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FEATHER IN AMBER IS EARLIEST NEW WORLD FOSSIL OF PICIDAE

ROXIE C. LAYBOURNE,[1] DOUGLAS W. DEEDRICK,[2] AND FRANCIS M. HUEBER[3]

ABSTRACT.—Two pieces of amber containing portions of feathers were obtained from the Dominican Republic. Only one feather was preserved in such a way that it showed diagnostic characters. By comparing the plumulaceous barbules of the fossil with several species of non-passerines, the fossil was identified as a member of the family Picidae. Further comparisons indicate that the fossil was related closely to the Antillean Piculet (*Nesoctites micromegas*). This confirms a long presence of birds similar to *Nesoctites* on Hispaniola and documents the earliest New World fossil of Picidae. *Received 1 June 1993, accepted 14 Aug. 1993.*

The Palo Alto Mine in the Cordillera Septentrional of the Dominican Republic is well known for amber with inclusions of animal and plant remains. The amber occurs as angular-to-slightly-rounded fragments in consolidated carbonaceous fine silts and sands that accumulated in a marine environment. Analyses of assemblages of foraminifera found in association with the amber at Palo Alto indicate a minimum age of lower Early Miocene for the sediments (Baroni-Urbani and Saunders 1980).

Two pieces of amber from Palo Alto in the collections of the Dept. of Paleobiology, Smithsonian Institution, contain portions of feathers. These pieces of amber were referred to the senior author who has been identifying whole and fragmentary feathers from all parts of the world since the early 1960s. Characters denoting the family of birds have been discovered through her research on the micromorphology of the plumulaceous (downy) barbules (for feather topography see Fig. 1). It is the knowledge gained in the study of these barbules that has made it possible to identify hitherto unidentifiable feather material, including fossil feathers. One piece of amber (USNM 474728), described by Poinar et al. (1985), is 22.5 × 13.8 mm and contains a single pennaceous barb 11.9 mm long. There are no plumulaceous structures with which to make comparisons, and no diagnostic characters are visible. The more important of the two pieces of amber (USNM 469150) is 30.6 mm long × 7.5 mm wide and contains a partial feather 17.5 mm with the longest pennaceous barb 8.4 mm long. Identification of the feather was based on conformation of the plumulaceous barbs attached at the base of the feather, which were studied and

[1] Dept. of Vertebrate Zoology, Smithsonian Institution, Washington, D.C. 20560.
[2] Federal Bureau of Investigation, Hairs & Fibers Unit, Washington, D.C. 20535.
[3] Dept. of Paleobiology, Smithsonian Institution, Washington, D.C. 20560.

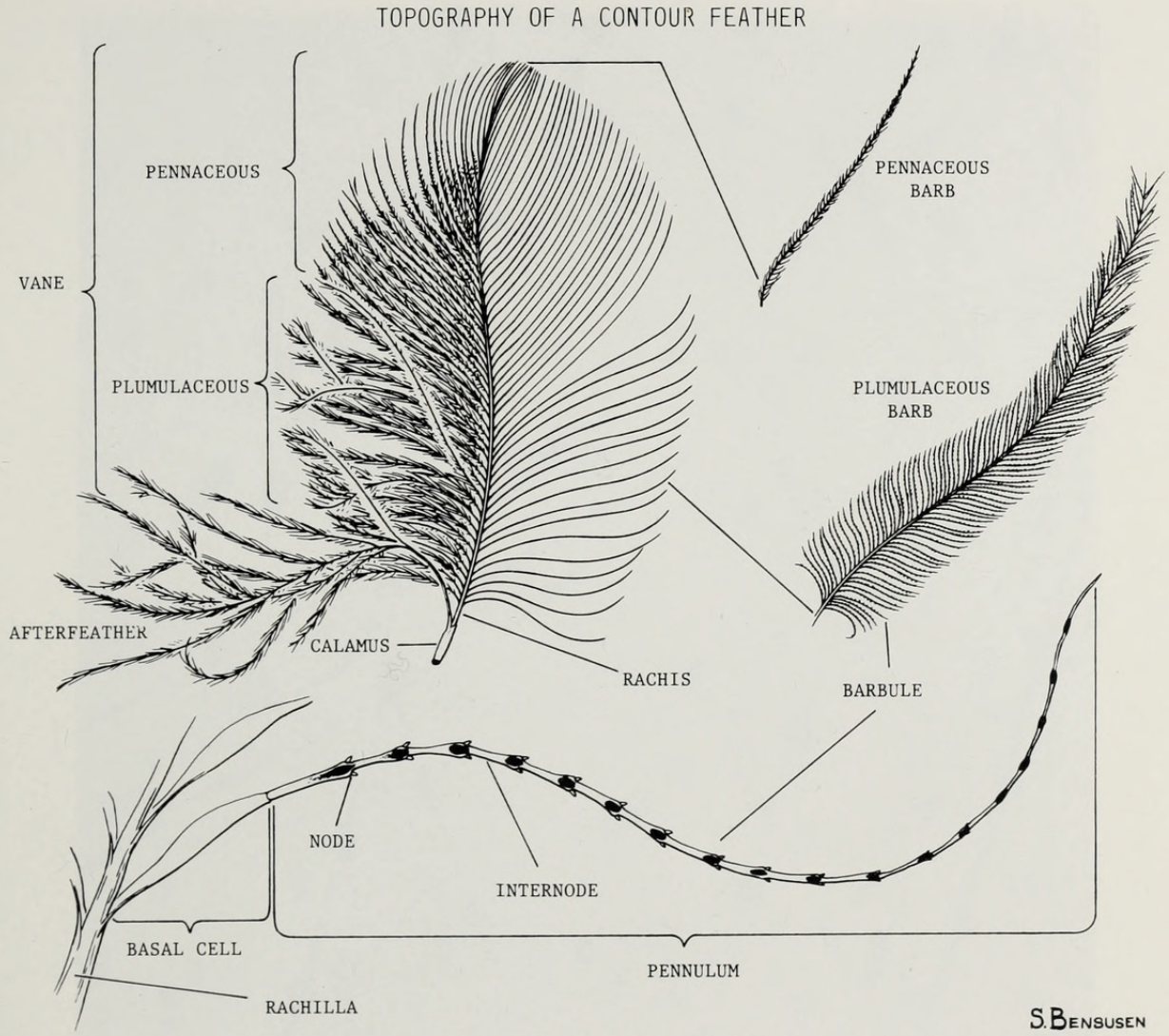

FIG. 1. Contour feather (flank) of Hispaniolan Woodpecker (*Melanerpes striatus*) depicting the parts of a feather (pen & ink by S. Bensusen).

photographed with the light microscope (Fig. 2). The length of the plumulaceous barbules varied from 1.09 to 1.54 mm, and the distance between the nodal structures proximal on the barbule varied from 0.021 to 0.023 mm. The villi on the basal cell are curved or scimitar shaped, a form unique to the Picidae (Brom 1991). The barbules are heavily pigmented and expanded at the nodes. These enlarged nodal structures bear slightly flared and transparent prongs at right angles to the node. One nodal structure clearly shows at least four prongs. The internodes are transparent.

When studying the microscopic structures of the downy barbules, a combination of characters is considered for each species studied. In this case, the microscopic study of these barbs and barbules indicated a non-passerine bird from the following characters: the relative distance between the barbules (at the junction of the rachilla), the long basal cell, relative

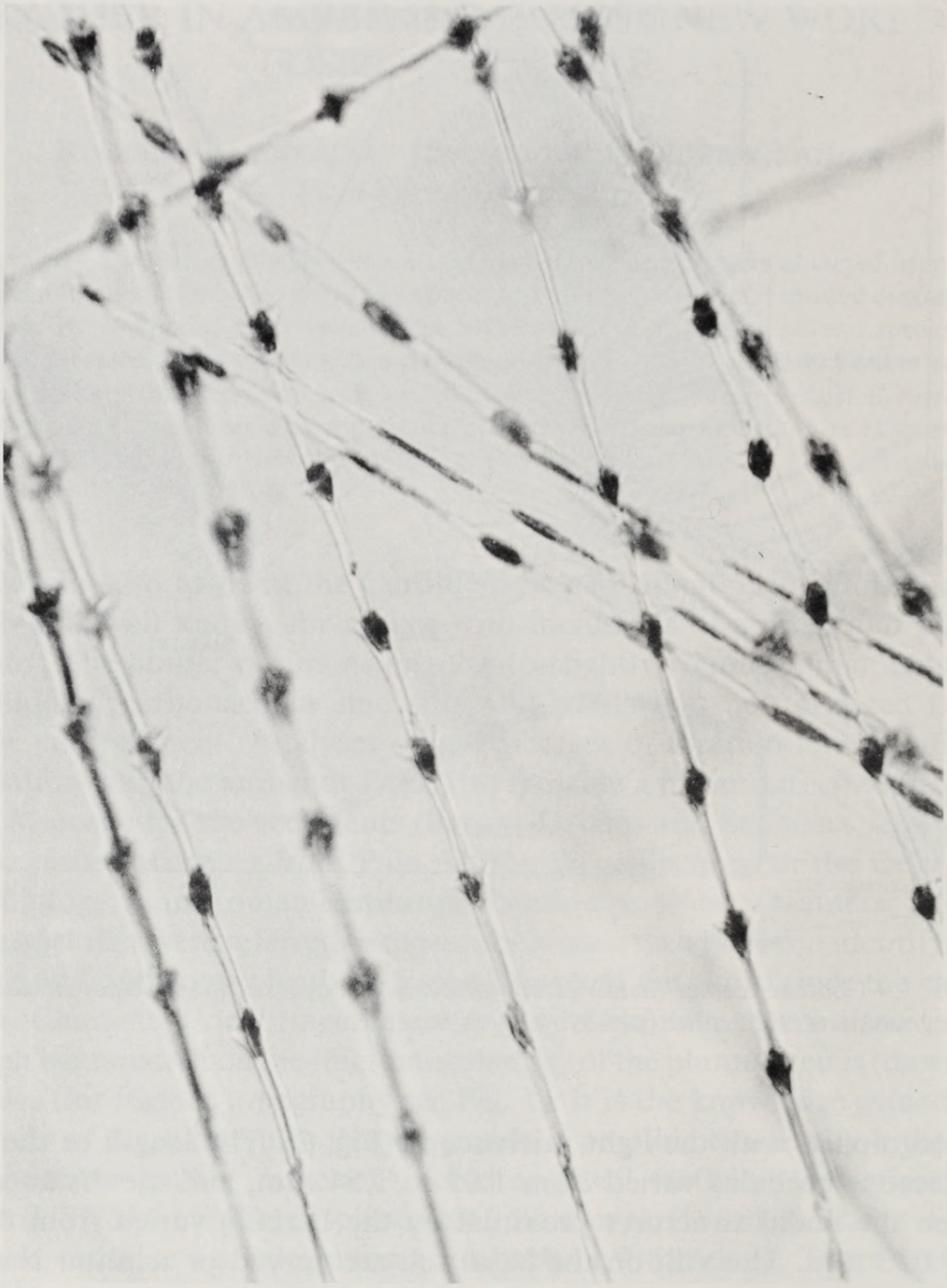

FIG. 2. Photomicrograph (250×) of downy barbules of fossil feather.

width of the internode, nodal morphology, and the relative distance between the nodes. The fossil feather contained in USNM 469150 was compared with feathers of likely species of non-passerines that now occur in the area where the amber was found—Gray-headed Quail-Dove (*Geotrygon caniceps*), Narrow-billed Tody (*Todus angustirostris*), Broad-billed Tody (*Todus subulatus*), and Hispaniolan Trogon (*Priotelus roseigaster*). We also studied species not now occurring in the area, for example:

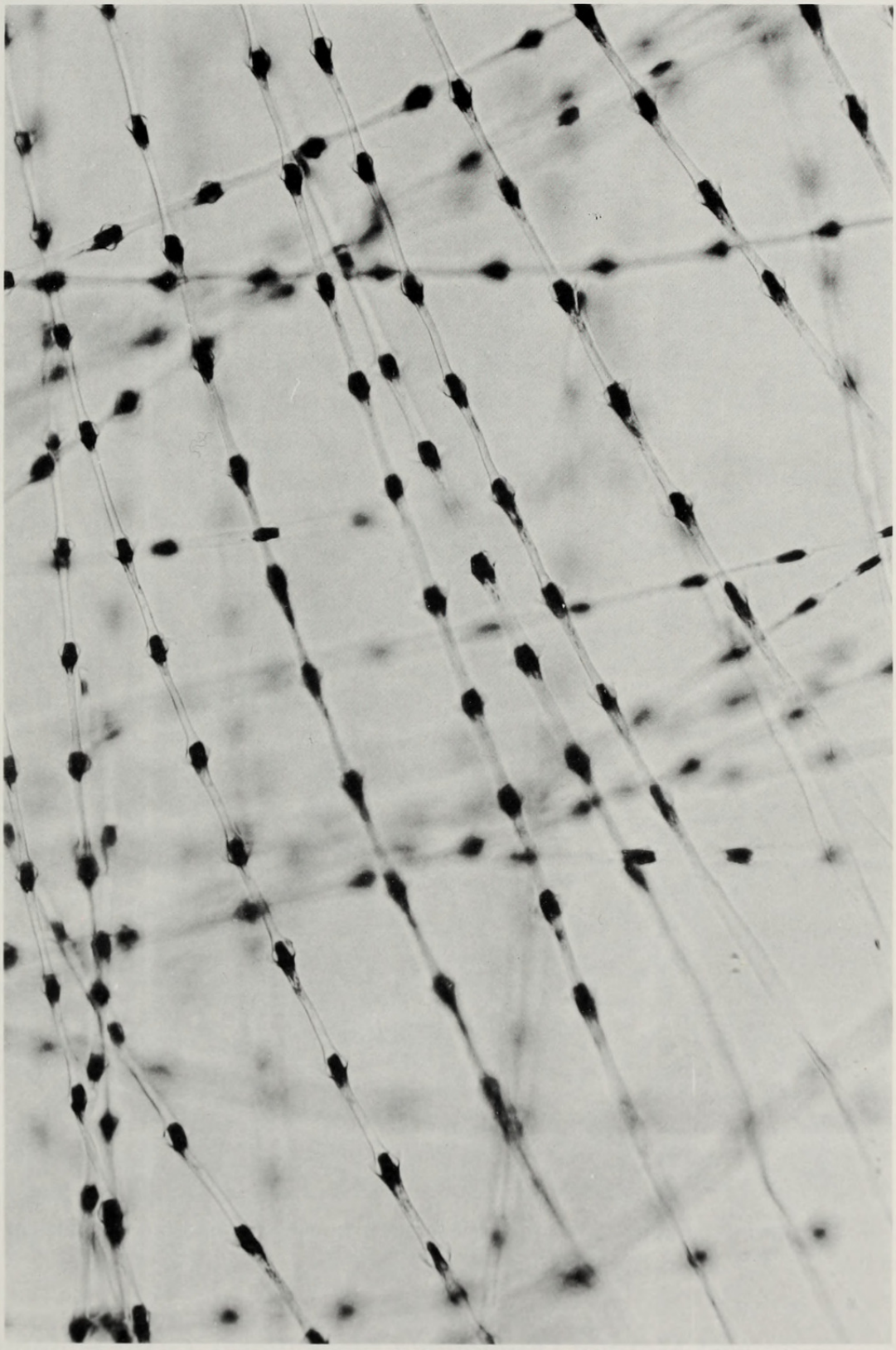

FIG. 3. Photomicrograph (250×) of downy barbules of Antillean Piculet.

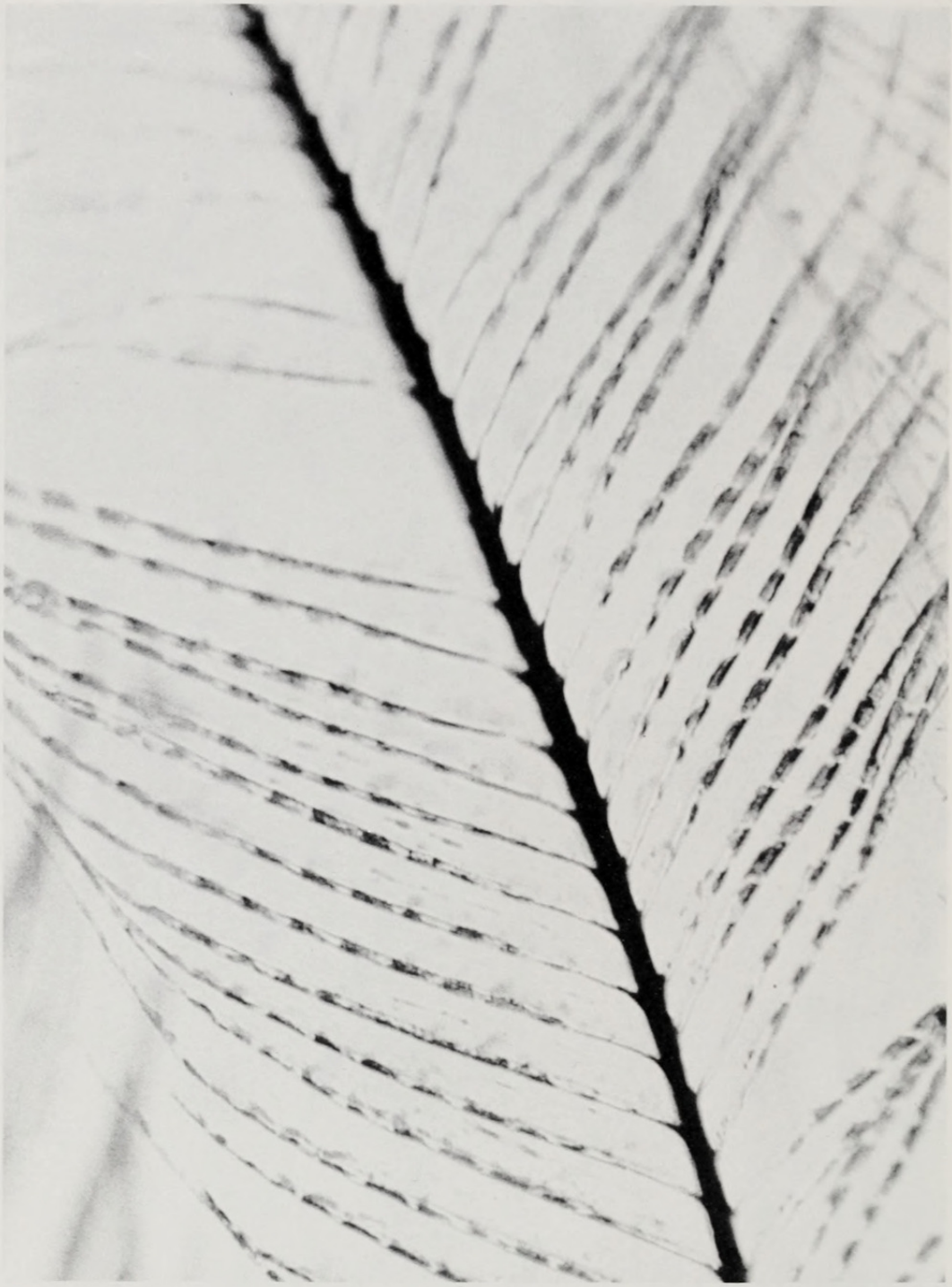

FIG. 4. Photomicrograph (250×) of fossil feather showing pennaceous barbules at base feather.

Turquoise-browed Motmot (*Eumomota superciliosa*), Giant Hummingbird (*Patagona gigas*), Long-tailed Hermit (*Phaethornis superciliosus*), and White-mantled Barbet (*Capito hypoleucus*). The nodal structures on the plumulaceous barbules of only the trogon and the barbet were similar to those of the fossil feather. In the trogon, the distance between the nodes along the entire pennulum was greater; the pigmented nodal area and the

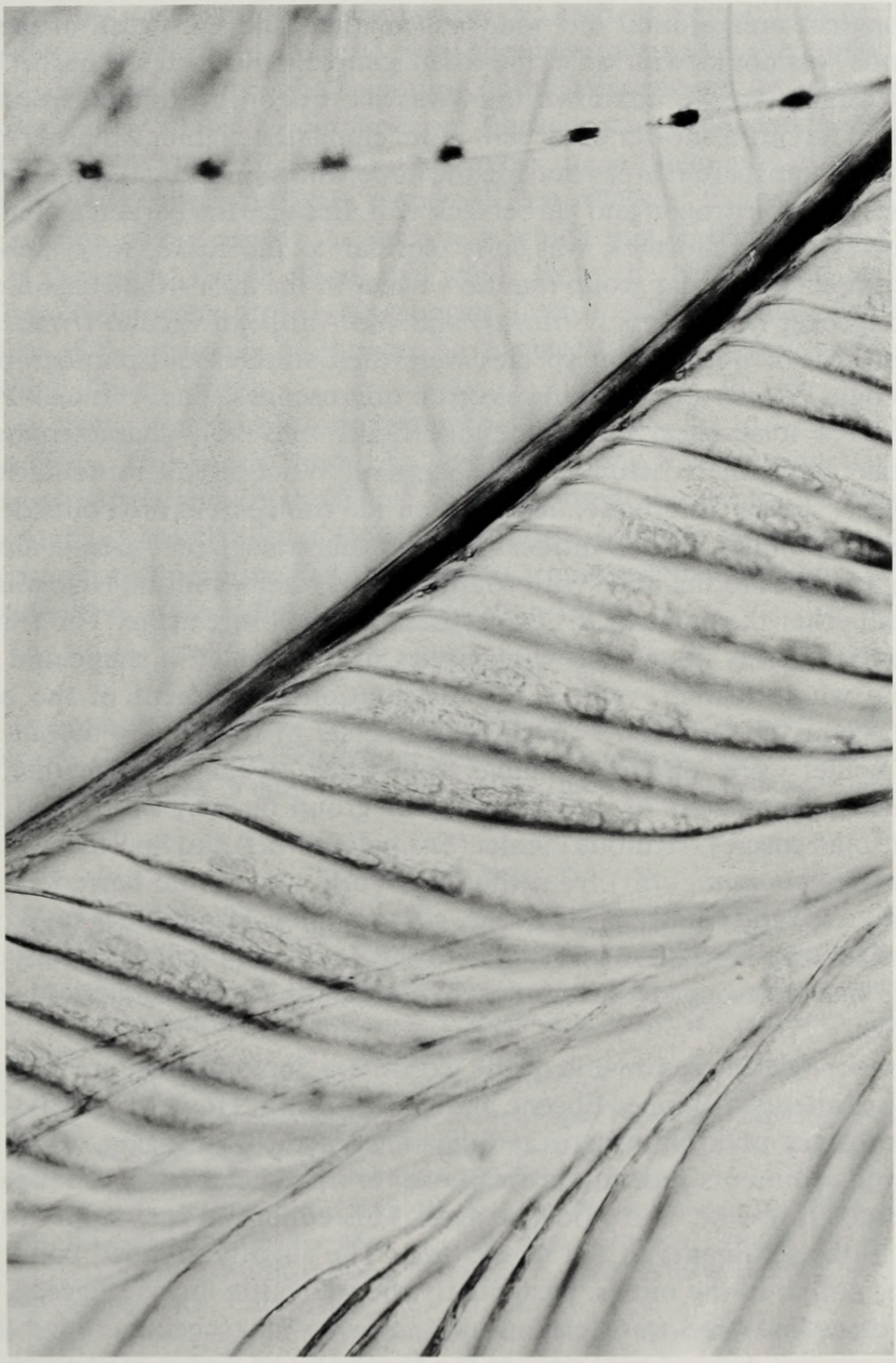

FIG. 5. Photomicrograph (250×) of Antillean Piculet showing pennaceous barbules at base of barbs from a wing covert.

transparent area around the node was smaller, and the width of the internode was not as wide as in the fossil sample. Although the barbet was more similar to the unknown than was the trogon, it differed from the fossil in having a shorter basal cell, more elongated pigmented area, more spinelike transparent areas outside the node, and shorter distance between nodes. Both the trogon and barbet lack villi. Because the barbet, a member of the Order Piciformes, was most similar to the fossil, we examined species related to that group that now occur in the area—the Hispaniolan Woodpecker (*Melanerpes striatus*) and the Antillean Piculet (*Nesoctites micromegas*). Both recent species were then studied and photographed with light (Fig. 3) and scanning electron microscopes. The Antillean Piculet had a long basal cell, wide internode, and villi characteristic of Picidae, and differed from the Hispaniolan Woodpecker in nodal morphology, shorter internode, and angle of the transparent area outside the pigmented node. In the Antillean Piculet this transparent area is almost at right angles to the node with rounded tips, whereas in the Hispaniolan Woodpecker the angle of the transparent area is more acute. The feather in amber closely matched a wing covert of the piculet in shape and size of the whole feather, and in the distribution of pigment in the basal pennaceous barbs (Figs. 4 and 5). Characters of the downy barbules of the piculet were indistinguishable from those of the fossil feather. To define the characters of the down of this group further, we studied four additional species—Rufous Piculet (*Sasia abnormis*) and Speckled Piculet (*Picumnus innominatus*) from the Old World and White-barred Piculet (*P. cirratus*) and Chestnut Piculet (*P. cinnamomeus*) from the New World. The fossil feather was most similar to the Antillean Piculet, and we conclude that it belongs to a bird closely related (at least congeneric) to that species.

Amber-bearing sediments of the Cordillera Septentrional are redeposited sediments of Upper Eocene age (Lewis 1980). However, analyses of assemblages of foraminifera at other sites across the basin of amber-bearing sediments indicate probable reworking and mixing of faunas of Eocene, Oligocene, and Miocene ages. This condition may apply to the flysch-like sediments of the whole area. The slightly abraded condition of the amber in the mines, particularly the stalactitic forms, suggests that the resins had been transformed into amber prior to being eroded from their original depositional sites as the toughness of amber relative to raw resins makes it less prone to heavy abrasion and fragmentation. Therefore, we conclude that the specimen of amber that contains the piculet feather is certainly older than lower Early Miocene, having been formed in and reworked from earlier terrestrial deposits into the marine. The nature of the mixed faunas of Miocene, Oligocene, and Eocene ages across the basin

extends the possible age of the amber to earliest Upper Eocene. The younger and older limits derive from the hypothesis that the amber was fully formed well before the beginning of the Miocene but no earlier than the beginning of the Upper Eocene. The consensus of geologists now working in the Dominican Republic favors the younger side of this time span, although more data are required. Regardless of the geologists' determination of the age of the amber in which this feather is preserved, this is the oldest known fossil of Picidae from the New World and the first pre-Pleistocene bird to be reported from the West Indies. Previous studies of fossil bones of Picidae have placed Picidae back to Middle Miocene (Olson 1985).

This report confirms a long presence of birds similar to *Nesoctites* on Hispaniola. This genus should be counted among the more ancient lineages of vertebrates in the West Indies, comparable to todies and the mammalian insectivores (Olson 1978). Long isolation of this piculet on Hispaniola has permitted differentiation to the extent that Short (1974) considered it to be a distinct tribe, Nesoctitini.

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