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ICHNOTAXONOMY OF GIANT HOMINOID TRACKS IN NORTH AMERICA

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Abstract—Large bipedal hominoid footprints, commonly attributed to Bigfoot or sasquatch, continue to be discovered and documented, occasionally in correlation with eyewitness sightings, and rarely in concert with photographic record of the trackmaker (gen. et sp. indet.). One of the best-documented instances occurred in 1967, when Roger Patterson and Bob Gimlin filmed an over two meter tall upright striding hominoid figure, at the site of Bluff Creek, in Del Norte County, California, and cast a right and left pair of exceptionally clear footprints in firm moist sand. Additional footprints were filmed, photographed, and cast by multiple witnesses. Molds and casts of a series of these are reposited at the National Museum of Natural History, Smithsonian Institution, while ten original casts are among the Titmus Collection at the Willow Creek – China Flats Museum, Humboldt County, California. These casts have been 3D-scanned and archived as part of a footprint virtualization project and scan images are accessible on-line through the Idaho Museum of Natural History. The initial pair, originally cast by Patterson, and the remaining casts made by Titmus, are designated the holotype of a novel ichnogenus and ichnospecies describing these plantigrade pentadactyl bipedal primate footprints – *Anthropoidipes ameriborealis* ("North American ape foot"). The footprints imply a primitively flat, flexible foot lacking a stiff longitudinal arch, combined with a derived, non-divergent medial digit.

INTRODUCTION

Persistent eyewitness claims of observations of an unrecognized hominoid, commonly referred to as Bigfoot or sasquatch, emanate primarily from the forests of the Pacific and Inter-Mountain West of the United States and Canada, although reports also originate from forested hill country and lowlands of other regions of the continent. Sightings occasionally correlate with the discovery of large distinctive tracks that have often been documented by photographs and/or plaster of paris or gypsum cement casts. Krantz (1986, 1992) proposed assigning the nomen *Gigantopithecus blacki* to a type specimen represented by three casts made in 1982 by the U.S. Forest Service at Elk Wallow (Blue Mountains, southeastern Washington) and described by Krantz (1983). In effect, he had merely identified the maker of the tracks as *G. blacki*, which would have referred them to the existing type specimen of *G. blacki*, a Pleistocene species of giant ape from eastern Asia. Designating a new type with the name of an existing taxon is inadmissible under the rules of taxonomic nomenclature established by the International Commission on Zoological Nomenclature (1985). However, Krantz went on to note that inferred contrasts in the ecological adaptations of *G. blacki* known from cave sites in China and Viet Nam, versus sasquatch reported in the temperate forests of North America might eventually warrant renaming sasquatch as *Gigantopithecus canadensis*. Heany (1990), in a critique of Krantz's misdirected nomenclature, suggested it would be more sensible to designate the footprints as the type of a new species, *G. canadensis*, rather than refer the casts to *G. blacki*. However, Lockley (1999) correctly pointed out that in accordance with ichnological nomenclature the name of the trackmaker is a biotaxon, distinct from the track, which is an ichnotaxon, and therefore both cannot have the same name. He recommended that something like *Gigantopithepodus* would have less obviously flown in the face of scientific convention, although would likely still remain controversial.

SYSTEMATIC DISCUSSION

Traditionally, the tracks of extant animals are not named. First, they are not fossilized, and therefore attaching a name is not expressly sanctioned by the International Code of Zoological Nomenclature (ICZN). Second, because extant trackmakers can ultimately be correlated with their tracks, the naming of such tracks would appear redundant. However, in the case of the alleged sasquatch, the presumed species in question has received no formal name, so the matter of redundancy is presently not at issue. Furthermore, a precedent for naming the preserved tracks of an extant taxon has been established by Kim et al. (in press) in the naming of fossil *Homo sapiens* tracks. Since faltering steps and equivocations have been directed towards the matter of naming the footprints, it seems appropriate to complete that objective properly and formally by acknowledging the ichnological evidence that bears on the question of the existence of an unrecognized bipedal ape in the forest habitats of North America. It should be noted that naming the tracks neither establishes the identity of the trackmaker, nor does it resolve the controversy over the existence of sasquatch. Properly naming the tracks is intended to facilitate objective discussion and comparison of the tracks within an ichnological context.

A number of ichnologists have stressed the desirability of designating a trackway (rather than an isolated print) as a holotype for a new ichnotaxon (Sarjeant, 1989). This guideline is followed here using the Patterson-Gimlin filmsite trackway, for which multiple casts, molds and 3D virtualizations are preserved in several institutions. Moreover, these tracks and casts are linked to a film record of the trackmaker in action and both film and tracks have been intensively studied by numerous researchers.

Anthropoidipes ichnogen. nov.
Figures 1-3

Diagnosis: Plantigrade, pentadactyl, entaxonic, elongate footprints of a hominoid biped, that differ from *Homo sapiens* footprints in their larger absolute size, greater relative breadth, elongated heel segment, lack of a longitudinal arch and evidence of midfoot flexibility.

Description: Large, plantigrade, pentadactyl, entaxonic, elongate footprints of a hominoid biped. Footprint is flat, lacking a fixed longitudinal arch typical of human footprints. Frequently, indication of a transverse axis of flexion at midfoot present, occasionally producing a midtarsal pressure release ridge or disc. Ball is poorly differentiated from surrounding forefoot; rarely transected by a flexion crease, if sole pad extends sufficiently distal beneath proximal phalanges. Widest part of the foot lies at inferred position of metatarsal heads. Heel is elongate, broad and rounded. Relative breadth-to-length ratio exceeds that of human footprints. Deepest part of the footprint often beneath the forefoot; lacking evidence of distinct heel-strike typical of human striding gait. Digit impressions are short and rounded to elongate ovals; toe stems

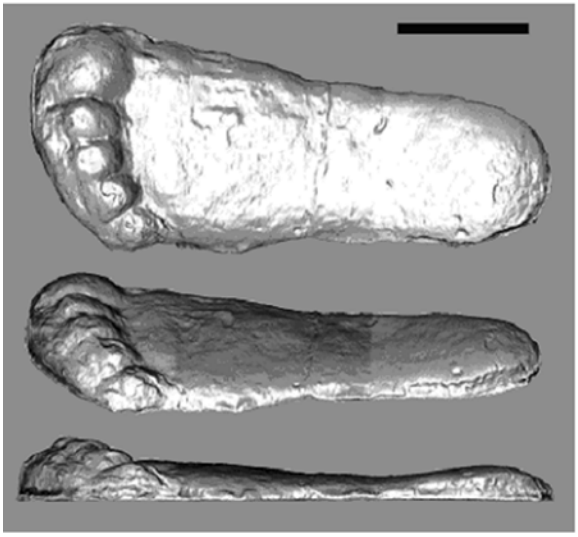

FIGURE 1. Multiple angles of the virtualized models of duplicate Patterson casts included in the holotype of *Anthropoidipes ameriborealis* (SI 390041 and SI 390042). Scale bar equals 10 cm.

FIGURE 2. Duplicates of the Patterson casts included in the holotype of *Anthropoidipes ameriborealis*; contour lines rendered at 3 mm intervals.

often visible when digits extended. Digit I approximately 50% wider than digits II-V; digits II – V more subequal than human toe row; digit I typically most distally projecting, although occasionally digit II is equally long or more distally projecting. Step length generally greater than 2.5 times foot length.

Included Ichnospecies: Type only

Distribution: Pacific, intermountain, boreal and lowland forests of North America.

Discussion: Detailed discussions and evaluation of distinctive features and range of variation are found in Meldrum (2004, 2006) and Krantz (1999).

Anthropoidipes ameriborealis ichnosp. nov.
Figures 1-3

Derivation of the name: North American ape foot.

Diagnosis: Same as for ichnogenus

Type Material: Holotype: Preserved portion of Patterson-Gimlin trackway, with Smithsonian Institution (SI) specimen 390041, left pes rubber mold and duplicate cast and SI 390042, right pes duplicate cast, representing left and right feet respectively.

Additional material relevant to the holotype: An additional 10 casts from the site, eight of these comprise SI 390043-50 (CA-11-18), including molds for SI 390047 and SI 390050.

Type Locality: A sandbar along Bluff Creek, in Del Norte County, California**,** midway between Notice Creek and the North Fork. Approximate latitude 123.70 degrees West, longitude 41.44 degrees North (Fig. 4).

Discussion: The type pair of casts was originally made by Roger Patterson on October 20, 1967. These represent the earliest documentation of the footprints in nearly pristine condition. Krantz labeled this pair as CA-9 and CA-10 respectively. Dupliates are reposited in the Division of Physical Anthropology, Department of Anthropology, National Museum of Natural History, Washington, D.C. Ten additional casts relevant to the holotype were made by Bob Titmus at the film site, nine days after the filming. The original ten casts are reposited in the Willow Creek – China Flats Museum, Humboldt County, CA.

A large sample of footprint casts and photos, representing a wide temporal and geographic range, has been evaluated by Meldrum (1999, 2004, 2006) and others (e.g. Bindernagel, 1998; Krantz 1999; Murphy, 2004). Statistical summary of linear metrics and proportions of a large sample of footprints are reported by Fahrenbach (1998), offering a summary of the range of variation in footprint dimensions. It is not widely known that more than 200 footprints have been examined and evaluated, with duplicates and some originals of a significant number of casts housed in the author's research lab at Idaho State University. These include material from important collections made by previous generations of researchers. In order to both make these specimens more readily accessible to serious researchers, and permit quantitative geometric morphometric analyses of the specimens, a project was undertaken to scan the casts and create an archive of 3D virtualized models. These are accessible on-line through the Idaho Virtualization Laboratory webpage (http://ivl.imnh.isu.edu/).

THE PATTERSON-GIMLIN FILM

The association of these tracks with an unrecognized giant bipedal hominoid is further indicated by the apparent documentation of the trackmaker on a brief 16mm film clip (Fig. 5). Roger Patterson and Bob Gimlin filmed the footage while searching in the Bluff Creek area subsequent to a discovery of extensive footprints in the region. A fuller account of the circumstances is found in Perez (1994) and Patterson and Murphy (2005). Although it had long been asserted that no footprints were visible in the film clip and therefore no direct correlations could be drawn between the tracks and the film subject, it has been demonstrated that indeed several footprints were clearly filmed and the indications of more can be discerned (Fig. 6) (Murphy, 2004). Furthermore the distinctions of the film subjects gait and visible foot kinematics indicate that the film subject is indeed the trackmaker. Affirmative and skeptical reactions to the film include Meldrum (2006) and Daegling (2004).

FIGURE 3. Scans of the ten original casts made by Titmus nine days after the filming at the Bluff Creek site, constituting additional material relevant to the holotype of *Anthropoidipes ameriborealis*.

PATTERSON CASTS

Patterson selectively cast a pair of footprints representing a right and left foot (Fig. 1-2). The substrate consisted of fine dampened sand that took the imprints with exceptional clarity. A sample of the substrate collected from the vicinity of the sandbar in 2003, resembles the material adhered to the original casts made by Titmus, and is characterized as a fine to very coarse lithic sand. Grain size ranges from fine upper (177-250 microns) to very coarse lower (1000-1410 microns), with isolated grains as large as very coarse upper (1410-2000 microns). The dominant grain size is coarse lower (500-710 microns). The sand is moderate-to-poorly sorted and the individual clasts are dominantly of subangular shape. The clast composition is dominated by metamorphic lithic clasts (schist and gneiss, ~85%), with small amounts of quartz (~10%) and other constituents (~5%, including altered siltstone lithics and other lithics). The angular nature of the clasts facilitated excellent preservation of footprint detail. The Patterson footprint casts are exceptional facsimiles of the feet themselves with little distortion resulting from dynamic artifacts of foot movement during the step.

LAVERTY PHOTOS

Three days after the filming by Patterson and Gimlin, a Forest Service timber cruiser, Lyle Laverty, and his crew of seasonal employees visited the site. They had been camped just downstream near the junction of Notice Creek and Bluff Creek since early summer, preparing timber sales in the region. While in Orleans for the weekend, they heard about the incident. On Monday they drove to the site, observed the footprints, and took pictures of three prints (Fig. 7). The dimpling effects of rainfall can be seen in some photographs. Laverty followed the tracks of a single trackmaker along the sandbar for several hundred feet. In contrast to Patterson's casts, Laverty's pictures depict examples of very dynamic footprints with features such as distinctive pressure ridges and discs in the midtarsal region. One footprint in particular clearly exhibits a pronounced pressure ridge across the midfoot.

TITMUS CASTS

Nine days after the filming, Bob Titmus, formerly a taxidermist in the region, but in 1967 a Canadian resident, arrived at the site. He came

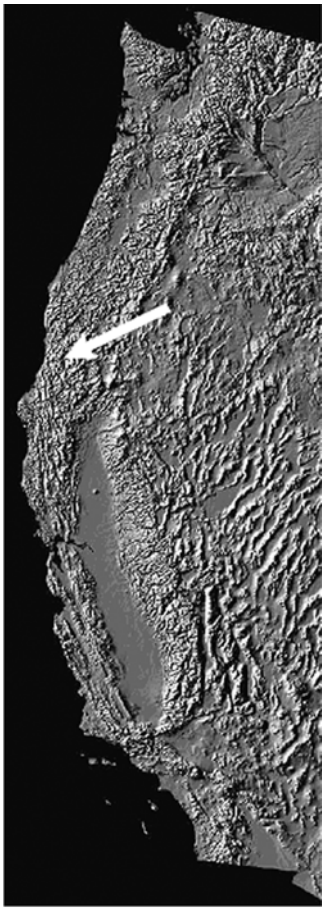

FIGURE 4. Outline county map of the state of California. Arrow indicates the approximate location of the film site designated as the type locality in the southeast corner of Del Norte County, CA, centered on the Bluff Creek drainage.

prepared to cast a sample of the footprints, which were still clearly impressed in the sandbar. In all, ten successive footprints were cast, providing a distinctly unique record of the individual footprint variation present in a single sasquatch trackway traversing a variable substrate (Fig. 3). Animation of the foot was quite evident in this series of footprints. Three of the ten casts were the very footprints photographed earlier by Laverty including the one that displayed a particularly pronounced pressure ridge, providing exceptional corroborative documentation of this significant dynamic feature.

CHARACTERISTICS OF THE *ANTHROPOIDIPES* TRACKWAY

The footprints lack evidence of differential concentration of pressure under the typical regions of the human foot, i.e. heel, ball, and great toe. Instead the footprint is notably flat, lacking indications of a distinct heel strike and often displaying little or no sign of a stiff and well-developed medial longitudinal arch. This indicates a compliant gait with flat placement of the foot on the substrate, presumably to maximize distribution of plantar pressures at the onset of touchdown. Occasionally, pressure release produces a distinctive ridge or disc proximal to the inferred position of the midtarsal joint (Meldrum, 1999, 2004). This dynamic feature is correlated with the midtarsal break of the hominoid foot, and is dramatically exhibited by the cast depicted in Fig. 8.

Unfortunately no comprehensive filming, photographs or map of the trackway was made. However, the incomplete photographic record and castings are useful. By knitting together a series of film frames, a composite figure depicting two strides was reconstructed by Yvon Leclerc (Fig. 9). Camera perspective during panning shots is potentially inconsistent and apparent angles are uncertain, but the medial border of the tracks is roughly aligned with the direction of travel, with a relatively narrow step width, or straddle. Individual step length estimates vary from 68.5 cm to 86 cm in this reconstruction. Krantz (1992) reports the overall average step length as 103.5 cm, nearly 2.8 times the footprint length.

FIGURE 5. Three cropped frames from the Patterson-Gimlin film clip. Note in particular the entire length of the plantar surface of the foot visible at left; the dorsiflexion of toes visible at center; the midfoot flexibility visible at right (courtesy of Erik and Martin Dahinden).

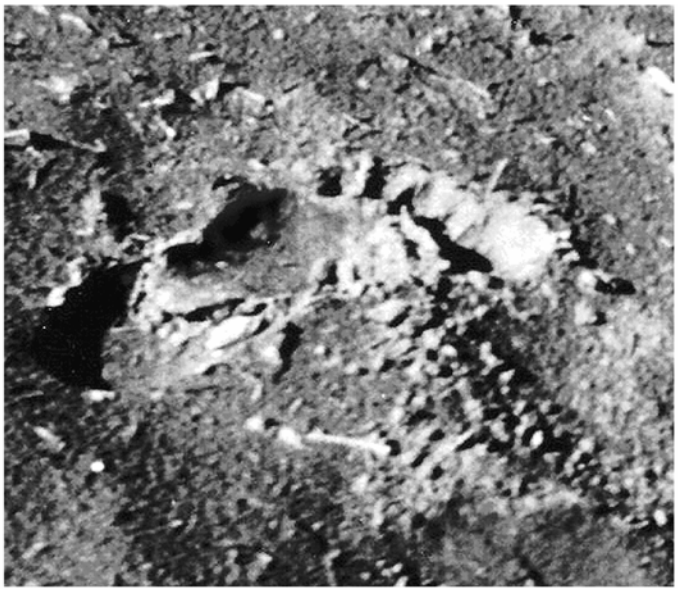

FIGURE 6. Still from the Patterson-Gimlin film clip illustrating a footprint. Note the midtarsal pressure ridge/disc running transversely approximately midway between the heel and forefoot.

DISCUSSION

It should become clear that these tracks are not merely oversized facsimiles of human footprints. Their superficial resemblance ends at the lack of a divergent medial digit. By contrast they lack the features that distinguish modern human footprints, foremost the longitudinal arch and differentiated ball at the base of the great toe (Meldrum, 2004). The *Anthropoidipes* tracks exhibit extensions along trajectories in hominoid foot form associated with trends toward greater body mass and greater commitments to terrestrial locomotion (Fig. 10). These include increased heel elongation and breadth; relatively shortened lateral toes; reduced divergence of the medial digit.

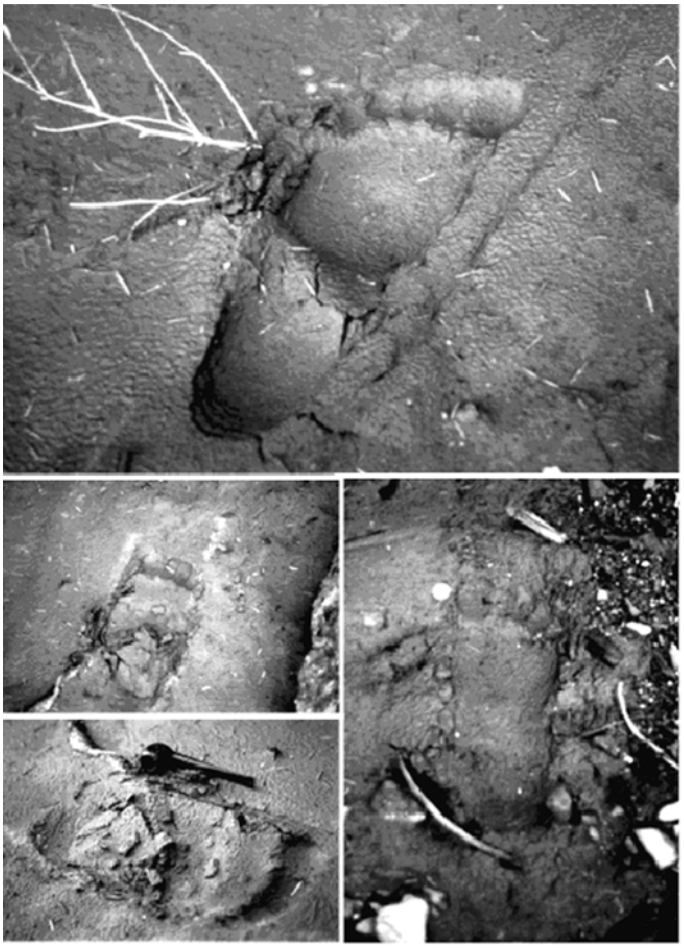

FIGURE 7. Photographs taken by Laverty on October 23, 1967 of footprints examined on the Bluff Creek sandbar film site.

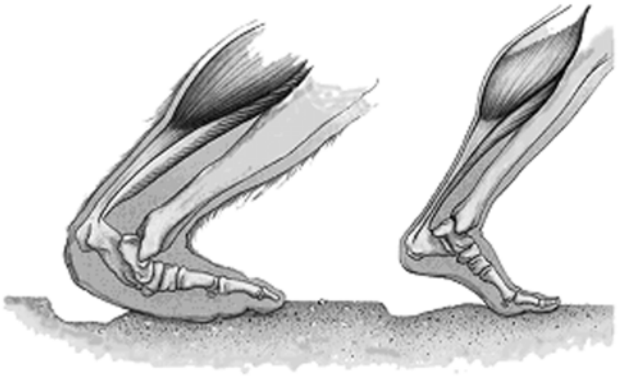

FIGURE 8. Multiple views of the cast with the pronounced pressure ridge indicative of midtarsal flexibility; the morphology inferred to account for the midtarsal pressure ridge contrasted with that of a modern human foot.

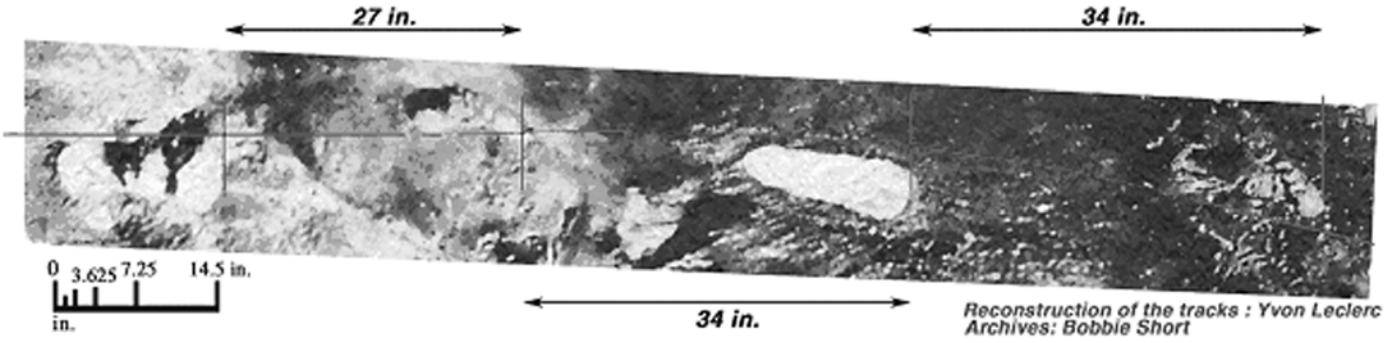

FIGURE 9. Composite image of a series of frames depicting two strides reconstructed by Leclerc. Note the track at far right is that illustrated in Figure 2; the track second from right is filled with plaster and is one of the Patterson casts included in the holotype.

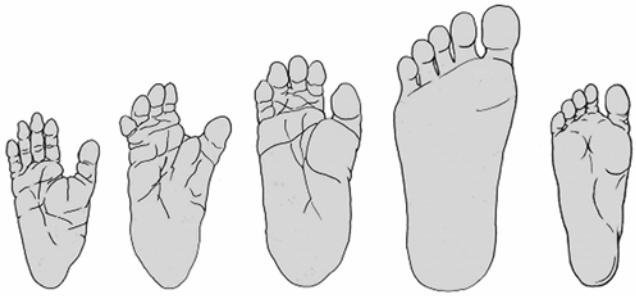

FIGURE 10. Comparative series of (l-r) chimpanzee, lowland gorilla, mountain gorilla, *Anthropoidipes*, human.

As summarized in the author's recent book (Meldrum, 2006) all serious sasquatch researchers are well aware of the general skepticism amongst scientists and lay persons alike. For this reason it is worth pointing out that those inclined to take the probability of sasquatch's existence seriously are either those with direct experience of seeing or hearing the animal, or seeing its tracks; whereas armchair skeptics have little or no direct field experience or knowledge of how widespread the trackway evidence is. On the other hand, a significant number of those who take the phenomenon seriously have extensive training and field experience in forensic science, wildlife biology and tracking in the montane forest of the western U.S. and Canada. Much of the more serious literature on the subject has been written by bona fide scientists with anthropological or biological credentials from recognized institutions (Sanderson, 1961; Napier, 1973; Shackley, 1983; Bourne, 1975; Krantz, 1999; Bindernagel, 1998; Sprague and Krantz, 1979; Markotic and Krantz, 1980; Haplin and Ames, 1980). These have acknowledged those cases of obvious hoaxing – which, incidentally, is indicated far less often than is commonly supposed. As noted by Meldrum (2006) the likelihood of a conspiracy of hoaxers, or simply anatomically-correct copy-cats, coordinated over a huge region for many decades is vanishingly small. The lack of physical remains is frustrating, but not surpising given the moist forest habitat, acidic soils, and the presumed intelligence and caution of the trackmaker. In this regard it is worth noting that large mammals and birds have eluded zoological search for centuries before being discovered alive and well in extant populations. In fact, the editor of *Scientific American* remarked that the recent pace of discovery of new species of large animals was "astonishing" (Rennie, 1996). The discovery of the Flores hominid and serious discussions of its possible links to the elusive orang pendek prompted the editor of *Nature* to opine that perhaps it was time for cryptozoology to "come in from the cold" (Gee, 2004).

That a giant ape once existed with the proportions necessary to produce a sasquatch-sized hominoid footprint is accepted. *Gigantopithecus blacki* is known exclusively from limited Pleistocene cave-deposits in China and North Viet Nam. Its meager fossil record consists of two mandibles and isolated teeth, which indicate an ape weighing as much as 450 kg. Presumed to have gone extinct a mere 250 Ka (Cameron, 2004), it is not hard to imagine its survival into the present within remote habitats including those North American forests periodically contiguous with its past Asian habitats. That an "extinct" giant ape is accepted by science on the basis of such scant fossil evidence, one might ask why serious consideration has been slow in coming to the hundreds of documented footprints (not to mention sightings, vocalizations, hair, scat, etc.).

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