



FIGURE 2. The Yanguoxia dinosaur footprints site, Yongjing County, Gansu Province.

SYSTEMATIC PALEONTOLOGY

Class AVES

Ichnofamily AVIPEDIDAE Sarjeant and Langston, 1994

AVIPEDIDAE gen. et sp. indet.

(Fig. 3, Table 1)

Material: RCPG (Research Center of Paleontology, Gansu Province) No. 001

Horizon and Locality: Hekou Group, Early Cretaceous, Yanguoxia, Yongjing Country, Gansu Province, China (Latitude 36°03'N, Longitude 103°15'E).

DESCRIPTION

Four positively impressed tracks are preserved on a slab (Fig. 3). These are asymmetric aviform tracks with tridactyl slender pedal digits without hallux and webbing. Track width is greater than length. The “heel” impression is not present, and the proximal end of three digits is isolated.

The average length of digits II, III, and IV are 22.7 mm, 26.3 mm, and 17.9 mm, respectively. The ratio of the track width and length (FW/FL) is 0.77. Divarication between digits II and IV impressions ranges from 104° to 125°; digit divarication between II and III is 63°, which 11° greater than between III and IV (52°). Digital pad organization is not evident, but entire outlines can be seen on each digit; three on digit III, and two on digits II and IV. The sharp claw impression (3–4 mm in length) is straight from the central axis of each digit.

Detailed measurements of each track are as follows (Table 1): Track no. 1 (Fig. 3a) is the deepest impression of four tracks. The track is 34.2 mm long and 39.7 mm wide. The ratio of the track width and length (FW/FL) is 1.16. The length of digit impressions, II, III, and IV is 21.6 mm, 31.8 mm, and 15.5 mm,

respectively. The width of digit II impression (4.5 mm) is greater than digit III (4.2 mm) and digit IV (3.8 mm) at its widest point. Divarication of digit II and IV impressions is 111°; digit divarication between II and III is 59°, which 7° greater than between III and IV (52°). The sharp claw impression (3.6 mm in length) is straight from the central axis of foot in digit III. There are three faint digital pads on the ventral side of the digit III, and at least two on digit II.

Track no. 2 (Fig. 3b) is the largest among four tracks (32.6 mm in length, 45.6 mm in width). The ratio of FW/FL is 1.4. The second digit is 24.4 mm long and 3.7 mm wide at its widest point. Digit III is 25.4 mm long and the greatest width is 4.6 mm. Digit IV is 14.1 mm long and 4.3 mm wide at its widest point. The divarication between digit II and IV is 124°; between digit II and III is 67°, and between III and IV is 57°. The 2.5 mm-long faint claw impression is preserved at the distal end of digit II.

The track no. 3 (Fig. 3c) is 32.6 mm long and 43.6 mm wide. The ratio FW/FL is 1.3. The second digit length is 22.2 mm and 3.4 mm at the greatest width point. Digit III is 24.2 mm long and the greatest width is 4.3 mm. Digit IV is 20.1 mm long and 3.4 mm at the greatest width point. The divarication between digit II and IV is 108°, which is the sum of 63° between digit II and digit III, and 45° between III and IV. The 3.7 mm-long faint claw impression is preserved the distal end of digit IV.

DISCUSSION

Yanguoxia tracks are typical of avian footprints judging from their wide divarication angle (104°–125°) between digits II and IV, slender digit impressions (Lockley et al., 1992), and width greater than length (McCrea and Sarjeant, 2001).

The Mesozoic bird tracks have been reported from Korea (*Jindongornipes kimi*, *Koreanaornis hamanensis*, *Uhangrichnus chuni*, *Hwangsanipes choughi*), China (*Aquatilavipes sinensis*), and Japan (*Aquatilavipes izumiensis*; Azuma et al., in this volume). *Koreanaornis* is small tetradactyl bird track (26.2 mm in length, 34.3 mm in width) with faint hallux impression, but often appearing tridactyl (Yang et al., 1995; Lim et al., 2000). There is no metatarsal pad impression. *Jindongornipes* is large tetradactyl bird track (80 mm in length) with well-developed hallux impression. Hallux impression often bent suggesting two distal phalanges in contact with substrate (Lockley et al., 1992).

Other Mesozoic bird tracks were found from Cretaceous beds in Canada, including *Aquatilavipes swiboldae* (Currie, 1981) and *A. curriei* (McCrea and Sarjeant, 2001). *Aquatilavipes* is small to large tetradactyl tracks without hallux. The average length and width of *A. swiboldae* is 35 mm and 44 mm, respectively. *A. curriei* is nearly two times larger than *A. swiboldae*.

Yanguoxia bird tracks are similar to *Koreanaornis* and *A. swiboldae* in size (Fig. 3). Digit traces of the Yanguoxia tracks are, however, not connected proximally as in *Koreanaornis*

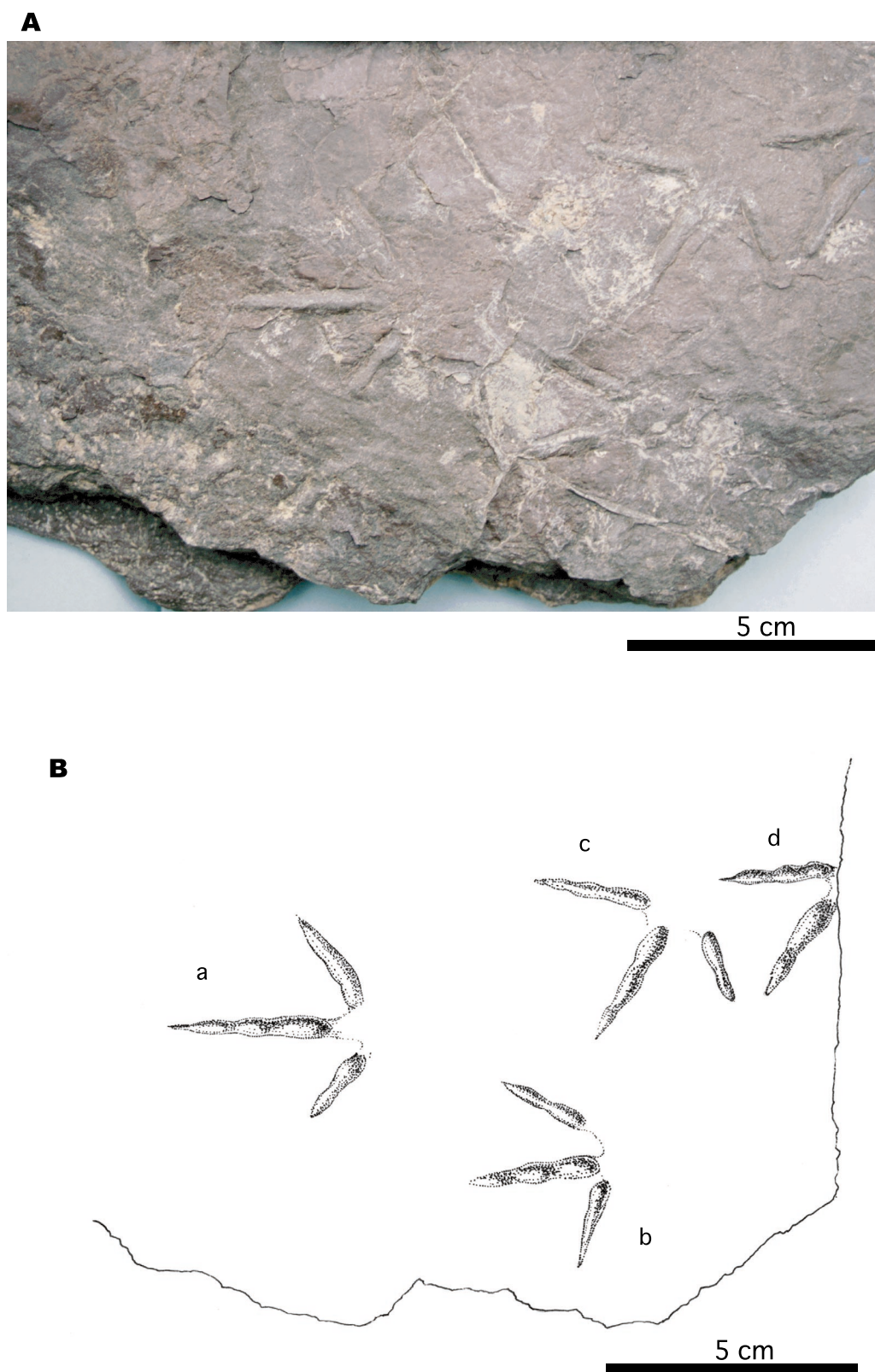


FIGURE 3. Yanguoxia bird tracks, photograph (A) and drawing (B).

TABLE 1. Measurements of the Gansu bird tracks.

Track Number	Footprint Length (mm)	Footprint Width (mm)	Ratio FL/FW	Digit Length (mm)			Divarication			Digit width (mm)		
				II	III	IV	II-III	III-IV	Total	II	III	IV
a	34.2	39.7	0.86	21.6	31.8	15.5	59	52	109	4.5	4.2	3.8
b	32.6	43.6	0.75	22.2	24.2	20.1	63	45	104	3.4	4.3	3.4
c	32.6	45.6	0.71	24.4	25.4	14.1	67	57	125	3.7	4.6	4.3
d	28.7	-	-	-	23.8	21.8	-	53	-	-	5.2	3.6
Average	32.0	43.0	0.77	22.7	26.3	17.9	63	69	113	3.9	4.6	3.8

hamanensis, which is different from *A. swiboldae*. Therefore, Yanguoxia bird tracks from Gansu Province could be an indication of avian connection between China and Korea during the Early Cretaceous.

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