on, devouring the nuts that grew in the forests through which they passed, and devastating the grain fields of the farmer along the route. Though these remarkable expeditions have been known and commented upon for many years, yet our knowledge of them is limited almost to the recognition of the fact of their existence. Scarcity of food very probably gives rise to the disquieting impulse that prompts them to leave their homes, but the true motives that operate in drawing them together, and in determining the direction and distance of their journeys, are as little understood to-day as they were before the discovery of the continent on which they dwell.

In the year 1749 they invaded Pennsylvania in such vast hosts as to endanger the crops of the entire inhabited portion of the State, and a reward of three pence a head was offered for their destruction. This necessitated the payment of eight thousand pounds sterling (six hundred and forty thousand individuals having been killed), which so depleted the treasury that the premium was decreased one-half. Commenting upon this statement Pennant observed: "How improved must the state of the *Americans* then be, in thirty-five years, to wage an expensive and successful war against its parent country, which before could not bear the charges of clearing the provinces from the ravages of these insignificant animals!"*

Since nearly all parts of our great country have become populated, since thousands of square miles of forests have been hewn down, and the lands tilled and made to yield to the wants of man, there has been such a vast decrease in the numbers of these animals that it is doubtful if another great migration will ever be recorded. It was their enormous abundance in former times, and the extensive depredations which they committed in the autumn, that caused the inhabitants to organize for their destruction. Robert Munro, in "A Description of the Genesee Country," published in 1804, states that in the western part of New York, "Squirrels are so numerous in some years as considerably to injure corn; and upwards of 2000 of them have sometimes been killed in a day, which is occasionally appointed for that purpose by the inhabitants; the most common kinds of them are the black, and the red; the grey coloured being very scarce."† Aside from the constant warfare which every man waged against those upon his own premises, there came to be established a much more effective system of extermination. Certain days were set apart, and every male person capable of carrying a gun, and who owned or could borrow one to carry, was supposed to join in the chase. Captains were appointed, sides

* Pennant's Arctic Zoology, Vol. I, 1792, p. 136.

† Documentary History of New York, Vol. II, p. 1175.

chosen, and everything was in readiness the night before. At daybreak the hunt commenced, and it ended only with the setting of the sun. Then the participants gathered at some rendezvous previously agreed upon, where a bountiful supper was in waiting. So many Squirrels had been killed that the hunters could not possibly carry them, hence the tails alone were preserved. These were then counted in order to ascertain which side had killed the greater number, the defeated party meeting the expense of the banquet. This was the "Squirrel hunt" of our forefathers. But the time when these animals could be ranked among the enemies of the farmer has long since passed away, probably never to return. And yet, for some unaccountable reason, the "Squirrel hunts" still continue—in name at least—but they have degenerated into the most despicable of "pot-hunts." Not only are the Squirrels slain wherever found, though innocent of the deeds for which they were originally persecuted, but large numbers of our insectivorous birds are likewise destroyed, and for no other reason than because each counts a certain tally in the reckoning that determines the victorious party!

The Gray Squirrel is easily tamed, if captured early enough, and being one of the most intelligent of our native mammals, makes a desirable pet, and may be allowed entire freedom of movement. The main objection to it is its tendency to gnaw objects about the premises.

In the Adirondack region its nest is invariably concealed within the hollow of some tree or limb, while in more temperate quarters it is commonly built on the outside, like that of the crow, which it closely resembles, and is placed either in a fork or at the point where a large branch leaves the trunk. Audubon and Bachman, and other writers, speak of these latter as "summer nests," affirming that the Squirrels spend the winter and bring forth their young in the hollows of trees. My experience proves the incorrectness of this statement, in certain localities at least; for, in southern Connecticut, in the southern part of New York State (Westchester County), and in

northern New Jersey, I have myself taken more than a hundred young from these outside nests.

A number found at Elizabeth, New Jersey, during March and the early part of April, 1872, contained young. They were, according to my note book, "composed of sticks, lined with the inner bark of trees and vines, mixed with other soft substances. They are entirely covered over above, the entrance being on one side. From the ground below they cannot be distinguished from crows' nests." In many instances dead leaves enter largely into their composition.

The number of young produced at a birth varies from three to five, exceptional litters containing six They are born in a very diminutive and helpless condition, wholly devoid of hair, and with the eyes not yet open. They usually remain in the nest fully two months, and do not shift for themselves till some time later. On the 19th of May, 1877, Mr. Walter R. Nichols and I took three half-grown young from a nest at Brandford, Connecticut. It so happened at the time that Mr. Nichols had a cat which had recently given birth to a kitten. The kitten we destroyed, and in its stead placed one of the Squirrels. Presently the cat returned to the barn, eyed the stranger suspiciously for a moment, and then entered the nest. The young Squirrel, who had now been several hours away from his mother and was evidently quite hungry, approached the cat in the most familiar manner possible. After a little hesitation the latter lay down beside the new comer, who lost no time in discovering the object of his desire, and forthwith commenced to nurse, keeping it up with an energy and perseverance that must have proved as satisfactory to the cat as a whole litter of kittens. From this time on the two were the most inseparable of friends; in fact, the cat seemed quite pleased with the change and no doubt considered the personal appearance of her new charge, who was now well formed and possessed a most extraordinary tail, a great improvement on that of her own ill-shaped offspring. The Squirrel grew and thrived under the devoted atten-

tion of its foster mother, and the pair soon became the centre of attraction in the neighborhood.

It is stated by Audubon and Bachman that the young are brought forth in May and June, which statement is at least two months out of the way. Even in this northern region the period when the important event takes place is rarely later than the first of April, and is frequently in March. The cause of their error, however, is not hard to explain; for if they were unacquainted with the very immature condition of the young at birth, and were ignorant of the time required to attain full growth, they might easily have made the mistake of considering young found in the nest in June to be only a few weeks from birth, when in reality they were two or three months old. In many localities south and west of the Adirondacks the Gray Squirrel commonly has two litters in a season, the second usually being born in September or October.

In closing the biography of this interesting species it seems hardly necessary to remark that the Black and Gray Squirrels are identical, both color varieties being sometimes found in the same litter.* Fifteen years ago the two forms were about equally abundant along the western border of the region under consideration; but the Black has gradually become less and less common, till now it may almost be regarded as one of our rarer mammals. However, it is still abundant in a number of places bordering Lake Ontario, both in this State and in Canada.

## SCIURUS NIGER CINEREUS (Linn.) Allen.

*Fox Squirrel.*

The Fox Squirrel cannot at present be regarded as other than a rare or accidental straggler in the Adirondack region. So far as I am aware, the only specimen taken here of late was killed by

* The case has a well-known parallel in our common mottled owl, in which species both red and gray plumages are occasionally met with in the same nest.

Oliver B. Lockhart at Lake George, Warren County, in 1872 or 1873. Mr. W. W. Lockhart saw another near the same place at about the same time.*

Formerly, the species was found in many parts of the State. In the year 1853 a specimen was presented to the State Cabinet of Natural History by Isaac B. Lottridge, who shot it at Hoosic, in Rensselaer County.† Two other specimens (male and female) were afterwards presented to the State Cabinet by Mr. Lottridge. Both "were taken in Rensselaer County, New York, in the spring of 1854."‡

Dr. J. Bachman, writing in 1839, speaks thus of this animal: "In the northern part of New York it is exceedingly rare, as I only saw two pair during fifteen years of close observation. In the lower part of that State, however, it appears to be more common, as I recently received several specimens procured in the County of Orange."§

## TAMIAS STRIATUS (Linn.) Baird.

*Chipmunk; Ground Squirrel; Striped Squirrel; Chipping Squirrel.*

The Chipmunk or Ground Squirrel is always present in greater or less numbers in some parts of the Adirondacks. It is a migratory animal and is exceedingly abundant some years, while during others it is scarcely seen at all, the difference being dependent upon the quantity of the food-supply.

The Striped Squirrel feeds upon a variety of nuts and roots,

* Since the above was written I have learned, through Dr. A. K. Fisher, that a caged Fox Squirrel escaped, near the southern end of Lake George, previous to the date of killing of Mr. Lockhart's specimen. Hence it is possible, though I think hardly probable, that the specimen in question was imported.

† Seventh Annual Report of the Regents of the University on the Condition of the State Cabinet of Natural History, 1854, p. 15.

‡ Eighth Annual Report on the Condition of the State Cabinet, 1855, p. 15.

§ Monograph of the Genus Sciurus. Charlesworth's Magazine of Natural History, Vol. III, 1839, p. 161.

and is fond of corn and several kinds of grain. It also eats the larvæ of certain insects. In this region the beechnut constitutes its staple commodity, as it does that of all our squirrels, and since this nut is produced in large quantity each alternate year, we are able to predict with considerable certainty the periods when the Chipmunk will be abundant. For wherever, in autumn, this animal finds a sufficient supply of nuts he is sure to remain until the following summer. Here, in beechnut years, the forerunners of the great migration arrive in September, and by the first week in October the woods literally swarm with them. Finding an abundance of food they immediately establish themselves for the winter, and begin at once to hoard up large stores. They are the least hardy of our squirrels, commonly going into winter quarters before the middle of November, and rarely appearing again in any numbers till the warm sun, in March or April, has caused plots of bare ground to appear between the snow-banks. Early thaws sometimes bring them out in February; and after having once emerged, they often make little excursions over the snow during pleasant days, though the temperature may be several degrees below freezing. In running from tree to tree, even when not pursued, the length of their bound varies from twenty-five to thirty-four inches (635 to 863 mm.), a long leap for so small an animal. The season of spring is occupied with the duties of rearing the young, which, before June, are old enough to leave the nest. At this time the species attains its maximum in numbers, the young and old together inhabiting all parts of the woodland. Foreseeing that the nut crop will fail (this being the even year), they commonly emigrate in July and do not again appear till September or October of the ensuing year.

Briefly, then (leaving out of consideration the small number of resident individuals, and the migrants that sometimes pass through on their way to distant parts), we find that Chipmunks reach the Adirondack region during September or October of the

odd years (nut years), remaining till the following July. They then depart and are not seen again till the autumn of the next year. Hence they are here about ten months and absent about fourteen months, the period of greatest abundance being in June of the even years (when there are no nuts).

They are most industrious creatures, and, though small, lay up an astonishingly large supply of food. Audubon and Bachman, who once dug out a nest occupied by four Chipmunks, speak thus of the larder: "There was about a gill of wheat and buckwheat in the nest; but in the galleries we afterwards dug out, we obtained about a quart of the beaked hazel nuts (*Corylus rostratus*), nearly a peck of acorns, some grains of Indian corn, about two quarts of buckwheat, and a very small quantity of grass seeds." *

In addition to their store-houses, they frequently, like the gray squirrel, make little caches, burying here and there beneath the leaves the contents of their cheek-pouches. Mr. Ira Sayles thus graphically describes this habit :—

"I lately noticed in my garden a bright-eyed Chipmunk, *Sciurus striatus*, advancing along a line directly towards me. He came briskly forward, without deviating a hair's breadth to the right or the left, until within two feet of me; then turned square towards my left—his right—and went about three feet or less. Here he paused a moment and gave a sharp look all around him, as if to detect any lurking spy on his movements. (His distended cheeks revealed his business: he had been out foraging.) He now put his nose to the ground, and, aiding this member with both forepaws, thrust his head and shoulders down through the dry leaves and soft muck, half burying himself in an instant.

"At first, I thought him after the bulb of an *Erythronium*, that grew directly in front of his face and about three inches from it. I was the more confirmed in this supposition, by the shaking of the plant.

* Quadrupeds of North America, Vol. I, 1846, p. 70.

"Presently, however, he became comparatively quiet. In this state he remained, possibly, half a minute. He then commenced a vigorous action, as if digging deeper; but I noticed that he did not get deeper; on the contrary, he was gradually backing out. I was surprised that, in all his apparent hard work (he worked like a man on a wager) he threw back no dirt. But this vigorous labor could not last long. He was very soon completely above ground; and then became manifest the object of his earnest work: he was refilling the hole he had made, and repacking the dirt and leaves he had disturbed. Nor was he content with simply refilling and repacking the hole. With his two little hand-like feet he patted the surface, and so exactly *replaced the leaves* that, when he had completed his task, my eye could detect not the slightest difference between the surface he had so cunningly manipulated, and that surrounding it. Having completed his task, he raised himself into a sitting posture, looked with a very satisfied air, and then silently dodged off into a bush-heap, some ten feet distant. Here he ventured to stop, and set up a triumphant 'chip! chip! chip!'

"It was now my turn to dig, in order to discover the little miser's treasures. I gently removed enough of the leaves and fine muck to expose his hoard—half a pint of buttercup seeds, *Ranunculus acris*." *

On the western side of the Adirondack region the Chipmunk feeds largely upon the tuberous roots of the dwarf ginseng or ground-nut (*Aralia trifolia*), and the yellow grain-like tubers of the unspurred dicentra or squirrel corn (*Dicentra Canadensis*). The winged seeds of the maple can also be ranked among his staple articles of diet. In June of the present year (1884), Mr. W. E. Bryant shot a Chipmunk, in Lewis County, whose cheek-pouches contained a number of larvæ and pupæ of insects.

Of the six species of squirrels known to occur in the Adirondacks, the present is the only one belonging to the group of ground

* American Naturalist, Vol. IV, No. 4, June, 1870, p. 249.

squirrels, a group that is largely represented in our western States and Territories. The Chipmunk establishes his head-quarters in some log or stump, or in a hole excavated by himself in the earth, generally among the roots of a tree. He is partial to brush-heaps, wood-piles, stone walls, rail fences, accumulations of old rubbish, and other places that afford him a pretty certain escape, and at the same time enable him to see what is transpiring outside. For, though by no means wary, he delights in these loosely sheltered hiding-places where he can whisk in and out at will, peep unobserved at passers-by, and dart back when prudence demands. If suddenly surprised he utters a sharp *chip'-per'*, *r*, *r*, *r*, and makes a quick dash for his retreat, which is no sooner reached than, simultaneously with the disappearance of his tail, out pops his head, his keen dark eyes gazing intently at the source of alarm. If not pursued farther he is very apt to advance toward the supposed enemy, betraying his excitement by a series of nervous starts and precipitous retreats, till finally, making a bold rush, he dashes by the object of his dread and in another instant is peering out from a hole beneath the roots of a neighboring tree.

Though a very inquisitive creature, this habit does not seem to be attributable to curiosity alone, but rather to the same reckless foolhardiness that prompts the small boy to cross and recross the road in front of a swiftly advancing carriage or locomotive.

With us the Chipmunk is not ordinarily given to climbing trees. But when at play he often runs part way up the trunks, and when pursued by man or dog and unable to reach his hole, he does not hesitate to take refuge in the topmost branches. Still, he is ill at ease there, apparently becoming giddy on attaining a little height, and often commences the descent while his pursuers are yet watching him from the ground beneath. This unfortunate habit has cost many a Chipmunk his life, and gave origin, in my younger days, to an effective method of hunting them. With the aid of a small dog the poor animal was readily "treed," and the dog soon learned

to watch one side of the tree while the boy guarded the other. Presently the affrighted and giddy Chipmunk, head downward, would commence to descend, circling around the trunk. Harassed on whichever side of the tree he appeared he usually lost his head and soon came rushing toward the ground, when he was either knocked over with a stick, or seized by the dog.

It occasionally happens that Chipmunks are met with that do not show this aversion to tree climbing, particularly when collecting food for their hoards. The trail from Big Moose Lake to West Pond crosses a low beech ridge whose northern exposure slopes gradually to the lake. Here, during the latter part of October and early November, 1881 (beechnut year), Chipmunks abounded. Here also Dr. A. K. Fisher and the writer, seated upon a half-decayed log, observed their actions unheeded. They were very busy. Some were gathering the nuts and crowding them into their over-distended cheek-pouches; others were carrying their loads to the store-houses in the ridge; whilst others still, returning for more, were bounding lightly over the fallen leaves and playfully chasing one another among the logs and brushwood that lay upon the ground. A few, more venturesome than the rest, were not content to gather the nuts that frost and wind had strewn upon the earth, but essayed to climb and pick them from the boughs. Two were seen at one time high up in the trees, and one in particular was observed making regular journeys from his hole in the side-hill to the uppermost branches of a beech fully sixty feet (over 18 metres) in height. He seemed as much at ease here as would any of our arboreal squirrels, but we noticed that he never tried to leap from limb to limb.

The Chipmunk is such a beautiful, graceful, active, and seemingly confiding animal in the wild state, that he would naturally be expected to become one of the most charming of pets. Experience, however, has not confirmed this supposition. Most writers, as well as myself, have found him morose and uninteresting in

confinement, and altogether too fond of biting his captor's fingers on insufficient provocation. It is proper to state, however, that the very young have not, to my knowledge, been caged, and I incline to the belief that they would well repay one for the care bestowed upon them.

In the *American Naturalist* for March, 1870 (p. 58), Mr. A. J. Cook, of Lansing, Michigan, states that a Chipmunk was observed "busily nibbling at a snake that had been recently killed. He could hardly be driven away, and soon returned to his feast when his tormentors had withdrawn a short distance."

Thomas Pennant says of this species: "During the *mayz* harvest, these squirrels are very busy in biting off the ears, and filling their mouths so full with the corn that their cheeks are quite distended. It is observable, that they give great preference to certain food; for if, after filling their mouths with rye, they happen to meet with wheat, they fling away the first, that they may indulge in the last." *

John Josselyn, writing in 1675 of the animals of New England, called the Chipmunk "mouse-squirril", and said of it: "The mouse-squirril is hardly so big as a Rat, streak'd on both sides with black and red streaks, they are mischievous vermine destroying abundance of Corn both in the field and in the house, where they will gnaw holes into Chests, and tear clothes both linnen and wollen, and are notable nut-gathers in *August;* when hasel and filbert nuts are ripe you may see upon every Nut-tree as many mouse-squirrils as leaves; So that the nuts are gone in a trice, which they convey to their Drays or Nests." †

* Synopsis of Quadrupeds. 1771, p. 289.

† Two Voyages to New England. Boston reprint, p. 69.

## ARCTOMYS MONAX (Linn.) Schreber.

*Woodchuck; Marmot.*

The Woodchuck delights in the open meadows and rocky hillsides that mark the possessions of the farmer, but has no love for the extensive evergreen forests that exist in districts remote from civilization. He is, therefore, of rare occurrence within the proper limits of the Adirondacks, though he has been found, sparingly, in the remotest parts of the Wilderness.* In the cultivated area surrounding the Adirondacks he is very abundant, and often proves a serious annoyance to the farmer.

He is a strict vegetarian, feeding chiefly upon clover and grass. Only in rare instances does he enter the garden, and were it not for the size of his holes he could hardly be regarded as an enemy to the agriculturist.

With us, the Woodchuck commonly lives in extensive burrows, excavated by himself, though he sometimes takes up his abode in rocky ledges, and in the hollow roots of large trees. During the summer season the greater number live in the open fields, generally selecting good meadows where they are sure to be surrounded with a luxuriant growth of rich grass or clover, so that they can procure an abundance of the best of food without exposing themselves to the danger of wandering far from their holes. As the season for going into winter-quarters draws near, many of them retire to the groves and borders of woods near by and take possession of other burrows which they occupy till late in the following spring. Some, indeed, leave the meadows immediately after the

* To cite a few cases: June 12th, 1883, I saw a large Woodchuck in the Brown's Tract road near the Hellgate Lakes; and later, on the same day, saw another between Third and Fourth Lakes of the Fulton Chain. I have also seen their holes between Upper and Lower Saranac Lakes, and in the side of a knoll between Morse Lake and Second Lake of North Branch, in which latter place E. L. Sheppard caught one in February or March, 1880. James Higby tells me that in the early part of July, 1878, he almost stepped on a full-grown and very fat Woodchuck on the portage between Seventh and Eighth Lakes, Fulton Chain.

hay is cut in July, while there are a few that never abandon their forest homes. But few reside permanently in the open fields.*

The Woodchuck is our most remarkable example of a hibernating mammal. He lays up no store of provision, but remains dormant throughout the winter. Neither temperature nor quantity of food at hand has to do with the beginning of his voluntary seclusion.

The first copious rains that fall after haying is over cause fresh green grass to spring up anew upon the meadows. This second crop, termed rowen or aftermath, usually attains a luxuriant growth by the latter part of August. In many places it consists largely of red clover (*Trifolium pratense*), the favorite food of the Woodchuck. And this animal eats so much during the month previous to his withdrawal into the earth that he becomes exceedingly fat, and proportionally inert, and is therefore in excellent condition for hibernating. Along the western border of the Adirondacks he usually goes into winter-quarters between the 18th and 25th of September, not to reappear till the middle or latter part of March. It is indeed a curious coincidence that the limits of the dormant state should so closely correspond with the periods of the equinoxes. In nine cases out of ten he disappears, with astonishing precision, within a few days of the autumnal equinox, and remains under ground till about the time the sun cuts the plane of the equator at the vernal equinox.†

* It may not be amiss to acquaint my readers with the reasons that lead me to believe that the majority of our Woodchucks desert the meadows in autumn and hibernate in burrows in the woods. There are two principal facts, either of which is sufficient, in my opinion, to establish the existence of this habit. First: As will be hereafter shown, Woodchucks, in this region, come out from their burrows in early spring two or three weeks before the disappearance of the snow, and may easily be tracked to their holes. Now it has been my experience (an experience covering at least fifteen years) that fully 99 per cent. of those that appear before the snow goes in spring, come from holes in the woods. Second: In the fall of the year I have opened a number of meadow burrows, which I knew were inhabited up to a week of the time when the animals went into winter-quarters in September, and almost without exception such burrows have been found to be tenantless.

† To this rule there are, of course, exceptions, but they are not sufficiently frequent to in any way invalidate the accuracy of the above general statement. During very warm weather it sometimes happens that a Woodchuck may be seen sunning himself at the mouth of his hole for an hour or two in the hottest part of the afternoon as late as the first of October, but such instances are

The remarkable circumstance has already been noticed that the Woodchuck often retires to winter-quarters when surrounded by an abundance of food, and during the continuance of fine warm weather; but still more surprising is the fact that he generally emerges from his hole and tunnels to the surface while the ground is buried in snow to the depth of several feet, and when no green thing is to be found upon which he can feed. He not only comes to the surface, but makes long journeys in various directions over the snow-covered land, and is apt to continue these apparently aimless pilgrimages night after night until the fast-melting snow enables him to reach the much-coveted grass, which has been kept fresh and green in places by its heavy covering.

The Hon. Daniel Wadsworth, of Hartford, Connecticut, once kept a Woodchuck alive for upwards of two years, and furnished Audubon and Bachman with the following interesting account of its hibernation: "Winter coming on, the box was placed in a warm corner, and the Woodchuck went into it, arranged its bed with care, and became torpid. Some six weeks having passed without its appearing, or having received any food; I had it taken out of the box, and brought into the parlour;—it was inanimate, and as round as a ball, its nose being buried as it were in the lower part of its abdomen, and covered by its tail—it was rolled over the carpet many times, but without effecting any apparent change in its lethargic condition, and being desirous to push the experiment as far as is in my power, I laid it close to the fire, and having ordered my dog to lie down by it, placed the Wood-Chuck in the dog's lap. In about half an hour my pet slowly unrolled itself, raised its nose from the carpet, looked around for a few minutes, and then slowly crawled away from the dog, moving about the room as if in search of its own bed! I took it up, and had it carried down stairs and

rare. In the early springs that sometimes follow exceptionally mild winters, Woodchucks occasionally appear in February, but re-enter their burrows and again become dormant if the temperature suddenly falls. In Southern New England they commonly remain out till late in October, and I have seen them in the Connecticut Valley even in November.

placed again in its box, where it went to sleep, as soundly as ever, until spring made its appearance. That season advancing, and the trees showing their leaves, the Wood-Chuck became as brisk and gentle as could be desired, and was frequently brought into the parlour. The succeeding winter this animal evinced the same dispositions, and never appeared to suffer by its long sleep." *

In Rensselaer County in this State, during the summer of 1814, Dr. Bachman marked a burrow that he knew to be inhabited by a pair of Woodchucks. Early in November he had it opened and found the animals lying close together in a nest of dry grass about twenty-five feet (7.62 metres) from the entrance. "They were each rolled up," he writes, "and looked somewhat like two misshapen balls of hair, and were perfectly dormant." †

In hibernation the temperature of the animal approximates that of the surrounding atmosphere, the heart's action slackens, and respiration can only be detected by means of delicate instruments devised for the purpose. This latter fact was known to Spallanzani nearly a hundred years ago, for he wrote to Senebier: "You will remember about my Marmot which was so exceedingly lethargic in the severe winter of 1795; during that time I held him in carbonic acid gas for four hours, the thermometer marking −12°, he continued to live in this gas which is the most deadly of all . . . at least a rat and a bird that I placed with him perished in an instant."

It is well to observe that different animals exhibit in different degrees the physiological process of hibernation; and that this fact is amply illustrated by the representatives of the family to which the present species belongs. Animals that are able to procure subsistence in the winter season, and those that lay up large stores in their nests, do not sleep so continuously, and their lethargy is not so profound as in the case of those species that are

* Quadrupeds of North America, Vol. I, 1846, pp. 20–21.

† Ibid., p. 22.

wholly cut off from food during this period. Thus the gray squirrel, being able to find a certain amount of sustenance when the ground is covered with snow, remains dormant during severe cold only; and the chipmunk, which lays up a great store of provision, frequently awakes to eat, and is at all times easily aroused; while the Woodchuck, whose food is of such a nature that he can neither gather a supply for winter's use, nor find any were he to go in search of it, must needs sleep long and soundly or starve.

The Woodchuck and the flying squirrel occupy the two extremes of the family to which both belong, while the ground squirrels and spermophiles hold intermediate positions. The flying squirrel is the most highly specialized form, showing the most perfect adaptation of structure to habit; while the Woodchuck must at present be regarded as the most generalized type of the living members of the group. These animals are so widely different that, taken alone, they would naturally be regarded as pertaining to separate families; but a careful study of the numerous intermediate forms not only proves this view to be incorrect, but also shows that the gradation of connecting species is so complete that it is even difficult, in many cases, to draw the line between genera.

The Woodchuck lacks the grace and agility of the arboreal squirrels, but his heavy body and powerful paws are well adapted to his terrestrial mode of life. Both animals are modified, but to widely different ends.

Woodchucks are both nocturnal and diurnal, the periods of feeding being determined, in a general way, by the time of the year, the weather, and the proximity and nature of enemies. In summer, throughout the farming districts, they commonly leave their burrows early in the morning, late in the afternoon, and during moonlight nights; but may sometimes be found abroad at all hours. As autumn approaches, and they become more and more fat and sleepy, they usually appear only in fine weather, and then but for a few hours in the hottest part of the afternoon.

In localities where they are much hunted they become wary and difficult of approach. Their hearing is so acute that they take alarm at sounds which escape our observation altogether. When feeding or otherwise occupied they frequently stop to listen, sitting bolt upright with the head inclined forward and the fore legs hanging down over the breast. If a suspicious noise is heard and a man or dog can be discerned in the distance, they are apt to precipitate themselves into their holes, not to emerge again till sufficient time has elapsed to discourage the most enthusiastic and patient of hunters who may be waiting for a shot. However, when seen in an open field they may generally be stalked by a very simple artifice. They seem to be wholly unacquainted with man except in the erect or semi-erect posture. Taking advantage of this fact, the hunter has merely to prostrate himself at full length upon the ground and crawl slowly till within easy rifle range of the astonished beast, which, seeing little save the top of the man's hat, and curious to see more, often stands erect at the mouth of his burrow, converting himself into a target that no marksman could fail to hit. When a Woodchuck, seeing a man approach, withdraws into his hole, he does not always retreat immediately to its innermost recesses, but sometimes tarries near the mouth to await developments. The hunter, availing himself of the knowledge of this fact, proceeds deliberately till within range, throws himself upon the ground and utters a sharp whistle, when, not infrequently, the animal's head will be seen to pop up inquiringly from its hole.

Woodchucks live singly or in pairs, the young as a rule remaining with their parents only through the first few months. In the latter part of the summer they usually begin to shift for themselves, and in early autumn they may often be met with in the fields and forests far from their holes. They now take refuge in stone walls, hollow logs, and even in hollow trees when there is a sufficiently large opening near the ground. It is not long before each has fixed upon a spot agreeable to his individual fancy, where he at

once commences to establish a home. The diversity of taste exercised in this selection is hardly outdone by our own idiosyncrasies in the same field.

Some evince a love for home and take up their abodes in the very door-yards of their parents; while others, impelled by a desire to see more of the world, wander far and wide before settling down to the sober task of excavating their holes. Some, indeed, never give themselves this trouble, but merely take possession of the deserted burrows of their ancestors, where a small amount of labor is all that is necessary to render the easily acquired, though somewhat musty apartments habitable. Woodchucks' holes are not all alike. There are two principal types: the first slopes at a moderate angle from the surface and has a mound of dirt near its entrance;* the other is more or less vertical for several feet (often a metre or more) immediately below the surface, and no loose earth can be found in its neighborhood. The latter are usually smaller than the others and several are often clustered about one of the large family burrows, though they are occasionally isolated. If the surface opening is in a meadow, the hole through the sod is apt to be sharp cut and more or less circular in outline. Intermediate forms are sometimes met with, and many of these are in time converted into primary burrows.

The galleries do not conform to any definite or uniform pattern, but vary in length, depth, and direction, and in the number of branches, nests, and surface openings, according to the location, character of soil, number of inhabitants, and individual idiosyncrasy. However, they resemble one another sufficiently in some respects to admit of general description. As a rule they slant abruptly downward from the entrance to a depth of from three to four feet (.914 to 1.219 metres), whence, inclining slightly upward and usually curving to one side, they extend horizontally for a varying

* The mounds in front of the large holes frequently, if not generally, contain accumulations of the animal's excrement, and in one case I removed fully half a bushel from a single mound.

distance (commonly from 10 to 25 feet, or 3.048 to 7.620 metres). Two or more short lateral branches are generally given off from the main gallery, and lead, sloping upward and then downward, to the more or less circular chambers that contain the animal's nests. It has been my invariable experience to find these chambers above the level of the bottom of the entrance incline, and I have seen one that was within a foot and a half (.457 metres) of the surface. The nest itself is usually composed of dry grasses and leaves, and rarely exceeds a foot in diameter.*

It not infrequently happens, where there are two surface openings, that the main gallery takes the form of a more or less irregular semicircle, with one or more lateral branches of considerable length, both ends of the main gallery coming to the surface.

During the last week of April or first of May, the Woodchuck commonly gives birth to from four to six young. A nest which was dug out May 11th, 1884, contained two young, whose eyes and ears were not yet open, though the animals were well haired. Each measured two hundred and five millimetres in length, and weighed one hundred and sixty-seven grammes. The nest was one metre below the surface, and was connected with the main burrow by a steeply sloping branch.

When unexpectedly surprised at close quarters the Woodchuck utters a loud, shrill, and tremulous whistle that pierces the ear and evokes from the intruder an involuntary movement or exclamation, even though he may have been similarly startled many times before.†

The Woodchuck is pre-eminently a terrestrial animal, usually spending the whole of his life in or upon the ground, yet some ambitious individuals, prompted either by choice or necessity,

* The main gallery or one of its branches commonly terminates in a slight excavation which is found to contain the animal's excrement. No other of the lower animals with which I am acquainted constructs a special receptacle for the deposit and accumulation of its dejections.

† Dr. Coues speaks of this note as "The merry whistle of the woodchuck at the mouth of its burrow" (Familiar Science, Vol. V, No. 12, Dec., 1878, p. 230.), but I am unable to conceive how a sudden cry of alarm can be construed into a "merry whistle."

occasionally take a more elevated view of the earth. Concerning these "tree-climbing Woodchucks" I quote from an article on the subject that I once wrote for *Forest and Stream*:— "Woodchucks, when unmolested, and particularly during their youthful days, often climb up ten or twelve feet in shrubbery and young trees that abound in low branches, and not infrequently scramble up the trunks of large trees which have partially fallen or slant sufficiently to insure them against slipping. Occasionally, especially when hard pressed by a fast approaching enemy, they ascend large erect trees whose lowest branches are some distance from the ground. But, in order to do this, they must take advantage of the impetus of a rush, for they cannot start slowly upon the trunk of an upright tree and climb more than a few feet without falling. Neither can they stop and go on again before reaching a branch or other resting place."*

In the *American Naturalist* for September, 1881 (pp. 737–738), the Hon. Charles Aldrich, of Webster City, Iowa, writes: "About two years ago a young man who was living with me, came in one day saying that he had just seen a small animal, possibly a raccoon, ascending a tree in the woods some sixty rods away. Taking my shot-gun, I went to the place, where I soon saw the creature in the top of a black oak tree, almost forty feet from the ground. The animal seemed very cunning, and managed for some time to keep on the opposite side of some of the larger limbs, but I finally got a shot at him. He came to the ground with a bounce, when I found it was a woodchuck. It was but slightly wounded in one of the fore legs, and I captured it and took it home. I put it in a hollow tree near my residence, and it remained there a couple of weeks, freely eating the corn which I regularly fed it."

As a rule the Woodchuck manifests great antipathy for water. In confinement he rarely partakes of it, and in the wild state his burrows are frequently so remote from it as to preclude the idea

* Forest and Stream, Vol. XVI, No. 23, July 7, 1881, p. 453.

of his journeying there to drink. Hence it seems probable that the moisture which his system requires is derived from the juices of the plants on which he feeds, together with the dew or rain that may have lodged upon them.

Having searched in vain for the record of an instance where a Woodchuck has been known to swim, voluntarily, I take great pleasure in being able to contribute an account of a case that recently fell under my personal observation. On the 12th of June, 1883, while rowing up the Fulton Chain of Lakes, in company with Dr. A. K. Fisher and Walter H. Merriam, a Woodchuck was observed in the water directly ahead of the boat swimming across the channel between Second and Third Lakes. He swam deep, at times the top of his head and the tip of his tail alone appearing above the surface. He crossed from the north to the south shore and was evidently very much fatigued and somewhat confused, for, although I pushed the boat close after him as he was about to emerge, he only partly climbed out upon a small log that extended into the water, and showed no inclination to move off, or even to change his position. He was poked several times with a stick, and finally Dr. Fisher actually stroked him with his hand before he became sufficiently aroused to show that he was aware of our presence. We left him standing partly upon the log, with one leg still in the water, shivering, and apparently in a very unhappy state of mind. This animal was young, and was evidently travelling about in search of a suitable place in which to establish his home.

The Woodchuck can always be taken in a steel trap set with proper care, and concealed from view. By this means it is generally easy to rid our fields of his presence. Dr. C. L. Bagg and I once caught thirty-three Woodchucks in a large meadow during a single season.

In a recent number of the *American Field* (Vol. XX, No. 10, Sept. 8, 1883, p. 225) I recorded the following very unusual occurrence: On the 28th of July last, hearing a commotion among some

half-grown chickens that had taken up their abode in the underbrush back of my office, Dr. A. K. Fisher, who was with me at the time, betook himself thither and much to his surprise found a Woodchuck to be the cause of the disturbance. The animal was chasing the fowls with much earnestness, and evidently meant to catch one; while the poor chickens, already well-nigh exhausted, were straining every nerve to escape. Fearing that the beast (which was a young and ambitious female) might propagate a race of Woodchucks that would rank among the depredators of the poultry yard, the Doctor brought the chase to an abrupt termination and added the rodent's skeleton to my osteological cabinet. This is the only example that has thus far come to my knowledge where a Woodchuck has pursued either bird or beast, and the question may be fairly asked whether in this instance it purposed to seize and devour the fowl, or, being of a jocose turn of mind, was merely chasing it to see it run, just as a puppy would do under similar circumstances.

Dr. Godman, who once had a tame Woodchuck, speaks thus of its habit of lugging various articles into its burrow: "Every thing fit to make a bed of, that he could get at, was sure to be carried under ground, and when clothes were missed, which had been hung out to dry, it was only necessary to fasten a hook to a long stick and draw them out of his burrow. When this was to be effected, it was necessary to tie the Marmot up short, as he appeared to understand perfectly what was to be done, and was by no means willing that his bed should be rendered less comfortable. Although he would not attempt to bite the person engaged in removing his plunder, he would rush to the entrance and endeavor to make his way in, as if to secure his prize, or remove it to a still greater distance. On one occasion he carried off and stowed at a distance of six feet from the entrance, eight pairs of stockings, a towel, and a girl's frock, and had he not been discovered in the act, would have

made a still larger transfer of materials to form a more luxurious bed." *

The power of song is not often attributed to mammals lower in the scale than ourselves, and yet it is a fact that several species are capable of producing musical notes which are pleasing to the ear. In the *American Naturalist* for June, 1872 (Vol. VI, No. 6, pp. 365–366), is an article from the pen of Dr. A. Kellogg, entitled "*Singing Maryland Marmot.*" The writer states: "For the last forty years the fact of the common Maryland Marmot, or Woodchuck, being able to sing like a canary bird, but in a softer, sweeter note, has been quite familiar to myself, and others who could be brought forward as witnesses.". He then speaks of a very young Woodchuck which he raised, and goes on to say: "It had a seat in the little high chair at the children's table full oft. Its earnest and restless concupiscent purr as it scented sweet cake and fragrant viands was wonderful. At length it became as familiar as the family cat and finally burrowed under the doorstep. My impression is now, and has always been, that it was a female. I used to watch the pet very closely to see how it sang, as children are apt to do. There was a slight moving of the nostrils and lips and consequently whiskers with an air of unmistakable happy or serene enjoyment. I question much if this is altogether unknown to others, *always excepting naturalists.*"

Woodchucks are so abundant in some parts of New Hampshire that the farmers have long demanded legislative aid for their riddance. At length the clamors from this source became so loud and continuous that the Legislature was forced to recognize the

* American Natural History. Vol. I, 1842, p. 329. In treating of the habits of this species, Dr. Godman makes some very astonishing statements, statements that are wholly incorrect as applied to it in this region, though possibly true in some parts of its extensive habitat. His figure bears as close a resemblance to the wolverine as it does to the Woodchuck, and yet, strangely enough, he speaks thus of those of his predecessors: "All the figures which have been heretofore published of this animal (with the exception of one given in the English translation of Cuvier, borrowed from a drawing by Le Sueur) have been copied from Edward's, which is altogether unlike the animal" (pp. 330–331).

postulations of its rural constituency, and a committee was appointed, of which the Hon. Charles R. Corning was made chairman. In due course of time the committee prepared a report which was submitted to the House, accompanied by a bill providing for a bounty of ten cents for each Woodchuck killed within the limits of the State. This act was approved Sept. 11, 1883.*

* From the "Report of the Woodchuck Committee" I beg leave to reproduce the following extracts: "Your committee finds that the Woodchuck is absolutely destitute of any interesting qualities, that is, such qualities as would recommend it to the average inhabitant of New Hampshire. . . . . Its body is thick and squatty, and its legs so short that its belly seems almost to touch the ground. This is not a pleasing picture. Its size varies all the way from those reared in Strafford County to the huge fellows that claim a homestead among the fertile farms of Grafton. Woodchucks have been known to attain a large size, even fifteen pounds. This, however, would not be an average Woodchuck. The casual observer is not attracted by the brilliancy of a Woodchuck's color. When one thinks it over, it certainly would seem that the family of Woodchucks was designed and brought forth under conditions of severe simplicity. While the usual color cannot be said to be a decided red, it is not Auburn, but more like Derry, which is next to Auburn. Your committee has now in mind the under side of the creature. The body even in very young Woodchucks, is inclined to be gray—a very significant circumstance in the mind of your committee, when the total depravity of the animal is considered. Besides Derry and gray, there are other hues blended about the Woodchuck; but these are merely details, and of no practical account. . . . . Like thieves in all climes, the Woodchuck remains securely concealed in its hole for a great part of the day. Its only purpose in venturing forth during the daytime is to get a good lay of the land. . . . Like the bear, the gait of the thing under consideration is plantigrade, but in order to occasionally exercise its toes it climbs small trees and shrubs; then, perfectly satisfied that its pedal extremities are in good working trim, it descends to the ground and again resumes its monotonous waddle. The Woodchuck, despite its deformities both of mind and of body, possesses some of the amenities of a higher civilization. It cleans its face after the manner of the squirrels and licks its fur after the manner of a cat. Your committee is too wise, however, to be deceived by this purely superficial observance of better habits. Contemporaneous with the ark, the Woodchuck has not made any material progress in social science, and it is now too late to attempt to reform the wayward sinner. The average age of the Woodchuck is too long to please your committee, but the estimate of Woodchuck population can only be approximated. . . . The Woodchuck is not only a nuisance, but also a bore. It burrows beneath the soil, and then chuckles to see a mowing machine, man and all, slump into one of these holes and disappear. . . . Your committee is confident that a small bounty will prove of incalculable good; at all events, even as an experiment, it is certainly worth trying; therefore your committee would respectfully recommend that the accompanying bill be passed. CHARLES R. CORNING, for the Committee.

"AN ACT PROVIDING FOR A BOUNTY ON WOODCHUCKS.

"Be it enacted by the Senate and House of Representatives in general Court convened:

"Section 1. If any person shall kill any Woodchuck within this State, and shall produce the tail thereof to any one of the selectmen of the town within which said woodchuck was killed, or if there be no selectmen in said town, then to any one of the selectmen of the nearest town having such selectmen, said selectmen shall take the said tail and so dispose of it that it shall not again be used for the purposes of bounty, and shall pay to the person so producing it the sum of ten cents: *Provided*, that no bounty shall be paid for any woodchuck killed on Sunday.

"Section 2. The selectmen of every such town shall keep a true account of the moneys so paid as bounty on woodchucks, and upon presentation of such amount, certified by a majority of such

Family CASTORIDÆ.

## CASTOR FIBER CANADENSIS (Linn.) Allen.

*American Beaver.*

That the Beaver was once abundant in all parts of the Adirondacks is attested by the numerous remains and effects of their dams; but at present they are so exceedingly rare that few people know that they still exist here.

Samuel de Champlain found them abundant in the Richelieu River in the early part of July, 1609. He said of them: "There is also quite a number of Beavers, as well in the river as in several other streams which fall into it." (Documentary History of New York, Vol. III, p. 5.)

Dr. DeKay says that, in 1815, "a party of St. Regis Indians from Canada ascended the Oswegatchie river in the county of St. Lawrence in pursuit of Beaver. In consequence of the previous hostilities between this country and England, this district had not been hunted in some years, and the Beaver had consequently been undisturbed. The party, after an absence of a few weeks, returned with three hundred Beaver skins. These were seen by my informant [Mr. T. O. Fowler], who adds that since that time very few have been observed." * They were not immediately exterminated, however, for Mr. Calvin V. Graves writes me that in 1834 a trapper named Hume caught six Beavers in Silverdog Pond, in the northeastern part of the town of Diana, in Lewis County; and that a few years later Norman and Hume caught three Beavers on the middle branch of the Oswegatchie, near Harrisville. These are believed to have been the last Beavers which inhabited that part of the Wilderness.

selectmen to be just and true, to the treasurer of the state, in the month of June, the same shall be paid from the state treasury either to the representative of such town or to the selectmen thereof, upon their written order.

"Section 3. This act shall take effect from and after its passage.

"Approved September 11, 1883."

* Zoology of New York, Part I, 1842, p. 73.

I am informed by William Clowbridge, an old hunter and trapper, that during his boyhood Beavers were common along the western border of the Adirondacks. In the year 1819 he caught two in one of their huts on the outlet of Brantingham Lake, in Lewis County, on which stream they had then two dams. In March, 1837, he caught, at Little Otter Lake, also in Lewis County, the last Beaver observed on this side of the Adirondacks. The veteran hunter, Asa Puffer, was at the time trapping for the same animal. Mr. Clowbridge tells me that the spring was unusually forward, and that there was some open water along the north shore of the lake, and about its outlet. He made a small opening in the dam, and in the gap thus formed set his trap, a few inches below the surface of the water. On returning to the lake, a week afterward, an eagle was seen to rise and fly away from the vicinity of the outlet. Proceeding to the dam he could find neither the trap nor the weight to which it had been attached. He then went to the spot from which the eagle rose and there found the Beaver in the trap.

Mr. John Constable has kindly presented me with the skull of a very large Beaver which was "trapped by William Wood, in the fall of 1837, in a pond northwest of Indian Point on the Raquette." Mr. Constable writes me that an old Indian who had been unsuccessful in his attempts to capture this same Beaver, and who was then about to leave this part of the Wilderness, told Wood where the animal was to be found. Wood carried his boat to the pond and paddled twice around it, searching carefully for signs, without going ashore. At last he discovered fur upon the root of an old birch that projected into the water. Here he placed the trap, attached to a float, and on the second day found the Beaver in it.

Dr. DeKay, writing in 1841, says: "In the summer of 1840, we traversed those almost interminable forests on the highlands separating the sources of the Hudson and St. Lawrence, and included in Hamilton, Herkimer, and a part of Essex counties. In the

course of our journey we saw several *beaver signs*, as they are termed by the hunters. The Beaver has been so much harassed in this State, that it has ceased making dams, and contents itself with making large excavations in the banks of streams. Within the past year, (1841,) they have been seen on Indian and Cedar rivers, and at Paskungameh or Tupper's lake; and although they are not numerous, yet they are still found in scattered families in the northern part of Hamilton, the southern part of St. Lawrence and the western part of Essex counties. Through the considerate attention of Mr. A. McIntyre, those yet existing in the southern part of Franklin county are carefully preserved from the avidity of the hunter, and there probably the last of the species in the Atlantic States will be found. We noticed the remains of an old and large beaver dam at the outlet of Lake Fourth in Herkimer county, but it is now nearly covered up by the drift sand from the lake" (loc. cit., p. 74).

Watson, in his History of Essex County, published in 1869, says: "The Beaver was found in great abundance throughout the region, by the first occupants. They no longer exist, it is believed, in the territory of Essex County" (p. 348).

During the fall of 1880, a Beaver was caught on Raquette River, between the Upper Saranac and Big Tupper's Lake, and about a mile below the "Sweeney carry." The skin was stuffed and preserved by the hunter who captured the animal. Subsequent to this date, saplings were cut in the neighborhood, showing that another was at work there. I have myself examined the locality and brought away a number of cuttings. They consist of young poplars (*Populus tremuloides*) averaging from two to four inches (50 to 100 mm.) in diameter; the largest measured fourteen inches (355 mm.) in circumference.

At present there is a small colony of Beavers on a stream that empties into the West Branch of the St. Regis River. It is probably the colony referred to by DeKay, in 1842, as "yet existing in

the southern part of Franklin county." It is to be earnestly hoped that the hunters who frequent that part of the Wilderness will spare no pains to protect these animals from molestation.

No animal has figured more prominently in the affairs of any nation than has the Beaver in the early history of the "New World." Its influence on the exploration, colonization, and settlement of this country was very great. The trade in its peltries proved a source of competition and strife, not only among the local merchants, but also between the several colonies, disputes over the boundaries having frequently arisen from this cause alone. Indeed, on more than one occasion, jealousy of the Beaver trade led to serious difficulties in the struggle for supremacy between the three rival powers—the Dutch, English, and French.

The Provincial Seal of New Netherland was a Beaver resting on a shield, encircled by the words "*Sigillum Novi Belgii.*"

In the year 1671, there appeared in Amsterdam a paper entitled, "De Nieuwe en Onbekende Weereld: of Beschryving van America en't Zuidland: door Arnoldus Montanus." Much of this account is devoted to the natural history of the country, and it contains some extraordinary tales concerning the animals found there. The author's remarks upon the Beaver run as follows: "But in addition to other wild animals *New Netherland* furnishes, according to the occular evidence of *Adriaen van der Donk*, full eighty thousand beavers a year. *Pliny* relates how these animals castrate themselves, and leave these parts to the hunters, inasmuch as they are much sought after, being an effectual remedy for mania, retention of the afterbirth, amenorrhœa, dizziness, gout, lameness, belly and tooth aches, dullness of vision, poisoning and rheumatism. But *Pliny* commits a grave error; for the Beavers have very small testicles fastened in such a manner to the back bone that they cannot remove them except with life. Moreover, they live in the water and on land together in troops, in houses built of timber over a running stream. The houses excite no common ad-

miration; they are thus constructed—the Beavers first collect together all the drift wood which they find along the river, and whenever this falls short, they gnaw away, in the next adjoining wood, the sweetest bark all around with the front teeth, of which they have two in the upper, and two in the lower gum, they then cut right around the trunk until the tree falls; when they also shorten the pieces in like manner, to adapt them to the proposed building. The females carry the pieces on the back, the males support it behind so that it may not fall off. The houses rise ingeniously to the height of five stories; they are smeared above with clay to protect them from the rain; in the middle is a convenient aperture through which to dive into the water as soon as they perceive any person. Wherefore, one of the troop keeps watch by turns, and in the winter a second keeps the water open by constant beating of the tail. The tail is flattish without hair, and most dainty food which in some places is served up as a rare delicacy. The beavers go with young sixteen weeks; they bear once a year four young, which cry and suck like young children; for the mother rises on her hind paws and gives each two a breast as she has only two breasts between the fore legs; these legs resemble somewhat those of the dog; the hindmost, like those of geese, lap in some measure over each other. On both sides of the privy parts lie two swellings enclosed in separate membranes. From the privy parts oozes an oleaginous humor, with which they smear all the accessible parts of the body in order to keep dry. Inwardly they resemble a cut up hog; they live on leaves and bark; are excessively attached to their young; the wind-hairs which rise glittering above the back, fall off in the summer, and grow again by the fall; they are short necked; have strong sinews and muscles; move rapidly in the water and on land; attacked by men or dogs, they bite fiercely. The pure *Castor*, so highly prised by physicians, consists of oblong follicles, resembling a wrinkled pear which are firmly attached to the *os pubis* of the female beaver;

the Indians cut up the little balls of the males with their tobacco as they afford no castor." *

In the year 1732 the immortal Linnæus was sent, by the Royal Academy of Upsal, on a tour through Lapland. In his personal journal he says: "I set out alone from the city of Upsal on Friday May 12, 1732, at eleven o'clock, being at that time within half a day of twenty-five years of age." Sixteen days later, when at a place called Genow, the young naturalist had the opportunity, apparently for the first time, of examining a recently killed Beaver. Of it he said, "I inquired concerning the food of this animal, and was told it was the bark of trees, the birch, fir, and mountain ash, but more especially the aspen, and the castor becomes larger in proportion as the Beaver can get more of the aspen bark. This confirmed the truth of what Assessor Rothman formerly asserted, that castor is secreted from the intermediate bark of the poplar, which has the same scent, though not quite so strong: hence it is to be presumed that a decoction of this bark, if the dose were sufficiently large, would have the same medicinal effects. I wonder no naturalist has classed this animal with the Mouse tribe [which term was then applied to all Rodents], as its broad depressed form at first sight suggested to me that it was of that family." † Thus, only a century and a half ago, appeared the germ of the idea that recognized in the structure of the Beaver its affinities with the members of the order Glires, to which order it was assigned by Linnæus in his great work, the *Systema Naturæ*.

Thomas Pennant said: "The skins are a prodigious article of trade; being the foundation of the hat manufactory. In 1763 were sold, in a single sale of the *Hudson's Bay* Company, 54,670 skins." ‡

* Documentary History of New York, Vol. IV, pp. 120–121.

† Lachesis Lapponica, Vol. I, 1811, pp. 88–89.

‡ Synopsis of Quadrupeds, 1771, p. 258.

Family MURIDÆ.

## MUS DECUMANUS Pallas.

*Rat.*

This ubiquitous naturalized exotic is found even within the confines of the Adirondacks. But his presence here omens no good. Like the lumberman, whose footsteps he follows, he is the personification of destruction, and desecrates the soil on which he treads.

He is omnivorous, greedy, and fierce, and is totally lacking in qualities of a compensatory character. His long residence in the very stronghold of his enemies has developed hereditary habits of great circumspection, and where much persecuted he is one of the most cunning and crafty of mammals. The means devised for his extermination may be numbered by hundreds, but he is so prolific, and so soon learns to avoid the artifices designed for his capture, that he has spread himself over nearly the whole civilized world.

The Rat ranks among the worst enemies of the farmer. Not only does he force his way into the cellar, the milk-house, and the granary; but he also commits great havoc in the poultry-yard. He wantonly destroys far more than he consumes. The choicest fruits and vegetables are ruined by a single bite; smoked hams suspended from the rafters show the marks of his sharp teeth; pans of rich cream are soiled by his lash-like tail; large holes through the plank-walls of the oat-bin leave no doubt as to the identity of the thief; and the constant loss of eggs and of young chickens and ducks may be regarded as one of the most serious evils his presence occasions. Even the sleeping child and the shrouded corpse have been mutilated by his cruel jaws.

He is not content with deriving his sustenance at our expense, but, to save himself the trouble of a walk between meals, takes up his abode in or under our dwellings and outhouses. In unsettled regions he often makes long journeys from house to house, but I

have never known him to make his home at any great distance from buildings.

Rats are good swimmers, and in their migrations from place to place (which are usually performed at night, and thus escape notice) they do not hesitate to swim rivers and ponds that lie in the way. Though chiefly nocturnal, they are often seen in the daytime.

They are excessively prolific, commonly bringing forth from seven to twelve young at a birth, and having several litters each season. Some idea of the number of Rats inhabiting large cities may be had from the fact that, at Paris, in a fortnight's time, more than six hundred thousand were killed in the sewers. Their skins were manufactured into kid gloves.

## MUS MUSCULUS Linnæus.

*House Mouse.*

The House Mouse is another exotic that has found the climate and productions of America so much to its liking that it has multiplied and diffused itself over the whole of the inhabited portions of our continent.

Like the rat, it abounds in our largest cities and makes itself a conspicuous, albeit unwelcome, member of the household; but unlike the latter it also inhabits districts as yet unoccupied by civilized man.

Such places, however, do not seem congenial to its urban disposition, and it is probable that none but those who, from long residence in the country, have acquired a taste for adventure, make bold to desert their traditional haunts, together with the cats and traps with which they have been for generations familiar, to seek new homes, amid new surroundings and new enemies.

I have observed the House Mouse in many of the camps scattered through the Adirondacks, and have killed it, though rarely, at a considerable distance from the habitations of man. It is common

in the fertile valleys along the outskirts of the Wilderness, living in the fields during the short summer season, and returning to the dwellings, barns, and haystacks at the approach of winter.

It is omnivorous, and, in the main, nocturnal. It usually gives birth to from five to nine young at a time, and has several litters in a season.

### *The House Mouse as a Vocalist.*

It has long been known that individuals of the common House Mouse occasionally possess very exceptional vocal powers. These "singing mice" have appeared, from time to time, in various parts of the country, and their performances have been eagerly listened to and carefully recorded by the delighted hearers.

My aunt, Mrs. Helen M. Bagg, once had a singing Mouse in her house at Detroit, Michigan, and has kindly favored me with the following account of it: "Early in the spring of 1858 I would occasionally hear faint musical sounds, like the warbling of a young bird, issue from the china closet, which was on one side of the dining room. Several days passed before I could get any clew to the sounds. We had singing birds—a mocking bird and canaries—and every one declared it was the birds I had heard, but I felt equally certain the sounds came from the closet. One afternoon when the house was quiet, the children taking their naps, and the cook having ceased to rattle her dishes, I opened the closet door and sat down where I could have a full view of the inside. After a long and patient waiting a mouse peered out from behind the plates, climbed up a little way on the brackets, and, after looking around several times, began to sing! I need not describe my feelings. Its song was not much of a song, 'as songs go,' but still a distinct musical effort. Sometimes it would run up an octave and end with a decided attempt at a trill. Sometimes it would try to trill all the notes. An octave seemed to be about its range. I could distinctly see the expansion and vibration of its throat and chest as one can in a song bird. Its favorite posi-

tion when singing was an erect one, standing on its hind feet, and holding by its forward ones to the wall or bracket, almost invariably turning its face toward us. It remained with us several weeks, and at length became so familiar as to appear to enjoy company, seemingly putting forth all its strength to amuse us with its little song, which improved daily in tone and volume, but not in compass. Its voice became so clear that we could frequently hear it in the parlor that opened out of the dining room. I frequently invited my visitors to listen to it. My next-door neighbors occasionally heard it in their house, but not very distinctly. It evidently did not feel at home there. Suddenly as it came it disappeared—probably falling a prey to some cat during its rambles from house to house."

In 1804 Dr. Samuel Cramer, of Virginia, communicated to Dr. Barton the following very curious account of the influence of music upon the common House Mouse. He said: "One evening, in the month of December, as a few officers on board of a British man of war, in the harbour of Portsmouth, were seated around the fire, one of them began to play a *plaintive* air on the violin. He had scarcely performed ten minutes, when a mouse, apparently frantic, made its appearance, in the centre of the floor, near the large table which usually stands in the wardroom, the residence of the lieutenants in ships of the line. The strange gestures of the little animal strongly excited the attention of the officers, who, with one consent, resolved to suffer it to continue its singular actions unmolested. Its exertions now appeared to be greater, every moment. It shook its head, leaped about the table, and exhibited signs of the most extatic delight.

"It was observed, that in proportion to the gradation of the tones of the soft point, the extacy of the animal appeared to be increased, and *vice versa*. After performing actions, which an animal so diminutive would, at first sight, seem incapable of, the little creature, to the astonishment of the delighted spectators, suddenly ceased to

move; fell down, and expired, without evincing any symptoms of pain." *

Linnæus, in his brief diagnosis of this species, said: "*Delectatur musica.*" †

## HESPEROMYS LEUCOPUS (Raf.) LeConte.

*White-footed Mouse; Deer Mouse; Field Mouse.*

The White-footed Mouse is common in all parts of the Adirondacks. In the wild state it feeds upon beechnuts and a variety of seeds; in captivity it is omnivorous.

Its haunts are various. Some take up their abode in dense evergreen forests, others in hardwood groves, and others still in the open fields. Many find the way into the hunter's camp and the log-house of the frontiersman; while in the more cultivated districts they vie with the common house mouse in the possession of our homes. Dr. Richardson tells us that in the Hudson's Bay Company's Territory, "no sooner is a fur-post established than this little animal becomes an inmate of the dwelling-houses" (Fauna Boreali Americana, 1829, p. 142).

It is an excellent climber and I have often found its nest in holes in living trees, more than seventy feet (21.33 metres) above the ground. While on a snow-shoe walk with a friend one bright moonlight evening, several winters ago, one of them was observed skipping lightly over the snow a short distance ahead. We gave chase, but the mouse escaped by running up the trunk of a smooth-barked beech hard by. My friend, who was not aware of its climbing propensities, looked on in amazement while the mouse, with as much ease and nimbleness as a squirrel, ascended the tree and disappeared in a knot-hole high among the branches.

The White-footed Mouse does not hibernate. Except during the

* The Philadelphia Medical and Physical Journal, Vol. I, 1804, pp. 37–38.

† Systema Naturæ, Ed. X, Vol. I, 1758, p. 62.

severest weather its tracks may be seen on the snow throughout the winter, its long tail leaving a furrow by which it may always be recognized. In the autumn it lays up an immense store of provision for so small an animal. The beechnut constitutes its favorite food, and in seasons when it is to be had no other article of diet is sought. The hoards are generally established in holes in trees or in hollow logs, and are, therefore, frequently discovered by the wood-chopper. The beechnuts they contain are usually shucked, and I have, on several occasions, removed two or three quarts from a single hoard.

Robert Kennicott tells us that in western New York, Joseph Kennicott found, "within a stump in a clover-field, several quarts of clean seed of red clover, collected by a family of these mice." *

They sometimes select odd sites for their store-houses. In October and November, 1881, Drs. Hoadley, Fisher, and myself occupied the neat log-house that is commonly known as the "Club Camp" at Big Moose Lake. We were here much annoyed by the White-footed Mice, which not only made way with any eatables that happened to be lying about, but also lugged off a quantity of the cotton we had brought for stuffing birds. They even climbed up to our drying-boards and pulled out the cotton which we had carefully tucked under the shoulders and backs of the newly-made bird skins. No place was free from their depredations, and the skins were only made secure by suspending them from the ceiling by means of cleats fastened to the smooth spruce rafters. The loss of the cotton was a matter of no small consequence, since it had to be carried there from a distance of more than forty miles. A careful search was begun, but no trace of it could be found till a small cupboard, supposed to be mouse-proof, was unlocked, when the whole of it fell in view. In this same cupboard we discovered an old shoe well filled with crackers and sugar which had been taken from the kitchen, and beechnut meats which had been brought from some distance outside. The

* Quadrupeds of Illinois, 1857, p. 91.

locker was entered from the top, and the path to it was circuitous and difficult.

The White-footed Mouse is fond of flesh and, like the flying squirrel, eagerly devours dead birds placed in its way. Indeed, this is done so naturally, that the suspicion arises as to whether it does not sometimes capture and prey upon the smaller birds while on their roosts at night.

Dr. Samuel Lockwood had a caged *Hesperomys* from Florida. "Sometimes a fly would enter the cage, when she would spring at, and catch it, sometimes with her mouth, and at others with her hands. This she would eat with great relish. . . . A little sod of fresh grass and white clover was occasionally put into the cage. This she enjoyed greatly, eating the greens like a rabbit; only always insisting on sitting up to do it. It was interesting to witness how ready she was for emergencies. Sitting on her hind feet, she would take hold with her hands of a blade of grass, and begin eating at the tip. The spear would rapidly shorten, and seemingly she must now stoop to finish it, or do it in the ordinary quadrupedal style. Now that was just what she did not choose to do. So when the emergency came, she would stoop down, and in a trice cut the blade off close to the sod with just one nip; then up again on her feet in a sitting posture, she would finish it in a comfortable and becoming way." *

In personal appearance the White-footed Mouse is far more attractive than the other members of the family. Its prominent, bead-like eyes, large ears, and long tail are striking characteristics, while the rich fawn-color of the sides and back, sharply contrasted with the snowy white of the under parts and feet, combine to produce an exterior of much beauty. Add to this the natural agility and grace of its movements and we have an animal that, by any other name than *mouse*, would be regarded as one of the most interesting inhabitants of our forests.

* American Naturalist, Vol. V, No. 12, Dec., 1871, p. 763.

Its disposition is in perfect harmony with its attractive appearance, for even the flying squirrel is not more gentle and affectionate. When first captured it rarely offers to bite, and within a few hours will generally eat from the hand. It manifests neither fear nor suspicion while in its box or on one's person, but if let loose in a large room is frightened when approached, and seeks to hide. If given the opportunity, it is pretty sure to select some particular pocket for its home. It is also fond of running up one's sleeves, and when pinched by the movements of the arm will never think of biting.

A few years ago I had a tame White-footed Mouse to which I had become considerably attached. During the day it never left my person, and at night was always placed in a large glass jar with an abundance of cotton. It would eat almost anything offered, sitting on its haunches on my hand or shoulder, and would eagerly lap water or milk from a glass, or from a finger wet in the same. It was scrupulously neat, continually washing its face and cleaning its soft fur. Many times each day it would reach back and grasp its long tail, which, guided and manipulated by the fore-paws, was several times in succession drawn for its entire length through the mouth. When let loose on the snow it invariably burrowed down with great rapidity. One clear cold day in midwinter, the temperature being many degrees below zero, I started on my usual snow-shoe walk with the Mouse asleep in my coat pocket. I had gone some distance and forgotten its presence, when a faint cry of distress warned me that all was not right. It responded to my call only by another cry of pain, fainter even than the first. On taking it from my pocket, it gave me a slight nip, and almost immediately expired. It was *very* cold, and in a few minutes was frozen through.

In the selection of sites for their nests scarcely less individuality is shown than in the choice of their haunts. Those that live in the deep forests commonly build in holes in trees or logs, or in the roots of stumps; while those that dwell in open fields excavate chambers

in the earth several inches below the surface, in which the young are reared. Mr. Kennicott says he has known of "numerous instances in which several have been observed inhabiting the same hole in a tree with a family of flying squirrels."

I have found this species with young at various times from April until November, but do not know how many litters it has in a season. As late as the 8th of November (1883) a nest was ploughed up in one of our fields at Locust Grove. It was lined with feathers and contained half-grown young. On the 29th of the same month I secured in one trap a female and her young, which were two-thirds grown. The mother bore evidence of having recently been nursed, and the stomach of the youngsters contained nothing but milk. From three to six are produced at a birth.

The young are leaden-gray in color and their ears are disproportionately large. Late in June the first litter begins to show pale fawn color—generally commencing on the flanks.

Throughout its southern range, and even so far north as southern New England and portions of New York, the White-footed Mouse, like the red, gray, and flying squirrels, is known to construct "outside nests" for the reception of its young. Such nests are usually more or less cocoa-nut shaped, and sometimes measure a foot in longest diameter. They consist of moss, grasses, leaves, inner bark, and other similar substances. The opening is at or near the bottom. They are commonly placed on a horizontal branch at a varying distance from the ground. Those that I have found have generally been in thickets overrun with *Smilax*, and were rarely more than ten feet high. Nests of birds are sometimes refitted and occupied by these animals. In the Adirondacks I have never known them to build or inhabit outside nests.

Dr. Barton, in 1804, published a note "On a species of North-American Wandering Mouse," which, from the meagre description given, seems to have been the White-footed Mouse. The Doctor says :—

"In the year 1796, a particular species of Mouse made its appearance at Burlington-Bay, on the west end of Lake-Ontario, and at Long-Point, on the north side of Lake-Erie. They came out of the woods, from the northward, in troops of thousands, and committed great havoc among the Indian-corn.

"These animals were so numerous, that, for a good while, they were caught by hundreds, at a time. It is said, that the cats, tired of killing them, came, at length, to play with them, without offering them any injury.

"Even in the winter-time, the corn-cribs were extremely offensive, from the great numbers of these mice, that had perished in them.

"This mouse is described as a small species, smaller than the common House-Mouse; with a white belly, and a very long tail. The general colour was that of the House-Mouse." *

### *Hesperomys as a Vocalist.*

Mr. W. O. Hiskey, in a note in the *American Naturalist* for May, 1871 (Vol. V, No. 3, pp. 171–172) states: "I was sitting a few evenings since, not far from a half-open closet door, when I was startled by a sound issuing from the closet, of such marvellous beauty that I at once asked my wife how Bobbie Burns (our canary) had found his way into the closet, and what could start him to singing such a queer and sweet song in the dark. I procured a light and found it to be a *mouse!* He had filled an over-shoe from a basket of pop-corn which had been popped and placed in the closet in the morning. Whether this rare collection of food inspired him with song I know not, but I had not the heart to disturb his corn, hoping to hear from him again. Last night his song was renewed. I approached with a subdued light and with great caution, and had the pleasure of seeing him sitting among his corn and singing his beautiful solo. I observed him without interruption for ten minutes, not over four feet

* The Philadelphia Medical and Physical Journal, Vol. I, 1804. pp. 31–32.

from him. His song was not a *chirp*, but a continuous song of musical tone, a kind of *to-wit-to-wee-woo-woo-wee-woo*, quite varied in pitch."

The most extended and interesting account that I have seen of a singing *Hesperomys* is from the pen of the Rev. Samuel Lockwood. The subject of his sketch was caught in Florida by Philip Ryall, Esq., and was presented to Dr. Lockwood, who named it *Hespie*. Its vocal powers were extraordinary, and two of its most frequently repeated performances were termed respectively the *Wheel Song* and the *Grand Role*, and were expressed in musical notation by Mr. Ferris C. Lockwood. After describing her ordinary songs in great detail, Dr. Lockwood observes: "A remarkable fact in the above *role* is the scope of little Hespie's musical powers. Her soft, clear voice falls an octave with all the precision possible; then at the wind-up, it rises again into a very quick trill on C sharp and D.

"Though it be at the risk of taxing belief, yet I must in duty record one of Hespie's most remarkable performances. She was gamboling in the large compartment of her cage, in a mood indicating intense animal enjoyment, having woke from a long sleep, and partaken of some favorite food. She burst into a fulness of song very rich in its variety. While running and jumping, she rolled off what I have called her Grand Role, then sitting, she went over it again, ringing out the strangest diversity of changes, by an almost whimsical transposition of the bars; then without for an instant stopping the music, she leapt into the wheel, started it revolving at its highest speed, and went through the Wheel Song in exquisite style, giving several repetitions of it. After this she returned to the large compartment, took up again the Grand Role, and put into it some variations of execution which astonished me. One measure I remember was so silvery and soft, that I said to a lady who was listening, that a canary able to execute that would be worth a hundred dollars. I occasionally detected what I am utterly unable to explain, a literal dual sound, very like a boy whistling as he draws a stick along the pickets of a fence.

So the music went on, as I listened, watch in hand, until actually *nine minutes had elapsed.* Now the wonderful fact is that the rest between the roles was never much more than for a second of time; and during all this singing the muscles could be seen in vigorous action through the entire length of the abdomen. This feat would be impossible to a professional singer; and the nearest to it that I have seen was the singing of a wild mocking bird in a grove.

"For several days the wheel grated on its axle. This afforded Hespie great delight; and her own little warble was completely lost in the harsher sound. It was pretty much as it is with some of the modern methods of praise; as when the vocal is subordinated to the instrumental, a mere murmur of song, on which the organist comes down as with the sound of many waters. A drop of oil, and the sound of the friction stopped. This quite excited her temper; and she bit the wires of her wheel most viciously. A little device was hit upon which set her in good humor again. A strip of stout writing paper, a half inch wide, was pinned down in such a way that its clean cut upper edge pressed against the wires of the wheel, making with its revolution a pleasant, purring sound. It was on the principle, exactly, of the old-time watchman's rattle, and the old toy known as a cricket. This for a while greatly delighted the capricious creature, and she made the wheel almost fly; at the same time, in unison with the whirr of the wheel, was her own soft, cheery warble. It was very low, yet very distinct."

Another noteworthy peculiarity of Hespie's was that she sometimes ate and sang at the same time. On one occasion a slender twig of black alder, about an inch in length, was given her. "She was delighted, and at once began in her usual pretty way, sitting up, to eat the bark, although it was very bitter. Thus she sat 'bolt upright;' and the manner in which she held this little black stick in both hands up to her mouth, at the precise angle in which a fife is held, although nibbling away, yet singing at the same time, it

looked so like a little fifer playing on an ebony fife that laughter was irresistible." *

## EVOTOMYS RUTILUS GAPPERI (Vigors) Coues.

*Red-backed Mouse; Long-eared Wood Mouse.*

The Red-backed Mouse is abundant in all parts of the Adirondacks. It occurs on the summits of the tree-covered mountains as well as in the deepest valleys. It is essentially a *wood* species in its local distribution, rarely frequenting the beaver meadows or the fields of the farmer. It often enters the woodman's camp, and I have sometimes caught it even in the luxurious log-houses which have, during the past few years, supplanted the old-time shanties in many parts of the Adirondacks.

It feeds upon beechnuts and a variety of seeds, berries, and roots, and also, at certain times in the winter season, upon the bark of shrubs and trees. The beech, maple, ash, and bass suffer most severely from its attacks, and in the order named. The bark is generally removed in irregular areas from the large roots just above the ground; but sometimes saplings, and even trees a foot (305 mm.) or more in diameter are completely girdled to the height of three or four feet (approximately 915 to 1220 mm.). The damage thus done to our deciduous groves is sometimes great, but does not compare with the ravages committed by the field mouse (*Arvicola riparius*).

The Wood Mouse is terrestrial, like the other members of the *Arvicoline* series, and commonly lives in burrows in the ground. It sometimes makes regular runways similar to those of the field mouse, but usually travels freely over the surface, not confining itself to any prescribed course. It is both diurnal and nocturnal. I have shot it at noonday, scampering over the leaves in the deep woods, and dodging in and out between the rocks of a lake shore. I have also seen it after dark in shanties and log-houses; and have caught many

* American Naturalist, Vol. V, No. 12, Dec., 1871, pp. 765–767.

during the night in traps baited with beechnuts and meat. Its ordinary gait is a moderately fast trot; I have never seen it proceed in leaps. Still, it runs swiftly for a short distance and its quick movements render it difficult of capture.

The nest of the Red-backed Mouse is usually, in this region, placed in a burrow in the earth, though it is sometimes found in a half-decayed log, or under the roots of a stump. I have shot females, each containing four young, as early as the 3d of April, and as late as the 4th of October. I have also taken a female early in June that was nursing her second brood. Hence it is clear that several litters are produced in a season.

The flesh of the Red-backed Mouse is tender and well flavored.

## ARVICOLA RIPARIUS Ord.

*Meadow Mouse; Field Mouse.*

The Meadow Mouse is common in the cleared lands within and around the Adirondack region. It occurs on many of the beaver meadows, but is never abundant in the coniferous forests.

It feeds, in the main, upon the roots of grasses, though in winter it sometimes commits great havoc by gnawing the bark of trees. Rich meadows and pasture lands constitute its favorite haunts, and are apt to be cut up, in all directions, by its deeply-worn runways. It is strictly terrestrial, rarely mounting even the log or limb that may lie in its path, and is both nocturnal and diurnal.

It does not hibernate. In the beginning of winter, when the ground is frozen for some distance below the surface, it abandons its burrows and lives entirely above ground. Its nests of dry grass then lie flat upon the surface, without attempt at concealment, and are soon buried in the snow. As winter advances and the snow becomes deeper, the Meadow Mice regularly betake themselves to their nests for rest. The heat from their bodies soon melts the snow in contact with and immediately adjoining the nests, which, from the continued

operation of the same cause, come to be surrounded by slowly-growing dome-shaped chambers. These increase in size until the spring thaws, in March and April, melt away their roofs, thus admitting the light and cold. They are then deserted. During snow-shoe tramps over the fields at this season I have often noticed holes, from a few inches to a foot in diameter, appearing as if sharply cut in the surface. On inspection, they invariably proved to be the summits of these dome-shaped cavities, and a nest was always found at the bottom of each, surrounded by a zone of bare ground. They ranged from one to two feet (approximately 300 to 600 mm.) in diameter, and most of them were two feet in height. From the bottom of each chamber numerous runways and burrows penetrated the snow in all directions. Some followed along directly upon the ground, while others sloped upward at various angles. Many ran horizontally at varying levels, resting upon the dense strata that indicated the surface lines at different times during the winter. Near each nest was one or more burrows that reached the surface and contained considerable accumulations of the animal's dejections. These seemed to be watch holes where the Mice came regularly to look at the prospect outside.

Meadow Mice sometimes, but not often, travel upon the snow, and they occasionally stray so far that they are unable to find the holes through which they came up. If this happens when there is a hard crust, through which they cannot burrow, they wander aimlessly about for a while and finally perish from the cold. In March and April I have several times found them frozen to death upon the crust.

They are always present in greater or less numbers, but are not often sufficiently abundant to direct the attention of the farmer to their depredations. Occasionally, however, they multiply to such an alarming extent that the most superficial observer is impressed with the magnitude of their ravages. They devastate the meadows, grain-fields, and orchards of the farmer, and ruin the nurseries of the horticulturist. Whether these periodical invasions are the result of unchecked reproduction, or of migration, has not been positively

ascertained. Fortunately, they generally recur at long intervals. Arboreous vegetation suffers most during winters of deep snow, the snow enabling the Mice to reach the bark at a considerable height, and at the same time protecting them from the inclemencies of the weather. I have seen fruit trees, and also saplings of the maple and beech, more or less completely girdled to the height of four and even five feet (1.21 to 1.52 metres). During the winter of 1868 or 1869 thousands of young trees were destroyed in Lewis County alone.

In places where corn or grain is allowed to stand in shocks for any length of time, large losses are occasioned by the Mice. The amount of food consumed by a single individual is of course comparatively insignificant, but that required to sustain the total number inhabiting a given district is not to be ignored. And when it is borne in mind that the food of this species consists almost exclusively of the produce of the agriculturist, the fact becomes evident that the animal is a source of continuous pecuniary loss to the farmer. Omitting reference to the years when the species is present in excessive numbers, it is a low estimate to say that twenty-five Mice live upon every acre of meadow land. Hence the total number present upon an ordinarily productive farm of two hundred acres would not be less than five thousand. Now suppose that the owner of a farm of this size should capture and keep in confinement five thousand Meadow Mice, feeding them upon their natural food, grain and the roots of grass. Would it be strange if, in the course of a few months, he should become so alarmed at the cost in dollars and cents, of keeping such a host of these ravenous creatures that he should have them all put to death? And yet, our farmers not only look on in stolid indifference while their property and the fruits of their labors suffer, from this source, annual losses which they can ill afford to bear, but they even help the Mice to increase in numbers and maintain supremacy over their fields! This they do in several ways, chiefly by neglecting measures for the riddance of the Mice, and, what is of vastly more consequence, by encouraging the destruction of those birds and mammals that habitually

prey upon Mice. Pre-eminent among these may be mentioned the marsh and rough-legged hawks, all the smaller hawks and owls, the shrike, the skunk, and the weasels. Thus the farmer in his short-sightedness omits no opportunity to deprive himself of nature's means of holding in check the vermin that ruin his crops.

When a field is overrun by Meadow Mice, immense numbers of them may be captured in narrow trenches, a spade's breadth in width, and a foot and a half (457 mm.) in depth. The trenches should be a trifle wider at the bottom than at the top. Into these the Mice tumble, without being able to escape.

The Meadow Mouse is exceedingly prolific, giving birth to from four to eight young at a time, and having several litters in a season. In early spring its nests are generally made just beneath the surface, but after the grass has attained a little height they are usually placed in slight depressions directly on the ground.

## FIBER ZIBETHICUS (Linn.) Cuvier.

*Muskrat; Musquash.*

Colonies of Muskrats may be found at suitable ponds, swamps, and sluggish streams in all parts of the Adirondacks.

These animals are in the main herbivorous, subsisting chiefly upon the roots of marsh grasses and aquatic plants. Still, they occasionally prey upon fish, and sometimes manifest evidences of cannibalism, devouring those of their own kind that are found dead or wounded and unable to escape. They are extremely fond of the fresh-water mussels (*Unio* and *Anodon*) and large quantities of empty shells may often be found near their homes.

Although the Muskrat and the beaver are the most strictly aquatic of all our mammals, the former not infrequently, in autumn, visits orchards in the neighborhood of water-courses to feed upon the apples that have fallen to the ground; and I have known it to follow up drains and enter the cellars of inhabited houses, and to attack the

potatoes, carrots, turnips, parsnips, and other vegetables stored there. Not many years ago an aged couple lived alone in an old house in the town of Leyden, in Lewis County. They were at one time very much annoyed by curious sounds that were heard every night, and sometimes by day as well, and which seemed to come from beneath the floor near the open fire-place. Having determined at length to investigate the source of these mysterious noises, the aged pair commenced by removing some of the hearth bricks that covered the very spot whence the sound usually came. Imagine their astonishment to find here two full-grown living Muskrats! The luckless beasts were lifted out with the old iron tongs and slain upon the spot.

The Muskrat, though chiefly nocturnal, is frequently seen swimming and feeding about the borders of ponds and streams in the day-time, particularly in cloudy weather. And when resting on the edge of a bog it so resembles a lump of mud as to escape the notice of those unacquainted with its habits. The distance that it can swim under water without coming to the surface to breathe is remarkable.

Its homes are of two principal kinds: huts and burrows. The latter are always present and may be inhabited at all times of the year, while the huts are for winter use and are confined to certain more or less restricted localities.

The burrows are excavated in the shores of the water-courses which the animals inhabit. The entrance is under water, the burrow thence sloping upward into the bank a distance of ten or fifteen feet (3 to 4½ metres) to an air-chamber eighteen inches (about half a metre) or more in diameter, which often contains a nest. There may be several passages leading to this nest, all of which are under water the greater part of the year. The roof of the air-chamber is generally so near the surface of the ground that it frequently falls in, particularly in pastures where cattle abound. Leading away from it, one or more galleries commonly extend back a considerable distance, keeping so near the surface that their occasional "caving in" may result in extensive damage to the fields of the farmer. When the animal

takes up its abode near dykes or dams, its perforations are liable to do great mischief.

In moving about on their feeding grounds Muskrats are in the habit of travelling along the same paths till they become deeply worn channels. Steel traps properly concealed in these runways are almost certain to capture the first animal that passes.

In places where the water is from two to six feet deep the Muskrat, in the fall of the year, sometimes collects and heaps together a large quantity of aquatic and marsh plants, the resulting mass taking a shape not unlike that of a "haycock," though commonly far less symmetrical. This accumulation of vegetation, with more or less adhering mud,* is called a Muskrat "hut" or "house." It varies greatly in size, those placed in water occasionally attaining extraordinary dimensions. The summit of the structure is commonly high enough out of water to admit of an air-chamber within, which communicates with the outside world by means of a hole through the centre of the mass, the entrance or entrances being under water. Many of the houses contain no mud or sticks, but consist wholly of balls and knots of roots and swamp grasses. It seems clear that the animals make no attempt to construct a dwelling of any particular shape, but merely heap the materials together without plan or order, the resulting mound naturally assuming, in a general way, the form of a flattened cone. In some cases the summit is quite dome-shaped, but I am convinced that this is purely the result of accident, for their upper parts are usually very irregular. The materials of which the hut is composed, it will be observed, are such as serve as food for the animals during the long winters; hence the Muskrat's house is, in reality, a store-house, which he devours piecemeal as the winter advances! The one structure supplies both the food itself, and the

* I have never seen a Muskrat house that was built of mud, or that even consisted largely of this material; but they must occur in certain localities, for no less trustworthy an authority than Sir John Richardson wrote: "In the autumn, before the shallow lakes and swamps freeze over, the Musquash builds its house of mud, giving it a conical form, and a sufficient base to raise the chamber above the level of the water." (Fauna Boreali Americana, Vol. I, 1829, p. 117.)

shelter in which it is eaten. It is quite a conspicuous object, the summit projecting above the water or ice, and is therefore most commonly found in places that are a little out of the beaten paths of man. During the fall and winter, Muskrats speedily repair injuries done to their houses. This habit is put to advantage by the trapper, who, chopping a hole in the side of the hut and placing a trap in the breach, often secures the entire family in the course of a few days. The above remarks apply to the highest type of Muskrat architecture. There are many less perfect, and at the same time less conspicuous forms of these store-houses, that are to be met with in almost every locality where the species exists in any numbers. Along the borders of ponds and sluggish streams there often stand old hollow stumps whose roots extend out under the water. Such stumps will frequently be found, as cold weather approaches, stuffed full of the wads of grass that are used in hut building, the angles and crevices between the roots being packed with the same material. Advantage is also taken of other inconspicuous places in which to deposit food, and sometimes, where there is no current, floating hoards of grass and roots are established—veritable floating islands in miniature—in the vicinity of their huts. When the ice is not too thick they generally keep open a few breathing holes at certain favorite feeding grounds in very shallow water, frequently covering them over with grass.

My observation that the Muskrat, in the North, habitually lays up provisions for winter's use does not accord with the statements of others, the only allusion to such a habit that I have seen being contained in the following very interesting narrative from Audubon and Bachman (who, by the way, evidently considered it as exceptional):—

"An acquaintance who had a garden in the neighborhood of a meadow which contained a large number of Musk-Rats, sent one day, to enquire whether we could aid in discovering the robbers who carried off almost every night a quantity of turnips. We were surprised to find on examining the premises, that the garden had been plundered and nearly ruined by these Rats. There were paths ex-

tending from the muddy banks of the stream, winding among the rank weeds and grasses, passing through the old worm fence, and leading to the various beds of vegetables. Many of the turnips had disappeared on the previous night—the duck-like tracks of the Musk-Rat were seen on the beds in every direction. The paths were strewn with turnip leaves, which either had dropped, or were bitten off, to render the transportation more convenient. Their paths after entering the meadow diverged to several burrows, all of which gave evidence that their tenants had been on a foraging expedition on the previous night. The most convenient burrow was opened, and we discovered in the nest so many different articles of food, that we were for some time under an impression, that like the chipping squirrel, chickaree, &c., this species laid up in autumn a store of food for winter use. There were carrots, and parsnips, which appeared to have been cut in halves, the lower part of the root having been left in the ground; but what struck us as most singular, was that ears of corn (maize) not yet quite ripe, had been dragged into the burrow, with a considerable portion of the stock attached." *

As has already been remarked, the Muskrat is exceedingly fond of our common fresh-water mussels, and it is usual to find large numbers of their empty but unbroken shells strewn along the shore or in shallow water covering the mud or sand bottoms where it abounds. Instead of devouring the mussels where he finds them, the Musk-rat often carries them to particular spots, where large accumulations of their shells may be found.

In the course of their remarks upon the habits of this species, Audubon and Bachman relate an experience that is as interesting and remarkable as it seems to be unique: "It is a well-known fact that many species of quadrupeds and birds, are endowed by Nature with the faculty of foreseeing or foreknowing, the changes of the seasons, and have premonitions of the coming storm. . . . After an unusual drought, succeeded by a warm Indian-summer, as we were one day

* Quadrupeds of North America, Vol. I, 1846, pp. 118–119.

passing near a mill-pond, inhabited by some families of Musk-Rats, we observed numbers of them swimming about in every direction, carrying mouthfuls of withered grasses, and building their huts higher on the land than any we had seen before. We had scarcely ever observed them in this locality in the middle of the day, and then only for a moment as they swam from one side of the pond to the other; but now they seemed bent on preparing for some approaching event, and the successive reports of several guns fired by some hunters, only produced a pause in their operations for five or ten minutes. Although the day was bright and fair, on that very night there fell torrents of rain succeeded by an unusual freshet, and intensely cold weather." *

Spearing the Muskrat in their huts, in the early winter, is an exciting and sometimes profitable occupation. The best account of this mode of hunting which I have seen is from the pen of Henry Thacker, who thus graphically describes his excursions to a large marsh in the vicinity of Chicago in the winter of 1844–45 :—

" With feelings of interest and excitement, I marched up to a large house very cautiously (for, with the least jar or crack of the ice, away goes your game), and, with uplifted spear, made ready for a thrust. I hesitated. There was a difficulty I had not taken into account; I knew not where to strike. The chances of missing the game were apparent, but there was no time to be lost; so bang! went the spear into a hard, frozen mass, penetrating it not more than three or four inches, and away went the game in every direction. With feelings of some chagrin I withdrew my spear, and began feeling about for a more vulnerable spot, which I was not long in detecting. It being a cold, freezing day, I discovered an accumulation of white frost on a certain spot of the house, and putting my spear on the place I found it readily entered. The mystery was solved at once; this frost on the outside of the house was caused by the breath and heat of the animals immediately beneath it, and it was generally

* Quadrupeds of North America, Vol. I, 1846, pp. 122–123.

on the southeast side of the centre of the house, this being the warmest side. Acting on these discoveries, I made another trial, and was successful ; and now the sport began in good earnest. Whenever I made a thrust, I would cut a hole through the wall of the house with my hatchet, and take out the game, close up the hole, and start for another house. The remaining members of the family would soon return, and immediately set about repairing the breach. I sometimes succeeded in pinning two rats at one thrust. I also became quite expert in taking the game in another way, as follows : Whenever I made an unsuccessful thrust into a house, the rats would dive into the water through their paths or run-ways, and disappear in all directions. I now found I could easily drive my one tined spear through the ice two inches thick, and pin a rat with considerable certainty, which very much increased the sport, and I was not long in securing a pile of fifteen or twenty rats.

" Here I made a discovery of what, until now, had been a mystery to me, namely, how a muskrat managed to remain so long a time in the water under the ice without drowning. The muskrat, I perceived, on leaving his house inhaled a full breath, and would then stay under water as long as he could without breathing ; when he would rise up with his nose against the ice, and breathe out his breath, which seemed to displace the water, forming a bubble. I could distinctly see him breathe his bubble in and out several times, and then dive again. In this way I have chased them about under the ice for some time before capturing them. . . .

" As I frequently speared the muskrat on his feeding-bed, and subsequently found it to be the best and surest place to set a trap for him, I will, for the benefit of the novice, undertake to describe one as found in the marshes. A feeding-bed is a place where the muskrat goes to feed, generally at night, and is frequently many rods from his house. Here he selects a place where his food is convenient, and by the aid of the refuse material of the roots, &c., which he carries here for food, he elevates himself partly out of water, in a sort

of hut. Here he sits and eats his food, and at the slightest noise, or least appearance of danger, disappears in an instant under water. In the winter these feeding-places are readily discovered by a bunch of wadded grass, flag, or some other material, about the size of a man's hat, protruding above the ice This little mound is hollow, and is only large enough for a single rat, where he sits and eats his food, with his lower parts in the water. When the rats were disturbed in their house, I found they generally fled to these feeding-huts, where they were almost a certain mark for the spearman. . . .

"In my next excursion, not many days after, to the same place, I had still better success. As the ice had now become too thick to be easily penetrated by my spear, I adopted, in part, a different mode of taking the game. This time I carried with me, in addition to my spear, two dozen steel-traps, and a bundle of willow sticks (cut on the way) about three feet long. On arriving at the hunting grounds I prepared myself for the day's sport by putting on my mufflers, and with traps and willow sticks slung upon my back, began the work by driving my spear into the first house I came to. I could not now see the rats as they fled from the house, on account of the thickness of the ice and a slight snow that lay upon it. Consequently the sport of spearing them through the ice was cut off. But as often as I had occasion to cut through the walls of the house to take out my game, I set a steel-trap in the nest, slipped a willow stick through the ring of the chain, laid it across the hole, slightly stopped it up, and then passed on to the next house; and so on, until my traps were all gone. I then started back to the place of beginning, driving my spear into every feeding-hut in my course, and killing many rats. Finally, I began going over the ground again, first driving my spear into a house, then examining the trap, taking out the game and re-setting the trap. In this course I was quite successful. I found by setting the trap in the right place, near the edge, and a little under the water, I was almost certain to take the first rat that returned. In making two or three rounds in this way, I found the rats became somewhat

disturbed, and sought temporary shelter elsewhere; when I would move to a new place, giving them time to recover from their fright." *

That the Muskrat was at one time a very important article of commerce is evident from the fact that Dr. Richardson, in writing of it in 1829, stated: "Between four and five hundred thousand skins are annually imported into Great Britain from North America." † And even at the present day several thousand are killed each year in the United States alone. It is probable that no other North American mammal is so extensively trapped by the rural small boy. This is due to the great abundance of the species, even in populous districts, and the ease with which it is trapped, rather than to its value, for Muskrat pelts have always ranked among the cheaper furs, a single skin rarely fetching more than fifteen or twenty cents.

The Muskrat is a very prolific animal. It brings forth from five to nine young at a birth, and is said to raise three litters in a season. The nest is usually placed in a hole in the bank, at some little distance from the water, though it is sometimes built in the hut. Robert Kennicott, in his very valuable paper upon The Quadrupeds of Illinois, says: "Though the young are generally brought forth in burrows, they were often found in the houses in the sloughs, only one female, however, remaining in a house." ‡ Mr. Thomas S. Roberts thus describes a litter of young that he found near Minneapolis, Minnesota, May 24th, 1880: "Upon knocking the top off from a Muskrat house on the edge of a slough, nine young Muskrats apparently but a day or two old were disclosed. They were hairless and showed not the least sign of their eyes opening. The nest was of dry grass and not more than an inch or two above the level of the water." §

The noise a Muskrat makes in diving is out of all proportion to its

* The Trapper's Guide. By S. Newhouse. Published by Oneida Community, Wallingford, Conn., 1867, pp. 147–150.

† Fauna Boreali Americana, Vol. I, 1829, p. 118.

‡ Report of the Commissioner of Patents for the year 1856. Agriculture, 1857, p. 108.

§ Forest and Stream, Vol. XIV, No. 22, July 1, 1880, pp. 428–429.

size, and many a drowsy hunter, while floating for deer, has been startled by its sudden plunge. A loud report is made by striking the flat tail against the water.

Dr. Richardson, writing in 1829, said that in the Fur Countries they were "subject at uncertain intervals to a great mortality from some unknown cause. Their great fecundity, however, enables them to recover these losses in a very few years, although the deaths at times are so numerous, that a fur-post, where the Musquash is the principal return, is not unfrequently abandoned until they have recruited." * Among the foes of the Muskrat may be mentioned the fox and mink, and the larger hawks and owls; the mink and the great-horned owl being its greatest enemies.

The flesh of the Muskrat is red and rather flabby; still it is fair eating for a time when other meat is unattainable. Thomas Pennant, whose notions of the causes of things were sometimes strangely sophistical, mentions that the Muskrat feeds upon the sweet flag, and then goes on to say: "This perhaps gives them that strong musky smell these animals are so remarkable for; which they lose during winter, probably when this species of plant is not to be got." †

Many distinguished naturalists, whose works are still regarded standard, give meagre and very erroneous accounts of the habits of the animals they describe. It is stated in the third volume of Griffith's Cuvier, published in 1827, that Muskrats "construct in winter, on the ice, a hut of clay, where they inhabit in great numbers, proceeding through a hole, to seek at the bottom the roots *acorus*, on which they subsist. When the ice closes their holes, they are reduced to feed upon each other" (p. 67). It is hardly necessary to add that the above is fallacious in almost every particular.

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* Fauna Boreali Americana, Vol. I, 1829, p. 117.

† Arctic Zoology, Vol. I, 1792, p. 123.

*The Muskrat as a Fish-eater.*

That the Muskrat is not commonly considered a fish-eater is evident from the absence of reference to such habit in the published accounts of the animal. Robert Kennicott and Gov. DeWitt Clinton are, so far as I have been able to ascertain, the only authors who mention this trait. Kennicott says: "Excepting in eating mollusks, and occasionally a dead fish, I am not aware that this species departs from a vegetable diet." *

Gov. Clinton, writing in 1820 of the then newly built Erie Canal, in New York, said: "In winter, when the water is frozen, muskrats go under the ice and prey on the fish. They are very destructive to trout, which is already in the canal." †

At a meeting of the Biological Society of Washington, held in the National Museum, December 14th, 1883, Mr. Henry W. Elliott spoke of the "*Appetite of the Muskrat.*" He stated that in certain parts of Ohio the Muskrat did great injury to Carp ponds, not only by perforating the banks and dams and thus letting off the water, but also by actually capturing and devouring the Carp, which is a sluggish fish, often remaining motionless, half buried in the mud. In the discussion that followed, Dr. Mason Graham Ellzey said that from boyhood he had been familiar with the fact that the Muskrat sometimes ate fish. In fact, he had seen Muskrats in the act of devouring fish that had recently been caught and left upon the bank. The President, Dr. Charles A. White, narrated a similar experience.

On the 7th of February, 1884, I brought this subject to the notice of the Linnæan Society of New York, and asked if any of the members knew the Muskrat to be a fish-eater. Dr. Edgar A. Mearns said that he had long been familiar with the fact, and that it was no uncommon thing to see a Muskrat munching a dead fish upon the borders of the salt marshes along the Hudson. He had shot them

* Quadrupeds of Illinois Injurious and Beneficial to the Farmer, 1857, p. 106.

† Letters on the Natural History and Internal Resources of the State of New York. By Hibernicus, 1822, p. 46.

while so engaged. He further stated that the Muskrat is very destructive to nets, destroying the fishermen's fykes by scores, by entering them in quest of fishes and then tearing the nets in order to escape.

Dr. A. K. Fisher said that at Sing Sing, New York, he had often known Muskrats to enter fykes, sometimes drowning, but oftener escaping by gnawing the meshes, thus doing considerable injury to the nets. He supposed they entered the nets because placed in their line of travel. He further stated that he knew that fykes made of fine wire were used with success in capturing these animals.

Mr. Wm. H. Dall, the well-known Alaskan explorer, now of the Coast Survey, in response to inquiry has kindly favored me with the following: "In 1863, I visited Kankakee, Illinois, on a collecting tour for river mollusks, in July. You know how the Muskrats throw up mounds of the shells they dig out. I examined many of these for *Unios*, etc. On several I saw the skeletons of fish (chiefly suckers I believe) partly or wholly denuded of their flesh, and showing the marks of Muskrat (or at least rodent) teeth. I also saw the shell of a common mud turtle, so gnawed and in the same situation. I did not see the animal in the act of feasting, which I believe is chiefly done at night, but I have no doubt that the fish and turtle were eaten by the Muskrat, as well as the mollusks associated with them in the same pile."

Under date of March 5th, 1884, I have received from Dr. Fisher, the most valuable record yet obtained concerning the habit in question. Dr. Fisher writes: "A few days since, two young men were fishing through the ice for pickerel, with live bait, at Croton Lake, Westchester County, N. Y. Several times they were troubled by having one of the lines pulled violently off the bush and run out to its full length. Finally they saw the line start again, and by pulling it up quickly they landed a large Muskrat on the ice." Here is an authentic instance where a Muskrat has actually captured a live fish

in the water. Fortunately, the fish was attached to a hook and line, and the Muskrat was caught and killed.

The above facts, which were published in *Forest and Stream* of March 27th and April 3d, 1884, fell under the eye of Mr. E W. Nelson, late Signal Observer at St. Michæls, Alaska, and elicited from him the following additional testimony: "The Muskrat is the most abundant mammal to be found in all the marshy parts of Alaska, south of the Arctic circle at least, and during my residence in that country I had frequent opportunity to learn of its fondness for fish. Often when skirting the border of a pool or following the edge of some sluggish stream in the evening or during the dim light of the Arctic nights in summer, I frightened the Muskrats from the body of dead fish on the bank at the water's edge. The fish were usually small sluggish species and such as could have been easily caught by the animal itself, although it feeds upon fish not killed by itself. That the Muskrat will feed upon dead water fowl I have also had frequent occasion to notice." *

Mr. Charles F. Carr writes me that in Wolf River, Wisconsin, twelve or fifteen years ago, Muskrats were in the habit of eating fish from a gill net set there by a man named Rich.

### *Ferocious Tendencies of the Muskrat.*

Under the above heading Mr. W. H. Ballou, in the *American Naturalist* for July, 1880, narrates the following very unusual experience: "I was sauntering along a prairie road just out of Boone, Iowa, one night during the past winter. There was no snow on the ground and the moon was just glimmering through the clouds. Of a sudden I was startled by the appearance of some animal from the long grass by the wayside, which dashed up my leg. I knocked it off, picked up a frozen piece of mud and broke its leg. Again it made a rush for me, and another piece of mud sent it rolling over.

* Forest and Stream, Vol. XXII, No. 15, May 8, 1884, p. 285.

I took hold of its tail during this little scene, and ended the matter by giving its head a severe bump on the ground. When I had access to more light I found that it was a full-grown Muskrat of enormous size. I can neither account for its attack nor appearance there. The previous summer season had dried up all the sloughs and there was no water in the vicinity. The houses of these animals had been deserted for some time previous, and nowhere on the prairies had I been able to find one with any inhabitants (they build in the sloughs of western prairies extensively). Alone and well away from its most natural element it had attacked me without provocation. The matter led to an inquiry among the farmers. The general statement was to the effect that considerable fun and some trouble was had with this species during each hay time, as they did not hesitate, when out of the water, to ferociously attack man or beast, with seldom any damage. One man related, however, that he received a severe bite in the hand from one of them, which laid him up for some time. It is either very courageous or very luny." *

The most remarkable foray of this kind which has come to my knowledge occurred in the city of Charlotte, North Carolina, during the evening of March 17th, 1884. It is thus recorded in the *Charlotte Observer* of March 18th: "Charlie Fox's adventure with a pack of Muskrats on Trade street one night about a year ago, was brought vividly to mind last night when several runners came into the Observer office bringing tidings of three sanguinary battles fought between citizens who had encountered bodies of the savage *Musquash* in the streets. It appears that all these fights occurred at 8 o'clock. Mr. John Davidson was going home about that hour when he was encountered at the corner of Tyron and Fifth streets, by a large and ferocious rat, which he finally killed with a stick. He sent his fallen foe to the *Observer* office for inspection. It was almost as large as a 'possum. When this fight was going on there was a lively scene on Trade street, opposite the mint, where the Muskrats fairly swarmed.

* The American Naturalist, July, 1880, Vol. XIV, No. 7, p. 524.

Mr. Martin McRae, a clerk of T. L. Seigle & Co, was set upon by seven of the 'varmints' and was put to flight, not having any weapons with which to defend himself. Shortly afterwards, Larkin Saddler, the *Observer's* janitor, passed by and about twenty of the rats began biting at his legs. Larkin kicked about for dear life and finally got one rat under his foot and crushed it to death. Their sharp teeth began perforating his hide, and jumping over the fence he fled across the mint yard and got away from them. John Smith, colored, an employee of the Air Line road, came along next, and seeing the curious pack that beset his ankles, uttered a terrific yell and fled at the top of his speed. Wm. Norman, a colored employee of Duls & Co., was the next victim. He had a stick and giving the Muskrats battle killed one of their number and put the others to flight.

"This is the second annual appearance of these savage pests upon our streets. Where do they come from and who can account for their appearance in our city in such numbers? One theory is that they come from Irwin's creek, making their way up the cemetery branch to the flats below the First Presbyterian church and thence to the streets of the city. It is very nearly opposite the mint that Charlie Fox was attacked by the rats last year."

Mr. Ernest E. T. Seton, of Manitoba, writes me that, September 13th, 1883, near Carberry, he found a Muskrat in a field of standing wheat a mile and a half from water. The animal showed fight and was captured alive. Mr. Seton writes further: "While travelling on the Rapid City trail in Manitoba, October 2d, 1883, the oxen suddenly shied and turned off the road. Then I saw just ahead what proved to be a Muskrat! It was in a threatening attitude and sprang toward the nose of one of the cattle. On running to it, it seized my trousers in its teeth and held on. When kicked off it did not attempt to escape, but fought until killed. It was a male."

Family ZAPODIDÆ.

## ZAPUS HUDSONIUS (Zimm.) Coues.

*Jumping Mouse; Labrador Mouse.*

The Jumping Mouse is common in many parts of the Adirondacks, as well as in the surrounding country. It feeds upon beechnuts, and various seeds and berries.

Within the Wilderness it is most often observed in the tangled borders of low shrubs that surround the lakes and beaver meadows; while beyond the confines of the region it inhabits both the clearings and woodlands. It delights in grain fields, and in meadows of tall waving grass, where it finds abundant food and can readily escape its most active enemies. But when the time for haying and harvesting arrives, the Mice are suddenly deprived of their accustomed shelter and many seek protection beneath the haycocks and stacks of grain. By quickly overturning these, they are confused and frightened and may be captured with comparative ease.

When stationed to watch for deer, on the borders of our Adirondack lakes, I have often remained in one place during the greater part of the day. Seated, sometimes on a log that crossed a narrow belt of marsh along the shore, sometimes on the mossy slope of a well-wooded knoll hard by, and hidden by the dense frontage of undershrubs, or by the more open shelter of a slender tamarack, I have learned much that fills these pages. Encroaching upon the very water's edge is a net-work of wiry bushes, repelling the canoe that attempts to land. It consists chiefly of the leather leaf (*Cassandra calyculata*) and sweet gale (*Myrica gale*), with smaller quantities of the wild rosemary (*Andromeda polifolia*), meadow sweet (*Spiræa salicifolia*), and swamp laurel (*Kalmia glauca*). Adjoining this is a strip of sphagnous bog which supports a luxuriant growth of the curious pitcher plant, interspersed with straggling cranberries. Careful search may reveal the insect-eating *Drosera*, as well as several rare species of orchids. Where the

sloping hill-side meets the marsh, another miniature thicket bars the way. Like the first, it is largely made up of the tough *Cassandra*, which here intertwines with Labrador tea (*Ledum latifolium*), sheep laurel (*Kalmia angustifolia*), and winterberry (*Ilex lævigata*). The beautiful *Azalea* and the woolly steeple bush (*Spiræa tomentosa*) are also usually present, while several species of *Viburnum* and *Cornus* contribute their share to the prominent features of the local flora.

While silently seated in the midst of these surroundings, I have on more than one occasion observed the Jumping Mouse. Sometimes he has crept quietly over the bog, winding his way amongst the pitcher plants and low clumps of matted bushes, presenting much the appearance of the white-footed mouse. At other times he has bounded lightly by, clearing the tops of the bushes with every leap, and disappearing so quickly that his identity was with difficulty determined. Indeed, when he hides after the first or second leap he is not rarely mistaken for the wood frog (*Rana temporaria sylvatica*), which he resembles in color.

The agility of these animals is almost incredible. I have repeatedly known them to clear a distance of more than ten feet (a trifle over 3 metres) at a single bound, and their leaps are made in such rapid succession that their feet seem barely to touch the ground. To attempt to catch one when any covert is near is a hopeless task.

The Jumping Mouse is said, by most writers, to be strictly nocturnal, but this is not the case. It is crepuscular, like the majority of our mammalia, and is also not infrequently seen abroad by day.

It nests in a variety of situations: sometimes in hollow stumps and trees, which it is said to climb from the inside; more often under logs and rails, and in piles of rubbish; frequently in crevices of rocky ledges; and occasionally in open fields, a short distance under the surface.

Since the foregoing was written, Mr. Elisha Slade, of Somerset, Bristol County, Massachusetts, has favored me with a very interesting and detailed account of the habits of this species, portions of which are here reproduced. Mr. Slade says: "The Long-tailed Jumping Mouse inhabits high land or low land, forest or pasture, cultivated field or swamp, and appears to be equally at home in either, and not numerous in any situation. It possesses a momentary agility second to no other Rodent, and a muscular strength of enormous power for so small a creature. When suddenly disturbed it often moves away in a direct line, the first three or four leaps being eight or ten feet in length; but these distances rapidly decline to about four feet, which are continued until it considers itself out of danger. This is not always the case, however, for it frequently takes an irregular course and jumps at diverse angles for several successive leaps, keeping the same general direction or changing at will. It can double, and quickly too, if pursued, and by its manœuvers and instantaneous squattings can, and often does, elude a hawk or an owl; and its spontaneous irregularities enable it to escape being brained by a weasel, or swallowed whole by the common black snake. . . . It feeds upon the buds, leaves, and twigs, of many kinds of plants; upon seeds, grain, wild berries, chestnuts, acorns, grass, and to some extent upon the bark of shrubs. . . . As a rule, three litters are produced in a season, each consisting of from two to four young."

Barton, writing of this species in 1795, says: "Upon showing my drawing of the animal to an intelligent Indian who is settled at Oneida, he assured me that the same animal is very common at that place. This Indian, who is a Mohegan, moreover said, that in his language this Dipus is called *Wauh peh Sous*, which signifies *the creature that jumps or skips like a deer*." He also says: "It often gets into the graneries of the Indians settled at Oneida, in the State of New York, and proves very destructive to the Indian-corn. . . . I have not learned, with certainty, at what time

this animal brings forth its young. But it has been seen leaping about with the young ones strongly attached to its teats. Four young ones have been seen thus attached."

Dr. DeKay says that Mr. Jesse Booth, of Orange County, New York, writes him: "In cross-plowing some years since, my attention was taken up by seeing some small thing move off from near my plough, at about the moderate walk of a man. It went over ridges and descended the hollows of the furrows, bearing some resemblance to an old withered oak leaf. I pursued it, when it proved to be one of these *wood-mice*, or *jumping mice;* a female, with four young ones attached by their mouths to its teats." *

*The Hibernation of the Jumping Mouse.*

Dr. Benjamin Smith Barton, of Philadelphia, was the first to make known the fact that the Jumping Mouse hibernates. On the 2d of October, 1795, he read a paper before the American Philosophical Society (which was not published, however, till 1799) in which he states: "In the month of February, one of these animals was found, seemingly in a torpid-state, under a stone, in opening a quarry." He further says, that a farmer, living near Philadelphia, has often discovered them, "at the depth of eighteen inches or two feet under ground, when he has been digging for the roots of horse-radish and parsley, in the winter-time." † In a supplement to this article, published in 1804, the same author observes:—

"In the month of August, 1796, one of these little animals was brought to me from the vicinity of this city. It was put into a large glass jar, where I was so fortunate as to preserve it for near four months. Though it made many efforts to escape from its

* Zoology of New York, Part I, 1842, p. 72.

† Some account of an American Species of Dipus, or Jerboa. By Benjamin Smith Barton, M. D. Transactions of the American Philosophical Society, Vol. IV, No. XII, 1799, p. 122. Barton again refers to the hibernation of this species in his Fragments of the Natural History of Pennsylvania, 1799, pp. xii, xiii.

confinement, it seemed, upon the whole, pretty well reconciled to it. It continued active, and both ate and drank abundantly. I fed it upon bread, the grain of Indian corn (Zea Mays), and the berries of the Prinos verticillatus, sometimes called black-alder.

"On or about the 22d of November, it passed into the torpid state. It is curious to observe, that at the time it became torpid, the weather was unusually mild for the season of the year, and moreover the animal was kept in a warm room, in which there was a large fire the greater part of the day and night. I sometimes roused it from its torpid state; at other times it came spontaneously out of it. During the intervals of its waking, it both ate and drank. It was frequently most active, while the weather was extremely cold in December; but when I placed the jar upon a thick cake of ice, in the open air, its movements or activity seemed wholly directed to the making of a comfortable habitation out of the hay with which I supplied it. It was sufficiently evident, however, that the cold was not the only cause of its torpid state. It was finally killed by the application of too great a degree of heat to it, whilst in its torpor.

"During its torpor, it commonly laid with its head between its hind legs, with the claws or feet of these closely applied to the head. Its respiration could always be perceived, but was very slow.

"The fact of the torpidity of this little animal is known to the gardeners and others near the city. They call it the 'seven sleepers,' and assert, that it is frequently found in the earth, at the lower extremity of the horse-radish, and other perpendicular roots. Does it use these as a measure of the distance to which it shall go in the earth, to avoid the influence of the frost?

"I have said, that the Dipus Americanus becomes torpid in the neighborhood of this city. But this, I believe, is not always the case. During the winter-season, this little animal and another species, which I call Dipus mellivorus, take possession of the

hives of bees, in which they form for themselves, a warm and comfortable habitation, having ingeniously scooped away some wax. The materials of its nest are fine dry grass, down of feathers, and old rags. It lives upon the honey, and seems to grow very fat upon it. I believe two individuals, a male and a female, commonly inhabit one hive. They sometimes devour the greater part of the honey of a hive.

"The circumstance just mentioned is not altogether uninteresting. It plainly proves what I have, long since, asserted, that the torpid state of animals is altogether 'an accidental circumstance,' and by no means constitutes a specific character. The same species becomes torpid in one country and not in another. Nay, different individuals of the same species become torpid, or continue awake, in the same neighborhood, and even on the same farm." *

On the 6th of June, 1797, Major-General Thomas Davies presented, before the Linnæan Society of London, "An account of the Jumping Mouse of Canada," which he supposed to be an undescribed species. This account was published in the Linnæan Transactions for 1798. Hence, though not read till more than a year and a half after Dr. Barton had presented his paper before the American Philosophical Society, it appeared in print before the publication of the latter.

General Davies gives a figure of the animal in the dormant state, observing that the specimen "was found by some workmen, in digging the foundation for a summer house, in a gentleman's garden about two miles from Quebec, in the latter end of May, 1787. It was discovered enclosed in a ball of clay, about the size of a cricket ball, nearly an inch in thickness, perfectly smooth within, and about twenty inches under ground. The man who first discovered it, not knowing what it was, struck the ball with his spade, by which means it was broken to pieces, or the ball also would have been presented to me. The drawing will perfectly

* Transactions of the American Philosophical Society, Vol. VI, 1804, pp. 143–144.

show, how the animal is laid during its dormant state. How long it had been under ground, it is impossible to say; but as I never could observe these animals in any part of the country after the beginning of September, I conceive they lay themselves up some time in that month, or beginning of October, when the frost becomes sharp; nor did I ever see them again before the last week in May, or beginning of June. From their being enveloped in balls of clay, without any appearance of food, I conceive they sleep during the Winter, and remain for that term without sustenance."

In the third volume of Griffith's Cuvier, published in 1827, it is stated: "One single species, the *Gerbillus* of Canada, has been found in a state of hibernation" (p. 154). And again: "In the winter it retires and falls asleep, rolled up like a ball, in a burrow about twenty inches deep. It places itself then in a sort of little chamber, of an oval form, and never stirs until the middle of spring. No provision is found in this retreat, nor is it exactly known on what substances it feeds" (p. 159).

Godman says: "At the commencement of cool weather, or about the time the frost sets in, the jumping mice go into their winter quarters, where they remain in a torpid state until the last of May or first of June." * Zadock Thompson also tells us that "they pass the winter in a torpid state and are not usually out in the spring before June." †

Is it not surprising, in the face of the evidence above narrated, ‡ that Audubon and Bachman should have given utterance to the following: "It is generally believed, that the Jumping Mouse, like the Hampster of Europe, (*Cricetus vulgaris*), and the Marmots, (*Arctomys*), hibernates, and passes the winter in a profound lethar-

* American Natural History, Vol. I, 1842, p. 322.

† Natural and Civil History of Vermont, 1842, p. 44.

‡ The statement in Griffith's Cuvier was unquestionably based upon General Davies' article, and it is probable that both Godman and Thompson derived their information from the same source. But even in this case there remain the two original, independent, and almost simultaneous accounts (those of Barton and Davies), the trustworthiness of which cannot be called in question.

gy. Although we made some efforts many years ago, to place this matter beyond a doubt by personal observation, we regret that our residence, being in a region where this species does not exist, no favorable opportunity has since been afforded us. Naturalists residing in the Northern and Middle States could easily solve the whole matter, by preserving the animal in confinement through the winter." *

If, in Audubon's time, there were grounds for questioning that this species hibernates, there are none at present. Robert Kennicott, in his valuable contribution to economic agriculture, states: "Dr. Hoy informs me that, when he was a boy in digging out a rabbit in winter, he found a pair of this species in a state of profound torpor, exhibiting all the phenomena of perfect hibernation. They were in a large nest of leaves situated two or three feet below the surface." †

In the *American Naturalist* for June, 1872 (Vol. VI, No. 6, pp. 330–332), the late Professor Sanborn Tenney published an article entitled "Hibernation of the Jumping Mouse." Without referring to a single published record or opinion, he narrates a personal experience so full of interest that I take pleasure in presenting it to my readers. Professor Tenney says:—

"On the 18th of January of the present year (1872), I went with Dr. A. Patton of Vincennes, Indiana, to visit a mound situated about a mile or a mile and a half in an easterly direction from Vincennes. While digging in the mound in search of relics that might throw light upon its origin and history, we came to a nest about two feet below the surface of the ground, carefully made of bits of grass, and in this nest was a Jumping Mouse (*Jaculus Hudsonius* Baird) apparently dead. It was coiled up as tightly as it could be, the nose being placed upon the belly, and the long tail coiled around the ball-like form which the animal had assumed. I

* Quadrupeds of North America, Vol. II, 1851, p. 355.

† Patent Office Report for 1856, 1857, p. 97.

took the little mouse into my hand. It exhibited no motion or sign of life. Its eyes and mouth were shut tight, and its little fore feet or hands were shut and placed close together. Everything indicated that the mouse was perfectly dead, excepting the fact that it was not as rigid as perhaps a dead mouse would be in the winter. I tied the mouse and nest in my handkerchief and carried them to Vincennes. Arriving at Dr. Patton's office I untied my treasures, and took out the mouse and held it for some time in my hand; it still exhibited no sign of life; but at length I thought I saw a very slight movement in one of the hind legs. Presently there was a very slight movement of the head, yet so feeble that one could hardly be sure it was real. Then there came to be some evidence of breathing, and a slight pressure of my fingers upon the tail near the body was followed by an immediate but feeble movement of one of the hind legs. At length there was unmistakable evidence that the animal was breathing, but the breathing was a labored action, and seemingly performed with great difficulty. As the mouse became warmer the signs of life became more and more marked; and in the course of the same afternoon on which I brought it into the warm room it became perfectly active, and was as ready to jump about as any other member of its species.

"I put this mouse into a little tin box with holes in the cover, and took him with me in my journeyings, taking care to put in the box a portion of an ear of corn and pieces of paper. It ate the corn by gnawing from the outside of the kernel, and it gnawed the paper into bits with which it made a nest. On the fourth day after its capture I gave it water which it seemed to relish. On the 23d of January, I took it with me to Elgin, Illinois, nearly three hundred miles farther north than the region where I found the specimen. The weather was intensely cold. Taking the mouse from the box, I placed it on a newspaper on a table, and covered it with a large glass bell, lifting the edge of the glass so as to admit

a supply of air. Under this glass was placed a good supply of waste cotton. Soon after it was fairly established in its new and more commodious quarters, it began to clean every part of its body in the most thorough manner, washing itself very much in the same manner as a cat washes. On coming to the tail it passed that long member, for its whole length, through the mouth from side to side, beginning near the body and ending at the tip. At night as soon as the lights were put out the mouse began gnawing the paper, and during the night it gnawed all the newspaper it could reach, and made the fragments and the cotton into a large nest perhaps five or six inches in diameter, and established itself in the centre. Here it spent the succeeding day. The next night it was supplied with more paper, and it gnawed all it could reach, and thus spent a large part of the night in work. I could hear the work going on when I was awake. In the morning it appeared to be reposing on the top of its nest; but after watching it for some time, and seeing no motion, I lifted up the glass and took the mouse in my hand. It showed no signs of life. I now felt that perhaps my pet was indeed really dead; but remembering what I had previously seen, I resolved to try to restore it again to activity. By holding it in my hand and thus warming it, the mouse soon began to show signs of life, and although it was nearly the whole day in coming back to activity, at last it was as lively as ever, and afterward, on being set free in the room, it moved about so swiftly by means of its long leaps, that it required two of us a long time to capture it uninjured.

"On the evening of February 6th I reached my home in Williamstown, and on my arrival the mouse was in good condition. But the next morning it was again apparently dead; in the course of the day, however, being placed where it was warm, it gradually came back to activity as before."

The statements of Godman and Thompson, that the Jumping Mouse remains torpid till the last of May or first of June, are

without weight, because it is very evident that these authors derive their knowledge from Davies, whose observations were limited to a single specimen taken near Quebec. Moreover, the fact that a hibernating animal does not emerge from winter-quarters till June in the latitude of Quebec, affords no reason for supposing it to remain dormant till this late date in more southern localities. Indeed, experience points to a contrary conclusion, as well in the present as in several other species. On the 11th of February, 1874, I caught an active male at Easthampton, Massachusetts; and Mr. Elisha Slade writes me that in the vicinity of his home, at Somerset, Bristol County, Mass., the animal "retires to hollow trees, stumps, or fissures of rocks, during cold snaps," and reappears with every return of warm weather. During the winter of 1881–1882, unprecedented for its mildness, I several times observed it in Lewis County, in Northern New York.

### Family HYSTRICIDÆ.

### ERETHIZON DORSATUS (Linn.) F. Cuvier.

*Canada Porcupine.*

The Porcupine is a common and well-known resident of all the wooded parts of the Adirondacks, and is equally abundant in the lowlands and on the highest mountains.

Of all the mammalian inhabitants of North America, not one possesses more striking peculiarities. To a person beholding him for the first time he seems a veritable prodigy. He presents a combination of positive characters which seem directly contradictory to his known habits of life. He is about twice the size of a full-grown woodchuck, well-conditioned adults averaging from fifteen to twenty pounds in weight. His muzzle is short and blunt, and his eyes and ears are small—the latter almost concealed in the bristles of the sides of the head. His neck is short and thick, and his body is large and chunked. He is very compactly built, and

remarkably broad across the back. His legs are short. The soles of his plantigrade feet are broad and naked, like those of the bear, and his claws are large, well-curved, and channelled beneath. His tail is most extraordinary. It is a large, ponderous, and somewhat four-sided structure, capable of dealing a powerful blow.

The entire upper surface of the animal, from in front of the eyes to the tip of the tail, the cheeks, sides of the neck, body and tail, the shoulders, flanks, and hips, are densely covered with thickly-set stout spines, varying from less than an inch (25.5 mm.) to more than four and one quarter inches (108 mm.) in length. These spines or quills, which in a state of rest are directed backward, are connected at their bases with a layer of muscle by which they may be erected at will. The mature quills cling so loosely to the skin that they are easily detached, and their finely barbed tips cause them to adhere to any animal with which they come in forcible contact. After having penetrated the skin, the tendency is to advance, and the muscular action of their victim causes them to become more and more deeply imbedded. There is no part of the body to which they may not travel. I have found them in the hind leg of a fisher, firmly fixed between the tibia and fibula.

The Porcupine, owing to this formidable dermal armature, has but few enemies. Chief among them, as has already been shown (Vol. I, pp. 30, and 48–50), are the panther and fisher; and since these powerful Carnivores have become rare in the Adirondacks, the Porcupine has been, and still is, on the increase. He is occasionally attacked by wolves, eagles,* and the great-horned owl.

He is a pretty strict vegetarian, deriving the greater part of his sustenance from different kinds of browse and bark. Among the conifers, the hemlock furnishes the most palatable food, for he is found upon it more often than upon any other evergreen. He

* In Forest and Stream of March 20, 1884 (p. 144), Mr. J. L. Davison, of Lockport, N. Y., states that he had recently examined a golden eagle that had been shot at Plessis, Jefferson County, N. Y. He says: "The feet of the eagle were full of porcupine quills, which was probably the last animal he had dined off, and about as hot a meal as he ever had."

also feeds upon the foliage and twigs of the maple and birch, and not infrequently comes to the water's edge to seek the lily-pads within reach from the bank. He is also partial to the staple commodity of the region—the beechnut—and I have killed several whose stomachs were distended with beechnut-meal.

The Porcupine is more strictly nocturnal than the majority of our mammals; still, he occasionally ventures abroad in the daytime. The greater part of his life is spent high in the trees, though his den is usually concealed in some ledge of rocks. He is not so active during extreme cold as at other times, but is not known to hibernate. I have seen fresh tracks * leading to his hole in a rocky side-hill in January, the thermometer indicating a temperature of $-27^{\circ}$ C. If ledges are not at hand, he is sometimes found asleep under an old log or brush-heap, or in a hollow tree. When he has selected and settled himself in a tree to his liking he may not leave it, day or night, until he has denuded it of the whole of its foliage. I have seen many hemlocks thus completely stripped, not a green twig remaining, even on the smallest bough. It seems incredible that so large and clumsy an animal should be able to climb out far enough on the branches to reach the terminal leaves; but he distributes his weight by bringing several branches together, and then, with his powerful paws, bends back their ends and passes them through his mouth. When high in the tree-tops he is often passed unnoticed, mistaken, if seen at all, for the nest of a crow or hawk.

He is very fond of salt and frequently comes around camp during the night for the purpose of obtaining it. He will eagerly lick a bag that has contained salt meat, or the dirt where brine has been spilt. He takes pains to devour all pork and ham rinds that fall in his way, and, if occasion offers, will gnaw a buttertub or other wooden receptacle that has contained any saline substance.

* His short legs allow his heavy body to drag in the snow, making even a deeper and broader rut than the otter. His footprints are nearer together than those of the otter, and are of a different pattern.

His familiarity at such times is surprising, for, while not aggressive, he is by no means timorous, and explores the camp with coolness and determination.

Porcupines have a curious habit of girdling trees, at a height of from six to thirty feet. The zone from which the bark is removed varies from a few inches to a foot or more in breadth. The spruce is more frequently girdled than any other tree, and those of small diameter more commonly than those of large size.

When feeding on lily-pads along the borders of water-courses they sometimes utter extraordinary noises, and occasionally quarrels arise for the possession of some log which affords them easy access to the coveted plants. At Beaver Lake, in Lewis County, Mr. John Constable once witnessed an encounter during which one of the combatants was tumbled into the water. The animals did not attempt to bite, but growled and snarled and pushed.

Mr. Eugene P. Bicknell, while encamped on the summit of Slide Mountain in the Catskills, in June, 1882, was favored by a visit from a number of these curious animals, and his account of their actions well illustrates some of their prominent characteristics. Mr. Bicknell says: "From evening till morning dusk our cabin on the extreme summit of the mountain was virtually besieged by them, and through the chinks their dark forms could be seen moving about among the shadows in the moonlight, while their sharp cries, and often low conversational chatter, singularly like the voices of infants, were weird interruptions of the midnight silence, or later, of the moaning wind.

"The seeming nocturnal temerity of these creatures appeared to be simply an exhibition of excessive stupidity. It was found impossible to drive them from the camp for any length of time; they seemed to be destitute of the faculty of memory, and even a light charge of shot sent among them was only for the moment effectual. Even when one particularly stupid individual had been shot dead in the doorway trying to effect an entrance by gnawing

its way through a gap, another, shortly after, continued the operation beside the lifeless body of its companion.

"It seems probable that these singular rodents cannot long survive human settlement. Incapable of rapid motion they are easily approached, and their spiny armature, so potent a protection from their natural enemies, fails before the merciless power of man. In the isolation of the mountain top where we have just seen them, they appeared to be at a loss to understand the nature of their disturbers, and when met with showed little excitement, or anxiety to escape. Their greatest effort in this direction appeared to be leisurely shuffling out of the immediate way, often climbing with sluggish effort into a small balsam and composing themselves among the branches just out of easy reach." *

Among certain Indian tribes the flesh of the Porcupine is a staple article of diet, and I have been informed by hunters and trappers that it is by no means bad eating.

In the copper districts of Lake Superior, Porcupines are put to a novel use. The following clipping is from the *Ontonagon* [Michigan] *Miner* of July 28th, 1883: "Porcupines as Fuel.—Mr. Stratton who has charge of the work at the Wilmot mine has found a new article of fuel which is more effective than green wood, Porcupines! Yes, Porcupines. These pests had become so numerous, that one day he threw a couple of them into the fire place of the steam-drill, and to his surprise his steam ran up to 80 pounds in a short time. Having made this discovery he concluded to follow it up, and the boys are ordered to kill and bring in every porcupine they can catch, which are thrown in to help make fuel. They have now killed and burned 126 of them."

By persons ignorant of natural history, the Porcupine is sometimes called "Hedgehog." The hedgehog is a small animal, related to the mole, and is not found in America.

The Porcupine makes its nest in a ledge of rocks, or in the hol-

* Transactions of the Linnæan Society of New York, Vol. I, 1882, pp. 121–122.

low of a tree or log. Its young, generally one or two in number, are born about the first of May, and are monstrous for the size of the species. They are actually larger, and relatively more than thirty times larger, than the young of the black bear at birth.*

Josselyn, in his account of *Two Voyages to New England*, says: "The *Porcupine* likewise I have treated of, only this I forgot to acquaint you with, that they lay Eggs, and are good meat" (p. 75).

The intestines of these animals usually contain large numbers of tape-worms.

### Family LEPORIDÆ.

### LEPUS AMERICANUS Erxleben.

*Great Northern Hare; Northern Varying Hare.*

The Northern Hare is found in greater or less abundance in most parts of the Adirondacks above the altitude of fifteen hundred feet (477 metres). Below this altitude, particularly on the eastern or Champlain side of the Wilderness, it grades insensibly into the southern variety, *Lepus Americanus Virginianus.*

In summer the Northern Hare feeds upon a variety of tender shoots, grasses, leaves, buds, and berries; in winter its diet is limited to the twigs and bark of shrubs and small trees, particularly of the poplar, birch, and willow.

The haunts of this species vary somewhat with the season. In summer it is found in the dark evergreen forests, while in winter, when the ground is frozen and covered with snow, it retires to the swamps, and to the dense thickets, chiefly of alder and black spruce,

* May 1st, 1882, I shot, at Big Moose Lake, a female Porcupine which contained a fœtus that would certainly have been born within two or three days. It weighed one and one-quarter pound avoirdupois (567 grammes), and measured in total length eleven and one-fourth inches (285 mm.), the head and body measuring about seven and three-fourth inches (just 195 mm.). It was densely covered with long black hair, and the quills on its back measured a little over half an inch (13 mm.) in length. The discoid placenta measured two and one-quarter inches (57 mm.) in diameter.

bordering many of the lakes and beaver meadows.* At all times of the year it inhabits the burnt districts that are strewn with charred logs and grown over with blackberry bushes, studded here and there with saplings of the poplar, birch, cherry, and shad-bush.

It does not inhabit burrows, nor take refuge in hollow trees, like the gray rabbit, but seeks temporary shelter under a log, tree-top, young evergreen, or other covert where it is not likely to be disturbed. Here it spends the greater part of the day, feeding chiefly by night. It follows certain definite routes with such frequency that regular runways are formed. In these it is often snared.

About the borders of the Wilderness the Varying Hare is a favorite object of the chase. It is hunted with hounds, during the early winter months, and is shot while circling through the swamps, or crossing from hill to hill in the burnt districts. Audubon and Bachman state that its flesh is not good eating, to which opinion I take exception, for, having eaten several dozens of them, I am prepared to pronounce them tender and well-flavored. When properly cooked they certainly constitute an excellent article of diet. The above-mentioned authors observe: "This species in the beginning of winter varies from three to six and a half pounds, but we consider five and a half pounds to be an average weight of a full-grown animal in good condition." † In the Adirondack region a five-pound Hare is exceptionally large, the adults averaging not more than four and a half pounds (2,041 grammes) in weight.

I have never found the nest, but it is doubtless placed under a brush heap, or in some other equally secure covert. From four to six young are produced at a birth, four being the usual number. They are born late in May. There may be two litters in a season, but I have no proof of it. This species has many enemies, among

* In my journal of a snow-shoe tramp in the Adirondacks, in January, 1883, I find the following entry concerning this species: "Scarcely a track seen except about the borders of lakes and beaver meadows. Very common near Big Otter Lake, and tolerably so at Little Safford Lake and in a swamp west of Independence Lake; also between Big Moose and Second Lake of North Branch, and near the Forge."

† Quadrupeds of North America, Vol. I, 1846, p. 96.

the most formidable of which are the lynx, fox, ermine, mink, marten, fisher, eagle, the snowy and great-horned owls, and the larger hawks.

The Varying Hare derives its name from the well-known circumstance that it changes color in spring and fall—being dark reddish-brown in summer and snowy white in winter. Concerning the method of the change much difference of opinion exists, and some of the ablest of recent writers pass the point in silence.

Pennant says: "These animals, at approach of winter, receive a new coat, which consists of a multitude of long white hairs, twice as long as the summer fur, which still remains beneath." * Dr. Richardson stated that, in his opinion, "the change to the winter dress takes place by a lengthening and blanching of the summer fur; whilst the change in the beginning of summer consists in the winter coat falling off during the growth of the new and coloured fur." † This opinion comes very near the truth, but does not express the whole truth. The first clause is absolutely correct; for in the fall the change certainly does occur "by a lengthening and blanching of the summer fur," the individual hairs changing color after the first fall of snow. This species, like the great majority of mammals, is clothed with two kinds of hair—a fine soft fur which densely covers all parts of the body, and longer, stiffer hairs, scattered through, and projecting beyond, the former. These long hairs are black in summer and white in winter. In the fall of the year, when the change begins, they become white at the tips first, the black gradually fading from above downwards until the entire hair is white. In spring the process is reversed, the exposed portion of the long hairs becoming black (though the extreme tip sometimes remains white until the change is far advanced), which color gradually extends downward, at the expense of the white, until the entire hair is black. Sometimes the displacement of the white is

* Arctic Zoology, Vol. I, 1792, p. 110.

† Fauna Boreali-Americana, Vol. I, 1829, p. 218.

temporarily interrupted, the two colors appearing in alternate zones. And during the latter part of March, when the body of the animal is still white, it is not uncommon to find hundreds of black hairs scattered over the back, many of them with the extreme apices, and a narrow zone between the middle and base, white. In fall or early winter the soft fur becomes tipped with white, the white portion increasing somewhat in length and diameter. In spring a curious phenomenon takes place. The white portion of the fur loses its vitality, becomes brittle, and breaks off on slight friction, so that the animal, in brushing through the undergrowth, soon rids himself of it. As a rule the long hairs change first.* Both in spring and fall the time of the change seems to be governed by the presence or absence of snow, and is not affected by the temperature. It occurs independently of the moult, and the new hairs assume the prevailing color of the animal, or the color toward which it is tending at the time of their appearance.

Mr. J. A. Allen, in his elaborate monograph of North American Hares, states that instances of melanism "are very rare among the American *Leporidæ*." He further says: "Among the specimens of var. *Americanus* is a single example of melanism, a mutilated skin (No. 6268) labeled as follows: '*Lepus Americanus*, Rainy Lake, H. B. T.' It is apparently a winter skin, the pelage being very long and full. The color is dull plumbeous-black throughout, there being a slight grayish cast to the surface of the pelage, particularly on the head, breast, and back."† I have had the good fortune to examine two excellent melanistic specimens of this species, both in the collection of Mr. Romeyn B. Hough, of Lowville, New York. The animals were shot in winter (one in March),

* Specimens in my museum, killed in Lewis County, December 1st, March 21st, and April 3d, well illustrate the above described conditions of pelage. In spring, while the change is in progress, the attachment of the white tips is so feeble that hundreds may be blown off at a single puff. The change occurs more or less irregularly over the greater part of the body, but is usually symmetrical on the head, giving rise to a very pretty pattern.

† Monographs of North American Rodentia, 1877, p. 305.

in the town of Lyonsdale, in Lewis County. In color they are a uniform dark sooty-brown, lighter on the soles of the feet.

## LEPUS AMERICANUS VIRGINIANUS (Harlan) Allen.

*Southern Varying Hare.*

This variety or subspecies of the Varying Hare occurs in the low border-lands of the Adirondacks, particularly in the valleys of Lakes George and Champlain, but is not met with at any great elevation, a few hundred feet constituting, in this latitude, its altitudinal limit.

Its food and habits are not known to differ from those of its nearest relative, the great northern hare, from which it may be distinguished, in winter, by the circumstance that the change to white is not complete, more or less light reddish-brown remaining about the head and ears, and on the upper surfaces of the fore-feet.

Rabbits are not commonly supposed to swim, but Mr. William Brewster has kindly written me of a case that fell under his personal observation. He says: "While at Lake Umbagog, Maine, in the summer of 1873, I saw something which may interest you. I was paddling up Cambridge River one warm July morning when, upon rounding a bend, my attention was attracted by a slight splashing sound ahead, and looking closely I discovered a Rabbit (*Lepus Americanus*) evidently about to attempt the passage of the stream which at that place was perhaps one hundred feet wide, and at least eight or ten deep. He entered the water deliberately, but without apparent fear or hesitation, and was soon beyond his depth and striking out boldly for the opposite shore. A more ridiculous (albeit successful) attempt at swimming can scarcely be imagined. He literally *hopped* through the water, using only his hind legs and kicking with such vigor that the whole forward part of his body was raised above the surface at each stroke. Between the strokes

he would sink back until, sometimes, only the tip of the nose was exposed. I fancy that an immense bull-frog, weighted after the manner of 'Mark Twain's' 'Dan'l Webster,' would cut a somewhat similar figure.

"This method of progression was naturally fatiguing, and before the animal reached the opposite bank the strokes became feebler and the intervals between them longer until I began to fear that the tired creature would be drowned. At length, however, he struck bottom, and, loping across a stretch of bare mud, disappeared in the woods. *Such* an appearance as he presented upon emerging from the water!—the lankness of his form revealed by the clinging and bedraggled fur, the ears drooping and the whole expression one of dejection and shame.

"None of the guides or trappers of my acquaintance have ever seen a Rabbit swim, although I have been told of an instance where one was observed to take to the shallow water on the margin of a pond and run through it for several hundred yards before leaping again into the woods. The purpose of this manœuvre was apparent a moment later when a Sable appeared on the Rabbit's track and following it to the water's edge lost it there.

"On the occasion just described, however, no pursuer appeared, nor do I think that *this* Rabbit entered the water under compulsion, or for the purpose of obliterating the scent of his tracks. On the contrary, the action was undertaken so deliberately, that I believe the animal to have been impelled by some idle whim, merely—such as a desire to try fresh pasturage or, perhaps, to see what the world was like on the other side of the stream. However this may be, the case is doubtless exceptional, for *Lepus Americanus* ordinarily has as great an aversion to the water as any house cat."

Mr. Nelson Harris, a well-known Adirondack hunter, tells me that while still-hunting in Northern Michigan, a few winters ago, he saw a white Rabbit, that had stumbled into camp and was

'cornered," plunge fearlessly into a swiftly flowing river and swim to the other side.

## LEPUS SYLVATICUS Bachman.

*Gray Rabbit.*

The Gray Rabbit is a more southern animal than either of the species heretofore considered, and only enters the Adirondack region along its southern border, in Fulton, Saratoga, and Warren Counties.

In addition to the food which constitutes the diet of the varying hare, the Gray Rabbit enters the garden and orchard, sometimes committing great havoc. Robert Kennicott says: "In hunting these quadrupeds, every winter, and working every summer, for ten years, in a very large nursery of fruit-trees, where they were numerous, I have never seen a tree from which bark had been gnawed by them, though thousands were severely 'pruned,' the rabbits, in deep snows, appearing to feed entirely upon the twigs and buds of the young apple trees. From the larger limbs they cut off the buds, of which they are fond; and in the woods, in winter, they can be tracked to living forest trees, recently felled, to which they repair to feed upon the buds. They also feed in winter upon the buds and young shoots of briars, sumach, hazel, thorn, oak, hickory, basswood, poplar, and other shrubs and trees." *

Its favorite haunts, according to my observation,† are pine barrens, and thickets of laurel (*Kalmia latifolia*) and other undergrowth. Like the northern hare, it has regular runways which it uses at all times of the year; but unlike that species it habitually takes refuge in burrows in the earth and in hollow trees.

* Quadrupeds of Illinojs Injurious and Beneficial to the Farmer. By Robert Kennicott, 1858, pp. 80–81.

† I have found it in greater or less abundance in the Connecticut Valley in central Massachusetts; in southern Connecticut; in southern New York (Westchester County); in the vicinity of Elizabeth, New Jersey; about Aiken, South Carolina; and in Florida.

Audubon and Bachman state: "In the Northern and Middle States, where the burrows of the Maryland marmot (*Arctomys monax*) and the holes resorted to by the common skunk, (*Mephitis chinga*,) are numerous, the Gray Rabbit, in order to effect its escape when pursued, betakes itself to them, and as they are generally deep, or placed among rocks or roots, it would require more labour to unearth it when it has taken possession of either of these animal's retreats than it is worth, and it is generally left unmolested. It is not always safe in these cases, however, for the skunk occasionally is 'at home' when the Rabbit runs into his hole, and often catches and devours the astonished fugitive before it can retrace its steps and reach the mouth of the burrow." *

Kennicott says: "The grey rabbit is very prolific, producing young three or four times a year, and usually from four to six at a birth. In open ground the female scratches a shallow hollow, in which to bring forth her young. In this she forms a nest of soft leaves and grasses, well-lined with fur from her own body; and when she is absent, the young are always completely covered and concealed in the nest, which they leave at an early age, and separate from the mother as soon as able to take care of themselves." †

* Quadrupeds of North America, Vol. I, 1846, p. 177.

† Quadrupeds of Illinois Injurious and Beneficial to the Farmer. By Robert Kennicott, 1858, p. 81.

# A NEW GENUS AND SPECIES OF THE SORECIDÆ.

(*Atophyrax Bendirii* Merriam.)

BY

CLINTON HART MERRIAM, M.D.

# DESCRIPTION OF A NEW GENUS AND SPECIES OF THE SORECIDÆ.

## ATOPHYRAX BENDIRII Merriam.

*Bendire's Shrew.*

By CLINTON HART MERRIAM, M. D.

In a collection of mammals from Klamath Basin, Oregon, kindly presented to me by Captain Chas. E. Bendire, Ist Cavalry, U. S. A., is a Shrew of more than ordinary interest. Concerning its history Captain Bendire writes me: "It was captured in one of my camps while I was constructing a telegraph line from Fort Klamath, Oregon, to Fort Bidwell, California. The exact locality was about a mile from Williamson's River, and some eighteen miles southeast of Fort Klamath. The last of July or first of August comes within a day or two of the date. I had just returned from fishing when one of my men brought me the specimen, stating that it had been caught an hour before by one of the dogs. I was camped near a little spring on the edge of a wet meadow, along and amongst a grove of pine timber."

It is one of the largest of the Shrews, weighing about four times as much as *Sorex Cooperi*, and proves to be the type of a new genus. It presents, in some respects, a curious combination of the characters of the Shrews hitherto described, together with certain peculiarities of its own which indicate a modification more extreme even than that met with in *Neosorex*. I take pleasure in bestowing upon this interesting animal the name of the distinguished naturalist by whom it was secured—a name that must ever be associated with the natural history, not of Oregon alone, but of a number of our western States and Territories.

In order to arrive at a clear conception of the peculiarities and

relationships of Bendire's Shrew, it must be compared with typical representatives of the genera to which it is most closely allied, and these are found to be *Sorex* and *Neosorex*—its affinities with *Blarina* being very remote. But, as preliminary to this inquiry, it becomes expedient to indicate the differences existing between the two first-mentioned genera.

The only tangible diagnostic characters that have been assigned to the genus *Neosorex* are the long fimbriated feet, the great length of the tail, and the circumstance that the known species are "sharply bicolor, blackish above and whitish beneath." No distinctive cranial or dental characters having been pointed out,* I have instituted a comparison between the type specimen of *Neosorex navigator* † and a specimen of *Sorex Cooperi*. The differences noted are as follows: In *Neosorex* the rostrum is longer, and its sides meet the cranium at a decided angle; while in *Sorex* the sides of the rostrum are but little out of line with the cranium. In *Neosorex* the rostrum is more sharply compressed just in front of the molariform series, so that its anterior portion is more attenuate, and the unicuspids more nearly parallel than in *Sorex*. The greater development of the facial portion of the skull is best shown in the lengthening of the upper jaw and the shortening of the floor of the cranium. In *Sorex*, the ratio to the entire length of the skull of the distance from the front incisor to the hinder margin of the palate is 43.2; in *Neosorex*, 46.3. On the other hand, the ratio to the entire length of skull of the distance from the hinder margin

* I am aware that Coues, in his "Precursory Notes on American Insectivorous Mammals" (Bull. U. S. Geol. and Geog. Survey, Vol. III, No. 3, 1877, pp. 631–653), says that in *Neosorex* the posterior hook of the upper incisor is "as large as the succeeding tooth" (p. 641). But Baird, in his original description of the genus, expressly states that the basal hook only equals the *fourth* unicuspid, which is considerably smaller than the first. Having the type specimen of *N. navigator* before me, and examining it with special reference to this point, I find that the basal hook is but little more than half—certainly not two-thirds—as large as the first unicuspid.

† I am indebted to the courtesy of Professor S. F. Baird for the privilege of examining the type of *Neosorex navigator* (No. $\frac{1.78.6}{4.29}$), together with several other representatives of the *Neosorex* group, belonging to the United States National Museum. My thanks are also due Captain Chas. E. Bendire and Dr. Elliott Coues for their kindness in selecting and transmitting the specimens.

of the palate to the foramen magnum is, in *Sorex*, 44.4; in *Neosorex*, 43.9. This production of the rostrum is accompanied by a corresponding increase in the length of the under jaw, and shortening of the distance between the glenoid process and occipital condyle, the ratio of which, to the entire length of the cranium, is 46.3 in *Sorex*, and 43.9 in *Neosorex*. In *Neosorex* the distance from the posterior margin of the palate to the front incisor is considerably greater than the distance from the same point to the foramen magnum. In *Sorex* the posterior margin of the palate is situate nearly midway between the front incisor and the foramen magnum. On the floor of the cranium, the narrowest part of the basi-occipital is broader in *Neosorex* than in *Sorex*.

Turning, now, to the animal under consideration, and examining it with reference to the points concerned in the above comparison, the fact appears that, while it is in some respects intermediate between the two genera, it also differs widely from both. The rostrum is even longer and more attenuate than in *Neosorex*, with a well-marked angle laterally at its point of union with the cranium. The unicuspid series are nearly parallel. The ratio of the length of rostrum to the entire length of skull is 57.7; in *Neosorex* it is 56; and in *Sorex* 55.5. The ratio to length of skull of the distance from hinder margin of palate to the foramen magnum is 40.8; in *Neosorex* 43.9; in *Sorex* 44.4. (For other ratios see table A, p. 225.)

So far as dental characters are concerned it stands alone among the species of the Pacific region. Prof. Baird, in his diagnosis of the genus *Neosorex*, stated that the fourth unicuspid was larger than the third. He further called attention to the circumstance that all the known species of *Sorex* from the Pacific Province had the third upper unicuspid decidedly *smaller* than the fourth.* Twenty years later (in 1877) Dr. Coues thus commented upon this feature: "A striking peculiarity of all the Western species, no matter how diverse

* Pacific Railroad Reports, Vol. VIII, 1857, p. 13.

in other respects, is to have the 'third premolar' decidedly smaller than the 'fourth;' while in all the species east of the Rocky Mountains (with one possible exception), the same tooth is as large as or larger than the other. Of the fact there is no question; it may be observed in an instant, and is unmistakable." *

But Bendire's Shrew, though an inhabitant of the Pacific province, has the third and fourth unicuspids of approximately equal size, presenting, in this respect, a curiously exceptional condition.

In the type of *Neosorex navigator* the ratio of the length of the hind foot to the head and body is 36, in the present species it is 26, and in *Sorex Cooperi* 21. In Bendire's Shrew the proportions of the feet differ from those of any known species, agreeing better with *Neosorex* than with any other member of the family. The fore feet are large and broad, measuring 11 by 4 mm.; the hind feet are very long and comparatively slender, measuring 20 by 3.5 mm. The fore feet much resemble those of the *Blarina brevicauda*, but the hind feet are both relatively and absolutely much longer. Thus, arranging the described American Shrews according to the length of the hind foot, *Blarina* would stand at one end of the series and *Neosorex* at the other, the various species of *Sorex* coming next after *Blarina*, and the present species next before *Neosorex*. The feet are moderately fimbriate, but not to the extent seen in *Neosorex;* still, the fimbriation is sufficient to indicate a non-fossorial habit.

The tail is almost as long as the head and body. In *Neosorex* it is given as "about equaling or exceeding the head and body." In coloration it differs widely from *Neosorex*, being unicolor instead of bicolor.

In comparing it with the genus *Sorex* it is necessary to consider only the subgenus *Sorex* proper, with which it agrees in the possession of thirty-two teeth. It is found to differ from this subgenus, as restricted by Coues, in the following particulars:

* Bull. U. S. Geol. and Geog. Survey, Vol. III, No. 3, 1877, p. 637.

*a.* The inner lobe of the upper front incisor is small.

*b.* The fifth unicuspid is nearly half as large as the fourth, and is not at all crowded.

*c.* The distance across the molars (outside to outside) is greater than half the width of the cranium (as in *Microsorex*).

*d.* The depth of the rostrum (including the closed jaw) is equal to that of the cerebral portion of the cranium.

*e.* The coronoid process of the mandible is large and *divergent* (as in *Neosorex*, and somewhat as in *Notiosorex*).

*f.* The insertion of the lower incisor is anterior to the middle of the second unicuspid.

*g.* The lower incisor has but two denticulations.

To recapitulate: Bendire's Shrew differs from all existing genera in external, cranial, and dental characters. It has affinities with both *Sorex* and *Neosorex* and is in some respects intermediate between them, though in other respects it passes *Neosorex* in the direction away from *Sorex*. It also possesses characters of its own not found in either of these genera. I propose for its reception the genus

ATOPHYRAX.*

*Generic characters.*—Teeth thirty-two, not crowded. Upper front incisor with basal hook about two-thirds as large as next succeeding tooth; subterminal notched lobe small, connivent with its fellow. Unicuspids five, imbricating, not crowded; fifth nearly half as large as fourth, with a well-developed conical cusp. Upper molariform teeth constituting just half the length of the entire series. Lower premolar markedly bicuspidate.

Rostrum much produced, occupying a little more than five-ninths of the entire length of skull. Greatest breadth of skull considerably less than half its length, and equal to the distance from front incisor to hinder margin of palate. Posterior margin of palate situate far behind a point midway between the front incisor and foramen magnum. Base of cranium shorter than in any other American group of *Soricidæ*. Vault of cranium higher, more arched laterally, and narrower than in *Neosorex* (somewhat as in *Sorex*), the cerebral portion rising considerably out of line with the rostrum. Sagittal, lambdoidal, squamous, and zygomatic crests well-marked. The occipital plane slopes forward, meeting the parietals at a more abrupt angle than in *Sorex*, instead of rounding up into the vault of the cranium as in *Neosorex*. Rostrum strongly

* Atóph'-yrax: ἄτοπος, anomalous; οὖραξ=sorex.

compressed in front of the molariform teeth, narrowest opposite the third unicuspid. Unicuspid series nearly parallel. Molariform series abruptly divergent. Alveolar border of maxillary deeply and somewhat angularly concave, the fifth unicuspid lying at the bottom of the concavity. Interpterygoid canal actually and relatively much broader than in either *Sorex* or *Neosorex* (in this respect resembling *Crossopus*), its lateral parietes nearly parallel. Horizontal ramus of the mandible stout and slightly convex. Coronoids large and high, divergent outward and inclining forward. Styliform angular processes much shorter than in the other genera. Depth of the rostrum (including closed jaw) equal to that of cerebral portion of cranium.

Hind foot more than one-fourth as long as head and body; moderately fimbriate. Tail nearly as long as head and body.

## ATOPHYRAX BENDIRII sp. nov.

*Bendire's Shrew.*

### DIAGNOSIS.

Size large; tail nearly equal to head and body; muzzle attenuate, depressed sub-cylindrical. *Unicolor:* above sooty blackish-brown, fading imperceptibly into dark ashen-brown on throat and breast. Tail well haired, pencilled, absolutely unicolor. Ratio of hind foot to length of head and body about 26.

First and second unicuspids subequal; third and fourth smaller and subequal to each other; fifth smallest, but nearly half as large as fourth, not crowded, provided with a conical, colored cusp. Lower incisor with two prominent denticulations; its visible base extending posteriorly to a little beyond the first succeeding tooth.

### DESCRIPTION. *

(Adult male, alcoholic.)

*External characters.*—Size large; total length 150 mm.; head and body 76 mm.; tail, vertebræ 68 mm., to end of hairs 74 mm.; manus 11 mm.; pes 20 mm.

*Unicolor:* above sooty blackish-brown, darkest over flanks and hips, fading imperceptibly into dark ashen-brown on the throat and breast.† No trace of line of demarkation on either body or tail. Tail colored like back; upper and lower surfaces indistinguishable. Chin soiled white. Feet same color as body. Whiskers

* With a few exceptions the generic characters already enumerated are not here repeated.

† Viewed in certain lights the animal has a somewhat "peppery" appearance, which is due to the admixture of two kinds of hair: the longer with a nearly black awn-shaped enlargement at the tip; the shorter, a coarse fur, of uniform size throughout, and brown tipped.

black with colorless tips, the longest reaching a little beyond the ear. Hair very dense and long, that on the back and shoulders measuring 6 mm.; basal two-thirds dark plumbeous.

Ears moderate, barely distinguishable without parting the fur; auricle, without fringe of hairs, 2.5 mm., with fringe, 6 mm. Eyes small but distinctly visible. Muffle rather large, deeply furrowed along the median line; nostrils opening laterally. Muzzle long, attenuate, depressed sub-cylindrical, protruding somewhat abruptly from the very broad head.*

Tail large, sub-quadrate for about two-thirds its length, well clothed with stiff, bristle-like, appressed hairs, measuring about 2.50 mm. on the middle third, gradually increasing in length on the terminal third, and ending in a pencil 5 mm. in length.

Manus large and broad, measuring 4 by 11 mm.; pes long and slender, 3.5 by 20 mm. Upper surfaces and sides of both feet densely haired to claws, the marginal hairs stiff, elongated, and turned down in such a way as to form a pronounced border on each side of each foot and toe (but not fimbriated to the extent seen in *Neosorex*). Soles naked to end of heel; nearly black. Toes with claws: *manus*, third and fourth subequal, second claw overreaching base of third, fifth not reaching base of fourth, first falling short of base of fifth; *pes*, third and fourth subequal, second but little shorter, fifth reaching nearly to base of fourth, first overreaching base of fifth. (Formula for toes of both manus and pes: 3=4, 2, 5, 1.)

*Dental Characters.* — First and second unicuspids subequal, largest; third and fourth subequal, smaller; fifth, smallest, but *very large for a Shrew* (distinctly visible to the naked eye from both sides and from below), nearly half as large as fourth, with a well-developed, conical, colored cusp; not crowded. Lower incisor with two prominent denticulations, two notches, and one sinuation; its base extending beyond the canine and appearing under the anterior third of the premolar. Premolar markedly bicuspidate, the anterior cusp longest and connected by an oblique, deeply notched ridge with the posterior, from which another ridge is inflected obliquely backward and inward, thus defining a triangular area whose apex points outward. The resemblance of this tooth to the anterior segment of the first true molar is striking. Tips of all the teeth well colored.

*Cranial Characters.*—Skull large and heavy (weighing .15 grammes—but only half as heavy as that of *Blarina brevicauda*, which, in adults, averages about .30 grammes). A broad constriction occupies the middle fifth of the skull, extending from the base

* This apparent breadth of the head is due to the length of the hairs on its sides, the cranium being narrow.

of the malar process of the maxillary bone to the glenoid fossa. The anteorbital foramen is very large. The rostrum is strongly compressed in front of the molariform teeth, its sides rising almost vertically to form the lateral walls of the anterior portion of the nasal chamber. The width opposite the third unicuspid is 2.20 mm., while the distance across the molars is 6 mm.—or 2.72 times greater. The pterygoid hamuli are slender styliform processes extending almost directly backward.

The mandible presents no marked peculiarities. The horizontal ramus is stout and slightly convex. The coronoids are large and high, diverge outward, and incline a little forward. The styliform angular processes are relatively short for a Shrew; they are parallel, and are directed backward, and slightly downward.

Nothing whatever is known of the habits of Bendire's Shrew. Its structure, however, leads to the belief that it is not amphibious like *Neosorex*, nor an inhabitant of dry uplands, like the various species of *Sorex* proper, but that it is a marsh species, dwelling in wet meadows, and occasionally taking the water either in the pursuit of its prey or as a means of escape from its enemies.

In view of its isolated position, speculations concerning its genetic affinities are perhaps unwarrantable; still, a somewhat critical study of its peculiarities shows that, whatever its past history, it cannot be regarded as intermediate between *Sorex* and *Neosorex*. Neither can it have been derived from *Neosorex*. Hence the logical inference is that *Atophyrax*, in common with *Neosorex*, was early differentiated from a group of thirty-two-toothed Shrews of which the genus *Sorex* contains the nearest living allies. Having abandoned a fossorial for, in the one case a natatory, in the other a paludal habit, *Neosorex* and *Atophyrax* doubtless began to diverge in the same direction, their distinctive features having been developed and intensified as their peculiarities of habit became fixed—each retaining in different degrees of modification certain characteristics of the original stock.

For the very accurate drawings accompanying this paper I am indebted to the kindness of Mr. Ernest E. T. Seton, who executed them, under my supervision, from the alcoholic specimen.

## TABLE A.

*Measurements* of certain parts of skull, with ratio of said parts to entire length of skull, in* Sorex Cooperi, Neosorex navigator, *and* Atophyrax Bendirii.

| NAME. | Sex. | Total length. | Length of rostrum. | | Breadth of cranium. | | Front incisors to hinder margin of palate. | | Foramen magnum to hinder margin of palate. | | Glenoid process to occipital condyle. | | Length of nasals. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Measm't. | Ratio. | Meas. | Ratio. | Meas. | Ratio. | Meas. | Ratio. | Meas. | Ratio. | Meas. | Ratio. |
| *Sorex Cooperi* . . . | ♀ | 16.20 | 9. | 55.5 | 8. | 49.4 | 7. | 43.2 | 7.20 | 44.4 | 7.50 | 46.3 | 5. | 30.9 |
| *Neosorex navigator* . | | 20.50 | 11.50 | 56. | 9.80 | 47.8 | 9.50 | 46.3 | 9. | 43.9 | 9. | 43.9 | 6.30 | 30.7 |
| *Atophyrax Bendirii* . | ♂ | 22.50 | 13. | 57.7 | 10.50 | 46.6 | 10.50 | 46.6 | 9.20 | 40.8 | 9.60 | 42.7 | 7. | 31.1 |

## TABLE B.

*Measurements of skull of* Atophyrax Bendirii. ♂ *ad.*

| Greatest length. | Greatest breadth. | Distance between orbits. | Length of nasals. | Front incisors to molariform series. | Front incisors to hinder margin of palate. | Front incisors to foramen magnum. | Foramen magnum to hinder margin of palate. | Distance between molars. | Greatest width across molars (outside). | Length of rostrum. | Length of cranium. | Height of cranium | Length of parietals (along interparietal suture). | Glenoid process to occipital condyle. | Length of mandible. | Height of coronoid process (above ramus). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.50 | 10.50 | 4.40 | 7. | 5. | 10.50 | 20. | 9.20 | 2.5 | 6. | 13. | 11.5 | 7. | 8.5 | 9.60 | 13.5 | 3.75 |

## TABLE C.

*Measurements of* Atophyrax Bendirii (*from alcohol, before skinning*).

| Nature of specimen. | Sex. | Total length | Tip of snout to | | | | Tail, to | | Manus. | | Pes. | | Breadth | | Height of ear to | | Weight. | Collector. | Date. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Teeth. | Eye. | Ear. | Occiput | Tail. | V'rt'bræ | Hairs. | Length. | Bre'dth. | Length. | Bre'dth | between eyes. | of muzzle. | Margin. | Tip of hairs. | | | | |
| Alcoholic | ♂ ad. | 150 | 4 | 12 | 22 | 28 | 76 | 68 | 74 | 11 | 4 | 20 | 3.5 | 5 | 6 | 2.5 | 6 | 12.50 | Capt. Chas. E Bendire. | Aug. 1, 1882. | 18 caudal vertebræ. |

* All measurements on this page are in millimetres.

# INDEX TO VOLUMES I AND II.