

## Article II.—ON THE CHANGES OF PLUMAGE IN THE SNOWFLAKE (PLECTROPHENAX NIVALIS).

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Although the changes of plumage in the Snowflake are in a general way well understood, they have not, I believe, been recorded in detail. The acquisition by the American Museum of a fine series of freshly plumaged birds taken in October, 1895, in Maine, by Mr. John Rowley, and numerous specimens collected in June, 1895, at Holsteinborg, Greenland, by Prof. L. L. Dyche, in connection with other specimens previously in the Museum, has led to a study of the changes of plumage in this species with results which seem of sufficient interest to warrant publication.

Snowflakes molt but once a year, after the breeding season. At this time the male acquires his well-known winter plumage, in which the upper parts are bordered with rusty, the cheeks, breast and sides being tinged with the same color. At first glance it would seem impossible for a bird in this plumage to assume the black and white breeding dress without molt, but a careful examination of even the extremes, that is September and June birds, readily shows how the change is accomplished, while with a connecting series each stage may be observed.

The breeding male, it will be remembered, has the whole head and neck, entire under parts, rump and parts of the wings and tail pure white, while the back and remaining parts of the wing and tail-feathers are jet black. Now if we examine the September bird we find that where the breeding bird is white the bases of its brown-tipped feathers are white, while where the breeding bird is black, the bases of the September bird's feathers are also black. This is especially noticeable on the back, and reference to the accompanying cut of a feather from the back of an October bird will at once show the distribution of black and brown.

It is not necessary to further describe the autumn plumage of so common a species, my object being to show how the change from this plumage to the breeding dress occurs. Briefly, it is through

a gradual wearing off of the brown tips, which may be a quarter of an inch in length, whereby the black or white bases of the feathers are exposed. Further reference to the feathers from the backs of October, January, March and June birds, so clearly explains the nature of this change that added remark is almost unnecessary. Not only is the apparent color changed, but the

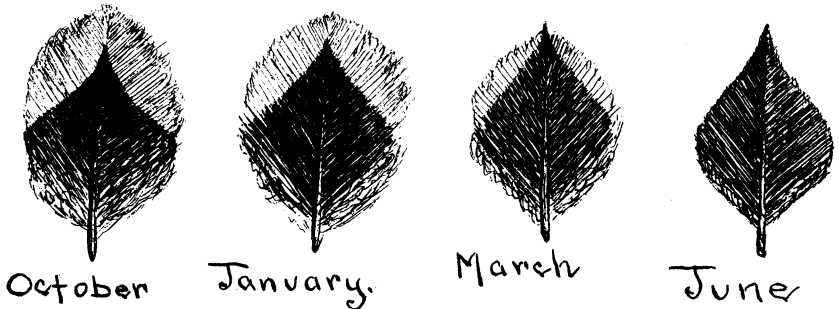


Fig. 1. Dorsal feathers of *Plectrophenax nivalis*, showing changes in form and color due to the wearing off of the tips.

shape also is altered, and in place of the rounded outline of the brown-tipped feather, we have left only its pointed, black base. The rest of the plumage undergoes a similar alteration, which in some places is evidently assisted by fading. For instance, the auriculars of September birds are brown nearly to their bases. The feathers of this region wear off only slightly, but in June birds the auriculars are pure white. There is also a fading of the brown tips themselves, and the small terminal fringe on the feathers of April birds is largely white.

The reason why these feathers in wearing off should assume a particular shape is found both in their pigment and structure. It is a well-known fact that certain pigments, doubtless in proportion to their density, give greater strength to feathers than others, and in this case that portion of the feather containing the black pigment, aside from other causes, is apparently better able to stand the effects of abrasion than the brownish or less heavily pigmented terminal portion. The strength of the black base, however, is more largely due to its structure. Examination under a low power of a dorsal feather from an October male shows that

the pointed end of the black basal area extends only to the end of the true shaft, the two barbs into which the shaft divides terminally being brownish. It also shows that at their apical portion the barbs are separated, and that the barbules do not become fairly interlocked until the black basal part is reached. This will be understood by reference to the accompanying cut of

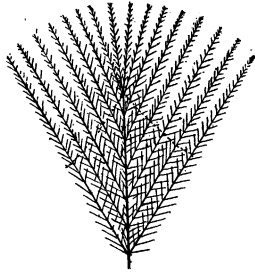


Fig. 2. Tip of a dorsal feather of *Plectrophenax nivalis*, from an October specimen. The apical portion down to the dotted line is later gradually worn off.

the tip of a dorsal feather from an October specimen. The black portion of the feather, therefore, not only is more protected than the tip, but is rendered stronger through both its pigment and structure.

Turning now to the female we find that whereas in breeding plumage she differs markedly from the male, in autumn plumage there is little apparent sexual difference. Closer examination, however, shows that the characters which so easily distinguish the female from the male in June, are also present in September, but are then largely concealed by the brownish tips to the feathers.

Thus the June female has the head, nape and rump dull blackish, not white as in the male, and when we examine September specimens we find that, aside from the difference in the wings, the sexes may be distinguished by this character; that is, the male has the feathers of the head, nape and rump basally white, while in the female they are basally black. It will also be observed that where both are black—for example, on the back—the black of the male is brighter and deeper in the autumn, just as it is in June.

But a more interesting point of difference between the sexes in breeding plumage lies in the fact that while in the male the brown tips to the feathers almost if not entirely disappear, the female retains a slight terminal fringe, which gives to her plumage a grayish cast. I cannot give a conclusive reason for this difference. There is no appreciable difference either in the length of the feather or its brownish fringe, but in the female the black center is somewhat narrower transversely, and the brownish fringe extends further down the sides of the feather, where 'it is evidently not so exposed. This, however, does not explain how in some feathers, for instance the tertials, the female retains a complete brownish border. The female may be less active than the male and her plumage be thus less exposed to abrasion. Still the fact remains that we have here a sexual character rendering the male more conspicuous and the female more obscure, which cannot be attributed to a fundamental sex-difference, but is made manifest through a mechanical cause.