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The history of dinosaur collecting in central India, 1828–1947

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Abstract: The history of dinosaur collecting in central India (former Central Provinces and Central India Agency) began in 1828 when W. H. Sleeman discovered isolated sauropod caudal vertebrae in the Lameta Formation near Jabalpur. Subsequently, the area became a focal point for fossil collection, leading to a series of further discoveries that continues today.

The earliest discoveries were made by numerous collectors for whom palaeontology was a secondary pursuit, and who were employed in the armed forces (W. H. Sleeman and W. T. Nicolls), medicine (G. G. Spilsbury) or as geologists (T. Oldham, H. B. Medicott, T. W. H. Hughes and C. A. Matley). Most of their finds were concentrated around Jabalpur or farther south near Pisdura and often consisted of isolated, surface-collected bones.

Charles Matley undertook the two most extensive collecting efforts, in 1917–1919 and 1932–1933 (Percy Sladen Trust Expedition). As a result he discovered significant deposits of dinosaurs on Bara Simla and Chhota Simla, revisited Pisdura, and mapped the Lameta Formation. Many new dinosaur taxa resulted from Matley's studies, which still represent most of the known Lameta Formation dinosaur fauna. Current scientific understanding places these fossils among the Sauropoda (as titanosaurians) and Theropoda (as abelisaurids and noasaurids). Early reports of armoured ornithischians were erroneous; these materials also pertain to sauropods and theropods.

Supplementary material: A list of the archival documents in the Natural History Museum, London that were used for this study is available at <http://www.geolsoc.org.uk/SUP18418>.

Dinosaur fossils have been collected from the latest Cretaceous deposits of central India since the early nineteenth century, beginning with a series of British soldiers, geologists and amateur naturalists. This work extended through to Indian independence, whence it continues to the present day with ongoing exploration and excavation led by members of the Indian palaeontological community. Despite this long history, which begins almost contemporaneously with early studies of dinosaur fossils in Europe, the early efforts associated with Indian palaeontology have been poorly documented. As a result, important information about the identities, geological settings and exact geographical locations of the fossils have been overlooked, leading to confusion and debate in the more recent scientific literature.

Here we review the early history of collecting in central India, a region consisting of the former Central Provinces (1861–1950) and Central India Agency (1854–1956), and now corresponding to

the states of Madhya Pradesh and Chhattisgarh with portions of neighbouring Maharashtra (Fig. 1). We focus on this time and place in order to strengthen the historical and scientific foundation for ongoing palaeontological research throughout the Indian subcontinent. Much of the information we present below has been collected from available historical literature, but we also include evidence from previously unpublished archival sources. The latter include letters, bills of lading and project reports associated with the fieldwork of Charles A. Matley, which are now housed at the Natural History Museum, London. These documents provide important new data concerning collecting efforts, localities and the fossils recovered.

Institutional Abbreviations: AMNH, American Museum of Natural History, New York, USA; GSI, Geological Survey of India, Kolkata, India; IM, Indian Museum, Kolkata, India; NHM, The Natural History Museum, London, UK.

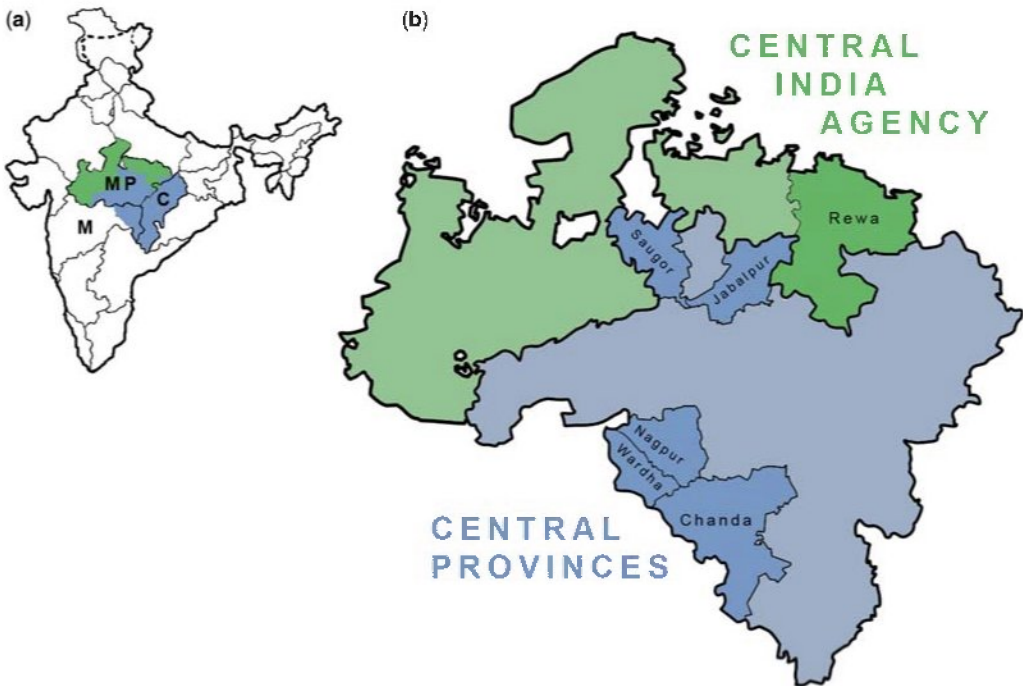


Fig. 1. Map of India showing location of areas discussed in the text. (a) Map of present-day India showing state boundaries; coloured areas represent the pre-independence area of the Central Provinces and Central India Agency. (b) 1909 boundaries of the Central Provinces and Central India Agency, showing districts and states (darker tones) where palaeontological work took place. Abbreviations: C, Chhattisgarh; M, Maharashtra; MP, Madhya Pradesh. Colours: blue, Central Provinces; green, Central India Agency.

Initial discoveries: 1828–1872

The first discoveries of dinosaur bones from the Indian subcontinent were made by W. H. Sleeman in the valley of the Narmada (= Nerbudda, Nerbadá) River in the early 1800s (Sleeman 1844). Sleeman, a captain (and eventually a lieutenant colonel) in the Bengal Army, was perhaps best known for his pursuit and suppression of the thaggi (= thuggee), a cult that practiced robbery and murder against travellers. (For these efforts, Sleeman is remembered today in the name of the village of Sleemanabad.) He also documented a long-term interest in natural history in his memoirs (Sleeman 1844). Among these, his initial discoveries were made just 0.9 km NE of his home in Jabalpur (= Jubbulpore) and concerned a ‘petrified forest’ in the stratum just below the basalt that caps the Jabalpur ridges (now recognized as one of the Deccan Traps) (Prinsep 1832). This discovery most probably occurred in 1828 (Sleeman 1844), although an 1830 date has also been suggested (Prinsep 1832; Medlicott 1860). Sleeman also found fossil bones with these silicified tree trunks, two of which he sent to Dr G. G. Spilsbury, a civil

surgeon in Jabalpur, who returned to the site and procured one additional specimen some time prior to 1832 (Prinsep 1832; Spilsbury 1837; Matley 1921*a*). Sleeman also visited the Saugor area in 1830 and discovered a similar deposit of petrified tree trunks below the Deccan Traps, but did not report any additional bones (Sleeman 1844).

Spilsbury sent all three specimens to James Prinsep in Kolkata in 1832 (Matley 1921*a*). Prinsep, a local antiquarian and the first to translate the Brahmi script into English, was unable to identify them owing to their poor preservation, although he observed that ‘the osseous structure of the first two is very apparent’ (Prinsep 1832, p. 456; see also Prinsep 1833). These two bones were then passed to Dr Thomas Oldham, the first Director of the Geological Survey of India, who brought the bones from Jabalpur in 1862, and then to Mr Hugh Falconer. Falconer described and illustrated the bones, which he recognized to be reptilian caudal vertebrae, but this work was not published until after his death (Falconer 1868). Richard Lydekker (1877) studied the caudal vertebrae and a femur (collected by Medlicott from an overlying horizon some years later; see later) and made them the

type series of the sauropod dinosaur *Titanosaurus indicus*. The locations of these specimens are now unknown, although Lydekker (1888) noted that they were originally deposited in the Indian Museum, Kolkata. A plaster cast of one caudal vertebra was presented to the British Museum (Natural History) by Falconer in 1867 and survives in the Natural History Museum, London as NHM 40867 (Fig. 2a; Table 1). As the original specimens cannot be located, this cast should be regarded as a plastotype for this species.

The Saugor area was visited again in the 1850s by W. T. Nicolls, a captain in the Madras Army (Matley in Huene & Matley 1933), who reported finding two fossiliferous localities near the village of Narayanpur (= Narrainpore). One site produced mostly fossil wood but also a fragment of bone. At the second locality Nicholls described 'fragments of large bones strewed on the surface of the black regur soil', at least one of which preserved the concave face of a vertebral centrum (Carter 1854, p. 322). Medlicott (1860, p. 199) identified these

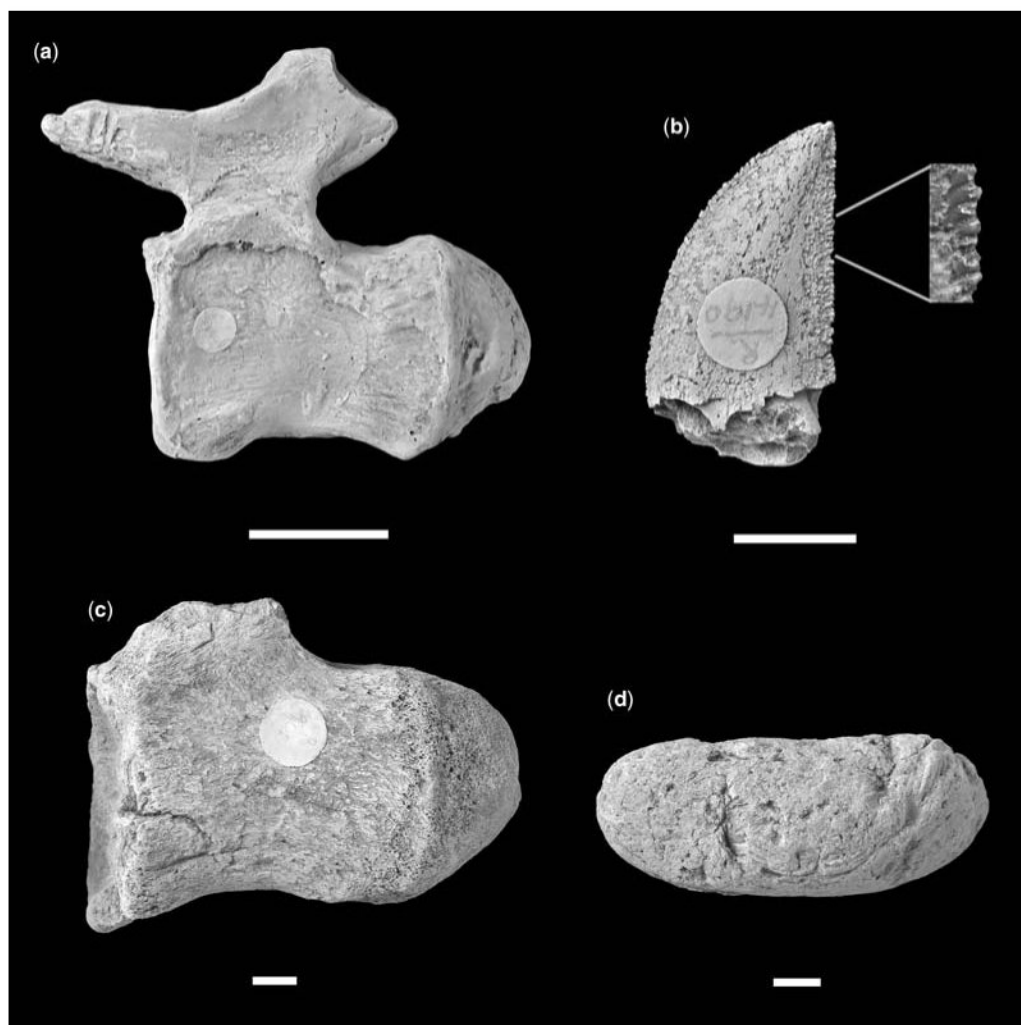


Fig. 2. Representative fossil specimens collected from the Late Cretaceous beds of central India, 1848–1933. (a) Plaster cast of syntypic caudal vertebra of *Titanosaurus indicus* (plastotype, NHM 40867). (b) Holotype tooth of *Massospondylus rawesi* (NHM R 4190), showing enlargement of serrated posterior carina. (c) *Titanosaurus* caudal vertebra (NHM R902). (d) Coprolite from Pisdura (NHM uncatalogued, 'specimen 66'). Scale bars: (a) 5 cm; and (b)–(d) 1 cm.

Table 1. Chronology of dinosaur expeditions in central India by year and district, 1828–1947, with specimens known to have been collected

Collector(s)	Year(s)	Locality	Specimen(s)	Current status		
Sleeman, Spilsbury	1828–1832	Jabalpur	Two sauropod caudal vertebrae	Types, <i>Titanosaurus indicus</i> (GSI/IM, lost; cast, NHM 40867)		
Nicolls	1850s	Saugor	Vertebral centrum	Bombay Branch, Asiatic Society (lost)		
Rawes	pre-1859	Takli	Theropod tooth	Type, <i>Massospondylus rawesi</i> (NHM R4190)		
Blanford	pre-1859	Pisdura	Two sauropod vertebrae	Type, <i>Titanosaurus blanfordi</i> (GSI), cf. <i>Laplatasaurus madagascariensis</i> (GSI)		
			Coprolites, turtle carapace	Lost		
Hislop	pre-1859	Pisdura	Dinosaur femur, vertebrae; molluscs; coprolites	Lost		
			Two turtle carapaces	<i>Hydraspis leithi</i> (unknown; cast, NHM R1728)		
Medlicott	1871–1872	Jabalpur	Sauropod femur	cf. <i>Antarctosaurus</i> sp. (GSI K22/754)		
Hughes	1870s	Karhayia	Large vertebrate remains	Unknown		
		Pisdura	Dinosaur bones, coprolites, shells	Unknown		
Matley	1917	Jabalpur	Numerous sauropod and theropod specimens	<i>Titanosaurus indicus</i> ; types, <i>Lametasaurus indicus</i> (GSI), <i>Antarctosaurus septentrionalis</i> , <i>Coeluroides largus</i> , <i>Compsosuchus solus</i> , <i>Dryptosauroides grandis</i> , <i>Indosaurus matleyi</i> , <i>Indosuchus raptorius</i> , <i>Jubbulpuria tenuis</i> , <i>Laeviusuchus indicus</i> , <i>Ornithomimoides</i> (?) <i>barasimlensis</i> , <i>Ornithomimoides mobilis</i> (all GSI; see Huene & Matley 1933 for specimen numbers)		
			Second theropod	Unknown; possibly refers to one of the taxa above		
			Lameta Ghat	Sauropod	Unknown	
			1920	Pisdura	Coprolites, turtle, mollusc, sauropod caudals	<i>Titanosaurus blanfordi</i> (unknown)
			Panchgaon	Sauropod caudal vertebra	<i>Titanosaurus blanfordi</i> (unknown)	
Brown	1922	Bara Simla	Theropod skull, titanosaur osteoderm	cf. <i>Indosuchus</i> (AMNH 1753, 1955, 1960), titanosaur (AMNH 1959)		
Das-Gupta	1924	Bara Simla	Theropod tooth	Type, <i>Orthogoniosaurus matleyi</i> (unknown)		
Matley	1932	Jabalpur	Sauropod, theropod, plants	Unknown		
		Pisdura	Sauropod caudal vertebrae; coprolites	NHM R5920–R5921; R12377–R12378 (also many unregistered bones and coprolites)		
		1933	Rewa State	Dinosaurs	Unknown	
		Chhota	Associated titanosaur postcrania	NHM R5903, R5931–R5933, R5935, 16481		
		Simla	Dinosaur limb bones	Unknown		
		Amakhoh				

bones as mammalian, and mentioned the similarities between the beds at Narayanpur and those at Jabalpur:

a similar bed is found . . . covered by a trap . . . colossal vertebrate bones, are embedded in the calcareous bed. These bones are much too broken for identification. They are supposed to have belonged to large Pachyderms, or possibly to cetacea.

The vertebra was favourably compared to the sauropod vertebrae later discovered at Pisdura (Hislop 1861, p. 190). These materials were collected and brought to the Bombay Branch of the Asiatic Society, but could not be found when requested by Charles Matley in 1925 (Matley in Huene & Matley 1933, p. 6) and are now presumed lost.

Three additional collections were made in the years prior to 1859 but, unfortunately, their specific dates are not recorded. Among the earliest of these was the discovery by Mr Rawes of a single dinosaurian tooth in the Nagpur area, Maharashtra. Although it was originally reported to have come from the intertrappean Takli Beds (Hislop 1861, 1864), which were at the time considered to be Eocene in age, Lydekker (1879, 1890) suggested that the tooth actually came from the underlying infratrappean Lameta Beds. Lydekker (1879, 1890) recognized the theropod affinities of the tooth, but considered it to be most similar to 'anchisaurid' teeth of *Thecodontosaurus* and *Massospondylus* (then thought to be theropods). This specimen was named *Massospondylus rawesi* by Lydekker (1890). Although the tooth can now be identified as a theropod (and resembles those of abelisaurids), it bears no diagnostic features that allow its referral to an existing or novel theropod genus (Fig. 2b).

Second came the first reported discoveries at Pisdura (= Phisdura, Phizdura, Pijdura), about 320 km from Jabalpur, in Chanda (now Chandrapur) District. Here, W. T. Blanford collected two sauropod dinosaur vertebrae that were later described by Lydekker as the type of *Titanosaurus blanfordi* (Lydekker 1879), although the smaller of the two was later referred to as *cf. Laplatasaurus madagascariensis* by Huene (1929, p. 39). Lydekker (1877, p. 41) also mentioned 'a considerable series of caudal vertebrae', along with coprolites and a turtle carapace, but none of these materials were ever described in detail, and their current whereabouts are not known. This was the first mention of coprolites from Pisdura.

Third, and subsequent to Blanford's visit, the Reverend Stephen Hislop also collected at Pisdura (Hislop 1860). Importantly, he noted a very similar arrangement of the beds to what had been observed at Jabalpur: 'On the west side of Phizdura, which is only 3 miles E.S.E. Of Mángali, there is a hill of trap . . . It also overlies a fossiliferous

deposit' (Hislop 1860, p. 163). Hislop was also the first to observe that most of the fossils were found as surface materials in a nearby field. His collection included vertebrae and a femur from a large dinosaur, in association with a tooth, a fish vertebra, a turtle plastron, and typical Lameta Formation molluscs and coprolites ('some of them huge enough': Hislop 1864, p. 282). Hislop originally considered the large bones to be mammalian ('Pachyderms': Hislop 1860, p. 163). They were too heavy to ship, but he made drawings in order to permit them to be studied by Falconer, who identified them as reptilian (Hislop 1861, 1864). Unfortunately, many of Hislop's notes were only published posthumously (Hislop 1864). Although most of the specimens were not seen by Lydekker during his time in India just a few years later (he noted, 'I do not at all know what has become of the specimens collected by Mr Hislop': Lydekker 1879, p. 24), he eventually described the turtle carapace and referred it to *Hydraspis leithi* (Lydekker 1890).

Between 1871 and 1872 H. B. Medlicott conducted a study of the 'infratrappean' rocks of the Jabalpur District, and documented the presence of vertebrate bones at both Jabalpur and 65 km to the WSW at Karhayia (= Kareia) (Medlicott 1872). At Jabalpur he collected an approximately 1.3 m-long sauropod femur (GS1K22/754), originally made part of the type series of *Titanosaurus indicus* (Lydekker 1877) but later removed to *cf. Antarctosaurus* sp. (Huene & Matley 1933, p. 29). Below Kareia, in the bed of the Sher River, Medlicott noted the presence of 'large vertebrate remains, though scarcely perfect enough for identification' that had 'weathered from beneath the trap' (Medlicott 1872, p. 119). Huene & Matley (1933) noted that these fossils probably came from the Greensand Zone.

At about the same time geologist T. W. H. Hughes followed upon Hislop's report and visited the Pisdura site, which he noted occurred in a field at the southern end of Pisdura Hill. The fossils were found as surface float, as they continue to be today, 'having been turned up by the ploughing of the land' (Hughes 1877). Hughes noted the presence of shells, coprolites and bones, specifically mentioning among the latter both limbs and vertebrae.

Subsequent to these reports and the works of Richard Lydekker, no further collecting in the Central Provinces appears to have been reported for nearly 45 years.

Expeditions of Charles A. Matley: 1917–1933

First expeditions, 1917–1924

A second, renewed phase of collecting began with Charles Matley, a British geologist and field



Fig. 3. Charles A. Matley. Photograph courtesy of NHM Archives.

officer based at the Geological Survey of India (Fig. 3). His first discoveries came in October 1917 during a visit to Jabalpur. There, on the western slope of Bara Simla, he found numerous remains of sauropod and theropod dinosaurs (Table 1) (Matley 1921*a, b*). Further excavation revealed that these remains came from two specimens in two different layers: a sauropod tentatively identified as *Titanosaurus indicus* in 'a red and green marly clay about 4 feet above the lower limestone'; and a smaller theropod from a slightly lower 'soft greenish sandstone at the base of the lower limestone' (Matley 1918, pp. clxxxvi–clxxxvii). Matley termed these two beds the Ossiferous Conglomerate and the Carnosaur Bed, respectively (Matley 1921*a*; Huene & Matley 1933); the latter would eventually produce abundant remains of large and small theropods, as well as sauropods (Fig. 4) (Huene & Matley 1933).

In February 1919 Matley travelled NE of Jabalpur to prospect the surrounding Lameta Formation outcrops. This 2-week trip took him as far as the Mahanadi River, about 65 km away (Fig. 5). For transport, he relied primarily on camels (Matley unpublished Second Percy Sladen Trust Expedition (PSTE) Report). He also revisited the

Bara Simla site in early 1919, where he found a second theropod specimen in the upper (sauropod-bearing) layer. The material consisted of 'two teeth, three ribs, and a vertebra' (Matley 1919, pp. cxviii–cxix).

Some of the preparation of these materials was accomplished in the field, primarily thanks to the work of Durgansankar Bhattacharji from the Indian Geological Survey (Matley in Huene & Matley 1933, p. 1). Bhattacharji worked extensively with Matley through many field seasons and provided important field expertise for his work, in addition to discovering several important dinosaur specimens at Bara Simla and Chhota Simla (Matley 1921*a*, pp. 155–156). Bhattacharji also kept extensive notes on the disposition and locations of the bones at these sites, but unfortunately his notebook has not been located (Matley letter to Bather dated 31 March 1921).

Matley realized that a more detailed appreciation of the geology of the Jabalpur area was needed and visited the type section of the Lameta beds at Lameta Ghat in October 1919 for this purpose. There he surface-collected dinosaur bones (mostly sauropod) at many sites, but also noted several *in situ* at Amakhoh, Kothi, and south of Sagona (Fig. 5) (Matley 1921*a*).

Matley made 'a hurried visit' to Pisdura in 1920, where he found fossils similar to those previously noted in a ploughed field east of the village (Matley 1921*a*, p. 161). These included large coprolites, part of a turtle and numerous molluscs, as well as a series of six caudal vertebrae that he assigned to *Titanosaurus blanfordi* (Table 1; Fig. 2*c, d*). With them he associated a tibia, a metacarpal and possible scapula. On the east side of an outlier hill, south of the village of Panchgaon, he reported the presence of another caudal vertebra of *T. blanfordi* (Matley 1921*a*, p. 161). Matley also visited nearby Dongargaon, but did not report finding any fossils and questioned whether the beds might be younger than the type Lameta strata (Matley letter to Bather dated 31 March 1921).

Most of the Bara Simla sauropod bones remained in India, but the majority of other specimens (including many theropod materials) were sent to London in two shipments, the cost of which was borne by the Government of India (Matley letter to Bather dated 20 May 1925). The first was sent in 1922 (exact date unknown, but it must have preceded Matley's 1923 writing of the description of *Lametasaurus*, as it is mentioned therein), and probably included the type of *Indosuchus* and those portions of the type materials of *Laevisuchus*, *Jubbulpuria*, *Dryptosauroides* and *Ornithomimoides mobilis* bearing 'K20' Geological Survey of India (GSI) catalogue numbers. The second shipment was made in April 1925; a list of

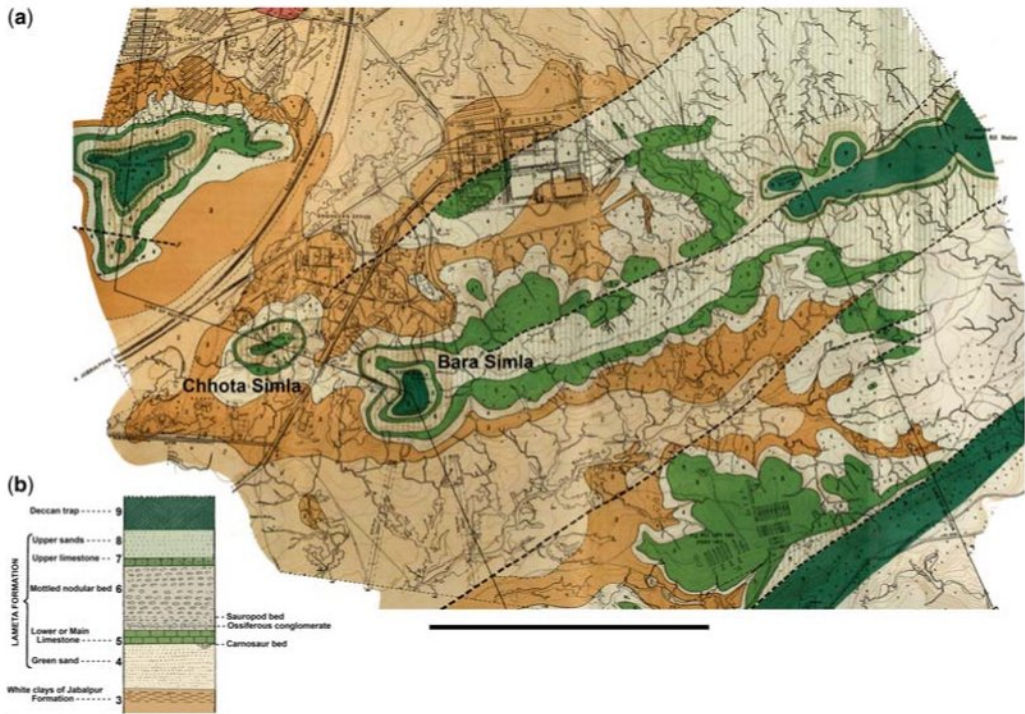


Fig. 4. (a) Geological map of the Jabalpur region, showing Lameta Formation outcrops at Chui Hill, Chhota Simla, and Bara Simla; scale bar, 1 km (modified from Matley 1921*a*). (b) Geological profile of the Lameta Formation at Jabalpur (modified from Huene & Matley 1933 by the addition of colours corresponding to strata in the main map).

these specimens includes both ‘K20’ and ‘K22’ GSI catalogue numbers, but no additional type specimens. These materials were received at the British Museum (Natural History) by A. S. Woodward, Keeper of the Geological Department. It is not known whether the remaining types from Bara Simla (those with ‘K27’ numbers) remained permanently in India or were sent to England for study as part of later shipments (see the subsection on ‘Percy Sladen Trust expedition, 1932–1933’ later).

In 1922 Barnum Brown visited India on an extensive tour, during which he married his wife Lillian (Brown 1950). He visited Matley’s Bara Simla site, and while there collected several theropod specimens and a large osteoderm for the American Museum of Natural History (AMNH) (Table 1) (Huene & Matley 1933; Chatterjee 1978; Novas *et al.* 2004). This latter element was initially identified as the tail club of an armoured dinosaur (Huene & Matley 1933; Coombs 1978), but it has recently been reinterpreted as a titanosaur osteoderm (Chatterjee & Rudra 1996; D’Emic *et al.* 2009). Although it has not been explicitly mentioned before, a letter from Matley to W. D. Lang (16 December 1932) makes it clear that Brown was working at the same site, and in the same bed,

as the one that produced the original Bara Simla theropod materials: ‘[t]he deposits at Jubbulpore seem to be worked out (Barnum Brown exploited my Carnosaur Bed since I was last there)’. This information casts doubt on the supposed associations between the elements collected by Brown (Chatterjee 1978) and indicates that they have the same likelihood of being associated as any of the other Carnosaur Bed specimens.

The first dinosaur to be described from Bara Simla was *Lametasaurus indicus*, first thought to be a theropod (Matley 1918, 1921*a*, pp. 154–155) and then a species of the stegosaur *Omosaurus* (Fig. 6) (Matley letter to Andrews dated 26 August 1922), but eventually given its own genus name (Matley 1924). Matley completed the paper while working as a geologist in Jamaica and asked C. W. Andrews of the British Museum (Natural History) to submit it on his behalf. After some delay it was issued in 1924 in the volume for 1923 of the *Records of the Geological Survey of India* (Matley letter to Woodward dated 23 February 1924). Although Matley now considered *Lametasaurus* to be a stegosaur, having associated it with the numerous small osteoderms also found at the site, it was later re-identified as a theropod by

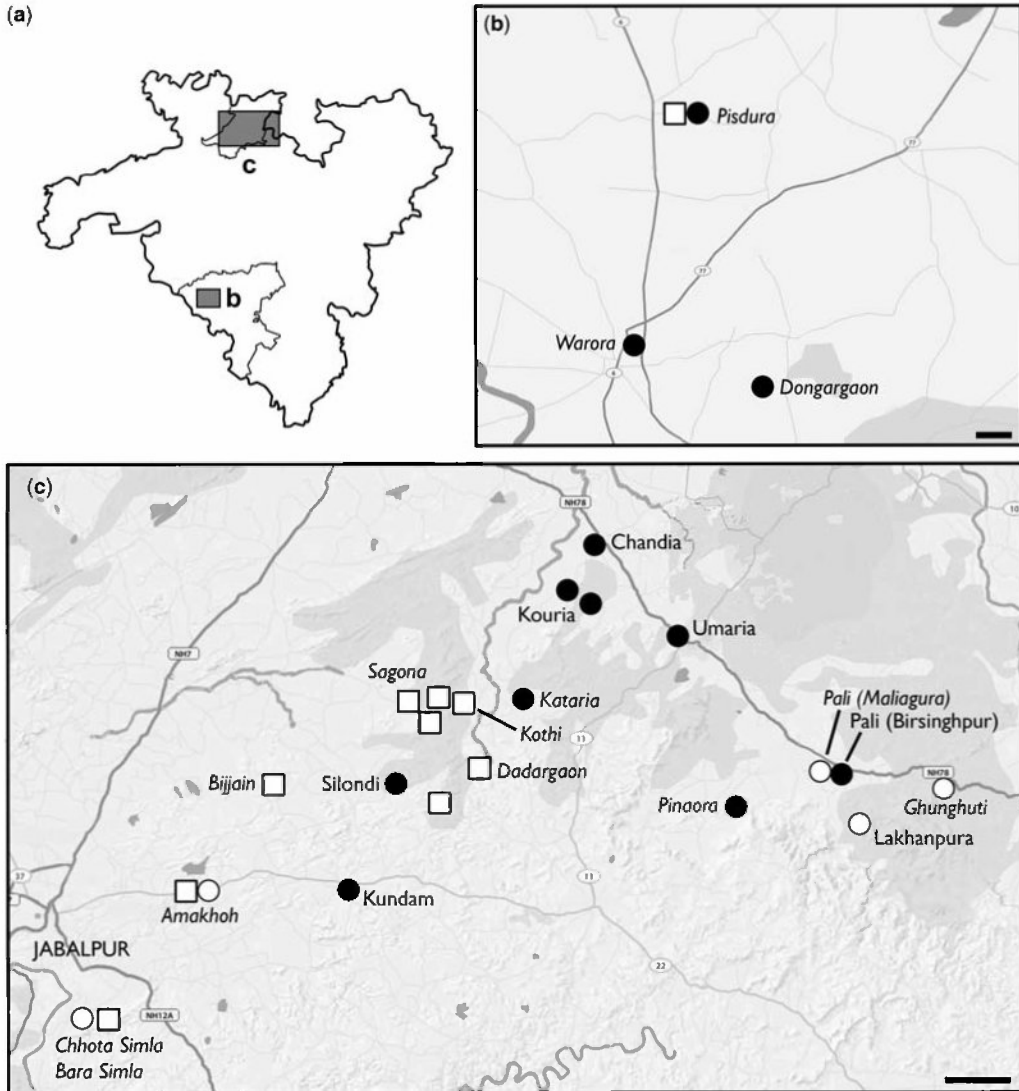


Fig. 5. Travels of C. A. Matley in central India, 1917–1933. (a) Outline map of the Central Provinces, with boxes showing location and size of inset maps of the Chandrapur (b) and Jabalpur (c) regions. (b) Chanda district (Chandrapur); scale bar, 2 km. (c) Jabalpur region (Jabalpur and western Rewa districts); scale bar, 10 km. Symbols: squares, 1917–1919; circles, PSTE, 1932–1933; open symbols, dinosaur-producing sites; closed symbols, non-dinosaurian fossils only. Base maps for (b) and (c) © 2008 Yahoo, Inc.

D. K. Chakravarti of the Geological Museum at Banares (Benares) Hindu University (Chakravarti 1934, 1935). The whereabouts of the type series of *Lametasaurus*, which includes a sacrum, ilia, tibia and osteoderms, are no longer known.

Bara Simla was next visited by H. C. Das-Gupta, who led a group of students from Presidency College (Kolkata) to the site in 1924. The ‘small collection’ made by Das-Gupta included a single theropod tooth, which he made the type of

Orthogoniosaurus matleyi (Das-Gupta 1930) and placed in the family Anchisauridae (Thecodontosauridae); at that time this family was considered to represent a group of small carnivorous dinosaurs. Huene & Matley (1933, p. 59) did not consider the tooth ‘sufficiently diagnostic’ to serve as the basis of a new genus, although the tooth does resemble those of abelisaurid theropods.

Finally, Matley made a 2-day trip to Narayanpur in March 1925 to the site originally discovered by

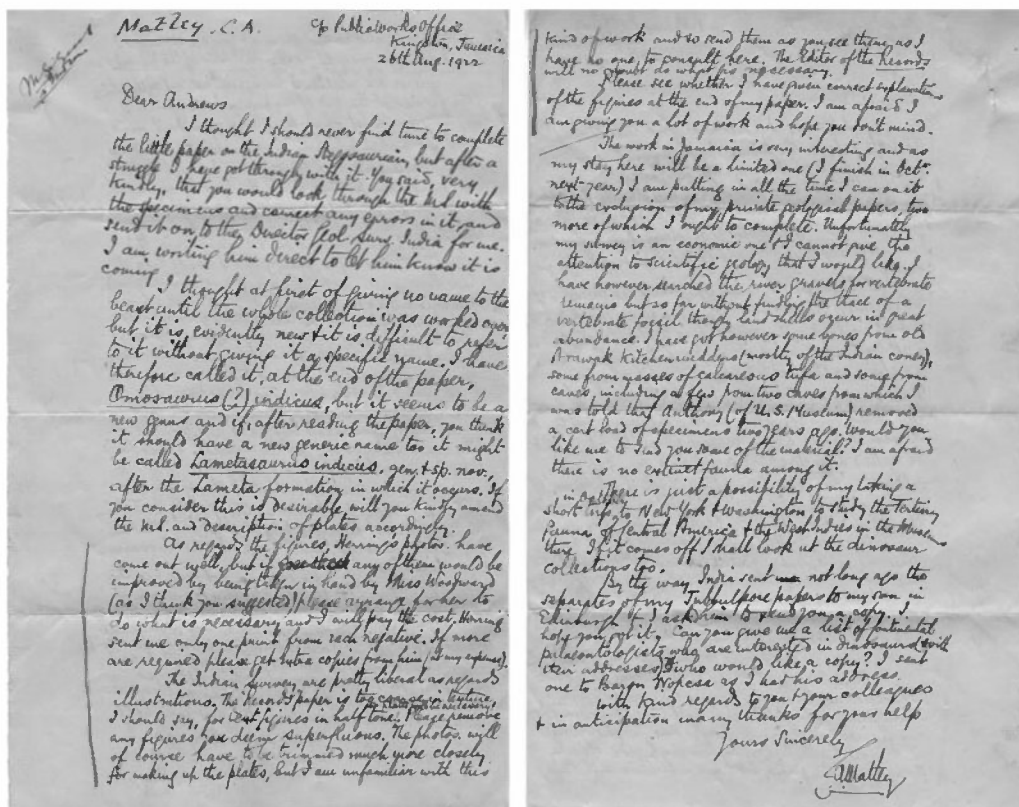


Fig. 6. Letter from C. A. Matley to C. W. Andrews dated 26 August 1922. Courtesy of NHM Archives.

Nicolls but was unsuccessful in locating any new materials (Matley in Huene & Matley 1933, p. 6).

Matley published a comprehensive study of the dinosaurs from central India in collaboration with F. von Huene (Huene & Matley 1933) in which they documented the prior history of dinosaur collecting in the region and described several new taxa. Among these were nine theropods and one sauropod in addition to the previously described *Lametasaurus* and new specimens of *Titanosaurus indicus*. These materials have been studied numerous times in the succeeding decades (e.g. Walker 1964; Chatterjee 1978), and, although many are now considered *nomina dubia*, nearly all the specimens appear to represent abelisaurid and noosaurid theropods and titanosaurian sauropods (Wilson & Upchurch 2003; Novas *et al.* 2004; Carrano & Sampson 2008).

Percy Sladen Trust expedition, 1932–1933

With his promising initial results, Matley applied for funds from the Percy Sladen Trust on 22 April 1932 (Matley letter to Swinton dated 30 April

kind of work and so read them as you see them, as I have no one to consult here. The Editor of the records will no doubt be most helpful in my opinion.

Please see whether I have given correct explanation of the figures at the end of my paper. I am afraid I am giving you a lot of work and hope you don't mind.

The work in Java is very interesting and so my stay here will be a limited one (I finished in Oct. next year) I am putting in all the time I can on it to the exclusion of my private prepared papers, two more of which I ought to complete. My financial my salary is an economic one I cannot give the attention to scientific study that I would like. I have however searched the river banks for vertebrate remains but so far without finding the trace of a vertebrate fossil though land shells occur in great abundance. I have got however quite a lot from old A. M. N. Ghosh's (now of the Indian Army) some from masses of calcareous tube and some from clays, including a few from two clays from which I was told that Andrews (of U.S. Museum) removed a vast load of specimens two years ago. Would you like me to send you some of the material? I am afraid there is no extinct fauna among it.

There is just a possibility of my taking a short trip to New York & Washington to study the history of Central America & the West Indies in the Museum. If it comes off I shall look at the dinosaur collections too.

In the way, I've sent you not long ago the separates of my *Titanosaurus* paper to my son in Chicago. I'd like him to send you a set of the plates help you get it. Can you give me a list of the interested paleontologists who are interested in the Indian and West Indian dinosaurs? I'd like to send you a copy of the paper to Baron Nipkow as I had his address with you and he's a very good colleague & in anticipation many thanks for your help

Yours sincerely
C. A. Matley

1932), which he was awarded in November 1932 (Trustees' minutes, October–November 1932). In addition to £200 from the Trust, he also received £48 15s from the Gloyne Fund, £50 from the British Museum (Natural History) Purchase Fund, and he utilized logistical support from the Geological Survey of India in the form of field assistant A. M. N. Ghosh, as well as c. £100 from his personal funds (Matley letters to Swinton dated 30 April 1932; Lang 15 October 1932; NHM Director enclosed with letter to Lang dated 15 January 1935). These resources enabled him to make several trips to Jabalpur, Pisdura and the surrounding areas over a period of 5 months, from 18 November 1932 to 17 April 1933 under the Percy Sladen Trust Expedition (PSTE) (Fig. 5; Table 2).

The PSTE began with a week of work at the sites Matley had already discovered at Bara Simla and Chhota Simla. These sites produced numerous sauropod and theropod materials as well as fossil plants.

The next 2 weeks were spent in Chanda district, at Pisdura and Warora. The visit to Pisdura (December 1932) revealed that fossil materials

Table 2. Chronology, locations and specimens associated with C. A. Matley's explorations under the Percy Sladen Trust Expedition, 1932–1933

Dates	District/ state	Location(s)	Material(s)
28 November–8 December 1932	Jabalpur	Bara Simla, Chhota Simla	Titanosaur and theropod (at least seven specimens), plants
9–21 December 1932	Chandrapur	Pisdura Warora	Coprolites, turtle, titanosaur, theropod, molluscs Dinosaur limb, fish scales, gastropods, cyprinids
22–24 December 1932	Jabalpur	Jabalpur (return via Chanda)	None listed
3 January–6 February 1933	Rewa	Obra, Munda, Bhundi, Pali (Birsinghpur) Kouria (near Jogin; Machrar Nadi, at Bansa) Chandia (nulla near Jhala; Barwar, 3.25 km SSE) Pali (south of Maliagura) Ghungthuti (on Kachodhar road) Lakhanpura (SE) Changera Pinaora Umaria (railway cutting near Narsaha nulla)	None Plants Plants Probable rib fragments Two large bones, limb fragment Bone fragment <i>Limnaea</i> , <i>Paludina</i> , <i>Bullinus</i> <i>Limnaea</i> , <i>Paludina</i> , <i>Bullinus</i> Spiriferidae, <i>Productus</i>
6–8 February 1933; 14 February–17 April 1933	Jabalpur	Chhota Simla Bara Simla	Titanosaur, theropod, scutes (160 specimens total) Plants, including cycads
9–13 February 1933	Jabalpur	Amakhoh	Limb bones, lamellibranchs
Weekend trip, 1933	Narsinghpur	Karhayia	Plants

Note: Dates and locations primarily from Matley's unpublished Second PSTE Report; see Figure 5 for the map.

could be found at several localities, not just the original site discovered by Hislop. According to Matley:

[t]his distribution suggested that the fossils were derived from below. Two of the richest localities were selected for excavation and trial holes were also made at other favourable spots, but in no case did the undisturbed Lameta clay produce a single fossil. As two of the localities lay at the foot of a slope capped by an outlier of Deccan Trap two trenches were dug up the slope as far as the Trap, but in neither case did they reveal a bone or mollusc *in situ*.

(Matley unpublished Interim PSTE Report, 1 January 1933)

Matley believed that 'four species and probably three genera of Titanosaurs' were present at Pisdura (Matley unpublished Interim PSTE Report), including *T. blanfordi*, cf. *T. indicus*, ?*Antarctosaurus* sp. and cf. *Laplataosaurus madagascariensis*. At Warora, he discovered a dinosaur limb bone, numerous gastropods and cyprids, and fish scales (Matley unpublished Interim PSTE Report).

Matley returned to Jabalpur and explored the surrounding area of the district in early January 1933, but reported finding no fossils. He then embarked on an extensive tour of Rewa State, where he discovered fossil plants and several deposits containing molluscs. He found fragmentary dinosaur bones at Pali, Ghungthuti and Lakhanpura, but none were well enough preserved to be identified.

Returning to Jabalpur district on 14 February 1933, Matley soon discovered a new dinosaur bone bed on the SE face of the nearby Chhota Simla hill. The site included an associated titanosaur skeleton, as well as other sauropod and theropod materials (Matley letter to Lang dated 9 March 1933). This discovery necessitated a re-evaluation of the field schedule, such that Matley eventually decided to extend his trip by several weeks, from 24 March to 21 April (Matley letters to Lang dated 23 February and 9 March 1933).

This extension permitted a brief trip to Amakhoh and a weekend visit to Karhayia. At Amakhoh, Matley discovered six or seven incomplete limb

bones, which, although poorly preserved, were apparently more abundant than anywhere in the vicinity aside from Jabalpur. Nothing was found at Karhayia aside from plant fossils (Matley unpublished Second PSTE Report).

Matley was unable to utilize camels for travel during most of the PSTE. However, he noted that most of the Jabalpur villages could now be reached by 'bullock carts' and used these as a means of transport, in addition to motor vehicles where it was possible to so do (Matley unpublished Second PSTE Report). He did obtain camels once in Rewa State, but as these were all females and most were pregnant they proved unsatisfactory and were 'discharged' before reaching Patpara.

The materials collected under the PSTE were sent to London in two shipments for preparation and study. The first consisted of 11 packages, primarily Pisdura specimens, held under the care of the Director of the Geological Survey of India in Kolkata. These were shipped through the Calcutta branch of Mackinnon Mackenzie on the British India cargo vessel *S.S. Lahore* on 9 May 1933 and were received at the British Museum (Natural History) in June (Swinton letter to Matley dated 28 June 1933). The second shipment consisted of 25 packages of Jabalpur material left in the care of the Superintendent of the Gun Carriage Factory (Jabalpur). These were sent by mail to Mackinnon Mackenzie in Mumbai, repacked into 18 boxes, shipped via sea and received at the British Museum (Natural History) in July (Swinton letter to Matley dated 20 July 1933).

Matley also returned to England, on the *S.S. Mashobra* from Kolkata via Madras and Marseilles (Matley letters to Lang dated 9 March and 25 April 1933), and took up residence at Barmouth, North Wales, before removing to Leamington Spa. His Indian materials were eventually prepared in London. Some were exhibited at a 'Conversazione' held at the Geological Society of London on 3 July 1935, including the Chhota Simla titanosaur limb and several Pisdura coprolites (Matley letters to Lang dated 17 May, 10 June and 10 August 1935). Matley also delivered a lecture on his experiences hunting dinosaur bones in India to the Geological Association on 3 January 1936 (Matley letter to Swinton dated 16 December 1935).

It was Matley's intention to work on the Pisdura coprolites himself. He intended for some materials to remain permanently in London, and 'as regards the remainder the Geological Survey of India should have the first choice' (Matley letter to Lang dated 19 June 1933). In addition, Matley requested that casts be made of the materials for distribution to various Indian museums, including a full set of casts for the Indian Museum in Kolkata, and a smaller collection of casts representing particularly

important finds for the Nagpur Museum (Matley letter to Lang dated 8 January 1935). These appear to have been done as requested, based on mention of their shipments (Swinton letter to Matley dated 3 June 1936).

Nearly all of the Indian materials sent to the British Museum (Natural History) appear to have been returned in a single shipment, which left the museum on 30 June 1936 (NHM Archives, file DF 110/4, Boxes Despatched Book No. 4). In a letter to Matley (23 May 1936), Swinton informed him that the museum had packed 'practically all your material', including 'type specimens etc. (vertebrates)'. As no type specimens were erected from the PSTE finds, this statement can only refer to the type materials from Matley's 1917–1919 expeditions. Although not specified, we infer that this must have included *Lametasaurus* and some (or all) of the other theropod types from Bara Simla, which Matley refers to as having been shipped to London (Matley 1924). This shipment also included casts of specimens for the Indian Museum (Swinton letter to Matley dated 3 June 1936).

This left only a few specimens in the permanent care of the Natural History Museum, London. Among them is the associated titanosaur hind limb from Chhota Simla, which was described as *Titanosaurus indicus* by Swinton (1947). These materials are now under restudy by the present authors, and details of their discovery and history will be presented elsewhere.

Summary and conclusions

Although the early discoveries of dinosaurs from India have often been mentioned in palaeontological literature, there has been some confusion and lack of clarity regarding the ordering of events, the specific materials collected and their localities, and the present disposition of specimens. Our recent archival research helps to enlighten these aspects of several important chapters in Indian palaeontology.

It is now clear that several different collectors were active in the latter half of the nineteenth century, but that many of the materials they collected are now lost. In addition, the Bara Simla and Chhota Simla sites, near Jabalpur, have held a central role in Indian dinosaur palaeontology since its beginnings. Although Richard Lydekker is often noted for his extensive work with Indian fossils, most of the materials he studied were found by a variety of collectors.

In the early twentieth century Charles Matley was instrumental in amassing the largest and most scientifically important collection of dinosaurs

from India prior to 1947. His contributions, some only recently recognized, include an associated titanosaur skeleton, the first dinosaur bone bed from the subcontinent and the earliest-discovered noosaurid remains. His expeditions also marked an important example of long-term collaboration between British and Indian scientists.

With the onset of Indian independence from Great Britain, dinosaur palaeontology in India became a predominately national affair. The subsequent decades have seen the field grow in size and scope, but the initial discovery localities of Jabalpur and Pisdura remain important. Today new collections and discoveries are made regularly, and the Indian dinosaur record holds a significant place in the study of dinosaur evolution, extinction and biogeography.

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