

the coast about forty miles north of Christchurch, which was stocked with rabbits some thirty years ago by Mr. Caverhill. About every seven years disease nearly exterminates the rabbits; but the fittest survive and breed up again. The reason is popularly supposed to be that the rabbits increase beyond their food-supply, and, becoming weakened in consequence, are attacked by disease. This Canadian disease may be similar.

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ART. XXXVI.—*The Soaring of the Hawk—A possible Reason for Notched Wing-feathers.*

By T. W. KIRK, F.R.M.S.

[*Read before the Wellington Philosophical Society, 31st July, 1889.*]

PLATE XVIII.

THE peculiar notched or cut-away shape of the primary feathers in the wings of many birds, more especially of the Raptores, or "birds of prey," has often attracted my attention, and the purpose of such emargination has been a source of curiosity to me for many years.

Before going further, however, allow me to direct your attention to this feather (Plate XVIII., fig. 1). You will observe that the outer portion of both the anterior and posterior vanes (I am speaking of the feather as though it were in position in the expanded wing) is cut away, the anterior for about half its length, the posterior for rather less. The form of these feathers has, of course, been frequently described, but I have never seen any explanation of why their shape should be as it is—indeed, I believe no such explanation has been published.

I recently stumbled, so to speak, upon what may perhaps prove to be a solution of the question. When up country a short time ago I saw a large hawk (*Circus gouldi*) shot while soaring. After receiving the charge it continued to soar although rapidly descending, and fell at some distance with both wings extended. On going to pick it up I was surprised to observe that, though quite dead, its wings were still expanded, and the primaries were locked by a partial reversal of their vanes, as shown in the specimen now on the table (fig. 2). Fig. 3 shows the under-side of the same wing.

The question arose, was this position of the feathers due to accident, or had the bird the power of placing them in this apparently unusual relationship? and, if the latter, with what object? After a careful examination, I replaced the vanes in

what, until more information is obtained, must be regarded as their correct position (fig. 4). Fig. 5 shows the under-side of the same wing. I then extended the wing, and after several experiments found that, by manipulating the joint with the fingers just before the wing became fully stretched, most of the primaries could be made to take the position they occupied when first examined—that is, the locked position (fig. 2).

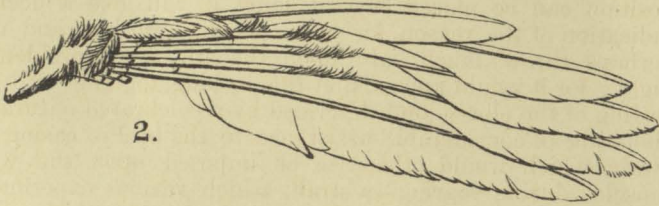
This seems to prove that the bird had the power of, at will, altering the relative positions of these feathers. If such a supposition can be placed beyond doubt it will give a decided indication of the reason for their peculiar outline, and may perhaps throw much light upon the still-vexed problem of flight; for it would appear that this locking, together with the setting of the elbow-joint described by a celebrated naturalist, should be of considerable assistance to the bird in easing the strain which would otherwise be imposed upon the wing-muscles during soaring—a strain which various experiments have shown would be very great—indeed, almost insupportable—unless the muscles were relaxed at short intervals; but, as birds sometimes remain soaring for hours, it is evident that no such relaxation or flapping takes place. I am aware that the partial change in the position of the primaries would seem to lessen the resistance which the expanded wing could give to the air; also, that all soaring-birds do not possess notched feathers, and that some birds which do not soar have them.

I have not had the opportunity, nor do I possess the skill, requisite to minutely examine the internal structure of the wing, but feel sure that, although the anatomy of wings has received great attention, and is apparently well understood, it will yet be found that there is some muscle either set apart for the purpose of altering the position of these feathers in the manner indicated, or one the secondary function of which is to do so.

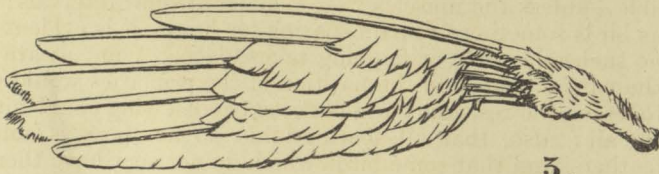
The whole question can only be decided by an extensive series of observations and experiments in the field, aided by the most careful anatomical work in the laboratory. This brief note is written, not with any pretence to settle the matter, but with the hope that others who possess more facilities for conducting experiments and research may be induced to study the subject. Then, perhaps, a satisfactory solution may be discovered.



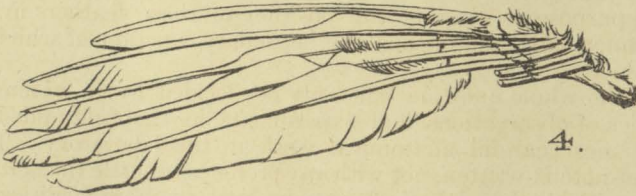
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