

# Sauropod tracks in the Early Jurassic of Poland

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After the discovery of Early Jurassic sauropod tracks in northern Italy, Polish Liassic strata revealed a second comparably early record of sauropod footprints in Europe. In comparison with the Italian material, described tracks seem to be left by juvenile or small primitive sauropods, presumably 4.4 m and 5.5 m long.

**Key words:** Sauropoda, tracks, Early Jurassic, Poland.

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## Introduction

The specimens reported herein are the first sauropodomorph tracks discovered in the Liassic deposits of the Holy Cross Mountains, central Poland, thus adding to the previous ichnological record of theropods and ornithischians in that region (e.g., Gierliński 1991, 1995b, 1996). Footprints were found in June of 1997, on two fallen slabs of the yellowish gray, fine-grained sandstone, below the exposure located along Kamionka River, in Gromadzice (5 km south of the town of Ostrowiec Świętokrzyski). The possible track-bearing strata represent early Hettangian fluvial plain deposits of the Zagaje Formation, and/or the middle Hettangian deltaic plain deposits of the Skłoby Formation (G. Pieńkowski personal communication; see Pieńkowski 1991 for general geological data).

## Description

The specimen Muz. PIG 1560.II.60 (Fig. 1A) comprises a trackway fragment, natural casts of the left and the right pes-manus set. Cast of the left pes impression is broken, being incomplete posteriorly. Trackway seems to be narrow-gauge *sensu* Farlow (1992). Ratio of pace length (measured between the most anterior points of

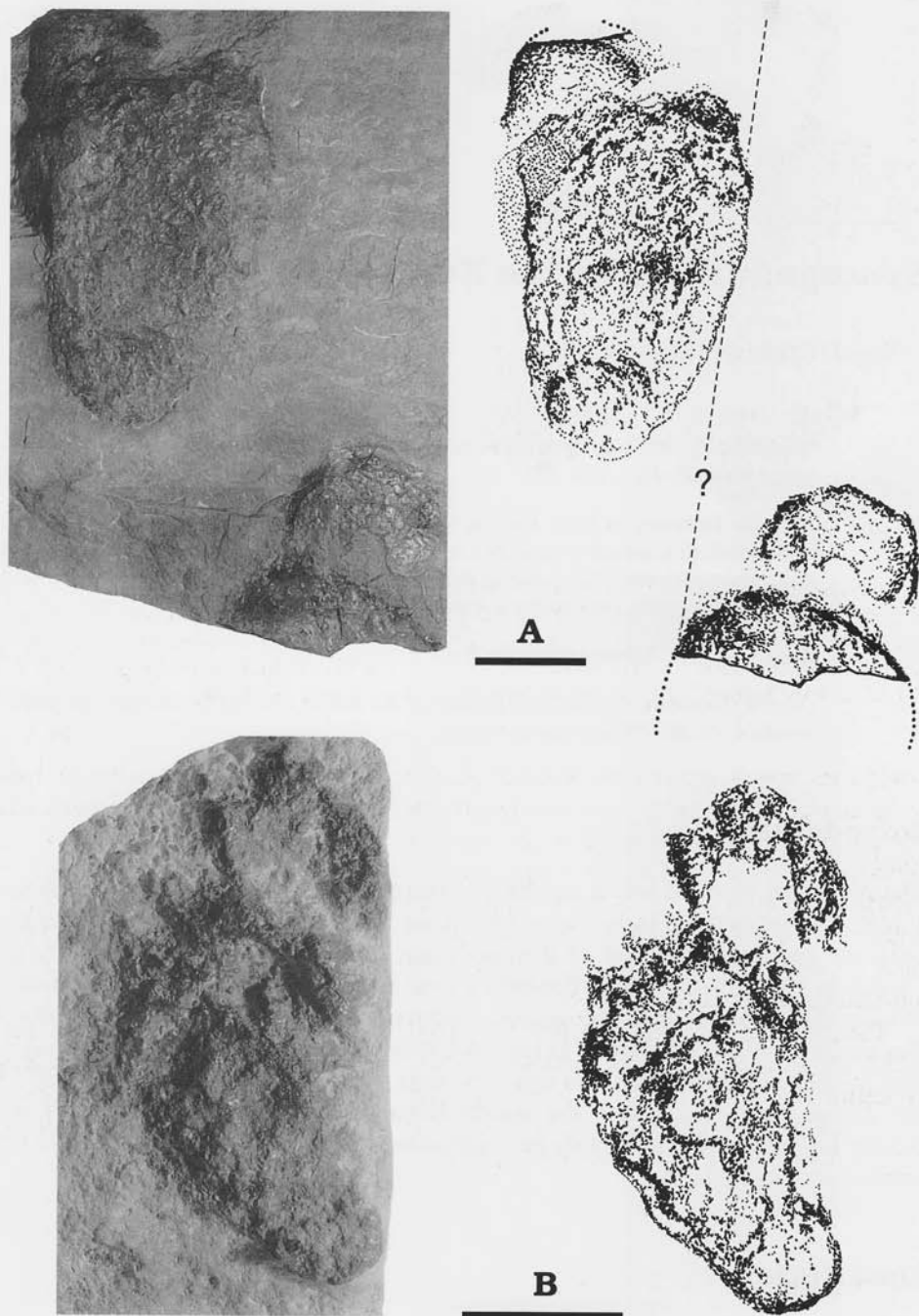


Fig. 1. (?)*Parabrontopodus* sp. from the Hettangian of Gromadzice, Poland. A. Muz. PIG 1560.II.60. B. Muz. PIG 1560.II.61. Supposed trackway midline marked by a broken line. Scale bars – 10 cm.

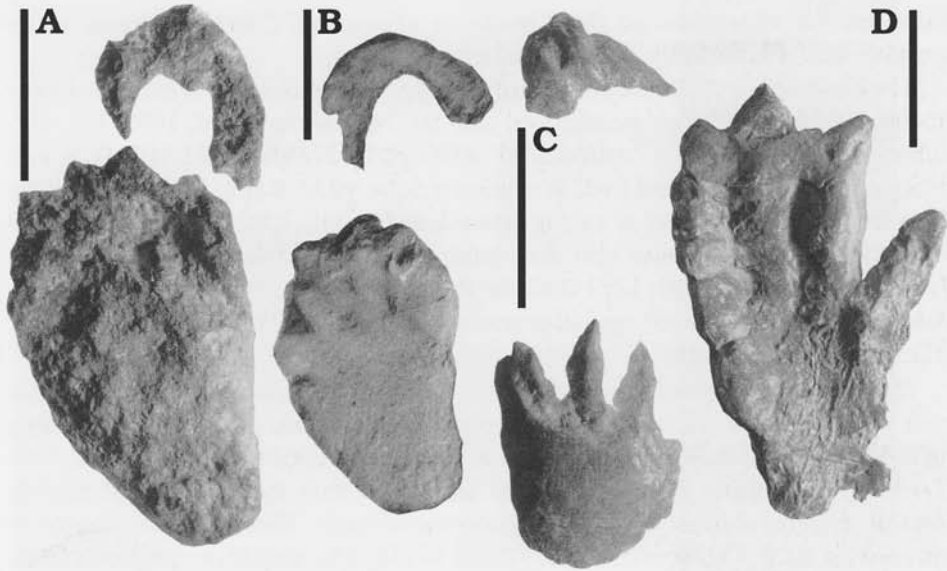


Fig. 2. Polish sauropod track in comparison with the Jurassic sauropodomorph tracks and those traditionally suspected of sauropodomorph origin. **A.** Muz. PIG 1560.II.61. **B.** Uncatalogued *Parabrontopodus* track from the Morrison Formation of Rancho Del Rio, Colorado. **C.** *Navahopus falcipollex* Baird, 1980 (MNA P.3.339[G2.7092]) from the Navajo Formation of Kaibito Plateau, Arizona. **D.** *Otozoum* sp. (CU-MWC 181.10) from the Kayenta-Navajo Formation, near Moab, Utah. Scale bars – 10 cm.

pes) to pes length equals 1.34. Ratio of pace length (measured between the geometrical mid-points of manus) to manus length (measured between the anteriormost and posteriormost points of impression) equals 6.20. There is no space between the supposed trackway midline and the pes medial margin, while the ratio of intermanus distance to manus width equals 1.9. Pes is longer than wide, 30.5 cm long, 20 cm wide anteriorly and 10 cm wide posteriorly. Manus is semicircular, broader than long, 13 cm wide and 8 cm long, being significantly smaller than pes. The manus is situated anterolaterally to the pes.

The specimen Muz. PIG 1560.II.61 (Fig. 1B) is a natural cast of a right pes-manus set, which shows similar features to those of Muz. PIG 1560.II.60. The only differences concern a slightly smaller pes (24.5 cm long), narrower manus (11.5 cm wide, while 8 cm long), and the manus located anteromedially to the pes. There are also four marks along the anterior pes margin, which could be produced by claws at digits I, II, III and IV.

## Discussion

The entire track features strongly resemble a sauropod track pattern (Fig. 2A, B), while the absence of interpedes distance *sensu* Leonardi (1987) corresponds with the narrow-gauge trackway morphotype of *Parabrontopodus* Lockley, Farlow, & Meyer, 1994.

However, the assignment of these tracks to ichnogenus *Parabrontopodus* seems tentative until a sufficiently complete trackway is found.

The Gromadzice tracks are clearly distinguished from prosauropod tracks and those traditionally considered as prosauropod ichnites. *Navahopus* Baird, 1980 (Fig. 2C), although proposed to have 'mammaloid' affinities by Lockley *et al.* (1994), is here thought to be a prosauropod trail, as originally believed by Baird. *Navahopus* differs from the Gromadzice prints in having better defined digits, a broader pes and a wider trackway. The same features also distinguish purported African prosauropod tracks *Tetrasauropus* Ellenberger, 1972 from the Polish footprints. Differences between the described tracks and alleged bipedal prosauropod footprints *Otozoum* Hitchcock, 1847 (Fig. 2D) are even greater.

Unlike sauropodomorph tracks, *Otozoum* prints have distinct digits with phalangeal pads well developed and the hypexes deeply located, near the bases of relatively long toes. Moreover, *Otozoum* footprints from the Navajo Formation near Moab, Utah (Lockley 1990) show extremely narrow trackways with the pes directed slightly inwards, features unusual among sauropodomorph tracks. Thus, *Otozoum* may be an ornithischian trace (Thulborn 1990; Gierliński 1995a). The inward pes rotation, typical for ornithischian tracks, is also present in another alleged prosauropod track, referred to *Pseudotetrasauropus* Ellenberger, 1972, from the Late Triassic of the western United States (Lockley & Hunt 1995).

In contrast, the specimen Muz. PIG 1560.II.61 bears a strong resemblance to the juvenile sauropod track of *Parabrontopodus*, from the Late Jurassic tracksite Rancho Del Rio in Colorado (Fig. 2B). This does not necessarily mean that Polish tracks were made by juvenile dinosaurs. An alternative explanation of their relatively small sizes (24.5 cm and 30.5 cm long) may be also proposed.

The early Sinemurian (G. Leonardi personal communication 1997) ichnofauna of the Lavini di Marco tracksite in northern Italy consists of various-sized theropod tracks, large (up to 40 cm long) ornithopod footprints, and 45–50 cm long sauropod tracks (Lanzinger & Leonardi 1991; Leonardi & Avanzini 1994; Dalla Vecchia 1994).

Polish sauropod tracks are about half the size of the Italian ones. Interestingly, *Moyenisauropus karaszewskii* Gierliński, 1991 (attributed to *Iguanodontia sensu* Sereno 1986) from the Polish late Hettangian site of Gliniany Las, reach a length of 26 cm, and are likewise markedly smaller than the presumably iguanodontian ornithopod tracks of Lavini di Marco. Consequently, Polish sauropods and iguanodontians might be diminutive, possibly more primitive, relatives of the Italian trackmakers. The Gromadzice footprint sizes allow estimates of the lengths of their trackmakers as approximately 4.4 m and 5.5 m. Thus, they are 32% and 15% smaller, respectively, than the supposed length of the primitive sauropod *Vulcanodon* Raath, 1972.

**Abbreviations of cited repositories:** CU-MWC – University of Colorado/Museum of Western Colorado Joint Collection, Denver, Colorado; MNA – Museum of Northern Arizona, Flagstaff, Arizona; Muz. PIG – Geological Museum of the Polish Geological Institute, Warsaw, Poland.

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## Tropy zauropodów z wczesnej jury Polski

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### Streszczenie

Tropy zauropodów znalezione zostały w liasie świętokrzyskim na dwóch płytach piaskowca u podnóża odsłonięcia utworów hetangu formacji zagajskiej i skłobskiej w Gromadzi-  
cach. Są to pierwsze ślady tej grupy dinozaurów w Polsce. Stosunkowo wąski rozstaw stóp  
widoczny w okazy Muz. PIG 1560.II.60 (Fig. 1A) przemawia za ich przypuszczalną  
przynależnością do ichnorodzaju *Parabrontopodus* Lockley, Farlow, & Meyer, 1994.

Dotychczas podobne wiekowo ślady zauropodów w Europie odnotowano jedynie  
w północnych Włoszech (Lanzinger & Leonardi 1991; Leonardi & Avanzini 1994; Dalla  
Vecchia 1994). Polskie tropy są jednak od nich prawie dwukrotnie mniejsze. Długość śladu  
stopy wynosi 24,5 cm w przypadku okazy Muz. PIG 1560.II.61 i 30,5 cm w przypadku  
okazy Muz. PIG 1560.II.60. Pozostawiły je osobniki młode lub przedstawiciele małych,  
wczesnych zauropodów o przypuszczalnej długości ciała odpowiednio ok. 4,4 m i 5,5 m.