ARTICLE III.—*On Seasonal Variations in Color in Sciurus hudsonius.* By J. A. ALLEN.

In preparing my Monograph of the American Sciuridæ, published in 1877,* my attention was attracted to what appeared to be well-marked seasonal variations in color in the common Chickaree or Red Squirrel (*Sciurus hudsonius*), particularly in respect to the presence or absence of the black line on the sides of the body. Although I had hundreds of specimens before me for examination, a few only were labeled with the date of capture. Of this material I said: "A small proportion of the specimens have a conspicuous black lateral line separating the white of the lower surface from the gray of the upper surface. Generally, not more than one specimen in ten is thus marked, and such specimens are found, on careful examination, to be in summer pelage. Yet only a small proportion of those in summer pelage are thus marked, while I have never met with it in any specimen in winter pelage. Many of those thus marked are evidently the young of the year, and I am hence led to believe that it is a temporary feature of coloration characteristic of animals less than a year old, and that it permanently disappears with the first autumnal moult. I find, however, two specimens with a distinct lateral line that are adult females" (l. c., p. 674). These conclusions were not based on an actual knowledge of the date of capture of the specimens examined, but on the general character of the pelage. Although the real state of the case is roughly outlined in the above quotation, it is in part erroneous, as more satisfactory material now enables me to show. The presence or absence of the black lateral line is not at all dependent upon age, but is strictly a seasonal feature.

This is shown by a large series of specimens collected mainly at Hastings, on the Hudson River, near New York City, by Mr. John Rowley, Jr., for the American Museum of Natural History, with the express purpose of showing the seasonal changes of color in the present species. The series numbers nearly sixty specimens, taken throughout the year, except during the months of June and July, these two months being unrepresented.

* Coues and Allen, Monographs of North American Rodentia. No. XI. Sciuridæ. <Report of the United States Geological Survey of the Territories (F. V. Hayden, United States Geologist-in-charge), Vol. XI, 1877, pp. 631-949.

To begin with the spring moult, specimens taken at various dates in April and May show no great change in color from mid-winter specimens; the coat, however, has become thinner, and is more or less worn and ragged. Signs of its renewal are seen on the feet, where the gray of the toes is already replaced by the yellowish rufous of the summer coat, which also appears in patches on the fore-arms and shoulders, even in specimens taken as early as April 19 and 26. Other specimens taken as late as the middle of May are but little more advanced toward the summer coat. During June and July the moult is completed, as specimens taken August 6 are in full summer pelage.

In August specimens the pelage is short and close, and the color very different from that of winter. The general color above is more rufous and the broad dorsal band of bright rufous, so characteristic of winter specimens, is entirely absent. The limbs externally and the upper surface of the feet are bright yellowish rufous, quite different from the gray or pale yellowish gray of these parts in winter. The lower surface of the body is snowy white, this color extending nearly to the roots of the hairs, instead of grayish white, as in winter specimens, when the dusky tint of the basal portion of the hairs comes so near the surface as to impart to it a grayish tinge. The lateral line is clearly shown, but is less intense black and not so clearly defined as later in the season. It is much stronger in specimens taken August 23 and 30 than in those taken August 6.

The redness of the coat and the distinctness and intensity of the black lateral line reach their highest development in September and October. In November the pelage becomes longer, thicker, and softer; the feet and the outer surface of the limbs begin to lose their redness, and the broad red dorsal band begins to be apparent, through the growth of long red hairs which are not subterminally ringed with black, as are those of the summer coat. In specimens taken in the early part of November the lateral line still remains distinct, but in those taken near the close of this month it has become much less prominent, and practically disappears early in December, while the rufous dorsal band becomes purer and broader. The feet have become gray or yellowish gray, and the general color of the sides and whole upper

surface (except the middle of the back) has changed to a yellowish or olivaceous gray. In November specimens the feet are still yellowish rufous, this color also extending up the extremities to near the elbow and knee. In a specimen taken December 4 the gray has worked down on the hind feet nearly to the base of the toes, and the yellowish rufous is fading out on the fore-arms, while in another, taken the same day, only the tops of the feet retain the summer coat. Specimens taken December 16–20 have the feet wholly gray above, the only trace of the summer coat being a few yellowish hairs about the tips of the toes.

There is little further change till April, when the cycle of change above outlined again begins. Towards spring (in February and March) the broad dorsal band of rufous appears to attain its greatest intensity, and the feet show the minimum amount of fulvous.

It should be added that the black lateral line rarely wholly disappears; it is occasionally distinctly traceable in winter specimens, but in such the rufous dorsal band is not well developed, and the specimens show other indications of immaturity. In fully adults in winter the lateral line is not readily traceable without parting the hairs, when those covering this area are found to be more dusky at the base than are the hairs on either side of it. In many specimens, however, there is not even this faint trace remaining.

It thus appears that the black lateral line is distinctively a feature of the summer pelage, as the broad rufous dorsal band is of the winter pelage. Also that the summer pelage is characterized by the strong yellowish rufous tint of the whole dorsal aspect, including the sides of the body, and especially the feet and outer surface of the limbs, which are then in strong contrast with the olivaceous gray of these parts in winter. In summer the outer surface of the limbs and sides of the body are more rufous than the middle of the back; in winter the middle of the back is clear rufous, and the sides and limbs yellowish gray, a more or less well-defined and rather broad band of bright rufous extending along the middle of the back to nearly the end of the tail, in strong contrast with the rest of the dorsal surface.

The young are born while the parents are still in the winter coat, or at about the time of the beginning of the change from

winter to summer pelage—that is, during the month of April. The first coat of the young is similar to the summer coat of the adults, as shown by a litter of half-grown young, taken early in May, in the Museum Collection; they having the strong black lateral line, the feet and limbs bright rusty, and the general coloration of the adults in late summer and early autumn.

A careful examination of the series above described shows that the change of color, both in spring and fall, is due to a change of coat. In the summer coat the pelage of the dorsal surface is plumbeous at base, with the apical half or two-thirds of the hairs yellowish rusty, ringed narrowly near the tip with black. The hairs covering the ears, and a small area at the posterior base of the ears, the upper surface of the hind feet, and the whole external surface of the fore limbs, including the sides of the shoulders, lack the subapical black ring characterizing the hairs of the rest of the upper surface of the body. In the winter pelage the hairs clothing the limbs are pale yellowish gray conspicuously ringed subterminally with black; the general color becomes less rufous and grayer, and the black-ringed hairs along the middle of the back give place to much longer hairs wholly red from the plumbeous basal portion to the tip. The bright red hair fringing the ears is replaced by blackish; the reddish patch behind the ears becomes merged with the red of the dorsal band; and the black hairs forming the lateral lines are shed.

It is thus evident that the seasonal change of color is produced, not by any change of color in the hairs themselves, or by any overgrowth of hairs of a different color, as might be supposed in the case of the autumnal change, but by a complete renewal, twice a year, of the hairs themselves.

While in birds the gradual replacement of feathers during moult can be easily observed through the presence of growing feathers in various stages of development, the case is different with mammals, since the growth of the new hairs cannot be readily detected; nor is the change easy to recognize except in cases like the present, where the individual hairs of the alternating seasonal coats differ markedly in coloration.

BULLETIN

OF THE

American Museum of Natural History

(CENTRAL PARK, NEW YORK,)

77th Street and 8th Avenue.

DECEMBER, 1890.

VOL. III.—NO. 1.

PRINTED FOR THE MUSEUM.

WM. C. MARTIN, PRINTER, NO. 111 JOHN STREET.

1890.