Jaki rodzaj piór mogły mieć dinozaury, wnioskując z wczesnojurajskiego materiału ichnologicznego z Massachusetts (USA)?

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W jednym ze znanych od wielu lat odcisków, siedzącego dinozaura, z dolnej jury Massachusetts, autor odkrył ślady piór (Gierliński, 1996). Jest to pierwsze znalezisko, wskazujące na obecność okrywy termicznej ciała, u niektórych przynajmniej przedstawicieli dinozaurów, wyłączając oczywiście ptaki. Omawiany okaz AC 1/7 (ryc. 1) wchodzi w skład dziewiętnastowiecznej kolekcji ichnologicznej Hitchcocka i jest przechowywany w Amherst College w Massachusetts. Część badaczy, sprawcę tego tropu, upatruje wśród wczesnych dinozaurów ptasiomiednicznych (Lull, 1915, 1953; Olsen & Baird, 1986). Inni natomiast autorzy przychylają się raczej do jego teropodowego pochodzenia (Haubold, 1984; Gierliński, 1994, 1996).

Ślady piór są widoczne w obrębie odcisku brzucha, a szczególnie wyraźnie wzdłuż jego lewej krawędzi (ryc. 2). Ich dobry stan zachowania pozwala na dokonanie porównań z odciskami głównych rodzajów piór okrywowych współczesnych ptaków (ryc. 3). Poczynione tu obserwacje pozwalają z całą pewnością odrzucić podobieństwo do puchu i pióra konturowego. Badane ślady piór, z okazu AC 1/7, wykazują natomiast duże podobieństwo do charakterystycznego, pędzelkowatego odcisku pióra półpuchowego, którego stosina jest w pełni wykształcona, lecz którego promienie nie zaczepiają się o siebie.

What type of feathers could nonavian dinosaurs have, according to an Early Jurassic ichnological evidence from Massachusetts?

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The present author's discovery of the feather impressions in the long-known dinosaur resting track, from the Lower Jurassic of Massachusetts (Gierliński, 1996), provided the first evidence for a feather acquisition in nonavian creature. However, in the initial report on that find, the present author refrained from comparisons with particular feather types, known in living birds. Such comparisons led

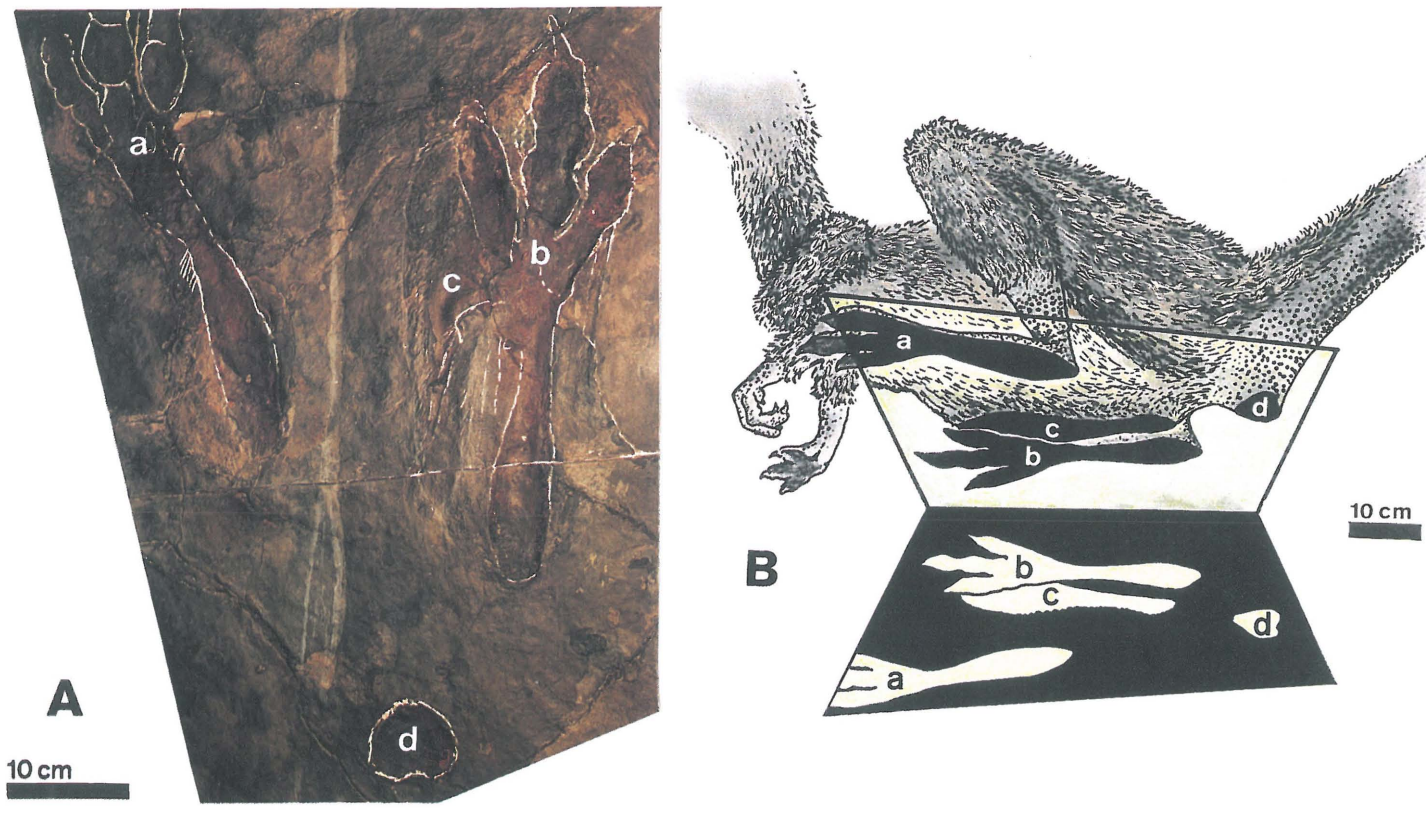

Fig. 1. AC 1/7, Early Jurassic track of a sitting nonavian dinosaur from Lily Pond, Massachusetts (A), and its trackmaker restoration in sitting posture (B). The impression comprises left (a) and right footprint (b), belly impression (c), and ischiadic imprint (d)
Ryc. 1. AC 1/7, wczesnojurajski ślad siedzącego dinozaura z Lily Pond w Massachusetts (A) i rekonstrukcja jego sprawcy (B). Ślad zawiera odcisk lewej (a) i prawej stopy (b), odcisk brzucha (c) i stopki siedzeniowej (d)

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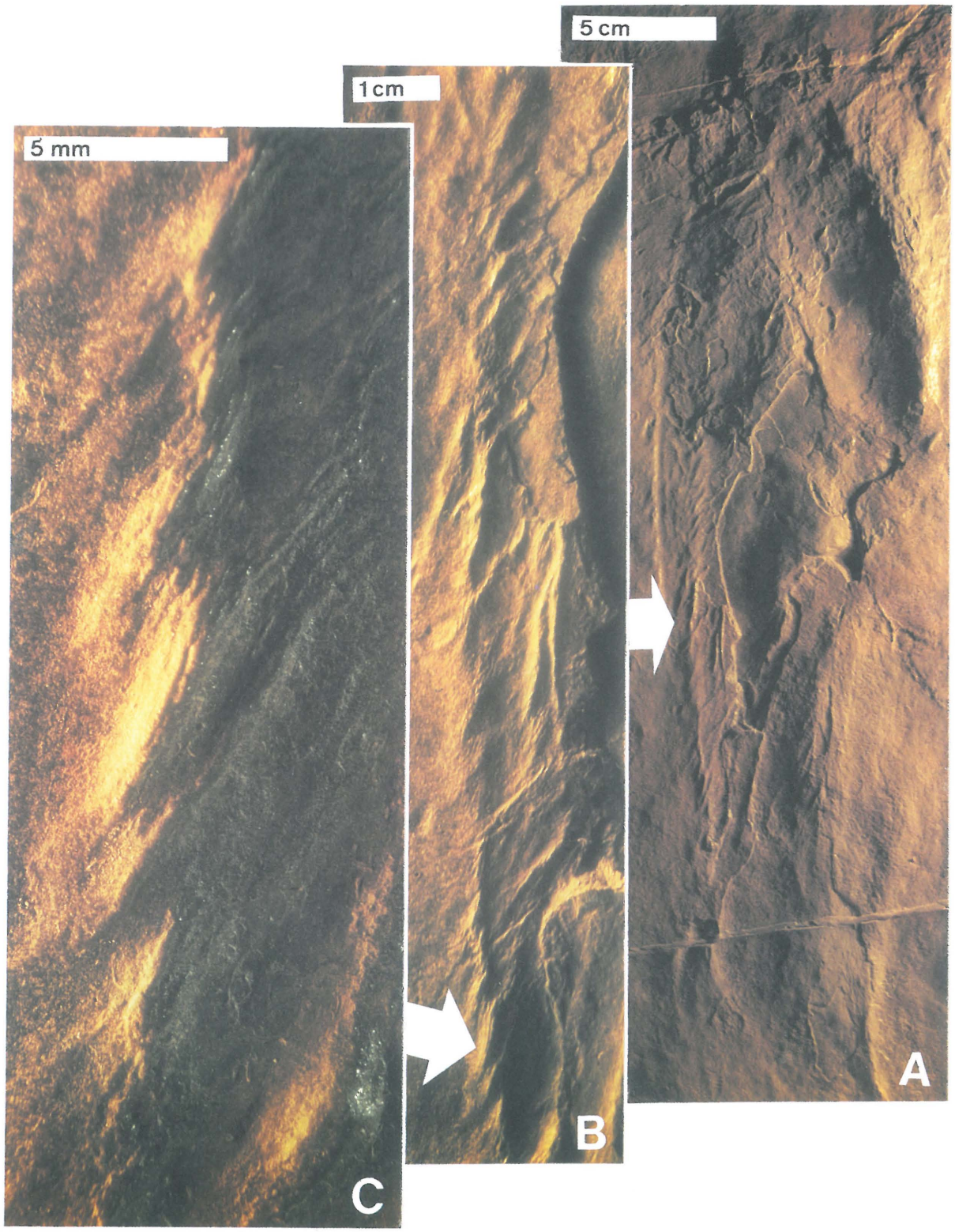

Fig. 2. Belly imprint of the AC 1/7 specimen (A), with the feather impressions densely imprinted along the left margin (B), and a close-up view of the feather impressions (C)
Ryc. 2. Odcisk brzucha z okazu AC 1/7 (A), z licznymi śladami piór wzdłuż jego lewego brzegu (B) i zbliżenie na ślady piór (C)

to hitherto unreported, interesting observations which are presented herein.

The squatting dinosaur track (Fig. 1), with recently recognized feather impressions, came from the Early Jurassic lacustrine deposits of the Portland Formation, from the Lily Pond quarry in Massachusetts. In the middle of nineteenth century, it became a part of the Edward Hitchcock collection, under the catalog number of AC 1/7. The specimen has been recently stored in the Pratt Museum of Amherst College, in Massachusetts, just 26 km south from its source locality.

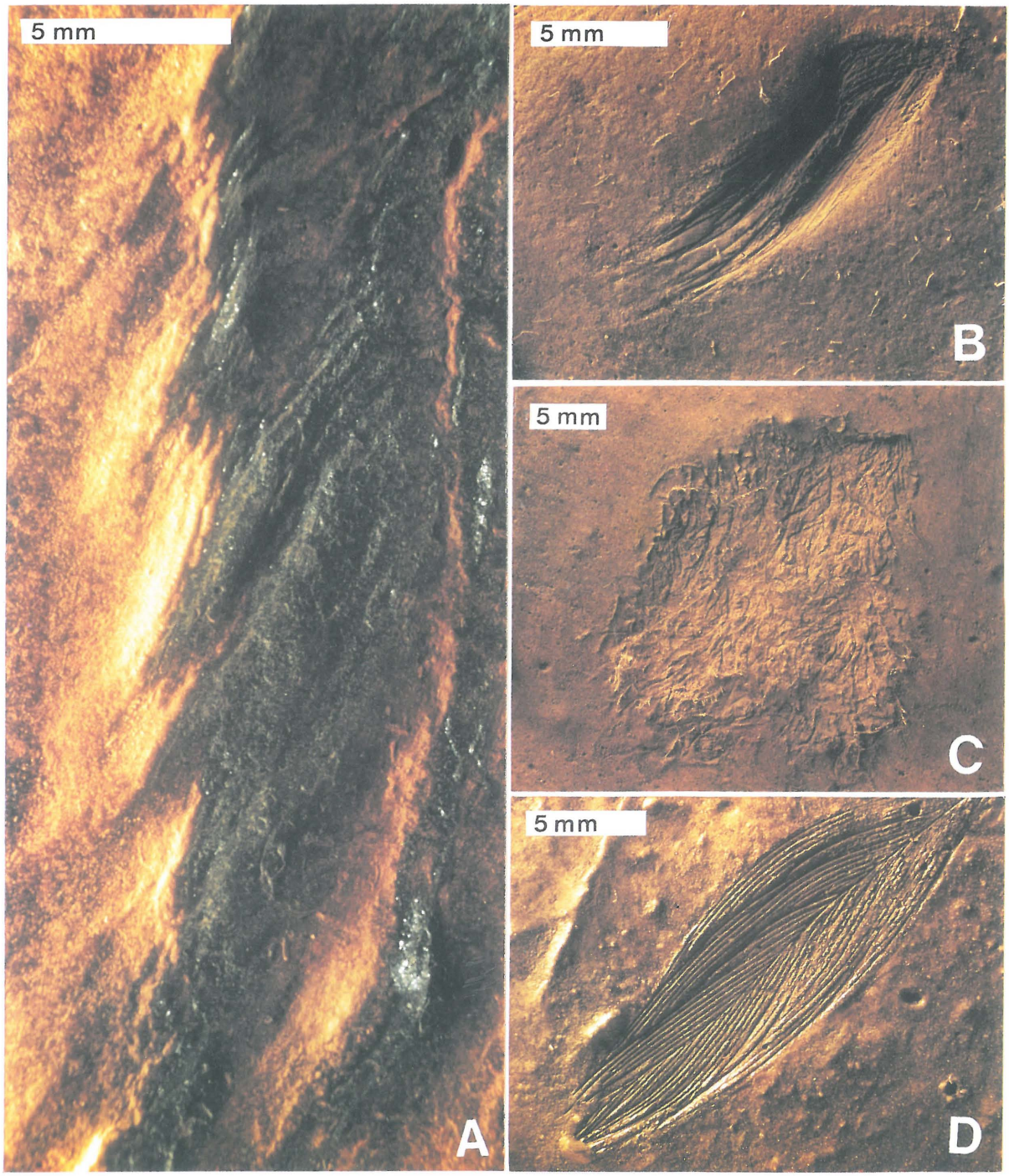

Fig. 3. Feather impressions AC 1/7 (A) in comparison with the three main types of body feathers imprinted into a wet plaster: goose semiplume (B), swan down (C) and parrot contour feather (D) — all with bases pointing towards the upper right corner
Ryc. 3. Ślady piór z AC 1/7 (A) w porównaniu z trzema głównymi rodzajami piór okrywowych odciśniętymi w mokrym gipsie: półpuchowym piórem gęsi (B), puchem łabędzia (C) i konturowym piórem papugi (D) — wszystkie skierowane swą podstawą w prawy górny róg zdjęcia

Originally, Hitchcock (1858) determined AC 1/7 as *Anomoepus major*, and he considered it, in his last paper (Hitchcock, 1865), as a primitive bird track. Thus, the occurrence of feather impressions might not be surprising. However, subsequent authors have referred anomoepodids, including AC 1/7, to early ornithischian trackmakers (Lull, 1915, 1953; Olsen & Baird, 1986). Others argued for its nonavian theropod orgin, regarding AC 1/7 as a grallatorid track (Haubold, 1984; Gierliński, 1994, 1996).

The impression is preserved as the natural mold on trapezoidal slab (730 mm long and 540 mm wide) of brown shale (Fig. 1A). The ichnite arrangement is typical for dinosaur sitting impressions, well known from other examples, from the Lower Jurassic of Massachusetts (Lull, 1953) and Lesotho (Ellenberger, 1972, 1974). The impression consists of a pair of plantigrade tridactyl footprints (Fig. 1Aa,b), the right one — 420 mm long, including metapodium; a 57 mm

long ischiadic imprint (Fig. 1Ad); a 320 mm long belly imprint near the right footprint (Fig. 1Ac; 2A).

The belly imprint is rotated outwardly from the trackway midline by 11°, overlapping the inner toe of right footprint, thus it seems that the trackmaker sat slightly irregularly, turning its body to the right side (Fig. 1B). The belly imprint is covered by numerous elongate impressions, approximately 10 mm long and 3 mm wide. They are especially well visible along the left belly margin (Fig. 2B, C), on that side which became stronger imprinted, while the right side of the belly was partially leaning on the right foot.

These elongate impressions are quite different from the scale impressions and drag-marks left by rough skin, strongly resembling those which are being recently left by the soft body covering of mammals and birds, as demonstrated experimentally (Gierliński, 1996). They also seem to have been left by structures broader than mammalian hairs, while thinner and more flexible than flight feathers (Gierliński, 1996). Each discussed impression comprises several tiny strands, showing a brush-like structure (Fig. 3A). An identical brush-like impression (Fig. 3B) is produced by semiplume, a feather type intermediate between contour feather and down, which has a flexible shaft and barbs loosely arranged. A typical down left lots of radomly oriented tiny traces (Fig. 3C), while a contour feather impression differs from those in AC 1/7 in being wider, shapely formed, with the shaft clearly imprinted (Fig. 3D).

Consequently, it is possible to suppose that the semiplume-like structures of a nonavian dinosaur covering came first, while the fully formed avian plumage, differentiated into contour feathers and down, originated from them during later stages of avian evolution. The avian down may have been developed for insulation, simultaneously with the overlaying contour feathers evolving for aerodynamic purpose. In birds, there is a continuous intergradation between down, semiplumes and contour feathers (Dyck, 1985).

Moreover, the molecular data suggests that the reptilian scales and the bird feathers are not homologous epidermal structures (Brush, 1996). Thus, the reptilian scales did not transform directly into the avian feathers, nor even nonavian dinosaur feathers and derived bird feathers have evolved from the reptilian scales.

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