may supply a hint or two, but these will not be dwelt upon just here.

To conclude, we may affirm, that beyond doubt there was a marked change of color in the feathers of my Owl from gray to a reddish cast; that this was not concurrent with any pronounced feather loss (ptosochromatism); that it was undoubtedly, as seen at the present, influenced partly, if not in whole, by an unnatural diet (liver and kidney); and that in consequence it is an example of abnormal aptosochromatism.

It appeared from the macroscopic nature of the change that repigmentation was forcibly present but to my misfortune, being unable to further investigate this, I will leave it open to the judgment of my readers.

THE COLOR OF CERTAIN BIRDS, IN RELATION TO INHERITANCE.

BY I. BICKERTON WILLIAMS, F. Z. S.

THERE are two powerful tendencies whose working has, apparently, determined, to a large extent, the differences and the resemblances in the color of birds, as well as many others of their characters.

These are 'Variation,' on the one hand, tending to produce desirable and necessary changes through the action of natural selection; and 'Inheritance,' on the other, tending to preserve and hand down those forms and qualities that were useful and beneficial to former generations, and which, even now, are not injurious.

In the determination of color, sometimes one of these tendencies seems to have got the upper hand, and sometimes the other. There are certain bird groups that display so many different styles and colors, that, like modern fashions, one might imagine they had been adopted merely for the sake of variety; while, in other groups, some ancient style of plumage and color appears to have

been handed down, almost unchanged, from primitive times; like the Highland costume, which, among ourselves, still survives as a memorial of the past.

The Pigeons are a very homogeneous order of about four hundred and fifty species, and it is not difficult to believe that they all sprung from some primeval pigeon-like bird.

They are divided by Count Salvadori[1] into three principal families — the Tree Pigeons (Treronidæ), Typical Pigeons (Columbidæ), and Ground Pigeons (Peristeridæ). There are, also, two small and peculiar families: the Crowned Pigeons (Gouridæ) with six species, inhabiting New Guinea and some neighboring islands; and the Tooth-billed Pigeon (*Didunculus*), which forms a family by itself. These last two families represent an older type than the others, and are more nearly allied to the extinct Dodo, which used to inhabit Mauritius.

The legs of the Crowned Pigeons are covered all over with small hexagonal scales. Birds with this kind of leg covering are, usually, of ancient type, for it is a more reptilian style than the broad scutellæ which most of them possess.

Gray is the general color of the Crowned Pigeons, with some chestnut markings on the wing-coverts, and a band of chestnut across the back, or the breast.

The Tooth-billed Pigeon has chestnut on the back and wings, though the gray has nearly disappeared, and only a slight tinge of it remains round the sides of the lower neck and on the mantle.

The Dodo, and its near ally, the Solitaire, were both gray birds; the one is described as having been "an ash-color," and the other "a brown gray."

Now, in almost every Pigeon, we find some trace of these primitive colors: some gray, usually on the head or neck; some chestnut, or other reddish shade, on the bend of the wing, or across the back or breast.

In the richly colored group of Tree Pigeons, variation has apparently got the upper hand, but even in a species like Swainson's Fruit Pigeon (*Ptilopus swainsoni*) a little gray still remains on the head, and the beautiful green feathers of the breast are

[1] Brit. Mus. Cat. of Birds, Vol. XXI.

tipped with it. The underside of the tail feathers is also gray; while a streak of lilac across the breast is the only trace left of the chestnut band.

The Passenger Pigeon is a fine example of the typical family, where gray usually predominates. The head and rump are a specially bright shade of gray; the breast is suffused with the reddish tint, and on the tail some almost concealed patches of chestnut still exist.

In the Blue-headed Quail Dove (*Starnœnas cyanocephala*), from Cuba, which represents the Ground Pigeons, the chestnut shade has spread nearly all over the body, but the olive brown of the back indicates the presence of a certain amount of the gray shade, and the rest of the gray, by being concentrated on the head, has become a deeper tint than usual. The legs of this bird, like those of the Crowned Pigeons, are covered with hexagonal scales; and the survival of this ancient type of scale, in such distant islands as Cuba and New Guinea, is as interesting and peculiar a fact as the two remaining examples of the tapir family being found, respectively, in the Malay Region and Brazil.

There is, also, a group of the Duck family, consisting of some sixteen or seventeen species, which form the subfamily Plectropterinæ of Count Salvadori's classification;[1] and all of them display a certain similarity in coloring that has, apparently, been handed down from a primeval type.

The Horned Screamer (*Palamedea cornuta*) represents a very old form of bird allied to the Ducks. It has spurs on the wings, hexagonal scales on its legs, and a curious horn-like projection on the head. Its main colors are glossy black above and white below.

The Pied Goose of Australia (*Anseranas melanoleucus*) is a more duck-like bird, with partially webbed feet; its general color is black above and white below, and it occupies an intermediate place between the Horned Screamer and the Plectropterinæ, of which the Spur-winged Geese of Africa are typical members; they, also, are glossy black above and white below, and have a knob, instead of a horn-like growth, on the top of the head.

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[1] Brit. Mus. Cat. of Birds. Vol. XXVII.

The Black-backed Goose of India and Africa (*Sarcidiornis melanonota*) also shows a similar black and white plumage, and a fleshy knob on the beak, but 'variation' is driving the black from the head and neck, which presents, in consequence, a most curiously speckled appearance.

In the Wood Duck (*Aix sponsa*) which also belongs to this group, variation has certainly got the upper hand: the fleshy knob has been succeeded by a crest of beautiful feathers; and, altogether, the bird has become one of the handsomest of its tribe; though it still retains the dark glossy back and wings, and the long rounded tail feathers, which are distinguishing marks of nearly all the subfamily.

The Pigeons and Ducks afford an illustration of the inheritance of general colors; but, in some groups, patches and spots of special color seem to be inherited, and become recognition marks of several allied families.

The strong tendency of the Woodpeckers to display a patch of red, or sometimes yellow, on the head of the male bird is well known; but the three other, most nearly allied, families of the zygodactyle Picariæ, viz., the Barbets, Toucans, and Honey-guides, have a similar tendency to show a red or yellow patch on the head or the rump, sometimes on both.

More than ninety of the hundred and twelve known species of Barbet display patches of one or other of these colors, and the few that are without them are generally dull colored birds.

In the Toucans the crimson or scarlet patch on the rump or crissum is a marked feature of the family. In a few species the patch is chestnut; but there are only four or five of the fifty-nine recognized species that are altogether without it.

Nine out of the twelve Honey-guides have some shade of yellow on the lower back or rump, and two, out of the three exceptions, have a white patch.

Like the Woodpeckers, these three families all nest in hollow trees, and lay white eggs.

Their national colors are, evidently, red and yellow.

The Kingfishers are as remarkable for their attachment to blue, or sometimes green, as the Woodpeckers to red. Many species are almost entirely blue on the upper surface, in others

the blue is confined to patches on the lower back, and on the wings. In the Belted Kingfisher it is diffused, as bluish gray over the whole upper surface.

Even a species like the Ruddy Kingfisher (*Halcyon coromandus*), whose plumage is almost entirely chestnut, has, still, a distinctly blue reflection on the white rump, and a purple gloss lingers over the upper surface of the back and wings. The Laughing Kingfisher (*Dacelo gigas*) has, also, notwithstanding its sombre tints, some bluish spots on the wings and rump.

Blue, or green, is a predominant color in the Rollers, Bee-eaters and Motmots, — the three anisodactyle families that are most nearly allied to the Kingfishers. The Rollers have generally rich shades of blue on the wings and tail, as well as on other parts; and the other two families have, as a rule, some bright patch of it on the head or rump.

Like the other group, they all lay white eggs, which are concealed, either in tunnels excavated in the banks of streams or in hollow trees.

Why should the zygodactyle group have a red tendency, and the anisodactyle a blue tendency? It has nothing to do, apparently, either with food or climate.

Is it not, probably, an inheritance from the primeval type of each group, which has become so strongly fixed in the constitution that it is almost impossible to get rid of it?

We may conclude, I think, that color, evanescent and transitory as it sometimes seems, is, under certain aspects, almost as good a guide in classification of birds as the shape of the bill, or the arrangement of the toes.

The groups here noticed were specially suggested by the birds that happened to be in the Natural History Society's Museum at Montreal; but the same persistence of primitive colors could, probably, be traced in other orders, where some early type of the group is still represented by a living form.