peculiar to nightjars, owls, herons, cormorants, and gannets, and different from anything found in any other bird, but merely as a highly modified form of a structure found in a less modified form in many birds. Presumably these structures serve to rid the birds of troublesome parasites. If this is correct, it would be interesting to learn whether the birds possessed of pectinated claws are particularly liable to the attacks of hurtful parasites, or whether we may consider that in them only have variations in the direction of pectination arisen.

Treborth, Bangor, January 24. H. R. DAVIES.

MR. DAVIES' confirmation of my results is very interesting, and in many ways, I think, conclusive. So far as my memory serves me (I have not here access to a collection), I can bear out all his facts. I regret that I have never taken the names of the different species in which I have observed the blade. The Pomarine Skua is one. A friend tells me that he has also noticed a jagged blade; and, he believes, in a guillemot.

It would appear that the list of pectinated birds given by Owen ("Anat. and Physiol. of Vertebrates," ii. 232) is too short. Indeed, we may hope to find many links between the blade and the serration. Mr. F. E. Beddard, in a paper on *Photodilus badius*—an owl considered by some ornithologists to be very near *Strix* (*Ibis*, 1890)—writes: "The claw is, however, produced laterally into a knife-edge, as in other owls. . . . I have examined an example of *Strix*, in which the jagged edge of the toe in question was very inconspicuous; and the question arises, whether it does not occasionally disappear altogether."

As regards the question of vermin, Owen says that each species of pectinated bird is infested by its peculiar louse (*Nirmus*). According to Hudson, the herons are especially free from vermin;[1] though the (roseate) spoonbill, which also has the pectination, is infested with them ("Argentine Ornithology," ii.). This author does not think that the herons could ever rid the entire plumage of vermin by means of the claw. It is curious that the herons were always in a miserable condition; the spoonbills plump and healthy.

Audubon once shot a frigate-bird which was scratching its head; and, on examining the pectination with a glass, found the racks of the comb crammed with the insects which occur on the bird's head, and especially about the ears. He also observed that the pectinated claws of birds of this kind were much longer, flatter, and more comb-like than those of any other species with which he was acquainted. He gives the tropic-bird (also a *Steganopod*) as having a knife-edge.

I am unable to say whether certain members of a genus are, as a rule, more infested by vermin than others.

E. B. TITCHENER.

Inselstrasse 13 Leipzig, February 11.

On the Affinities of Hesperornis.

IN Dr. Shufeldt's letter (NATURE, Dec. 25, 1890, p. 176) no mention whatever is made of Prof. Fürbringer's studies on the point in question, and they appear, moreover, to have been partially misunderstood by Prof. Thompson. Prof. Fürbringer published his "Untersuchungen zur Morphologie und Systematik der Vögel" (2 vols. in folio; Amsterdam) in May 1888, and I beg to reproduce some of his results as to the family *Hesperornithidæ*.

Like Prof. Marsh, Prof. Fürbringer sees Ratite characters in the configuration of sternum, breast-girdle, and anterior extremity, but, in opposition to that author, finds nothing of a specifically Ratite description in the remaining parts of the skeleton. On the other hand, these parts—especially the pelvis and hinder extremity—correspond, as shown in detail, decidedly with the type *Colymbidæ*, *Podicipidæ*, and *Enaliornithidæ*. Herein lies the clue to the systematic position of *Hesperornis*.

Particular attention has, further, been paid to the dentition, on account of which Prof. Marsh has grouped under the S.C. *Odontornithes* the *Hesperornithidæ*, as O. *Odontolcæ*, with the *Ichthyornithidæ* (O. *Odontotormæ*), and with the *Archæopterygidæ* (O. *Saururæ*). In this Prof. Fürbringer does not follow him, but maintains that, in all probability, all ancestral ornithological forms possessed toothed jaws, and, consequently, that the dentition is of as little decisive genealogical importance in birds as in mammals, and that the three orders of toothed birds mentioned belong to completely different ornithological types, of which the Ratite *Hesperornithes* stand much nearer to the *Colymbo-Podicipites*, and the Carinate *Ichthyornithes* to the *Laro-Limicolæ*, than they do to one another.

The condition of the sternum, however, whether Ratite or Carinate, may not afford a point of more weighty genealogical significance. According to Prof. Fürbringer, the better-known *Ratitæ* form a perfectly artificial group—a medley of once Carinate birds sprung from the most dissimilar genealogical branches, which now possess nothing in common further than the purely secondary point of analogy that, with the advancing development of the hind-limb and increasing bulk, they have lost the power of flight. The representative forms of the so-named S.C. *Ratitæ* are as far, if not further, removed from one another, as are those of the S.C. *Carinatæ*, though, between this or that division of either S.C., certain points of affinity of a non-intimate nature are to be found. These are closely examined in Prof. Fürbringer's work.

After having set aside the higher taxonomic significance of the dental and sternal characters, there remains for Prof. Fürbringer only the decided agreement of the skeleton of the *Hesperornithidæ* with that of the *Colymbidæ*, *Podicipidæ*, and *Enaliornithidæ* as of true genealogical worth. The relations of these divisions are of a truly genetic description, but it is impossible to derive the *Colymbo-Podicipites* from the *Hesperornithes*, which were differentiated already in the Cretaceous period in the most one-sided manner. We might with better right trace the latter to some very ancient *Colymbo-Podicipite* form, though the safest course to follow is to regard both as independent branches of a common bough.

The avian system drawn up in chapter vi of Prof. Fürbringer's work, and represented in the accompanying genealogical trees (Plates xxvii.–xxx.), is based upon these considerations. Neither *Odontornithes* and *Anodontornithes* (*Euornithes*), nor *Ratitæ* (*Platycoracoideæ*) and *Carinatæ* (*Acrocoracoideæ*), are mentioned as genealogical divisions, but a S.O. *Podicipitiformes* is formed out of the *gentes Enaliornithes* (F. *Enaliornithidæ*), *Hesperornithes* (F. *Hesperornithidæ*), and *Colymbo-Podicipites* (F. *Colymbidæ* and F. *Podicipitidæ*).

All this proves that the penetrative researches and observations of Prof. Fürbringer on the position of *Hesperornis* had raised him no less than two and a half years ago in the chief question to the point attained by Prof. Thompson and Dr. Shufeldt in 1890. The latter writers differ from him only in that Prof. Thompson ascribes to *Hesperornis* as intimate a relationship to the *Colymbi* as, for instance, that of *Stringops* to the *Psittaci*; while Dr. Shufeldt holds it possible that the *Colymbi* are descended from *Hesperornis*. As is shown in a recent paper on the subject (cf. *Ornitholog. Monatschr. d. Deutsch. Ver. z. Schutze d. Vogelwelt*, 1890, No. 18), Prof. Fürbringer is unable to share these taxonomic views, but abides by the opinion maintained by him in 1888. F. HELM.

Royal Zoological Museum, Dresden, January 29.

Destruction of Fish by Frost.

I THINK it follows from the second clause in the question at the end of my letter of January 26 (p. 295) that I assume want of air to be the cause of the destruction of the fish in the Regent's Canal. Cases like that which Mr. Hill mentions (p. 345) have been so familiar to me from boyhood that it did not occur to me to be more explicit. Moreover, I did not say that the effect of this agent of destruction would often be "on a scale visible to the geological eye." This it is of which I was thinking: occasionally fossil fish are very numerous in a particular stratum. Various causes for this apparently sudden destruction have been suggested; it occurred to me that this one sometimes might have to be considered among the possible contingencies. Though, as he says, a slight flow of fresh water is "seldom wanting in any natural body of water," yet fish may be killed (as I have seen) in a pond through which a streamlet runs. The supply must be equal to the demand. Now the volume of streams in certain cases is greatly reduced in winter: the Reuss above Wasen on November 28, 1889, was a very different river from that which we have seen in summer. If, then, a lake were frozen, and the amount of water which entered it greatly reduced, the conditions of a pond might possibly be imitated during an exceptionally long winter, or even a river become almost like a canal. This remark applies especially to freshwater deposits, but as long frosts are sometimes followed by floods, the dead fish might be carried for a considerable distance. T. G. BONNEY.

[1] The fact that my bird scratched himself immediately after a meal may be in point here.