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Large Pelycosaur Footprints from the Lower Pennsylvanian of Alabama, USA

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Relatively large tetrapod footprints from Lower Pennsylvanian strata of the Pottsville Formation in the Warrior basin coal field of Alabama were previously assigned to the ichnogenus *Attenosaurus*. However, three morphotypes are present, and we assign these tracks to *Attenosaurus*, a new ichnogenus (*Alabamasauripus*) and *Dimetropus*. Most of these tracks apparently were made by large pelycosaurs, for which there is no bone record older than Late Pennsylvanian.

Keywords Alabama, Pennsylvanian, pelycosaur, trackways, *Dimetropus*

INTRODUCTION

Aldrich and Jones (1930) first documented the presence of extensive assemblages of tetrapod footprints found in coal mines developed in Lower Pennsylvanian strata of the Warrior basin coal field of Alabama (Fig. 1). Until recently this remained essentially all that was known of these footprint assemblages. However, the discovery of tracks at the Union Chapel Mine in Walker County, Alabama, by Ashley Allen in the 1990s initiated new interest in the Pennsylvanian tetrapod footprint record in Alabama that was culminated by a recent symposium on the footprints held by the University of Alabama. Our purpose here is to document a large footprint ichnotaxon that Aldrich (1930) named "*Attenosaurus*," to demonstrate that it encompasses three distinct morphotypes and to argue that they, in part, demonstrate an anomalously old record of large pelycosaurs. In this article, ALNH = Alabama Museum of Natural History, Tuscaloosa, NMMNH = New Mexico Museum of Natural History, Albuquerque and UCM = Union Chapel Mine collection, stored at various sites (mostly private collections) in Alabama.

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GEOLOGICAL CONTEXT

Two localities in the Pottsville Formation of Walker County, Alabama, are relevant to this article (Fig. 1). The older locality is the Number 11 Mine of the Galloway Coal Company near Carbon Hill (Aldrich and Jones, 1930). The younger is the Union Chapel Mine near Jasper (Pashin, 2003). The track-bearing horizon at the Number 11 Mine is in the shale immediately above the Jagger coal seam, whereas at the Union Chapel Mine it is in the Mary Lee coal zone (above the Newcastle coal bed). The stratigraphic separation of the two track horizons is about 20 m (Metzger, 1965).

The track-bearing interval at the Union Chapel Mine is in sandstone-shale couplets interpreted as tidal rhythmites (Pashin, 2003). Invertebrate ichnotaxa in these strata include abundant limulid trails (*Kouphichnium*) and insect feeding traces (*Treptichnus*), as well as less common arthropod walking and feeding traces (Rindsberg and Kopaska-Merkel, 2003). Fish swimming traces (*Undichna*) are also present, as are the tracks of small amphibians (*Batrachichnus*) and small captorinomorph reptiles (*Notalacerta* and *Cincosaurus*) (Haubold et al., 2003a, 2003b; Martin, 2003). Indeed, tracks assigned to *Cincosaurus* so dominate the footprint assemblage that local collectors refer to the track-bearing strata at the Union Chapel Mine as the "*Cincosaurus* beds." *Attenosaurus* tracks occur on bedding planes with other tetrapods.

It is important to note, as did Haubold et al. (2003), that the majority of the Pottsville footprints are undertracks. This is not a collecting bias but a true reflection of the ichnofaunas. We have collected large footprints from UCM, and they are all undertracks. Imprinting of the tracks must have been followed, in almost all cases by erosion of the surficial laminae that preserved the true tracks. Although this assemblage is one of the largest Carboniferous ichnofaunas known in terms of number of specimens collected, it presents serious challenges to ichnotaxonomy. This ichnofauna is thus not as useful a "Rosetta Stone" for Pennsylvanian tracks as the Robledo Mountains assemblages of

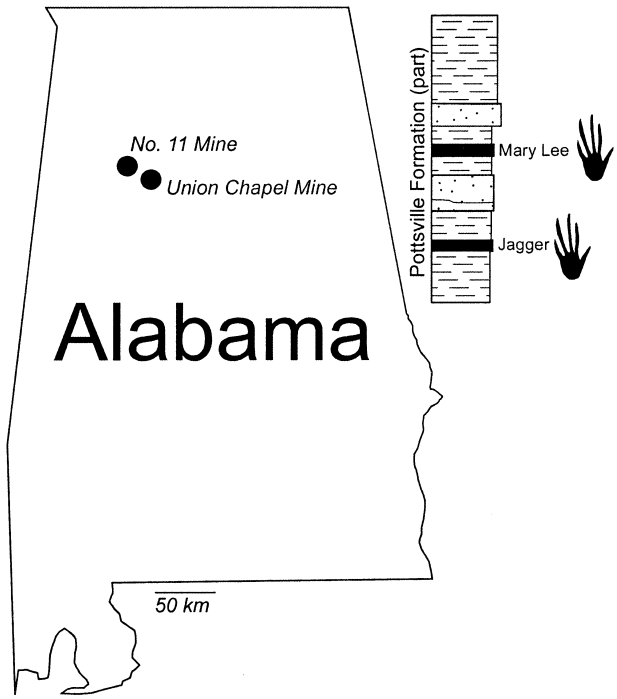

FIG. 1. Map of Alabama showing location of footprint localities and generalized stratigraphy of part of the Pottsville Formation (after Metzger, 1965) showing location of Jagger seam and Mary Lee coal zone and track horizons.

New Mexico are for Early Permian tracks (Haubold et al., 1995; Hunt et al., 1995).

ICHNOTAXONOMY OF *ATTENOSAURUS*

Aldrich (1930, p. 13) named the largest tetrapod footprints from the Number 11 Mine as two species of *Attenosaurus, A. indistinctus* and *A. subulensis.* The descriptions of these ichnotaxa are deficient in several ways, including:

1. No type species designated.
2. Only one species (*A. indistinctus*) has a differential diagnosis.
3. No type specimens designated, and all illustrated specimens are now lost.

The first problem was addressed by Haubold (1970) who, as the first reviser (ICZN, 1999), synonymized *A. indistinctus* into *A. subulensis* and so by default designated *A. subulensis* as the type species of *Attenosaurus.*

The deficiencies in the differential diagnoses are not relevant because the ICZN Article 12 (ICZN, 1999) indicates that names established before 1931 need only have a description and not a differential diagnosis.

Aldrich (1930) did not explicitly designate holotypes for either species of *Attenosaurus.* He discussed and illustrated (Aldrich, 1930, pl. 1; Fig. 2A) only one specimen of *A. indistinctus,* so this (now lost) specimen is the holotype. Aldrich (1930, p. 13) described one slab of tracks of *A. subulensis*, but illustrated three (Aldrich, 1930, pls. 2–4; Figs. 2B–D). Plate 2 (Fig. 2B) agrees best with the description of the ichnotaxon because it shows a trackway with a stride of about 26.5 cm (10.5 inches). The caption to plate 3 (Fig. 2C) indicates that it represents a larger animal than shown in plate 2 and so it presumably represents a second specimen. Plate 4 (Fig. 2D) shows a pedal track that is 15.25 cm long and about half the 27 cm (10.75 inches) of the described specimen and thus represents a third specimen. We interpret that the intent of Aldrich (1930) was to designate the lost specimen illustrated in his plate 2 as the holotype. This is also the specimen that provides the most morphological information.

Haubold (1970) synonymized *A. indistinctus* with *A. subulensis* and he also placed Aldrich's (1930) *Cincosaurus jonesi* in *Attenosaurus*. Haubold (1971, 1984) and Cotton et al. (1995) followed this taxonomy. Haubold et al. (2003a,b) consider *A. jonesi* to be a synonym of *Cincosaurus cobbi* and *Attenosaurus* to be monotypic, containing only *A. subulensis.*

We consider *Attenosaurus indistinctus* (Aldrich, 1930, p. 13, pl. 1; Fig. 2A) to have been properly named and to be a *nomen dubium*. However, it is likely a poorly preserved undertrack of *A. subulensis.* Similarly, we consider *Cincosaurus jonesi* (Aldrich, 1930, p. 28, pls.10–11) to be based on indeterminate tracks of a size that is much smaller than all the tracks that Aldrich (1930) described, and that we consider attributable to *Attenosaurus*.

We conclude that *Attenosaurus subulensis* is a valid ichnotaxon based on Aldrich (1930, p. 13, pl. 2; Fig. 2B). This specimen has no holotype. However, an uncatalogued specimen on display at ALNH was collected by Aldrich and Jones from the Holly Grove Mine above the Jagger coal seam and we designate this specimen as a neotype (Fig. 4A). This specimen, like all the *Attenosaurus* specimens collected by Aldrich and Jones (1930) and more recently at UCM, is an undertrack. The neotype shows a typical preservation of only pedal impressions preserving digit impressions II, III, IV, and V. The pedal impression is 80 mm wide and 200 mm long. All the digit impressions are extramorphologically elongated. Digit II impression is the shortest (60 mm), with digit III impression about twice as long (95 mm) and digit IV impression subequal in length to III. Digit V is intermediate in length between digit impressions II and III. Digit impressions II–IV originate on a plane perpendicular to the direction of travel. Digit V impression has its origin 3–4 cm posterior to the other digit impressions. The pedal impression has a relatively short and rounded heel impression (see Fig. 3A, lower right). The placement of the impression of digit V on a pedal impression that is pentadactyl (apparent from other specimens) with narrow elongate digit impressions and a short rounded sole impression is diagnostic of this ichnotaxon. The manus, which is not preserved in the holotype, is pentadactyl, with elongate narrow digits and a short, rounded heel impression.

THREE MORPHOTYPES OF LARGE TETRAPOD TRACKS FROM THE POTTSVILLE FORMATION

Haubold et al. (2003a, 2003b) alluded to the fact that specimens that they assigned to *Attenosaurus subulensis* might

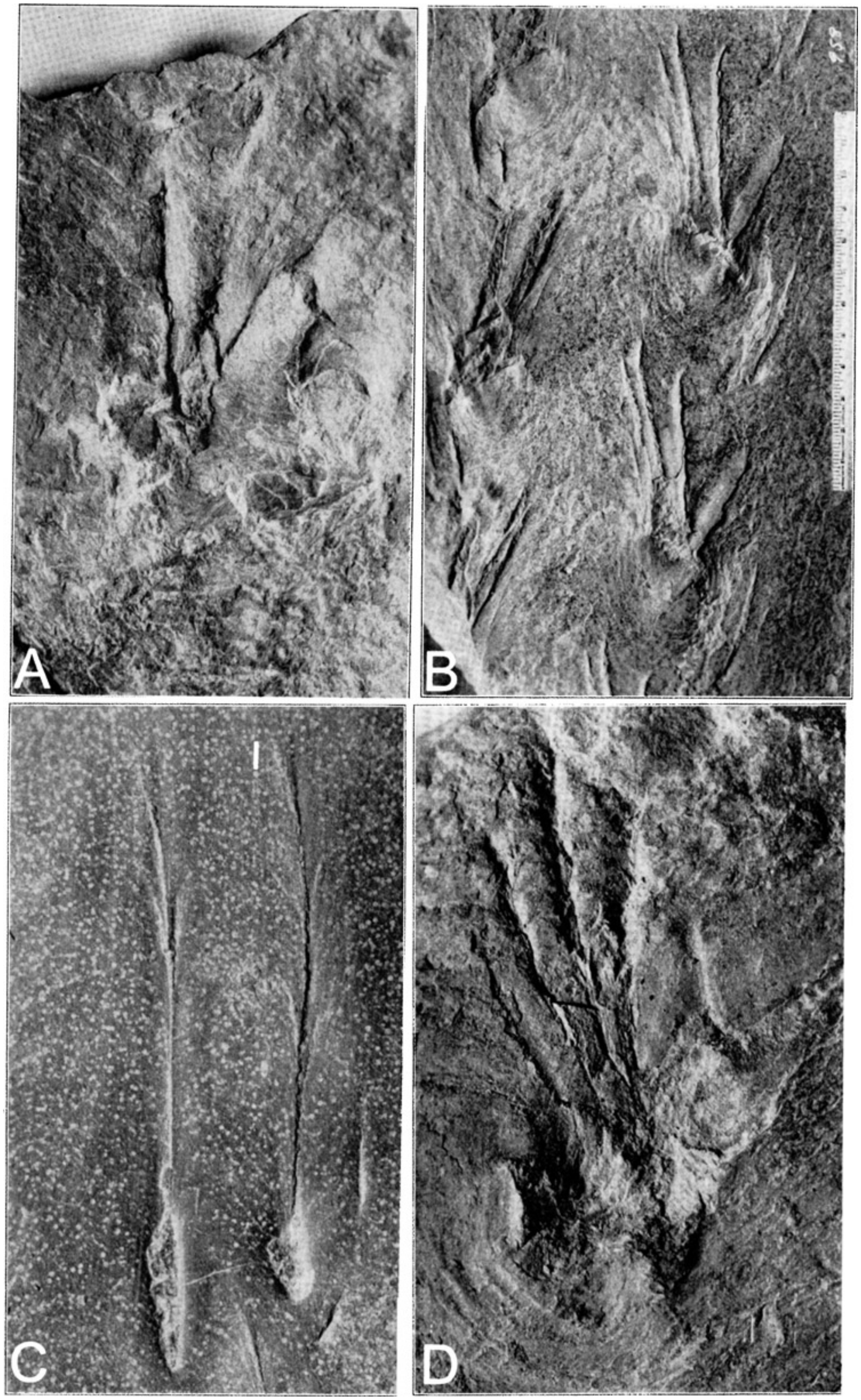

FIG. 2. Photographs of the (now lost) type material of *Attenosaurus*, from Aldrich and Jones (1930). **A**, *Attenosaurus indistinctus* (Aldrich and Jones, 1930, pl. 1). **B**, *Attenosaurus subulensis* (Aldrich and Jones, 1930, pl. 2). **C**, *Attenosaurus subulensis* (Aldrich and Jones, 1930, pl. 3). **D**, *Attenosaurus subulensis* (Aldrich and Jones, 1930, pl. 4).

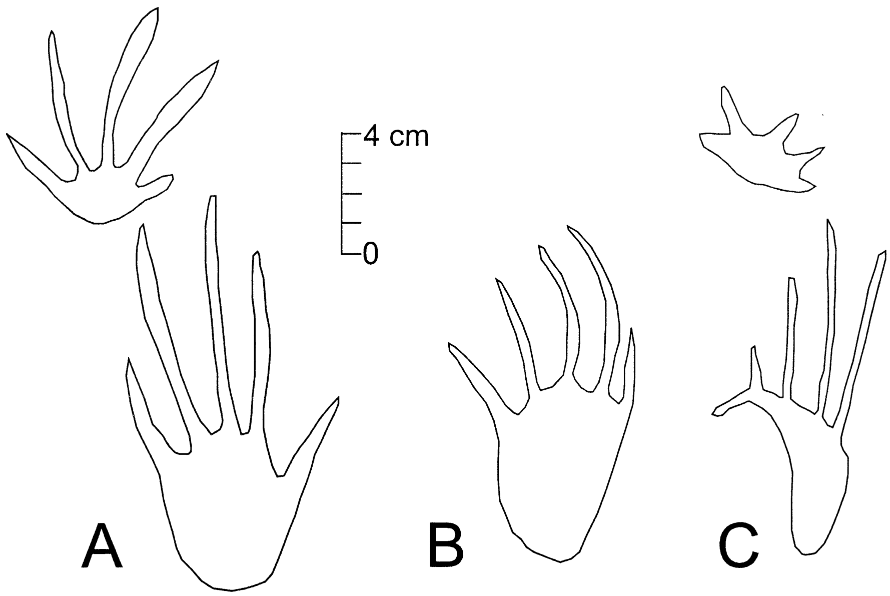

FIG. 3. Outline drawing of the three morphotypes of large tetrapod tracks (right) from the Pottsville Formation. **A**, *Attenosaurus subulensis.*, **B**, *Dimetropus* sp. **C**, *Alabamasauripus aldrichi.*

actually pertain to more than one ichnotaxon. After examining the surviving specimens of Aldrich and Jones and the new UCM collection, we believe there are three distinct morphotypes of large tracks in the Pottsville Formation (Figs. 3–4). The most common morphotype (ichnotaxon) is *Attenosaurus subulensis* (Figs. 3A, 4A), which is represented by tens of specimens (e.g., UCM 199, 200, 270).

The second most common ichnotaxon is represented by only a few specimens and it is characterized by a short digit impression I that is parallel to the direction of travel or recurved posteriorly (Figs. 3C, 4B–C). This ichnotaxon is also represented only by undertracks. The digit V impression is slightly shorter than the digit IV impression and slightly longer than the digit III impression. Digit I and II impressions are subequal in length. The heel impression is narrow, elongate and L-shaped. The manual impression is pentadactyl with fairly short digit impressions with a long axis directly obliquely to the direction of travel. We designate this as a new ichnotaxon.

The third morphotype (Figs. 3B, 4C) has five anteriorly directed digit impressions and a long and broad pedal heel impression. This ichnotaxon is represented by only two or three specimens (e.g., UCM 021). This morphotype is clearly comparable to Late Pennsylvanian-Permian specimens assigned to *Dimetropus* (compare Figs. 3B and 4C with Haubold et al., 1995, figs. 23–24 and Hunt et al., 1995, figs. 6 and 7). We tentatively identify these specimens as *Dimetropus* sp.

SYSTEMATIC ICHNOTAXONOMY

Alabamasauripus ichnogen. nov.

Type ichnospecies—*A. aldrichi* ichnosp. nov.
Included ichnospecies—Known only from the type species.
Etymology—For the state of Alabama and the fact that it is a reptilian track.
Distribution—Lower Pennsylvanian of northern Alabama.
Diagnosis—This ichnotaxon can be differentiated from other ichnotaxa by possessing a pentadactyl pedal impression (and manual) with an elongate, narrow, L-shaped heel impression, the impression of digit I oriented medially or posteriorly and pedal digit impressions that increase in length from digit impression II to IV with digit V impression slightly shorter than IV.

Alabamasauripus aldrichi ichnosp. nov

Holotype—NMMNH P-40012, right pedal impression (Fig. 4D).
Etymology—Named for T. H. Aldrich, for his early work on tetrapod tracks from the Pottsville Formation.
Type locality—NMMMH locality 5392 (UCM).
Type horizon—Upper Pottsville Formation (Lower Pennsylvanian).
Distribution—As for genus.
Referred specimens—UCM 024, ALNH PV987.0001.

WHO ARE THE TRACKMAKERS OF THE LARGE POTTSVILLE FOOTPRINTS?

The large track types from the Pottsville have generally been attributed to anthracosaurs (e.g., Haubold et al., 2003a, 2003b) even though they clearly represent animals far larger than any known Early Pennsylvanian anthracosaur. We were initially struck by the morphological similarity between some UCM specimens and *Dimetropus* to the extent that without question we would have assigned such specimens found in Permian strata to this ichnotaxon. Further study presented here shows that

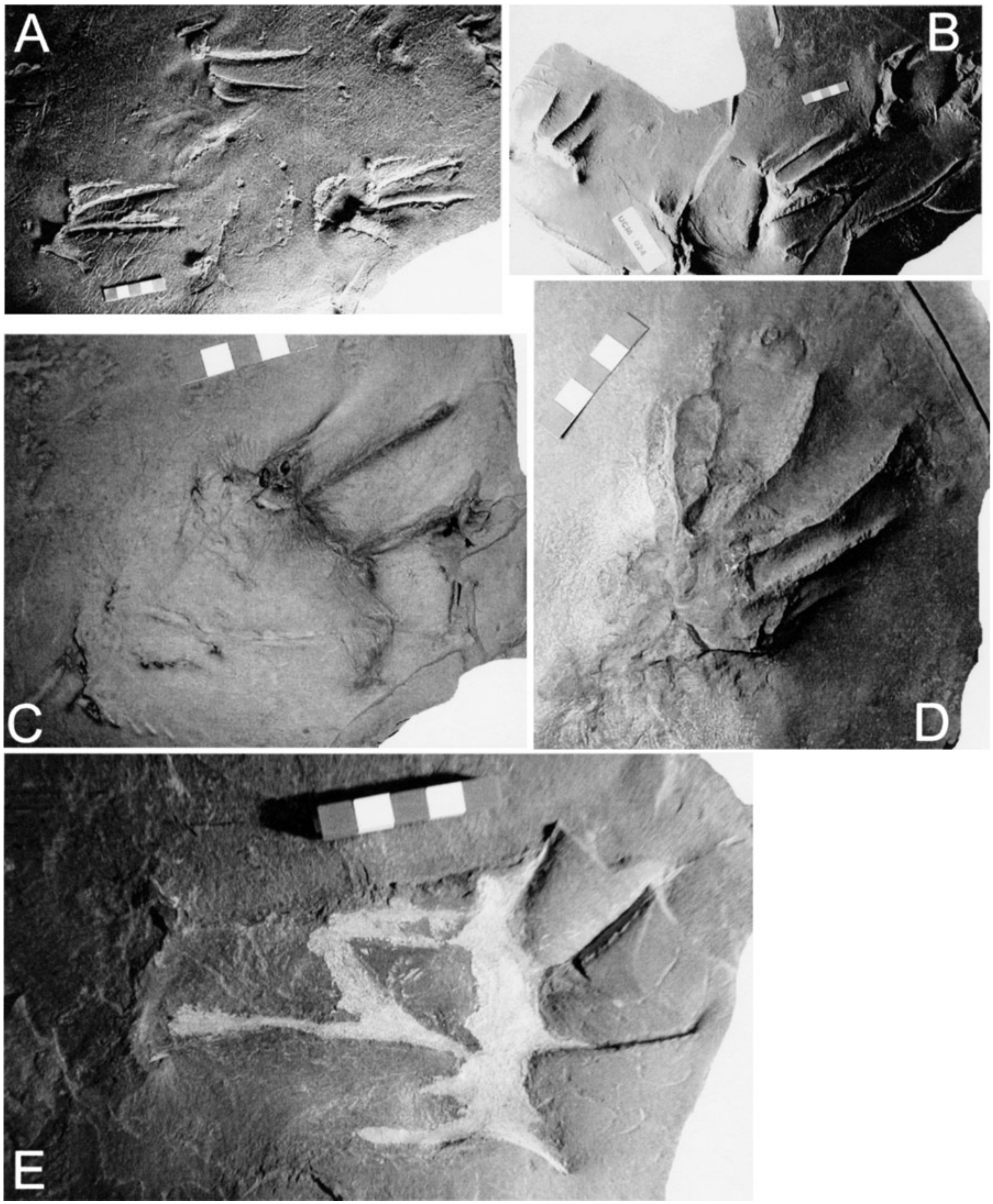

FIG. 4. Photographs of large tetrapod tracks from the Union Chapel Mine. **A**, ALNH unnumbered, *Attenosaurus subulensis.* **B–C**, *Alabamasauripus aldrichi.* **B**, UCM 024, *Alabamasauripus aldrichi.* **C**, ALNH PV987.0001, *Alabamasauripus aldrichi* . **D**, UCM 021, *Dimetropus* sp. **E**, NMMNH P-40012, holotype of *Alabamasauripus aldrichi.*

only a few of the UCM specimens are assignable to *Dimetropus*. However, this is a significant discovery because *Dimetropus* is by consensus considered to be the track of a large pelycosaur, which are unknown as body fossils from the Early Pennsylvanian.

The most obvious candidate for the trackmaker of a large Lower Pennsylvanian tracks would be an anthracosaur (e.g., Haubold et al., 2003a, 2003b). Indeed, *Attenosaurus subulensis* shows some morphological similarities to anthracosaurs such as *Gephyrosteus* (Carroll, 1970). However, *Attenosaurus* differs both in size and in that digit V is appreciably larger than digit I. Pelycosaurs have a relatively longer digit I on the pes (e.g., Reisz, 1986, fig. 28) and appear to be a better candidate for a trackmaker. *Alabamasauripus* is an unusual track for which we can find no viable trackmaker.

Clearly, the large tracks from the Pottsville Formation demonstrate the presence of several large tetrapods in the Early Pennsylvanian for which there is no bone record. Thus, these tracks have a potential to further elucidate our understanding of late Paleozoic tetrapod evolution.

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