AN INADEQUATE "THEORY OF BIRDS' NESTS."

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WHY the thousands of species of birds build each a peculiar nest, differing more or less in situation and architecture from those of all other species, is a question which has as yet received no satisfactory answer. As a rule, the nest, including its location, the materials and manner of its construction, is as distinctive of the species as the number, size, form, and color of the eggs, or, in some instances, as any fact in its history, not excepting even the details of structure and coloration of the bird itself. Why this is so we can perhaps explain when we can satisfactorily account for the diversity of song that is scarcely less a specific characteristic. Yet the structure and position of the nest, even among birds of the same species, is more or less varied by circumstances, sometimes even to a striking degree. In some cases the influence of peculiar surroundings is most obvious, as when, for instance, a species that habitually nests in trees, like the Carolina Dove, is found in treeless regions to place its nest on the ground, or when a Woodpecker, under similar circumstances, excavates for its nesting-site a cavity in a clay-bank. Not unfrequently birds exhibit in their choice of nesting-sites something quite akin to intelligent foresight, as is manifestly the case when such species as the Brown Thrush and

the Canada Goose, that commonly nest on the ground, place their nests in bushes or trees in localities subject to sudden inundation. Many species, profiting by dearly bought experience, will abandon, in consequence of persistent persecution, long-occupied breeding-grounds for those more remote from danger. A remarkable instance of change in breeding habits from this cause is afforded by the Herring Gull, which, to escape its human foes, has been known to depart so widely from its usual habit of nesting on the open seashore as to place its nest in trees in more or less inland swamps. That birds have the power to grapple intelligently with unexpected emergencies has been repeatedly shown, a most striking instance being afforded by the Baltimore Oriole, which has been observed to repair a half-demolished nest by weaving one end of a string into the weaker side and fastening the other end taut to a branch above. The fact that various species of Swallows, the Wren, Chimney Swift, and some other of our native birds which originally nested in deserted Woodpeckers' holes or hollow trees, abandon such nesting-sites for the better ones accidentally or intentionally provided by man, shows that they are by no means the slaves of "blind instinct," but are able to take advantage of favoring circumstances.

The materials used by birds in forming their nests, it has been assumed, are those nearest at hand or most easy to obtain, or such as their peculiar habits chance to render them most familiar with, and that the mode of nidification depends upon their constructive ability, — upon the "tools" with which nature has provided them. This is undoubtedly to a great degree true, for it would be hard to conceive of the construction of an elaborate nest by any members of the Whippoorwill or Night-Hawk family, whose bills are excessively weak and small, and whose feet are unfitted for walking or perching, being barely able to support them on a flat surface. Hence we are not surprised that they place their eggs on the ground without the provision of a nest. Many other groups of birds are almost equally incapable of building nests. But among species equally furnished with the means for elaborate nest-making, there is the greatest diversity in the results of their architectural labors. Even when the materials employed by different species chance to be the same, the structures resulting from their use bear the impress of different architects. Nests of the same species also vary greatly at different localities in consequence of the materials

most readily available for their construction being not everywhere the same; they also vary in accordance with the climatic conditions of the locality, the same species building a quite different nest, as respects warmth and stability, in the colder portions of its habitat from that which it constructs in the warmer portions.

But while these deviations under diverse circumstances readily explain variation in the situation and character of the nests of the same species, they fail to explain why closely allied species, living together under precisely the same conditions of environment, and sometimes so closely resembling each other in size, color, and all external characters as to require the eye of an expert to detect their specific diversity, should build totally unlike nests, and display almost the widest possible differences in respect to their situation. To cite, in illustration, a single example from the many that might be given, we may instance our common Pewees and Flycatchers. In this small group we find a wide range of diversity in breeding habits among species most intimately related in structure and general habits. The Least Pewee builds a small, compact, felted nest of fine soft materials, and its nearest allies, the Acadian and Traill's, build far ruder and much more bulky structures of coarse grasses, strips of bark, and other similar materials. Another near relative of these species, the Wood Pewee, selects for its nesting-site a lichen-covered dead branch, on which to saddle its small, highly artistic, cup-shaped nest, covered externally with lichens glued to the surface in such a manner as to render the structure almost indistinguishable from a natural protuberance of the branch itself. The Bridge Pewee, another allied species, builds a large bulky nest, formed outwardly of a heavy layer of mud, copiously lined with dry grass and feathers, and shelters it in the chinks of walls, under shelving rocks, in sheds, outbuildings, and under bridges. The Great-crested Flycatcher chooses hollow trees or deserted Woodpeckers' holes in which to form its nest and deposit its eggs, while its allies, the Kingbirds (genus *Tyrannus*), build large open nests, which they make no attempt to conceal.

Notwithstanding all this diversity of situation and structure among closely allied species, birds' nests have been divided into two classes, according to "whether the contents (eggs, young, or sitting bird) are hidden or exposed to view," and the broad generalization based thereon that the character of the nest is intimately related to the color of the female parent-bird. This, in fact, is Mr.

Wallace's "Theory of Birds' Nests." * This "theory" has for its basis the assumed "law which connects the colors of female birds with the mode of nidification." Mr. Wallace states it to be a rule, open to "but few exceptions," "that when both sexes are of strikingly gay and conspicuous colors, the nest is .... such as to conceal the sitting bird; while, whenever there is a striking contrast of colors, the male being gay and conspicuous and the female dull and obscure, the nest is open and the sitting bird exposed to view." He cites as examples of the first class, or those in which the female is conspicuously colored and the nest concealed or covered, "six important families of *Fissirostres*, four of *Scansores*, the *Psittaci*, and several genera and three entire families of *Passeres*, comprising about twelve hundred species, or about one seventh of all known birds." This statement, however, proves on examination to be quite too sweeping, since a large proportion of the species here named either do not have a concealed nest, or are of sombre and obscure tints. There are also other entire families and various additional genera, in which the males are brilliantly and the females obscurely colored, which build a domed nest. I now propose, so far as the limits of a short article will allow, to test this theory by a rapid survey of the birds of North America, — an area certainly large enough to afford a fair basis of judgment. For this purpose I shall consider the modes of nidification under four heads, namely, (1) nidification in holes in trees; (2) in burrows; (3) domed, pensile, or otherwise more or less "covered" nests; and (4) nests wholly open.

1. Among North American birds those that habitually nest in holes in trees embrace several species of the smaller Owls, one or two kinds of small Hawks, all the various species of Woodpeckers, all the numerous species of Titmice of the genera *Lophophanes* and *Parus*, the several species of Nuthatches, the Brown Creeper, some of the Wrens, the Bluebirds (three species of *Sialia*), several species of Swallows, Martins, and Swifts, the Great-crested Flycatcher, the Carolina Paroquet, and three or four species of Ducks. In very few of these can the colors be considered as "strikingly gay and conspicuous," and when this is the case, as in the Bluebirds, a few of

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the Woodpeckers, some of the Swallows, the Wood-Duck, the Hooded Merganser and the Buffle-head, the females are much paler and duller colored than the males. In many other instances the colors are in the highest degree adapted for concealment under every circumstance, and especially in a sitting female bird, as, for instance, in the Brown Creeper, the Wrens, some of the Titmice, the Swifts, and various others.

2. The burrowing species embrace the Prairie Owl, the Kingfishers, two species of Sand Martin or Bank Swallow, the Petrels, various species of Auks and Puffins, and some of the Guillemots. The Kingfishers possibly excepted, almost none of these have bright or conspicuous colors, while in several the colors could scarcely be better adapted for concealment. Especially is this the case with the Owl and Sand Martins, with their dull neutral tints.

3. Among the comparatively few species that build a covered or domed nest are the ground-building Golden-crowned Wagtail or "Oven-Bird," the Dipper or Water-Ousel, the Meadow Lark, the common Quail, and several Warblers. The first two of these have tints peculiarly adapted for concealment, and the colors of the dorsal area in the others are likewise "protective." Among the species building covered nests in reeds, bushes, or low trees, are Marsh Wrens, some of the other Wrens, the smaller Tits (genera *Psaltriparus*, *Auriparus*, etc.), several of the Warblers (family *Sylvicolidæ*), the Magpie, and perhaps a very few others. Of these the Wrens and Tits are all obscurely or protectively colored, and have no "surprisingly gay and conspicuous" tints. Some of the Warblers are more brightly colored, and a few have rather conspicuous markings; but these features are almost wholly confined to the male, the females being of comparatively dull and obscure tints. The Magpie has showy colors and a very long tail, and the bulky nest, wholly concealing the sitting bird, may be useful in hiding these otherwise betraying features. The species which build hanging, purse-shaped, or subpensile nests are the Orioles and Vireos. In the case of the former the nest is most illy adapted for protection from the most dangerous foes of the species, the predatory Crows, Jays, and Cuckoos, being often a conspicuous object, with, so far as the United States species are concerned, no compensating feature of security. Here again, while the males are in some instances arrayed in "strikingly gay and conspicuous colors," the females do not to any great extent share their bright hues, the sexual differences in

color among our native birds being rarely greater than in these species. The subpensile nests of some of the Vireos are to be perhaps more properly referred to the type of open nests. In either case we find only slight sexual difference in color, with the olivaceous hue of the back well fitted for concealing the female bird. But this is in part offset by the usually light color and somewhat exposed situation of the nest.

4. The great bulk of the species fall of course into the fourth category, or those with the nest open. These embrace (with two exceptions, the Woodpeckers and the Kingfishers) birds of every family represented in our fauna, and are about equally divided between ground-builders and those which nest in bushes or trees. As a rule (as, in fact, throughout the class of birds) in those arrayed in conspicuous tints the females are obscurely colored, in comparison with the males. Yet to this rule there are exceptions, as notably among the Jays, some of which do have "surprisingly gay and conspicuous colors," and among which both sexes are equally brilliant. The shining black color of the Crows, the Raven, and some of the Blackbirds are equally or (in the latter) almost equally shared by both sexes, while the color is by no means well adapted to concealment. In many species the males, even when brightly colored, share with the females the duties of incubation. This is the case with the Rose-breasted Grosbeak, in which the male is most conspicuously colored, and who not only shares the labor of incubation, but has the most injudicious habit of indulging in loud song while sitting on the nest. In many of our ground-nesting Sparrows the sexes, in respect to coloration, are wholly indistinguishable; their obscure colors, arranged generally in streaks and spots, are certainly in the highest degree protective; their nests, although not domed, or even "covered," in the strict sense of the term, are generally most effectually concealed under tufts of herbage, and are hence far better shielded from observation than the pensile, domed, or bulky, covered nests that are regarded by our author as so highly conducive to security through the concealment of the eggs and young or the sitting female.

Among the groups instanced by Mr. Wallace as building open nests are "the extensive families of the Warblers (*Sylviadæ*), Thrushes (*Turdidæ*), Flycatchers (*Muscicapidæ*), and Shrikes (*Laniadæ*)." While in a considerable proportion of the species of these groups the males are "beautifully marked with gay and con-

spicuous tints," "in every case the females are less gay, and are most frequently of the very plainest and least conspicuous hues. Now," he continues, "throughout *the whole of these families the nest is open*,* and I am not aware of a single instance in which any one of these birds builds a *domed nest*, or places it in a *hole of a tree*, or *under ground*, or in any place where it is effectually concealed." As regards the North American representatives of these groups, there are frequent exceptions to this rule, as I have already shown, and that Mr. Wallace did not know of exceptions only shows that his examination of the subject must have been very superficial. As further evidence of the imperfection and inexactness of Mr. Wallace's knowledge of the subject concerning which he theorizes so boldly and speaks so emphatically, may be cited his remark about the *Icteridæ*, or "Hangnests." "The red or yellow and black plumage of most of these birds," he says, "is very conspicuous, and is exactly alike in both sexes. They are celebrated for their fine purse-shaped pensile nests." As regards the facts of the case, there is no family of Passerine birds where the sexes, *as a rule*, are more widely different, the difference affecting not merely color, but also size, the females being not only much duller colored than the males, but much smaller. The instances in which both sexes are equally brilliant are the exceptions.

To summarize the foregoing remarks, it has been shown, so far as the birds of North America are concerned (and the same could easily be shown for other equally extensive regions), that the species which breed in holes in trees, in burrows in the ground, or in domed, pensile, or covered nests, are as often dull, obscurely colored species as bright-colored; that when the species are conspicuously colored, it is generally only the male that is attired in strikingly gay tints, the females having comparatively dull colors; and that often species in which both sexes are clothed in bright and equally conspicuous tints build an open nest; while the "theory" demands just the opposite of these conditions. In other words, that birds nest in holes, in open or in covered nests, without regard to whether the female is brightly or obscurely colored. Furthermore, that pensile and bulky covered nests are far more open to discovery than ordinary open nests, so that the advantage of having the contents concealed, be it eggs, young, or the female parent, is more

* The italicized portions are as in the original.

than counterbalanced by the readiness with which the nest itself is discovered.

Not to do Mr. Wallace or his theory injustice, it may be added that he has instanced a considerable number of large families of birds, found outside of North America, in which the species nest in hollow trees, and in which both sexes do have "surprisingly gay and conspicuous colors." Among these are the Trogons, the Barbets, the Puff-birds, the Toucans, and the great group of Parrots and Paroquets. But Mr. Wallace has himself given an apparently far better reason for this method of nidification in some of these groups than that involved in his above-given theory, namely, that they have not the necessary "tools" for the construction of an elaborate nest. Most of them are weak-footed and sedentary, while in other cases the form of the bill renders the construction of a nest almost impossible. Another large group, the species of which nest in holes in trees, are the Woodpeckers. Here an obvious and far more rational explanation is apparent than that afforded by the theory of concealment, for here the scores of dull-plumaged, sombre-colored species nest in holes just as do those that are conspicuously attired. In this group the species do not seek cavities already at hand, as is the case in some of the groups just cited, but form them themselves, and use them not only for purposes of nidification, but often more or less habitually as places of shelter. Nothing seems more natural than that they should avail themselves in this way of the advantages afforded them by their powerful chisel-shaped beaks, which they are constantly using as an abrading or "digging" organ in their search for food. The same explanation holds equally good for the plainly colored Tits that nidificate in holes that they themselves have the power of forming.

The Auks, Puffins, and some of the Guillemots are among the species I have cited as breeding in burrows. As they are species (occasionally conspicuous markings about the bill or head excepted) of neutral or obscure tints, — particularly as respects the exposed dorsal area of the sitting female, — their resorting to burrows is hardly necessary for concealment, since these species have no "strikingly gay" attire of plumage that would render the sitting bird in any case conspicuous. Such resorts, however, prove to be to them a great source of security, and give them an immense advantage over other species of the same family that breed at the same localities with them, but in a wholly exposed manner. The

chief enemy of these birds is man, by whom they are robbed of their eggs in a most brutal and wholesale way. The species that breed in deep crevices in the rocks almost wholly escape the rapacity of their human foes, the eggs being almost invariably, it is said, placed beyond reach, while those (some of the Guillemots) that deposit their eggs on the surface are robbed almost to extermination. The dull, thoroughly protective colors of the Burrowing Owls, of which there are several species, render them often difficult objects to discover even when wholly exposed, yet they nidificate in deserted marmot holes, and there find security against the attacks of predatory skunks and foxes, to which they would be exposed if nesting on the ground, — usually the only other alternative in the localities they inhabit. In fact, instances might be multiplied in which the breeding of birds in holes in trees, or in the earth, or in otherwise concealed nests, might be explained more rationally than by the theory of concealment of a brightly colored female parent, — the basis of Mr. Wallace's ingenious "Theory of Birds' Nests," — namely, security from enemies through other means than simply concealment.

Mr. Wallace, in commenting on "What the Facts Teach us" in relation to this theory, argues that the differences in color between the sexes in birds that build an open nest may have been brought about by the bright-colored females being weeded out or eliminated in consequence of being more exposed to the attacks of enemies, since any modification of color which rendered them more conspicuous would lead to their destruction and that of their offspring, while the attainment of inconspicuous tints would tend to their preservation. Hence this theory is intimately connected with, or in part based upon, Mr. Darwin's theory of "sexual selection," which Mr. Wallace at this time accepted, but which he has recently had the better judgment to discard as an inadequate explanation of sexual differences in color among animals.

The most surprising thing about Mr. Wallace's "Theory of Birds' Nests"* is its inadequacy, and its irrelevancy to the facts it was proposed to explain, and in this respect it is scarcely excelled by any of the crude inventions into which the more ardent supporters of the

* I wish to here state explicitly that I refer in these remarks wholly to Mr. Wallace's "Theory of Birds' Nests," and not to his most admirable essay on "The Philosophy of Birds' Nests," which is replete with sound sense, and to nearly every syllable of which I most heartily subscribe.

theory of evolution by means of what has been termed "natural selection" and "sexual selection" have been betrayed.

In conclusion, I desire to call attention to an interesting coincidence between the manner of nesting among birds and the color of the eggs, and one so striking that it is almost surprising that some ingenious theorist has not seized upon it as a basis for a "theory of birds' nests," either independently or as a modification of that proposed by Mr. Wallace. It curiously happens that nearly all birds that nest in holes, either in the ground or in trees, lay *white eggs*, embracing, for instance, all the Woodpeckers, Kingfishers, Bee-eaters, Rollers, Hornbills, Barbets, Puff-Birds, Trogons, Toucans, Parrots, Paroquets, and Swifts, while only occasionally are the eggs white in species which build an open nest. In only two or three groups of land birds, co-ordinate with those just named, that build an open nest, are the eggs white, namely, the Owls, Humming-Birds, and Pigeons. On the other hand, in only two or three small groups of species that nidificate in holes are the eggs speckled or in any way colored. There is, in fact, a closer relationship, or rather a more uniform correlation, between the color of the eggs and the manner of nesting than between the color of the female parent and the concealment or exposure of the nest. There are, however, here apparently too many exceptions to bring this coincidence into the relation of cause and effect. It is perhaps rather comparable with the pattern of coloration that so often, to a greater or less degree, marks nearly all the species of a whole natural family, and often prevails throughout large genera, for which the conditions of environment offer no explanation, since it as often occurs in cosmopolitan groups as in those of local distribution, and which, in the present state of our knowledge, seems wholly inexplicable.