the rough tarsus to the bird's habit of roosting in trees, but under *Crypturus variegatus* (Wagler) (*Ibid.*, p. 748) says that he does not know whether that species also passes the night in trees. More recently F. P. and A. P. Penard, under the names *Tinamus subcristatus* (*l. c.* 1908, i, p. 318) and *Crypturus variegatus* (*Ibid.*, p. 322) definitely state the bearing of the construction of the tarsi in these two genera upon the dissimilarity in roosting habits.

Mr. Beebe's discoveries in regard to the homes of Toucans, also, are extremely interesting, although the state of affairs regarding our knowledge of the life history of Toucans was really not so scanty as conveyed by the few words of Levaillant which the author quotes. It may be of interest to call attention here to a Toucan egg said to be of *Ramphastos ariel* Vigors, collected by Krone at Iguape, and recorded by Ihering (Rev. Mus. Paulista, 1900, iv, p. 262). It is described as oval, measuring 37 × 28 mm., white, with deep pits on the surface. Schomburgk, Burmeister, and others from time to time, have mentioned Toucan eggs, but beyond saying that the eggs were white, two in number, laid in holes in trees, they did not give much information.

In concluding I wish to emphasize that I appreciate fully Mr. Beebe's good work at the research station in British Guiana, and my remarks should not be construed as having been made with the purpose of depreciating the excellent publication, of which I have discussed, after all, only some very unimportant details.

PROBLEMS SUGGESTED BY NESTS OF WARBLERS OF THE GENUS *DENDROICA.*

BY JOHN TREADWELL NICHOLS.

THE genus *Dendroica* with center of abundance in eastern North America, containing numerous closely related birds, inhabiting in a general way the same region and boldly contrasted the one from the other in plumage, constitutes a striking natural phenomenon calling for explanation.[1]

[1] Nichols, J. T., American Naturalist. September, 1916; pp. 565–574.

First what advantage to the race can there be in the evolution of so many species of similar habits? Probably though in the main not unlike, a careful comparative study of the species will show that sufficient difference of habit accompanies each to make it fit a slightly different niche in the environment. I mention a single phase, the construction of the nest. For my data on warbler nests I am indebted to Mr. P. B. Philipp of New York, who possesses a very complete personally collected series of these. In his collection we have together verified interesting points that he has learned, and also worked out other matters.

The nests of different species of *Dendroica*, even when found in the same country, are remarkably distinct and can usually be recognized at a glance. In Northumberland County, New Brunswick, a locality with which Mr. Philipp is particularly familiar, Cape May, Yellow, Black-throated Blue, Myrtle, Magnolia, Bay-breasted, Blackpoll, Blackburnian, Black-throated Green, and Yellow Palm Warblers all breed, and he has found the nests of all but the Blackburnian placed in spruces at different heights. The nest of the Blackburnian has not been found here, but doubtless is placed high up in the spruces, as he has found it in such situations in Pennsylvania. The Yellow Palm Warbler usually nests on the ground in moss or dead ferns, but one nest was placed a few inches from the ground in a small spruce. Though a single nest of the Yellow Warbler was found in a spruce, that species may nest more commonly in the willows. Cape May, Myrtle, and Blackburnian Warblers nest high, the other species low.

The nest of the Black-throated Blue has a characteristically pale exterior, weed stems, pale bark, and rotten wood-chips being favorite materials for the bird to use in its construction. It is lined with black, hair-like, slightly crinkly substance, much used for that purpose by Warblers, the stem of a woodland ground-moss (the Cape May has been seen gathering this material). Occasionally horsehair is substituted for it. In the Black-throated Green, spruce twigs and birch-bark whorls are characteristic of the exterior; hair and an occasional feather, of the interior. The Myrtle and Blackpoll both line the nest heavily with feathers; but the exterior is very different in the two,— in the Myrtle compact, of spruce twigs and fine dry grass, in the Blackpoll loose and bulky, rotten

wood-chips, mosses, and a few twigs being used. The Magnolia lines its nest with horse-hair if it can get it, this material being present in Pennsylvania nests taken where it was obtainable, but will use other hair or "moss-stems." One half or more of Mr. Phillipp's nests are lined with horse-hair. The Magnolia's nest is composed outside entirely or almost entirely of spruce twigs or grass and is a ragged looking nest. The Baybreast builds a ragged nest that looks like that of the Magnolia but is much larger; for lining it uses fine roots or "moss-stems." The Cape May's nest is thick-walled, rather flat, with fine sticks, a little grass and characteristic dried green moss on the outside, feathers and usually light colored hairs neatly molded down inside. A few "moss-stems" are used in construction, and outside, here and there are specks of very adhesive down. Mr. Philipp has seen a Cape May gathering fur from a dead rabbit, and also apparently picking hair out of a brush-pile.

As regards other species, the Blackburnian builds a nest resembling the Magnolia's but more compact and placed higher. The nest of the Yellow Warbler is smooth, very pale, of plant-down without, and fern-down within. The Yellow Palm Warbler's nest, usually placed on the ground in moss at the foot of a small spruce, is bulky, fairly thick-walled, of grass lined with fine rootlets often combined with some porcupine and at times other hair, and with usually only a few feathers.

There is some variation in the typical location of the nests by species, and in general the nest is very inconspicuous in its location. The dried moss on the Cape May's nest may be especially adapted to conceal it (from below) in the spruce tops from its enemy, the Red-Squirrel. The Baybreasts' ragged nest, well out on a low limb, is almost transparent. The pale Black-throated Blue nest in New Brunswick spruces is placed close to the trunk where it is well concealed; nesting in the rhododendrons in Pennsylvania, the Black-throated Blue nest is well concealed by the glint of light on the rhododendron leaves.

The nest of a bird is one of the most notable products of its instinct. Obviously much precision is necessary in selecting the appropriate materials and fitting them together, for the attainment of a successful product. That to obtain the right materials

is a problem to the individual bird is evidenced by the adoption of horse-hair by the Magnolia Warbler to supplant the very similar "moss-stems" which doubtless were its original material. The Chipping Sparrow must have substituted horse-hair for some pre-civilization material, and its habits are such that horse-hair is almost always obtainable by it and now almost the invariable nest-lining for the species. It is clear that to be successful the nest-building instinct of a given species must be pretty well fixed, that a bird must know what material it will use, also were all the *Dendroicas* dependent on,— let us say, feathers, horse-hair, or rabbit fur, there would be less of it for each, and specific differentiation is thus an advantage to the Dendroicine population as a whole.

Secondly, what advantage to the species is there in their contrasted plumages — in the writer's opinion the colors of each act as a uniform, facilitating the recognition by a bird of its own kind just as they facilitate its recognition by a bird student.[1]

A varicolored group of animals such as *Dendroica,* where many related species occupy the same locality,— other such groups come to the writer's mind, notably among tropical reef fishes,— should be considered in formulating or accepting theories on species formation. In many cases isolation and reinvasion are doubtless the succeeding steps in speciation, a process clearly indicated by work recently done by Taylor on the mammals of California.[2] There is no inherent impossibility of the many *Dendroicas* of eastern North America having been similarly evolved, but with them it would seem to have been a difficult and complicated process instead of a simple and easy one, as with sedentary mammals in a broken country, and may not the forms have arisen for biological advantage without these steps?

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[1] Nichols, J. T., Auk. Jan. 1912: pp. 44-48.

[2] Taylor, Walter P. Univ. of Cal. pub. Zoology, Vol. 12, no. 15, March, 1916.