

2

Eugène Dubois' work in Sumatra

Paul C.H. Albers, Julien Louys and Alexandra A.E. van der Geer

Abstract

This chapter presents the historical story of Dubois' cave research on Sumatra. Over two years in the Padang Highlands, Dubois explored a number of cave sites in his search for the 'missing link'. These include not only caves such as Lida Ajer, Jambu and Sibrambang that yielded large amounts of fossils, but also many other caves, often much smaller or with fewer or no fossils in them. As a supplement to the story, Dubois' field notes and official reports are disclosed and translated into English. Dubois' observations in the field indicate that he had a strong grasp of geological and palaeontological principles, given the knowledge current at the time. Dubois' later success in Java greatly overshadowed his accomplishments in Sumatra, which, although not as well known, have been significant for understanding its biological history.

Keywords: Lida Ajer, Jambu, Sibrambang, Padang Highlands, palaeontology, cave exploration

Abstrak

Bab ini menyajikan alur sejarah penelitian gua yang dilakukan Dubois di Sumatra. Selama lebih dari dua tahun di Dataran Tinggi Padang, Dubois menjelajahi sejumlah situs gua untuk meneliti tentang 'mata rantai yang hilang'. Penelitiannya meliputi gua-gua, seperti Lida Ajer, Jambu dan Sibrambang, yang menghasilkan fosil dalam jumlah besar, juga telah ditemukan beberapa gua lainnya yang sering berukuran lebih kecil yang hanya mengandung sedikit fosil atau bahkan tidak ada fosilnya. Sebagai tambahan, ada catatan lapangan dan laporan resmi yang diterjemahkan dalam bahasa Inggris. Pengamatan Dubois di lapangan menunjukkan bahwa ia memiliki pemahaman yang sangat kuat tentang dasar-dasar geologi dan paleontologi yang telah memberikan pengetahuannya tentang aspek waktu. Keberhasilan Dubois di Jawa di kemudian hari sangat dipengaruhi oleh keberhasilan dan prestasinya ketika di Sumatra, yang meski tidak banyak diketahui dengan baik, namun hal tersebut sangat penting untuk memahami sejarah biologis pulau tersebut.

Kata kunci: Lida Ajer, Jambu, Sibrambang, Dataran Tinggi Padang, paleontologi, penjelajahan gua

Very brief introduction to Eugène Dubois

Dubois' life and contemplations are well described in the dissertation of Bert Theunissen (1985). They are also the subject of the more imaginative life description that Pat Shipman wrote based on research into parts of the Dubois Archive that had been disclosed by Theunissen and Paul Storm (Shipman 2001). All this was made possible by John de Vos, curator of the Dubois collection and archive at Naturalis, the natural history museum in Leiden. De Vos then assisted with further disclosure of these archives, resulting in a book by Albers and de Vos (2010) and the accounts of Sumatran research in this special issue.

The following brief biography of Dubois is drawn from both aforementioned sources, while the bulk of the section after that references Dubois' notes, employing the coding system used at Naturalis for individual scans of Dubois Archive pages or groups of pages. For each reference, a translation (by PCHA, of either the entire page or the appropriate paragraph) is provided in the appendix. For example, '50-040' refers to [MM774C-000050-040].

Eugène Dubois was born in 1859 in Eijsden in the deep south of the Netherlands, as the son of a well-to-do family. His father was the local apothecary, and was the mayor for some time. Eugène received a good education at school, then took up the study of medicine in Amsterdam. He was soon recognised as a brilliant scientist and accomplished anatomist. He was intended to succeed anatomist Max Fürbringer, his promoter, but Dubois was disillusioned with the university system and became convinced that Fürbringer was stealing his ideas to present them as if they were his. Whether or not Fürbringer indeed did so is not at all certain, but once this idea became fixed in Dubois' mind, he saw no other way out than to leave Amsterdam and pursue a dream he had: to find the 'missing link' between ape and humans. Dubois mentioned Lyell, Wallace and Virchow as the people who influenced him to look for it in Indonesia (50-040).

Aware of their favourable conditions for the preservation of fossils, Dubois chose to focus on examining caves, and the Padang Highlands in Sumatra seemed a good place to start. In one of the first caves he examined, Ngatau Lida Ajer, which he explored in 1888, he immediately met with success. He even found a hominin fossil tooth, but he was sure it belonged to *Homo sapiens* and that the faunal assemblage was young; thus, he concluded that these caves did not contain material old enough to deliver the 'missing link' he was looking for. Meanwhile, fossils had been found at Wajak on Java, and in 1890, he shifted his attention to that island, where he was again successful almost immediately. Within months, he found a *Homo erectus* jaw fragment in Kedung Brubus. He did recognise this fragment as fossil hominin, but he put it aside as it was too incomplete to persuade anybody that it represented the missing link. In 1891, he found a tooth and skullcap in Trinil, and initially assumed it to be that of a fossil chimpanzee. A year later, however, he found the famous hominin Femur 1, and with the arrival of a recent chimpanzee skull for comparison, it all fell into place and Dubois no longer considered the previous 'chimpanzee' finds to be of an anthropoid. He then named them and Femur 1 *Pithecanthropus erectus*, making Femur 1 the pivotal fossil of the species we now know as *Homo erectus*. Although Dubois found more *H. erectus* fossils in Java, with the exception of one tooth these did not play any role in the initial conception and description of *H. erectus* because they were not recognised in the Dubois collection until 40 years later when the first Ngandong skulls were also unearthed. Until his death in 1940, Dubois never acknowledged any finds other than his own as being *H. erectus*, leaving Ralph von Koenigswald in particular (but also many others) with a grudge that resulted in Dubois not being very warmly remembered. However, his contribution to science is unquestionable, as we will see in the following account of Dubois' life.

Arrival in Sumatra and discovery of Ngalau Lida Ajer

Dubois arrived as an army doctor in Padang, Sumatra, on 16 December 1887 with his pregnant wife Anna and their infant daughter Eugénie. Within three months, while still in Padang, he had already started exploring in his spare time (7-501, 7-502). He applied to be transferred, probably to be closer to the limestone caves as well as to be in a better climate, higher up in the mountains. In the second half of April, he finally moved from Padang to Payakumbuh. He performed his service as an army doctor in the local hospital but made no secret of his intentions for exploring science rather than a medical career. That this was a premeditated plan is abundantly clear from his correspondence. Jentink, the director of the natural history museum in Leiden, who was aware of Dubois' intentions, wrote to him to keep his head down and quietly be an army doctor for a year or two before making his intentions known, to avoid the risk of being sacked (e.g. 6-310, 6-313). Jentink wrote these words in vain: by the time they arrived in Indonesia, Dubois had already submitted a paper stating the desirability of palaeontological research in the Dutch Indies (Dubois 1888), contacted a high government official for support (Kroesen; 7-467) and further explored in his spare time (40-447).

On 1 June 1888, he noted his first visit to a cave near Payakumbuh (40-447). According to his route description, this was most probably Ngalau Sampit (see Figure 2.1; see also Duval et al. 2021 for current location details). These route descriptions mention names of places nearby, distances and directions. Maps copied into his notebook make it clear that Dubois had at his disposal the book *Topographische en geologische beschrijving van een gedeelte van Sumatra's westkust* (*Topographical and Geological Description of a Part of Sumatra's West Coast*) by geologist R.D.M. Verbeek (1883), chief engineer of the Dutch government mining department and famous for his work on the Krakatau volcano (Verbeek 1888). This book contains an extensive atlas, scaled 1:100.000, of this region, with geological descriptions of the soil; most of the names of locations that Dubois mentioned in his writings can be found on these maps in the old spelling. This book has proven to be an important key to unravelling Dubois' notes.

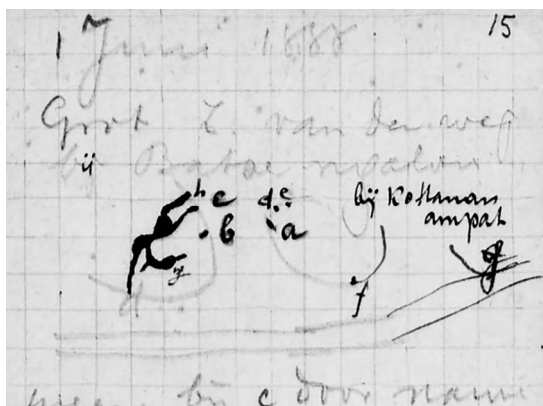


Figure 2.1: Dubois' first sketch of the cave entries and layout of a site most likely to be Ngalau Sampit.

Source: Field notes of Dubois, page 40-447. Dubois Archive, Naturalis Biodiversity Center, Leiden.



Figure 2.2: Drawing from Dubois' notebook showing the position of the Balei Pandjang cave in relation to the Sinamar River, which situates this cave near the location now called Nagari Bukik Sikumpa.

Source: Field notes of Dubois, page 40-446. Dubois Archive, Naturalis Biodiversity Center, Leiden.

Shortly afterwards, on 3 June 1888, he seems to have visited another cave close by—possibly Ngalau Indah—of which his description is merely ‘being South of Balei Pandjang’, which is ambiguous because Balei Pandjang is a name that occurs both southwest and southeast of Payakumbuh, giving us reason for uncertainty. However, given the small map in the notebook indicating the course of the Sinamar River in relation to this cave, its position can be established as the southeast alternative (see Figure 2.2).

In the Balei Pandjang cave he had a hole dug of 2 m depth. Dubois described it as containing a yellowish loam at the top; further down, this gradually became darker, as if bat excrements had been mixed in, until at 2 m depth, it overlaid a reddish-brown soil, which he described as ‘baked’ into a solid mass (40-448).

On 10 June 1888, his next free weekend, he apparently started again in the vicinity of Ngalau Sampit, further exploring the layout of the caves, but did not report any digging. On 15 June, his son Jean was born, and Dubois did not report any further explorations that month.

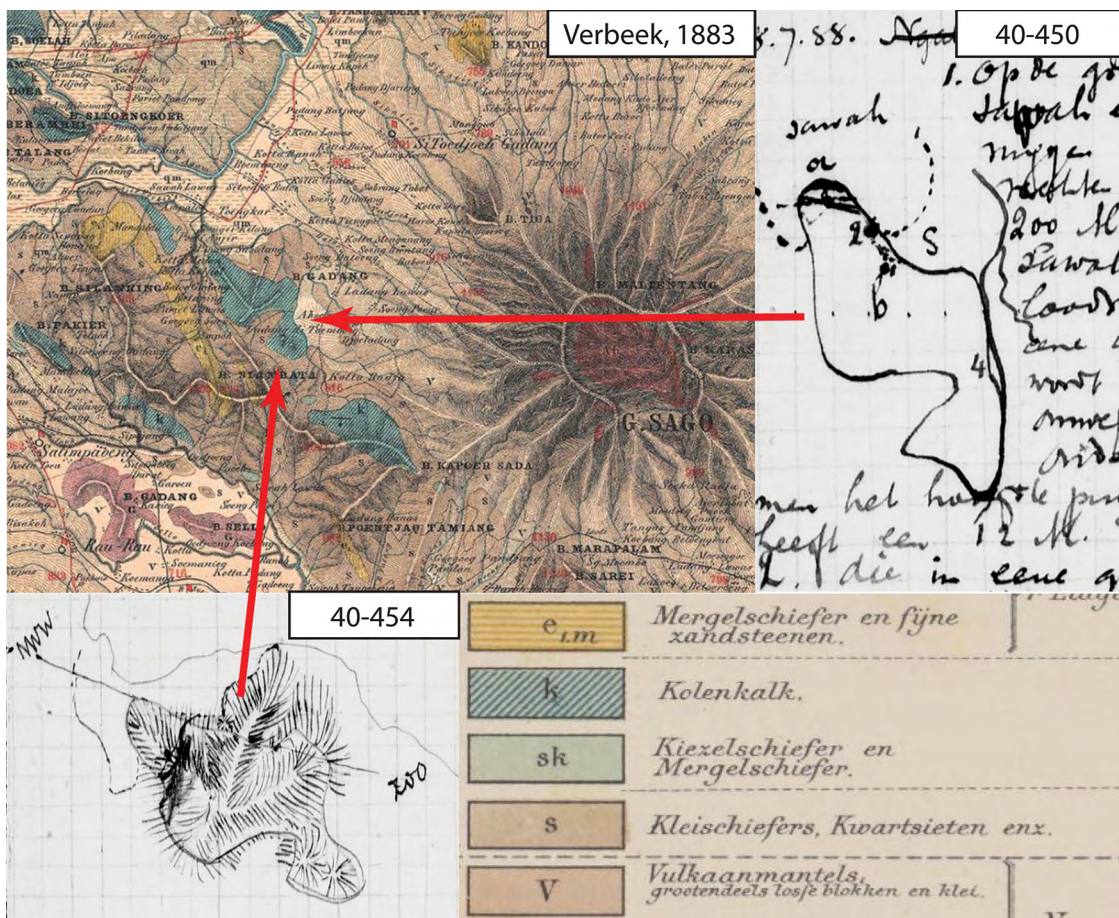


Figure 2.3: Part of a map from the Verbeek atlas and two excerpts from the Dubois notebooks concerning the surroundings of Ngalau Lida Ajer.

Note: To the right on the map is the old volcano Gunung Sago. The green-blue areas are indicated in the Dutch legend as ‘Kolenkalk’, coal limestone, which is the terrain where caves are most likely to be found. At that time, this terminology was mostly used to describe dark-coloured Carboniferous limestones.

Sources: Verbeek (1883); Dubois Archive and Library, Naturalis Biodiversity Center, Leiden.

On 1 July 1888, Dubois continued exploring for caves near Situdjuh Batu. He started at the north of a 'coal' (Dubois' description in translation) limestone ridge west of Mount Sago, where he located three caves (see Figure 2.3). From the descriptions he made in the following week (on 8 July) it is apparent that the third of these caves must have been Ngalau Lida Ajer (even though the notebook is not conclusive on this point), as later he clearly stated that in 'Ngalau Lida-ajer, cave 3 excavations have started 15.7.88' (40-452). In the official report, this date is stated to be 18 July 1888, but this could have been for political reasons, as some support and manpower for the excavations were supplied by the Assistant-Resident, and this date might reflect that transaction (50-035). Strictly speaking, that is also the date they actually began to dig a hole inside the cave (40-452). The cave opens in the mountain wall at about 150 m above the current level of the *sawahs* (rice fields). Dubois noted that the small brook, Betang Babuwe, that dug a course alongside this wall must have been much larger at some point, given the thick layers of large pebbles that could be observed in several places, and that it was also likely that a small waterway had once run through this cave (50-035). Dubois used the atlas of Verbeek (1883) to situate this cave within its geological context (see Figure 2.3). Also, sandy layers were present inside the cave but absent in the immediate vicinity outside, and Dubois considered this further evidence that the cave had previously channelled water (50-035). This demonstrates that Dubois was a keen observer of geological clues and well prepared for the task he had set himself.

Excavation of Ngalau Lida Ajer

Our written sources for the excavation of Ngalau Lida Ajer are his notebooks and reports and several letters he wrote. He kept copies or drafts of these letters with his received correspondence. Whereas the notebooks are just that—lists of short notes or reminders made in the field in pencil, sometimes later overwritten with ink—the reports and correspondence give a clear chronological account of the work that was done.

After Dubois had gained access to the cave and visually inspected it, men were put to work, but he did not have the manpower to systematically clear it out as he would have liked (50-036). From the start, soil samples were taken (40-451), but, alas, many of these samples were lost during World War II when a bomb hit the part of the museum in Leiden where all Dubois' soil samples were kept. Those irretrievably lost, were, together with the damaged part of the building, used to fill an adjacent canal (Natasja den Ouden, pers. comm. 2021).

Once Dubois had inspected the cave and taken soil samples, irregular pieces of stalagmite and fallen parts of stalactites were removed. On 18 July 1888, they started to dig a hole in the second chamber. This is shown at x in the top right part of Figure 2.4.

Whereas in the first chamber, the top layer was a continuation of the topsoil outside the cave, a 20–30 cm-thick black soil, in the second chamber, the top layer was described by Dubois as a loose loam or a brownish-yellowish claylike soil. In this, a piece of turned pottery was found. Underneath, there was an irregular stalagmite floor, very hard and crystalline, with a very broad foot expanding to most of the surface of the chamber, and with its top 45 cm underneath the ground level in the middle of the room. A large piece of petrified charcoal was found at its base, at a depth of 1 m, on its right side when coming from outside (40-453, 50-036). Dubois claimed that it was possible that this piece of charcoal pointed to human occupation of the cave long ago (50-036).

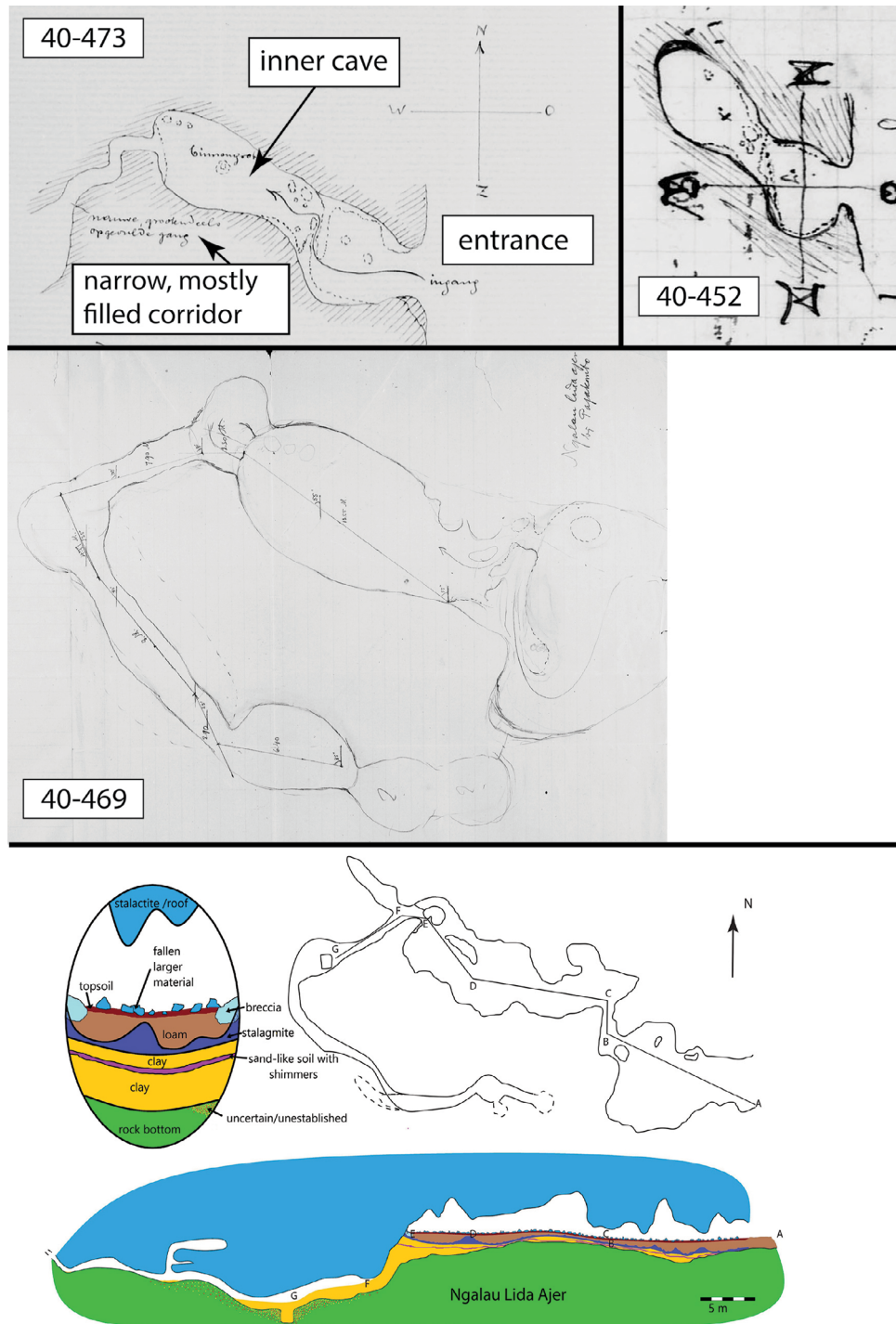


Figure 2.4: Sketches and drawings from Dubois' notebook and letter and their interpretation.

Top left (40-473): drawing in draft letter dated 17 September 1888.

Top right (40-452): sketch in notebook, dated 15 July 1888.

Middle (40-469): sketch in notebook, probably drawn towards the end of the excavation around the middle of October 1888.

Bottom: PCHA's interpretation of Dubois' layering superimposed on recent drawing of Ngalau Lida Ajer; the oval shape is the legend, top view and lateral view.

Sources: Dubois Archive, Naturalis Biodiversity Center, Leiden; Louys et al. (2022).

The stalagmite cone was removed using dynamite on 23 July 1888 (40-453). Underneath, they encountered a fine, yellowish, plastic clay. The excavation was expanded towards the rear of the cave, but to do that, the breccia, which extended about 1 m inwards from the walls and which so far had been neglected, had to be removed. This breccia was present over the whole width of the chamber and was about 70 cm thick. Besides both sharp and rounded pieces of limestone, it contained andesite pebbles, terrestrial gastropods next to a large number of teeth, and some bone fragments of several mammals (50-036). Thus, on 17 August 1888, the first fossils were found and brought to Dubois, who was not present at that time due to his medical duties (40-471). On 31 August, he inspected the location again and reported that he himself had dug up teeth (40-455), which were abundant in the calcified breccias and at the feet of the dripstones in the back of the cave, and even more abundant in the silt layer underneath (50-036).

He reported his finds to Kroesen, the governor of Sumatra, on 17 September 1888 (40-471), and after that, Dubois' position quickly improved. His paper arguing for palaeontological research (Dubois 1888), which had now been published, and his immediate success in finding a cave littered with fossils, did the trick. One thing that substantially boosted Dubois' efforts would have been that his work had immediately attracted the attention of Verbeek, who had been among the first to congratulate Dubois on his results and praise him for finding just what he had been looking for (12-400). In his reply on 1 October 1888, Dubois told Verbeek that after a month's work he had already recovered thousands of fossils from Ngalau Lida Ajer. He also stated that he had no doubt about them being fossil but did not dare to say anything about their true age yet (33-506). Verbeek would have recognised the scientific value of these finds, and, because of his high position at the mining department, would have been asked for his expert opinion by any office deciding on Dubois' future.

The other very influential person with whom Dubois was in correspondence was Melchior Treub, the effective head of all scientific research in the Dutch Indies (the actual head being the Minister). He, too, applauded Dubois' success and offered support as well as advice on how to deal with the politics (12-265). As a result of all this, Dubois was granted leave from his medical duties (as soon as a replacement for him had arrived) and could from then on spend all his time on palaeontological research. As early as his first official report, dated 15 October 1888, he had already presented a faunal list (50-037; shown in Table 2.1) that later changed only a little.

The whole report (50-032–50-039) has a long introduction, as if it is a scientific article, in an effort to convince any readers of the importance of the work. The subsequent chronological account of the work has all kinds of details that anyone working in the field today recognises, but which, at that time, were not common knowledge: for example, that fossils from cave deposits can be recognised because they 'stick to the tongue' (50-036).

Dubois also recognised that almost all the fossils had been gnawed by porcupines, a feature he knew from the literature (Lydekker 1886). In a cave nearby, Ngalau Gudja (Porcupine Cave), he also saw 'innumerable traces of these animals [that] are proof of their quite recent stay' (50-037). To further test his hypothesis that porcupines had indeed gnawed the fossil bones, he offered fresh bones to a living porcupine in captivity, in order to compare the gnawing patterns of modern porcupines with what he saw on his fossils and to deliver 'the final convincing proof that porcupines had been the destructors of the bones here' (50-037). Dubois was quite possibly the first to conduct such neotaphonomic experiments (see Figure 2.5).

Table 2.1: Species reported by Dubois for Ngalau Lida Ajer.

Species as reported by Dubois	Dubois' remarks (translated by PCHA)	Current identification in the Dubois collection catalogue
<i>Simia satyrus</i>	large differences in size	<i>Pongo pygmaeus palaeosumatrensis</i>
<i>Hylobates</i>	probably more than one species	<i>Symphalangus syndactylus subfossilis</i> , <i>Hylobates</i> sp. indet.
<i>Semnopithecus</i>		currently not identified in the collection
<i>Macacus</i>		<i>Macaca</i> sp. indet.
<i>Cercocebus</i>		currently not identified in the collection
<i>Felis</i>	of the tiger	currently not identified in the collection
Smaller <i>Felis</i> species	maybe	<i>Profelis temmincki temmincki</i> , <i>Paguma</i> sp. indet.
<i>Elephas</i>	probably two species	<i>Elephas maximus</i>
<i>Rhinoceros</i>		<i>Dicerorhinus sumatrensis</i> ,
<i>Tapirus</i>		<i>Tapirus indicus intermedius</i>
<i>Sus</i>	probably more than one species ³	<i>Sus</i> sp. indet.
<i>Bos</i>	or <i>Bubalus</i>	<i>Bibos javanicus</i>
<i>Cervus</i>	probably distinguishable species	<i>Muntiacus muntjak</i> , <i>Rusa</i> sp. indet.
Other ruminants		<i>Capricornis sumatraensis</i>
<i>Hystrix</i>		<i>Hystrix</i> sp. indet.
Other rodents		<i>Leopoldamys sabanus</i>
<i>Homo sapiens</i> ¹	molar superior III	<i>Homo sapiens</i>
Gastropods ²		currently not identified in the collection

Note: All these fauna were present in the report of 15 October 1888 (50-037), except the last two entries which are in the following two notebooks:

¹ 31 October 1888 (40-459).

² Already mentioned on 15 July 1888 (40-452).

³ There might have been more species indeed, but he also might have mistaken some of the more than 10 *Ursus malayanus* dental elements as being *Sus*.

Source: Dubois Archive, Naturalis Biodiversity Center, Leiden.



Figure 2.5: Recent *Sus barbatus* jawbone (RGM.1333508) at Naturalis Biodiversity Centre, Leiden, originally collected in Borneo by Büttikofer in 1894 but later added to the Dubois collection as a clear example of porcupine gnawing marks.

Source: Photograph by Natasja den Ouden.

The drawing included with Dubois' letter to Kroesen of 17 September 1888 (Figure 2.4; 40-473) shows that by this date they had already reached the corridor at the end of the first large inner chamber, going down between F and G in the modern drawing in Figure 2.4 (this is the 'sinkhole' mentioned by Louys et al. [2022:2]). This corridor was largely filled in; in fact, its entrance was found at a depth of about 3–4 m when most of the inner chamber had been emptied.

Dubois reported that while excavating this chamber, at some 2 m below the original surface, they came across a sandy layer containing numerous 'shimmers'. He had no time to examine these but suspected a pumice tuff origin. Samples were no doubt collected for later examination. Below the sand, a brownish clay layer like the one above the sandy layer was encountered, and this again contained teeth and bone fragments despite its depth.

The corridor yielded many teeth, among which were two intact molars of *Elephas* lying on top of the soil, and, according to Hooijer (1955), so alike they were probably from the same individual. The passage was followed for some 10 m more, but lack of fresh air (the candles would not burn any longer) prevented further examination (50-037). Along the way, Dubois noticed that two small stalactite pillars had been polished on the sides facing each other, and he assumed this to have been caused by larger animals living in the cave, passing between them, in times before the cave was filled with a 4 m-thick layer of soil. He argued that the large number of remnants, mainly teeth, sometimes of very large species, could only have been dragged in, meaning the cave had been the den of large predators. Dubois did not conclude which predator was responsible, but he did mention that some tiger and small-bear teeth had been found. He further remarked that although the work progressed slowly, and under insufficient supervision, thousands of teeth and many bone fragments were found, resulting in a preliminary faunal list (see Table 2.1). Given the contents of the list, and particularly the presence of about 600 orangutan teeth, Dubois concluded that the whole flats around Payakumbuh must have been a continuous, single forest in the past.

Dubois started a new notebook titled 'Ngalau Lida Ajer and Gua Balei-Pandjang 1888' (40-458), in which the first dated entry reads: '31 October 1888 at 4 to 4½ m. depth below the original level in the narrow corridor, 1½ m from the entrance a human molar was found (mol. sup. III)' (40-459).

He further described the corridor as having had a yellow loam layer with a sandier top layer 4–5 cm deep. The yellow loam, which he described as plastic, was:

[...] present in the whole corridor at ± the same level slightly descending towards the deeper chamber and 40–70 cm below the surface of the less humic, slightly darker than ordinary clay, which is present everywhere in the cave and in which the fossils can be found. In the sandy layer et cetera in the first inner chamber they do also appear, but very scarcely and likely only ending up there because of them being dug or tossed up. (40-459)

He continued on the next page, stating:

At the entrance of the second inner chamber the deeper layer of the plastic loam has, because of infiltration by chalk, been baked together to a hard mass.

Everywhere this hard plastic loam is sharply separated from the above more porous loose and less homogeneous dark clay.

It is apparent and without doubt that this loam and the accompanying layer of sand have been the result of deposition by a very slow-moving stream of water.

From the second inner chamber we had access to a 10-m long corridor on 8 November 1888, which after using dynamite gave access to a third small chamber with a second floor higher up. This corridor, which on one side has not been completely filled, is widening strongly and actually (40-460)

forms one room with the so-called second inner chamber.

First from there the subsidence became apparent. (40-461)

The same page contains another small map of the cave and the remark that the excavation ended on 12 December 1888. (For the complete notebooks, with transcriptions and translations, please see the appendix).

Other caves in the area of Payakumbuh

Dubois had his workforce divided over several locations at the same time, so the reader should keep in mind that we here present a list of descriptions of the work done in the caves that necessarily can only loosely follow the timeline as the work in different caves overlapped and in some caves their work was long and in others it was short.

Ngalau Gundja (Porcupine Cave)

About 200 m from Ngalau Lida Ajer, Dubois started a preliminary examination of Ngalau Gundja: Porcupine Cave. At a depth of 0.75 m, he recorded that a 'horizontal layer of pumice tuff of 80–90 cm thickness was found, under which a similar reddish-brown clay was present [to that which] currently forms the surface' (May 1889 report; 50-039). Another notebook states about this cave:

[...] opening clearly shaped later.

Descending strongly into a deep crevasse which is also shaped later. Above these, one can however along the wall reach into the farthest point of the cave, entering a spacious round chamber which is communicating with a small one to the left. Both bear the traces of numerous porcupines. In the large chamber I had a transverse section made more than 2 m wide.

At a depth of 75 cm the dry red clay changed into a dry white sandy mass. (pumice tuff, marl or sand) probably sand. (40-456)

Further documenting this cave, there are field notes (Figure 2.6), which state:

In the deepest (farthest from the entrance) part, in a spacious room (of 8 by 10 m) I had an incision made over the length, which was 2½ metres wide, into the soil which was brown-yellow at the top, and red further on. Getting grainier further down (75–130 cm), whitish with lots of shimmers. Followed up to a max depth of 2.70 m. To the back part there are layers of gravel (not horizontally but irregularly crossing each other) which have largely baked together to a conglomerate. In the deeper layers sandy. Also irregularly a layer of speleothem is interspersed with the gravel mass. It was followed up to a max depth of 2.60 m below the surface where there was sandstone and it was 20 cm thick. It starts completely at the back 60 cm below the surface. The speleothem is not fully covering the gravel. The gravel is only present to about 2.25 m from the rear wall. Largest depth of the whitish soil 2.70 m. (49-264)

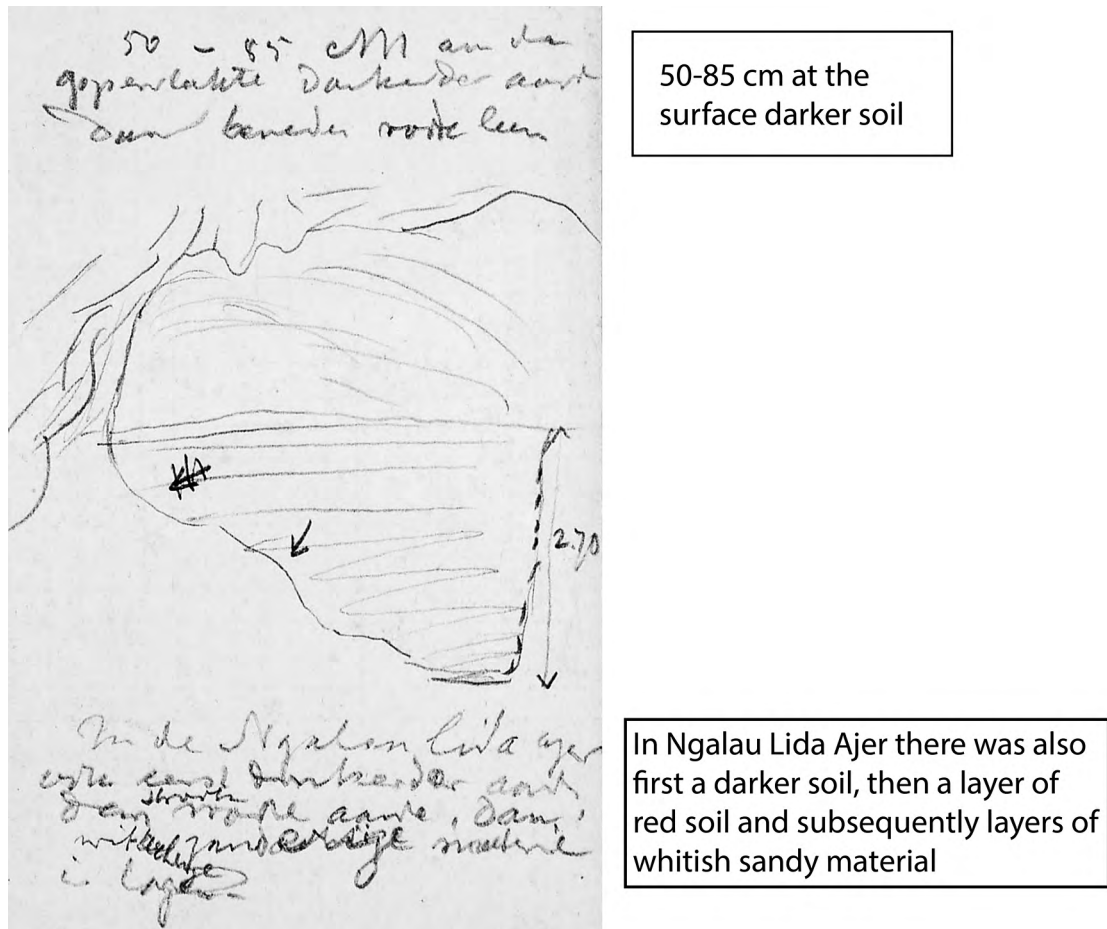


Figure 2.6: Dubois' sketch of Ngalau Gundja.

Note: The arrow in the centre seems to indicate where the gravel reached.

Source: Field notes of Dubois (49-265). Dubois Archive, Naturalis Biodiversity Center, Leiden.

Balei Pandjang Cave

In Dubois' notes, the descriptions of this so-called 'cave' suggest a complex of caves within one mountain. His notes say:

Gua Balei-Pandjang

Started 13 December 1888

At the first point (deepest) at 90–100 cm underneath the yellow clay which was deposited in horizontal layers, a dark brownish clay with small calcium-concretions was found.

At point 2, to the right of the first corridor 1½ m yellow clay in layers, then 30 cm bat guano (on top of which a piece of charcoal) sharply separated from it and basically removable by peeling it off.

a. Cave with a 12 m deep pit at ± 300 m above the sawah.

b. Cave at ± 250 m height above the sawah

35 m. deep vault at the bottom of which there is a second entrance in the perpendicular wall

1 [?] hard] upper vault of cave b

- 3 hard stalagmite mass to the right
- 2— ditto
- 4? Soft “ “ [stalagmite mass] left
- 6 out of (crater pit) (40-462, 40-463)

The text and the numbering of the drawing on the next page of the notebook (Figure 2.7) suggest that a much more detailed drawing probably existed, but we have not been able to identify it.

The other notebook states:

13 October, 1888 started with the Ngalau (gua) Balei pandjang, which we had to abandon again on 24 February 1889 without any result because of lack of decent surveillance and difficulties because of the water dripping down. (40-457)

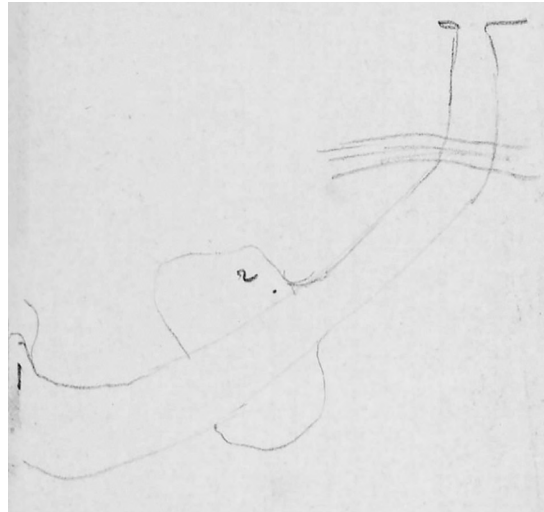


Figure 2.7: Drawing in Dubois' notebook related to Balei Pandjang.

Source: Dubois Archive, Naturalis Biodiversity Center, Leiden (40-464).

In his report, Dubois also mentioned the cave he called 'a' in the notes quoted above (we cannot be certain as the report did not identify the cave clearly, but the timing makes any other option unlikely):

In the same mountain slightly below the top at about 300 m. height above the valley lies a natural pit of ± 15 m. depth. This pit widens below to a beautiful cave and in the corner of this cave, almost directly below the surface of a very thin layer of clay, a layer of pumice tuff of about $\frac{1}{2}$ m. thick was found. (50-039)

He further stated that this pumice tuff must have been deposited at the same time as the pumice tuff layers present 'outside' in the Payakumbuh valley (50-039).

Ngalau Sampit

In early 1889, Dubois also started working in Ngalau Sampit, which was probably the very first cave he had visited in June 1888, but which he excavated only after he finished with Lida Ajer. In a popular-science account of the time (Pijnappel 1897), an anecdote is told about Dubois entering a cave with a fellow countryman. After crawling for some time through a narrow entrance, they reach a larger chamber, from which many corridors continue. The description and timing make it likely that this refers to Ngalau Sampit. After some time, they cannot remember which entrance they came in through, which causes some panic in Dubois' companion. Dubois calms him down, then examines the corridors one by one to find the one through which they came; when he sees light at the end of the tunnel he is examining, he goes back to fetch his companion, and they both crawl out—only to find themselves on the other side of the mountain.

The report Dubois wrote about Ngalau Sampit (April 1889 report; 50-011) has already been published in full (translated into English by PCHA) in Duval et al. (2021), to which we refer readers for more details, except to mention that the fossil species encountered in Ngalau Sampit resembled those recovered from Lida Ajer, with remains of *Elephas*, *Rhinoceros*, *Sus*, *Bos* or *Bubalus*, *Cervus* and *Simia satyrus* (= *Pongo*), but in much lower frequencies. Dubois also described a more recent 'cave-in' in which remains of *Sus vittatus*, *Cervus muntjac*, *Antelope* (= *Capricornus*) *sumatraensis* and some *Canis* were found (50-011).

Meanwhile, his work and his success were being picked up by newspapers (e.g. *de Locomotief* of 11 and 29 November 1888; these clippings are in the Dubois Archive; 42-211; 42-212). He had really only barely started, but he now had formal support, and as soon as his replacement arrived, he would be able to dedicate his full attention to excavating. He asked to be transferred to Bua, where he started his explorations of the Ngalau Saribu mountain range, for which the Assistant-Resident of Tanah Datar had provided him with an extensive list of caves (50-006). He was also granted the use of convicts for labour (e.g. 50-005) and supplied with tools (50-007), and by 22 April 1889, two workmen from the engineer corps had been assigned to him, namely Franke and van de Nesse (50-009). His replacement, Vollema, arrived on 2 May, and Dubois was finally free to spend all his time on excavating (50-010).

Two caves are mentioned in his report for May 1889—‘Ngalau kapala sawah liat’ and ‘Ngalau bateng pangean’—but excavations did not start until 1 June (50-039). The monthly report for June was not submitted until the end of July because Dubois had suffered a severe attack of malaria (50-013).

Caves approached from Bua

Ngalau Kapala Sawah Liat, or Ngalau Pandjang

The cave Ngalau Kapala Sawah Liat, which Dubois also referred to as ‘Ngalau Pandjang’, near Sibalen was described in the June 1889 report (50-040) as being a 45 m long corridor with an average width of 5 m, which widened to form some kind of chamber only for the first 8.5 m from the entrance and again at a depth of 30 m, where there was a width of 10 m. The cave did not actually end at 45 m and was thought to continue to the other side of the mountain, but further access was impossible because of narrowness and a collapsed roof. Dubois thought it had originally been a waterway through the mountain. He started digging at three points 10 m apart and found the stratigraphy to be similar at all three. The work was so hard, however, that he soon decided to concentrate all his workforce on one point. The topsoil was a yellow clay 0.30 m deep, which in the more inward parts of the cave was covered with 0.25 m of speleothem. The report states:

Next was a very hard mass, a conglomerate of pebbles of different sizes, gravel and pieces of limestone, with here and there thin layers of sand interspersed with very hard clay, and locally sometimes thin layers of dripstone [speleothem]. This reached a thickness of 2–3 m. Next to that on some parts we already hit the bedrock, otherwise yellow clay which mainly expanded far into a small hollow left of the entrance. This ‘corridor-shaped’ small hollow started at 4.75 m depth and continued in a diagonal southeast direction into the mountain. Whilst in the clay at the surface only a few incisors of the common porcupine were found, apparently of rather recent date, more bones were found in this deep clay, of which a greater age cannot be doubted. In the mentioned small hollow a number of bones, predominantly of rodents and bats were found. An important find however was done on 30 June at a depth of 3.75 m in the middle of the chamber at the entrance, being the humerus of a species of Rhinoceros, which judging from the size of the bone was significantly larger than the current Sumatran species. (50-040)

Figure 2.8 shows this bone.



Figure 2.8: Humerus of *Dicerorhinus sumatrensis* (DUB9276) from Ngalau Pandjang near Sibalen.

Note: Length: 421 mm, according to Hooijer (1946).

Source: Photograph by Natasja den Ouden.

By July 1889, Dubois stated in his report on June:

[The] work was continued up to a maximum depth of 8 m. where the bedrock of the cave was reached. Underneath the yellow clay that was reached last month, locally a layer of gravel impregnated with chalk was found, which was resting at the bottom of the cave. Fossils of any importance were not found, with the exception of a plastron of tortoise, which however upon removing the hardened clay mass by carelessness of the workmen was broken into many pieces. (50-048)

On 20 July 1889, Ngalau Pandjang was exhausted after they had reached the bottom.

In the September 1889 report, Dubois briefly mentioned a cave—close to a *dusun* [village] named Sibalin—whose:

[...] local name is not known to me, is located in the same valley at the right bank of the Sumpur as the other caves examined here so far, \pm 40 m above the floor of it and consists of a 150-m long corridor with an average width of 7 m whilst its yellowish clay floor is rather even and almost horizontal. (50-050)

The October 1889 report speaks of a large cave at Sisawah that:

[...] turned out to be the earlier southern extension of the Ngalau pandjang (Ng kapala sawah luat), with which it was connected by a narrow passage, which now could be slightly widened. (50-050)

The entrance of [that part of] the cave is located 20 m. above the valley floor (erroneously in the previous report it was stated to be 40 m) and it is facing Southward; it consists of a 150-m long corridor in north-northwest direction, which is on average 6–8 m wide, but at the end widens to a wide chamber 40 m long and in the middle 20 m wide.

Its smooth and almost horizontal floor consists of a thick layer of chalk tuff, which in some spots is absent. Only near the entrance (up to 15–20 m), this chalk mass is missing and the floor, which is 2 metres lower, consists of yellow clay.

Excavations were started at two points; one near the entrance, whereby the end of October they had reached a depth of 3.50 m, while the soil continued to consist of the same clay. A further excavation was started at 30 m distance from the entrance where they encountered:

1.35 m chalk tuff, a 0.30 m. thick breccia of small limestone parts and fine quartz gravel, baked together by the hard chalk tuff, 20 cm fine gravel mixed with clay and finally (at 1.85 m.) yellow clay. Fossils had not been found by the end of October. (50-051)

In November 1889, the southern extension yielded teeth and bones from:

[...] the yellow clay next to the entrance at a depth between 4.20 m. and 5.50 m. The latter however were in such a bad state of conservation that the majority were mere fragments which for the time being cannot be identified. They chiefly originate from elephant, rhinoceros, tapir, pig, porcupine (*Hystrix*) and the orangutan (*S. satyrus*), so represent the same species, of which the existence also became apparent in other caves that have been examined.

The geological age of these fossils cannot rightly be ascertained and can only somewhat be established by comparison with others. The greatest depth by the end of November was 5.75 m. From 4.50 m down, the yellow clay from before was found to be strongly mixed with a moderately fine gravel delivered by weathering of tertiary conglomerate.

The hole we dug at 30 m distance from the entrance of the cave with the size of 6.50 m by 5.50 m delivered the following profile starting from the top: 1.35 chalk tuff, 0.30 breccia of limestone pieces [50-051 up to here] and fine quartz gravel baked together by chalk tuff, 0.20 m fine gravel mixed with clay; underneath this, in total 1.85 m thick top layer the same yellow clay was found as near the entrance, at 2.75 m the bottom of the cave was found, which only along its east wall was covered with a maximally 0.75 m thick layer of clay stones.

It was regrettable that the mentioned clay did not contain any fossils, as especially here one could have expected, underneath the strong limestone coverage that they would have [been] conserved well by calcification. (50-044)

By early December 1889, fossils were becoming scarce, and the site was abandoned (50-051).

Unnamed cavity near the southern entrance of Ngalau Pandjang

In his annual report for 1889, Dubois mentions a small cavity in the same valley as the one into which the entrance to the southern extension of Ngalau Pandjang opened; finding this led him to an elaborate insight on the local geology, which is presented here in full:

At a short distance of the southern Ng. pandjang and completely at the same height a small hole found in the rocks at the east side of the valley was further examined. Although it was only 0.80 m long and 0.60 m high, it seems to be the remains of an earlier cave which had become filled up in later times with boulders and pointy limestone pieces connected to a conglomerate by the chalk. After this conglomerate breccia was broken away to the west the entrance of a small cave opened up, however only 3 m wide and 1.80 m high. Against the ceiling a 25 cm thick layer of hardened clay had remained which contained a number of teeth and some bones, most of which had completely calcified. By further breaking away the mentioned stone mass we could finally enter up to 20 m deep, where the cave seemed to end after it had widened, but it [the ceiling] remained as low as it was near the entrance.

The teeth and bones originated from a Rhinoceros, a Tapir, a kind of buffalo (*Bos*), a deer (*Cervus*), one or more species of pig (*Sus*), the orangutan (*Simia*) and a common Karo-monkey (*Cercopithecus*) or some species closely related to that; so here yet again the same company we found everywhere. This is now however of great significance and confirms again the great age of this fauna. It is namely a peculiar phenomenon that here at a height of about 20 m above the floor, where both these caves are located and at many places apparently in the same horizon crevices in the rock can be observed which are of the same nature like for instance those along the Kuantan near Muka-Muka at the height of the water level. Surely the water must have

gnawed out these crevices and is now depositing pebbles and gravel and clay in them. This must also have been the case for the caves we have examined. The small cave is but an extension of such a crevice and also the southern Ngalau pandjang shows this at the entrance. (50-044)

In this valley, which now doesn't even have a brook anymore, the water level must have been 20 m above the current valley floor, and this will certainly not have been a small brook, for the crevices can be found along the whole length of the valley and quite strongly so. The water must also have deposited the boulders, the gravel and the fossil-bearing clay and such large changes demand a very long time which contributes to the decision of a substantial age of the fossils.

It is furthermore noteworthy, that higher up in the valley there is a rock wall in which there are three such crevices with a distance between them of 8–10 m and at which the same phenomenon can be seen where the valley of the Sisawah leads in southeastern direction towards the *tarata* Kabun.

Traces of such higher water levels and the rerouting of rivers are a well-known phenomenon and a consequence of the erosion doing its work over the whole globe, but what is noteworthy here is that these phenomena seem to have some periodicity.

Up to three or four times at least the water level was able to do its erosive action for a longer time (because the formation of these crevices must have taken quite some time), after which every time an abrupt decrease of the water level took place. Note it is not completely sure whether this water, which was a river, was as far from the shore as it is now. If it turns out, that during the diluvial times, as assumed by Verbeek, at the west coast of Sumatra the sea was yet covering part of the current land (up to a height of 180 m) then the phenomenon observed here might be related to these changes of sea-level and the here observed repeated rather local changes might have bearing on the work that by Inesz has been turned into a *question coulante* on the changes of the beach lines and the borders between sea and land and may be of no little significance. But this is only a suspicion, which I however not thought I should keep quiet, because the observed phenomena might deserve further investigation at other locations. (50-045)

The ideas highlighted in these reports and field notes again show Dubois to have been a keen observer of geology and thoroughly conversant with the geological knowledge of that time; he was able to combine information from the geological and palaeontological or physical anthropological disciplines to create logical and defensible hypotheses. Dubois finds reasonable geological explanations for his observations, even if the knowledge existing at the time meant that he was wrong in some details. Dubois considers observations of boulders, gravels and fossil-bearing clays in high crevices evidence that the fossils must be of significant antiquity, accurately using his geomorphological observations to deduce relative chronological information. More significantly, his observation that crevices are found together at different heights, and that these patterns are repeated across valleys and outcrops with an indication of periodicity, anticipates much later cave terrace development concepts (e.g. Durringer et al. 2012; Palmer 1991). His explanation for such phenomena relied on Verbeek's diluvial interpretation (i.e. eustatic variations due to glacial–interglacial cycles), which, although incorrect, was the best available knowledge at the time (it predated the concept of plate tectonics, from which we now understand that the Barisan Mountains are the result of a series of orogenies beginning in the Miocene). Nevertheless, the idea that sea-level changes can control the formation of limestone caves is not without merit and has been used to explain cave formation in limestone islands (e.g. Mylroie and Carew 1990).

Ngalau Bulan, or Ngalau Pandjang II

Work in this cave started at 20 July 1889 (50-048), but in the subsequent monthly report Dubois wrote:

Ngalau bulan (Ngalau pandjang II) near Sibalin did not bring anything peculiar. Although rather many bones were found in the top, 0.60 m thick layer of loose black earth, these were also almost all broken into such tiny parts, that for most of them (at least for the time being) there can be no thought of having them identified. Most seem to be originating from small animals and must, after predators brought them in, have been shattered by porcupines whilst digging through the earth. They are however no big loss, as they are without doubt bones of a recent date.

Upon further digging we came into 1.15 m of yellow clay, which at greater depth turns into a fine gravel. This yellow clay did contain some teeth of the ordinary wild pig (*Sus vittatus*), of the tapir (*Tapirus indicus*) and of the ordinary Karo (*Cercopithecus cynomolgus*), and a few bones of the Kidjang (*Cervulus muntjac*), all species still living today. (50-049)

In September 1889, no more fossils were found. Dubois reported that:

Underneath the deepest layer of fine gravel we found in the previous month, which had a thickness of 30 to 40 cm, we found again a darkish yellow clay earth which we followed up to a depth of more than 5 m without finding anything important. This result and even more so the strong increase of fever amongst the workmen in this moist cave (up to 50% of the number of forced labourers were suffering from fevers) make me decide to quit the work here. (50-050)

Ngalau Batang Pangian and Ngalau Monsiu

The cave of Bua, Ngalau Batang Pangian, was abandoned after 12 days as too many workers were suffering from fever there. Instead, on 15 June 1889, they started excavating in Ngalau Monsiu (Gunpowder Cave, named for its saltpetre from bat guano):

[...] at 4 paal [about 4 miles] from Bua on the opposite side of the Sinamar-river in the Gugug andjieng. It is a very deep cave; its main corridor is estimated to be 150–200 m long. It is connected to a cave at a lower level, through which the Batang Janki flows and it surely at one point was itself the conduit for this or some other river.

We started excavating here close to the entrance on 15 June and we found a layer of sand lithified through impregnation of chalk 0.50 m., 1.60 m yellow loam, 0.20 conglomerate of silicates and pieces of limestone; all deposited in horizontal layers, apparently aquatic deposits. In the loam a few molars of a species of pig, a few incisors of the common porcupine and two molars of a deer were found. (50-047)

A few weeks later, however, the work was abandoned after no more fossils had surfaced (50-048). Dubois kept trying to track down suitable caves, and although a few were found, no further caves were opened in June (50-048).

Ngalau Bandar, or Ngalau Batang Chiparok

On 15 July 1889, excavations started in a small, shallow 8 m deep cave named after a *bandar* (water conduit) that transported water from the Sangtei brook to the *sawahs* (rice fields). It was excavated down to 2 m. Dubois stated that it:

[...] almost completely consisted of limestone blocks that had fallen out of the ceiling and which, only with very little soil, had connected to a moderately vast and hard breccia. Completely at the surface, underneath only a few centimetres of loose clay, there was a 15 cm thick layer of

wood ashes, in which shards of pottery of more recent shapes appeared as well as some bones of the common goat and larger birds, of which some were clearly carrying the marks of having been cut with a knife, proving the cave has been in use by people. Any significant thickness of the ash layer makes us assume that throughout a number of years this cave has been inhabited and used up to recently as a temporary or permanent stay, probably for Malay people.

Up to the end of this month the limestone breccia did not deliver many bones. Just a few teeth of pigs, deer, porcupines and a tiger, were found, apart from the remains of bats. (50-048)

The August 1889 report shows that continuation was bothersome:

The sediment found, a breccia of limestone mixed with only very little soil, not hard enough to be successfully removed with dynamite, but then again so hard that removing it with ordinary tools results in very slow progress, which was partly the cause that this month we only reached a maximal depth of 2.75 m. The bones found were few in number and mostly small and broken into unidentifiable fragments, by the way apparently from the same animal species as we used to find before. (50-049)

In the September 1889 report, Dubois added that they found in the breccia:

[...] teeth of the ordinary wild hog (*Sus vittatus*), of the tapir (*Tapirus indicus*), the deer (*Cervus equinus*), the forest goat (*Antilope sumatrensis*) and the porcupine (*Hystrix mülleri*), all animals still present here today. Underneath the breccia we finally at 3.50 m found a brownish-red clay, of which we by the end of September had only removed a few centimetres. (50-050)

In the October 1889 report, Dubois stated that this brownish-red clay:

[...] turned out to be mixed with small pieces of limestone for 0.60 m until we encountered for 0.50 m pure clay and finally 1 m clayish quartz sand (originating from weathered Tertiary conglomerates); so now we have reached at a total depth of 5.60 m below the original surface floor the bottom of the cave. No more bones had been found and looking for them came to an unexpected end. It had already been noted lately that small cracks had appeared in the ceiling and when these started to increase, I had the work stopped. Luckily in time, for soon after a large part of the ceiling collapsed (some hundreds of cubic metres). Thus work that had been taken a long time remained fruitless. (50-050)

Ngalau Jambu

From Ngalau Jambu, Dubois brought back some 1,000 fossils. It is first mentioned in the July 1889 monthly report, in which Dubois stated:

Because of being indisposed I was not able to continue tracking down new caves during the larger part of this month. A Kampong chief however informed me about the existence of some thus far unknown caves near Tapi-Sello and in one of these, the Ngalau Jambu, on 31 July the Kampong chief together with one of the forced labourers, who was already more able in finding fossils, brought from there a great many teeth. They are of the same species, and in the same relative numbers towards each other and in the same state of conservation as those I found earlier in Ngalau Lida Ajer, near Payakumbuh; many teeth of pigs and of orangutan, further tapirs, rhinoceroses, elephants, deer, buffaloes, monkeys and porcupines are also here in abundance. (50-048)

In the following month's report, the description continued:

This cave is located at a short distance [of Tapi-Sello], north of the old little volcano Kuliet-monies, West of the brook Muara-panas, closer [than the previously described cave] to the top of the limestone mountain. It consists of two rather spacious chambers, which are in connection to each other by a high narrow opening. The front chamber opens to the outside and receives full daylight. Its floor consists entirely of heavy limestone blocks that have fallen from the

ceiling. The inner chamber is completely devoid of daylight, it contains a few similar rocks like in the front chamber but in between the floor is flat and covered with an up to 0.50 M thick layer of earth.

Already in this dark red soil, which is of the same kind as is covering the old slate layers everywhere in this area, a great many teeth were found [...] Underneath this layer we had a very irregular stalagmite mass which partly enveloped limestone blocks and which was followed to a maximum depth of 1.80 m. In its upper part there were still similar fossils present as in the red earth; further down these were completely lacking. We yet continued removing this mass, as there was the possibility that it was covering a deeper fossil-bearing layer or other soil. (50-049)

Excavations were stopped by the end of September 1889 after, at a depth of almost 3 m, the bedrock had been reached, and no more fossils had been found (50-050).

Ngalau Lebawah near Sisawah

In his September 1889 report, Dubois wrote of this cave:

On the right side of the road to the *dusun* Kabun, a few hours away from d.s. [*dusun*?] on top of a mountain ridge, this cave, which is a natural pit into which I climbed down along a rattan ladder for 28 m until I had reached its apparent floor; along a sideways crevice I could, from resting place to resting place, on rocks pointing out, climb down a further 25–30 m until I had reached its true floor. In there was like a very small bowl, in which there was hardly room for two people, but on the floor $\pm \frac{1}{2}$ m. of fine gravel mixed with earth, which looked very much tossed over and on top of it was a truly large bone, a thighbone, of which both the distal ends were missing and that turned out to be of an elephant. It had completely calcified, was very heavy and partly covered with a drip stone layer; there can be no doubt about its great age and fossil state, but lacking material for comparison it can for the time being not be ascertained as to which species of elephant it belongs; it is surely not of any other family than *Elephas*. Other remains were not found here although they might yet have been present in higher layers of earth (the top floor) of this pit; it is probably yet likely that this animal has fallen down this pit alive (like the complete Rhinoceros skeleton found in the Dream-cave near Wirksworth in England, which had fallen in the cave similarly [found by lead miners in 1822; see Mello 1880]). Quick attempts to find these gave no results and for a systematic exploration this cave, given its location on a mountain ridge hours away from any Kampong and drinking water, is unsuitable. So here we experienced again to what extent the terrain limits the number of caves suitable to be opened in these areas. (50-050)

Caves approached from Singkarah

In December 1889, Dubois left the Bua area and started exploring close to Singkarah in the vicinity of Paningahan. The 'famous' cave of Paningahan, located under the *nagari* Tandjung Bonei through which the Batang Pigago flows (50-042), was considered unsuitable as it was located only 20 m above the current water level of Lake Singkarah, whereas 'there are clear signs everywhere on several spots, that the level in recent times must have been at least 70 m higher than it currently is'.

Ngalau Si Babantu

One of the two teams was set to work at Ngalau Si Babantu, a cave located about 120 m above the lake on the bank of the Paningahan brook. To gain entrance, they first had to remove a heavy rock, which was partly blocking the entrance, using dynamite, but they did not manage to do so until the end of December (50-051).

In January 1890:

After removing limestone blocks the black earth was dug through to a depth of 0.50 m to 1.25 m and subsequently yellow earth, mixed with small pieces of limestone up to a depth of about 1 m. The latter contains numerous teeth, again richly representing the Lida-ajer fauna. (50-045)

By the end of the month, however, the cave was exhausted, so they abandoned it (50-046).

Ngalau Pala Pisang and another unnamed hole nearby

After leaving Bua the second team started work in Ngalau Pala Pisang, a cave about 250 m above the lake on the left bank of the Paningahan brook. They encountered:

[...] near the entrance a yellow clay mixed with pieces of limestone of which up to 1.50 m was removed; further down at about 15 m from the entrance inward in a spacious room bat guano was removed up to a depth of 2 m.

On 20 January 1890, however, the cave:

[...] was already abandoned, after the solid rock floor of the cave had been reached near the entrance without finding any fossils, whilst in the deeper 'hall' because of the meanwhile started heavy rains so much water had entered that working there became completely impossible. Not that there was much to look forward to for reward. The bat guano was reaching at least to a depth of 4 m and the rock walls were converging thus, that the floor would soon have been reached.

This Ngalau pala pisang is therefore one of the few caves that did not contain any mammal remains at all.

Near to this cave in the ravine of the Batang Paningahan we found a hole in the rocks, too narrow to crawl in, which however after being widened, turned out to be the remainder of an old cave. In the yellow earth, which was completely filling the space underneath a hanging drip stone, a number of teeth were found of the already so often encountered Lida-ajer fauna. The yellow earth was covering river sand that had been hardened by impregnation of limestone, which therefore must be younger than the deposits of this sand by the Paningahan that is currently incised 25 m lower. (50-045)

This second excavation was finished by the beginning of February 1890 (50-046).

Ngalau Agung Agung or Sibrambang

On 9 February 1890, digging started in Ngalau Agung Agung (50-046). This was the cave from which Dubois brought home the largest number of fossils, over 3,400. (A cave of this name has recently been located in the area indicated by Dubois and will be the subject of future research. This site is now known as Sibrambang due to the village nearby.) In his February report, Dubois wrote:

[...] our efforts were soon rewarded. After from the floor of this 11 m wide and 8 m deep cave some large dripstones which had fallen off or were growing to the floor, had been removed one could start taking out a thin layer of yellow clay ($\pm \frac{1}{2}$ m), which was covering a black soil. This black earth, of which by the end of February $2\frac{1}{2}$ m had been dug up, was mixed with pieces of limestone and contained an immense amount of teeth and molars from the animals of the aforementioned fauna, in which now elephants and buffaloes were now more strongly represented than before. The remains of thousands of large animals must have been dragged in here and one cannot without amazement and wonder think about the rich animal life which must once have existed in an area where currently even the common Indian hog is rare. (50-046)

The cave kept yielding fossils until:

[...] on 25 March at a depth of 3.50 m below the original surface the rocky bottom was reached and as at another location within the cave up to 2.50 m no results of a different kind were encountered than had already been obtained, on 26 March this cave was also abandoned. (50-046)

Ngalau Sibatie (Bukit Mengkapok)

On 13 February 1890, work started in Ngalau Sibatie, which was 'actually 2 caves with the same name', but no results were reported that month (50-046). By halfway through March, this cave was completely emptied. Dubois stated:

This little cave with a depth of only 5 m and a width of 8 m contains, underneath a 0.50 m thick layer of black earth, about 2.50 m hard yellow clay mixed with smaller and larger pieces of limestone. In this breccia-like mass a few completely calcified but yet very much broken bones were found, presumably of a kind of deer. (50-046)

Leaving Sumatra

For Dubois, his time in Sumatra ended in disappointment. He had hoped to find a human forerunner, but the contents of the caves were not old enough—in his view—to produce what he was looking for. Furthermore, conditions had been harsher than he had anticipated. He had barely survived several malaria attacks, and one of the sergeants initially assigned to him, Franke, had died, probably of malaria, three and a half months after he started. The other sergeant, van de Nesse, had not been capable of handling the convicts, so it had been necessary to replace him.

The convicts were also often ill and unable to work. *Plasmodium* being the cause of malaria was at that time known, but mosquitoes as the intermediate hosts were not, and malaria was still thought to be caused by so-called 'bad air'. Because of this, work in some caves ceased if too many people got ill within a short time; this happened, for example, in Muka-Muka Cave near Muara (50-047) and in Ngalau Bulan (50-048).

Moreover, war had been ongoing in Aceh, Sumatra, since 1873; consequently, throughout Sumatra the local people were less inclined towards the Dutch than they were on other islands. Although Dubois' intentions were benign, he did not meet with the support of the local people. They were worried that Dubois was surveying the caves for gold and saltpetre, commodities they were mining themselves and that they did not want to lose to the Dutch. Someone just looking for ancient bones was beyond their experience. As a result, Dubois was led astray more than once, and his complaints about that to, for instance, Jentink (6-373), are well described in Theunissen (1989). However, further similar letters exist, to Martin (33-512), Treub (12-271) and Verbeek (33-551), for example. (A book containing the correspondence of Dubois during his Indonesian period is in preparation).

After the Wajak skull had been found in Java in October 1888, Verbeek in particular had been pushing Dubois to go there (12-405, 12-408). The success of Lida Ajer, however, made Dubois decide at first to keep trying in Sumatra. In the end, however, the jungle defeated him, and he chose to go to Java where circumstances were much better (e.g. there was more deforestation). His final trip in Sumatra, moving with his family to the harbour at Padang, is telling: he fell ill, had to rent a house far from major towns as he was not able to continue travelling, and when he finally did arrive in Padang a month later, people did not recognise him because of his emaciated state (33-665). He arrived in Java in May 1890.

Concluding remarks

Eugène Dubois' work on Sumatra never got much attention, being completely overshadowed by his *Homo erectus* discoveries on Java. His work on Sumatra, however, was clearly conducted at the highest standards of his time. He worked from the sound hypothesis that caves would be likely places to find fossil faunas. He used all geological knowledge available to him to locate the areas where these caves were most likely to be found, and subsequently found both caves and fossils. He did not just pick up the bones in these caves, but also collected sediment samples of the different layers he encountered and described them. He made astute observations on the geology of the caves and the relationship between geomorphology and the chronology of his finds. He even conducted a neotaphonomic experiment with a live porcupine, something never done before as far as we know.

Today, the Dubois collection at Naturalis Biodiversity Center in Leiden has over 10,000 collection numbers for finds from Sumatran caves. Had a World War II bomb not destroyed part of the museum where the sediment samples were stored, we would have had many hundreds more of those too. Dubois may have been disappointed by the results of his endeavours on Sumatra, but what he did achieve there was extraordinary.

Although the original locations of all the fossils Dubois found are not currently known, sampling the bones for chemical clues of those locations with, for instance, X-ray Fluorescence Spectrometry, if necessary in combination with revisiting the sites, might well resolve this question in the future. This possibility, in combination with the archival information, makes the Dubois collection extremely valuable to this day.

Acknowledgements

We thank the anonymous reviewers for their constructive comments. Naturalis Biodiversity Center is gratefully acknowledged for allowing access to the Dubois Archive, and we are grateful in particular to Karien Lahaise of Naturalis, for supporting our access to the Dubois Archive, and Antje Weeda, who was a Naturalis volunteer from 2010 to 2014, for valuable biographical information about the authors of the letters in the Dubois Archive. J.L.'s funding for this research was generously provided by the Australian Research Council (FT160100450).

References

- Albers, P.C.H. and J. de Vos 2010. *Through Eugène Dubois' Eyes: Stills of a Turbulent Life*. Brill, Leiden. doi.org/10.1163/ej.9789004183001.i-186
- Dubois, M.E.F.T. 1888. Over de wenschelijkheid van een onderzoek naar de diluviale fauna van Ned. Indië, in het bijzonder van Sumatra. *Natuurkundig Tijdschrift voor Nederlandsch-Indië* 48:148–165.
- Duringer, P., A.M. Bacon, T. Sayavongkhamdy and T.K.T. Nguyen 2012. Karst development, breccias history, and mammalian assemblages in Southeast Asia: A brief review. *Comptes Rendus Palevol* 11(2–3):133–157. doi.org/10.1016/j.crpv.2011.07.003
- Duval, M., K. Westaway, Y. Zaim, Y. Rizal, Aswan, M.R. Puspaningrum, A. Trihascaryo, P.C.H. Albers, H.E. Smith, G.M. Drawhorn, G.J. Price and J. Louys 2021. New chronological constraints for the Late Pleistocene fossil assemblage and associated breccia from Ngatau Sampit, Sumatra. *Open Quaternary* 7:1–24. doi.org/10.5334/oq.96

- Hooijer, D.A. 1946. Prehistoric and fossil rhinoceroses from the Malay Archipelago and India. *Zoologische Mededelingen* 26:1–138.
- Hooijer, D.A. 1955. Fossil Proboscidae from the Malay Archipelago and the Punjab. *Zoologische Verhandelingen* 28:1–146.
- Louys, J., M. Duval, G. Price, K. Westaway, Y. Zaim, Y. Rizal, Aswan, M. Puspaningrum, A. Trihascaryo, S. Breitenbach, O. Kwiecien, Y. Cai, P. Higgins, P.C.H. Albers, J. de Vos and P. Roberts 2022. Speleological and environmental history of Lida Ajer cave, western Sumatra. *Philosophical Transactions of the Royal Society B* 377:20200494. doi.org/10.1098/rstb.2020.0494
- Lydekker, R. 1886. The fauna of the Karnul caves. *Palaeontologia Indica Series* 10 4:23–58.
- Mello, J.M. 1880. On a short history of the Creswell caves. *Proceedings of the Yorkshire Geological and Polytechnic Society* 7:252–265. doi.org/10.1144/pygs.7.3.252a
- Mylroie, J.E. and J.L. Carew 1990. The flank margin model for dissolution cave development in carbonate platforms. *Earth Surface Processes and Landforms* 15(5):413–424. doi.org/10.1002/esp.3290150505
- Palmer, A.N. 1991. Origin and morphology of limestone caves. *Geological Society of America Bulletin* 103:1–21. doi.org/10.1130/0016-7606(1991)103<0001:OAMOLC>2.3.CO;2
- Pijnappel, M.W. 1897. Fossiele overblijfselen op Java (de *Pithecanthropus erectus* Dubois). *Huis en haard* 1897:29–31, 43–45, 58–62 and 72–79.
- Shipman, P. 2001. *The Man Who Found the Missing Link. The Extraordinary Life of Eugène Dubois*. Weidenfeld & Nicholson, London.
- Theunissen, L.T.G. 1985. *Eugène Dubois en de Aapmens van Java*. Rodopi, Amsterdam.
- Theunissen, L.T.G. 1989. *Eugène Dubois and the Ape-Man from Java* (E. Perlin-West, trans.). Kluwer, Dordrecht. doi.org/10.1007/978-94-009-2209-9
- Verbeek, R.D.M. 1883. *Topografische en Geologische Beschrijving van een Gedeelte van Sumatra's Westkust*. Landsdrukkerij, Batavia.
- Verbeek, R.D.M. 1888. *Krakatau. Eerste gedeelte*. (Tweede verbeterde druk.) Landsdrukkerij, Batavia.

Appendix: Extracts from Eugène Dubois' notes and letters

Code	Date	Description
6-310 6-311 6-312 6-313	7 June 1888	<p>[Letter from Jentink (director of the natural history museum in Leiden) to Dubois] STATE MUSEUM OF NATURAL HISTORY. Leiden, the 7th of June 1888</p> <p><i>Amice Dubois,</i></p> <p>you surely must have been wondering often, why still no messages from Leiden had arrived, but all kinds of obstructions, not mine, but from professor Fürbringer, prevented me from writing to you earlier about the important matter. Many times we had set a date and time to come together and then suddenly he cancelled.</p> <p>Careful reading of your letters to professor Fürbringer and to me has convinced us, that you yourself will be the cause if your plans don't succeed, for repeatedly we pressed you not to speak to anyone about your</p> <p>[6-311]</p> <p>future plans: I've clearly pointed out what the questionable results would be if people were to find out that you have put on the soldier's uniform with ulterior motives. And now you have not only spoken to many in Amsterdam about your plans, but also to your superiors in the Dutch Indies, yes and even held conferences, whilst it is also highly reprehensible that your wife has meddled in your affairs in writing! Friend, you know I am <u>very</u> dedicated towards you and you will forgive me for speaking out plainly, it is in your own interest. In my profession I have to deal with many people, whom, if I am to have my way, I need to approach very diplomatically and I could have told you up front (as I did) that laying your cards on the table in this stage could spoil everything. But enough of this. What's done is done. Take my advice for the time to come and you will with more certainty achieve the goal, if it is at all achievable, than going further down the road you have taken so far. Speak with nobody whatsoever about your plans, tell them, you have put them aside, be for the eyes of your colleagues and superiors a fully committed and diligent officer of health; who has therein found his ideal for life and has great desire to climb in rank. This way people will (what would happen easily in the lethargic Insulinde) be put to sleep and within a few months everybody will have forgotten all about it and you will be known for your diligence and knowledge as an excellent army man, who is due for promotion. Don't just hide your reluctance towards the service and the medical practice, but speak about it like your respect for it is ever-growing. So if you keep completely silent about the main matter, you will make your way in the Indies and be well established. Meanwhile we will try to sort the matter out here and will one day or another</p> <p>[6-312]</p> <p>submit a proposal to the Governor-General and you will get an assignment for scientific research. What can be done about that, believe me, can only be done out of Holland. And even here, Fürbringer, Martin and I can only fight your corner, if we strictly exclude other committees and societies. The less people know about it, the less they can do to oppose this. The Royal Academy of Sciences, the Geographical Society, the Natural History Committee, nothing can be expected from them other than opposition, as they eventually would all propose to get their own candidate for that research. The 10,000 guilders mentioned will for at least two years be allocated to the Key-expedition: even if we could get this for you, it would take too much time to get it for you. You speak of an advantage to be given by the government! Dear friend, something like that has never been seen and will never happen in a well-administrated country, it not only needs to be put to the Budget every year, but also has to be approved by the Chamber of Commons. What should happen to an advantage already given, if the chamber of Commons subsequently voted against it or when the Minister decided to not put it in the Budget?</p>

Code	Date	Description
		<p>If you think the tone of this letter is too patronising, please excuse me, consider it is not written and tear it apart immediately. But I do think I have the right to speak, as I've had more experience in these matters and if you had followed my advice from the start, things would look better for you now. Mind that in the first year doing or speaking about research in the Indies is out of the question. Never forget that in the Indies 'making money' is the main reason for being there and they look at energetic people as strange beings, a mythical beast, and they cannot imagine what goes on in the mind of such a man. And now <i>basta</i>, I hope to receive letters from you from time to time; from my side I promise to keep you apprised and take all necessary steps to support your cause from here. But everything 'sub rosa'! Fürbringer's health is not as it should be: he overworked himself now with that giants task, that has now [6-313]</p> <p>been printed, the 'Morphology etc. of the Birds', two giant volumes. He needs 'Erholung' [German: recreation]!</p> <p>I regret to hear that your wife is not doing very well: it has been a dreadful start for her, hardly arrived in the Indies and mother and sister die! I heartily hope that she will find courage for the future and will be able to forcefully support you in doing your duty.</p> <p>I wonder what the consequences for us all will be of this new ministry? And who will become the next Governor-General? Who knows whether under the given circumstances your Catholic background might give you unexpected support from this clerical ministry, maybe Schaepman can help you: I could go and visit him on your behalf. Do you know him? <u>Do write this to me!</u> Here all is well: we all fondly remember the time you have allowed us, and my relatives all send heartily greetings to their cheerful nephew. And now '<i>praesta te vivum</i>', receive with your wife the friendly hand pressed by your dedicated and interested F.A. Jentink.</p>
7-467	8 September 1888	<p>I was very pleasantly surprised by your message of the second of this month, which was just followed by your message of the 5th and I cordially congratulate you on your initial and so rapidly acquired success.</p>
7-501 7-502	February 1888	<p>[Letter from Dubois to Kroeze (possibly a government official) and Kroeze's answer to it]</p> <p>Noble and Severe Sir.</p> <p>By the kindness of Mr de Freytag I am pleased to be able to tell you that I have also been acquitted of my afternoon duty. I'm therefore pleased to be able to be at your disposal at a much earlier time which will allow us to be able to make the trip by daylight. If it suits you I could be at 4 o'clock on the back of my horse and wherever is convenient to you, such as at the hospital or at your office.</p> <p>Could you give a message to the bearer of this, where and when you want to meet me?</p> <p>After polite greetings, with the highest esteem towards your noble and severe Sir your willing servant Eug. Dubois [7-502]</p> <p>Dear Doctor</p> <p>In answer to the attached note I take the liberty to give you into consideration that we meet each other on horseback at about 16:30 near the house of the provost.</p> <p>Do you think about bringing pajamas, kabaja and a warm jacket? Nights can be very cold at Lubu kelangan. If you prefer taking a thin blanket, that is also good.—I will bring food and drink. Do also take a towel and a few stockings and shoes. We need to wade through a river and it is always preferable to take along dry stockings. My boys will start marching at about 3 o'clock. Please have your servant be at my house at that time to carry your clothes and such and then they can point him in the right direction. Until later, please accept my polite and respectful greetings, your willing servant Kroeze</p>

Code	Date	Description
12-400	28 September 1888	[Letter from Verbeek (Head engineer of the Governmental Mining Department and head scientist of the Geological Survey of the West Coast, Sumatra) to Dubois] Yesterday I heard from Doctor Schmeling Kool, whom you seem to know, that you have already found fossilised bones, molars and human remains et cetera. You seem to have been more lucky than us—for we always looked for them in vain. Please write to me in which caves you have found these fossil remains.
12-405	1 October 1888	[Letter from Verbeek to Dubois] I [...] advised that you would be given immediately two years of leave, and that you would be summoned to not just examine the caves of Sumatra, but also, subsequently, those of Java, and pointed out that only regular systematic research will do for fruitful science; and further that such research cannot be done by the mining department as that would mean they would have to [12-406] do without a mining engineer for years and their number is too few as it is already. I hope this will be helpful.
12-408	8 December 1888	[Letter from Verbeek to Dubois] I have seen the skull from Wadjak at Sluiter's [office], [12-409] it is truly a human skull with nice molars in it, but alas broken; and completely covered with limestone. Sluiter will send it to you. You can prepare it by dissolving the limestone with diluted hydrochloric acid; we tried it on a small shard, it works excellently, the bone remains and the chalk within the limestone is naturally dissolved. The skull is not broken from back to front but crosswise and Sluiter did not succeed in fitting the chunks together. As soon as you have dissolved the matrix, you will probably be able to piece the largest part together; but some parts appear to have been lost in excavation. Whether we are truly dealing with a diluvial remains is somewhat unsure.
12-265 12-266	10 October 1888	[Letter from Treub (Director of the Botanical gardens in Bogor and the most senior scientist in the Dutch Indies) to Dubois] I had just also wanted to advise you to not ask for leave <u>as yet</u> ; it's prudent to be careful. If you again have [12-266] obtained important results, there will be opportunity and cause to see what can be done. That these important results will not fail to come up, I doubt as little as you do. A few months ago I already, as president of the Committee for nature research in our colonies, brought up your research in our meeting and subsequently contacted the Chief of the Medical Service. I have had a long and extensive talk with Colonel Lokhorst about the scientific importance of the success of your plan. I am <u>very</u> pleased to learn from your writing that this meeting has not been without result. You can always fully count on my <u>warm</u> interest both as a person and as the president of the Committee. Allow me to yet again advise you to be careful with your contact with the official world; nice and easy does it! The matter is so important that it would be a shame if it were to falter through some rash steps, that would diminish the sympathies that have been raised for your research. Please do excuse these remarks. They spring up out of true interest.

Code	Date	Description
12-271	end of September 1889	<p>[Letter from Dubois to Treub]</p> <p>This is also my first letter after starting the cave research. If I had not met with so much misfortune and had so little success I would surely have notified you sooner, as you have shown such a great interest in the work. In comparison however to the enormous amount of work we have put in, the results are so little, that I did not want to bother you with my whining. The local people, who are very distrustful towards the 'Company' and not very forthcoming, along with the immensely rugged terrain and the high incidence of fever among the workmen, were insurmountable adversities. And that is the reason, and even with all the support from the government, very little research could be done. How discouraging this is for me your noble Sir will certainly understand knowing what it is to be committed to research with heart and soul.</p>
33-506	1 October 1888	<p>[Letter from Dubois to Verbeek]</p> <p>The respective remains, thousands by now, I have found after a month of work in the [illegible word: cave?] Ngalau lida ajer in the coal limestone located south of Situdju batu, (south-southwest of Fort de Kock in your Atlas) and it is</p> <p>[33-507]</p> <p>certainly a happy coincidence that I made an important find so soon where better men than me have been looking in vain. There can be no doubt that the objects found are truly fossil, as is apparent from the high level of calcification that the bones have undergone as well as from their position. However I will not yet hazard an opinion about their true age and consider it more careful to await further research before I do so.</p>
33-512 33-513	October 1889	<p>[Draft or copy of letter from Dubois to Martin (director of the geological museum in Leiden)]</p> <p>Although it has been long since the arrival of your kind letter of 8 May last I do not want to fail to politely thank your highly learned Sir for it. I had hoped so much to be able to send you word about results that were such that they would be a worthy reciprocation to the interest that you have shown me. So far this was not to be. I have only been able to collect about as much as I had before and the reason for this relatively unsuccessful result is not, because there's nothing to find here, because in two out of three reasonably completely excavated caves fossils were found. The causes however are 1) the thickly grown jungle that is largely even without any path, which makes the caves difficult to find and a lot of them therefore not viable for research; further 2) the distrustful nature of the population, that fear that the Government is trying to get their hands on the gold and saltpetre, that they are mining in many caves, which they therefore carefully keep secret and they continuously keep deceiving me about where they are, and 3) the poor work, that the convicts are delivering because many are ill (currently some 50%) and there wasn't always good supervision (by the engineer workmen, that each had to supervise one of the groups in my absence; one died and the other had to be sent away for being inadequate, whilst they could not be immediately replaced) and as these convicts are poorer workers from their nature. It must however be said that the lonely and unhealthy life in the jungle is not encouraging for these people. Earlier, when we were near Payakumbuh, an area more inhabited and more civilised, their work was much better.</p> <p>This has all been very disappointing and my expectations have not been met at all and as I have little hope that things will improve here and currently—in the rainy season—it is not the time to work on Java, I do regret now not to have</p>

Code	Date	Description
		<p>[33-513]</p> <p>asked to first start opening caves on Java, where the conditions are so much better and such wonderful finds like the fossil (Papuan-like) human skull have been found and from many locations finds of bones in caves have become known.</p> <p>Whether the Government, if I do not get more luck than I had so far, will yet allow me to continue my excavations on Java, is something that I seriously doubt, which would destroy every further prospect. That would certainly be a shame, now that on several locations on Java find sites have been encountered and it would dissipate the other wish I had and that I hoped might come true on Java. What I mean is, should I be allowed to continue excavating on Java I would suddenly also be getting the opportunity to dig up more of the Javan Siwalik fauna that you have discovered. When you asked me, before I left to the Indies, after I told you about my plans, whether I not rather want to go and look for these fossils I rejected the idea because I was of the opinion that trying so would be more difficult for technical reasons as there were no find sites near any garrisons and thus as an officer of health I would not have the means to get there. Your research about the Siwalik fauna together with the description of mammals from the Karnool caves in Madras have actually brought me to my current cave plans and I realised then as I do now, that Miocene fauna might even be more important than anything that the caves could deliver. It now seems that finding these tertiary fossils is not as problematic as I originally thought and should I be given another year of leave, you certainly would not have any difficulty convincing the Government to also</p> <p>[transposed in left margin] entrust me with the task of finding these tertiary mammal remains. Obviously all the material would be for you, unless you would and could leave me some for later for me to get my teeth in.</p> <p>[33-512 transposed in left margin]</p> <p>Forgive me for pre-empting the situation so far, even though it's very doubtful whether I will be given a year's extension. But exactly because of that I take the liberty to bring the so important palaeontological preliminary research that I would do on Java to your Noble Sir's attention for a moment, and it would have a much larger chance of success than on Sumatra, where no find sites were known upfront and many more difficulties have been encountered. Thank you for eventually safeguarding the diluvialia.</p>
33-551 33-552 33-550	November(?) 1889	<p>[Draft letter from Dubois to Verbeek]</p> <p>Whilst I have already been doing cave research at Bua for four months I have not sent Your Honour any report, although you not only have continuously shown interest in my work but also supported it with more strength than anybody else. But after I have told you the cause for the long delay of this report I am certain you will understand and forgive my silence. Up to now I have not found what I wished for so furiously, not because the terrain here seems barren but because maybe expectations have been very high and the difficulties have been unexpectedly large. Having come to the Dutch Indies full of hope of achievement, the initial success and even more the large appreciation for my efforts, in particular by knowledgeable people like you, and being now well supported and equipped by the government I was filled with the best of hopes and more than ever enthused and fully intending to use all my powers to make this research succeed. And you yourself, knowing how much one can get attached to one's scientific research, will not be amazed that when these great expectations did not come to be—not because of the research itself—this experience made me very sad, in particular, because I felt obliged towards the Government and people like you, that have put their trust in me largely because of the expectations I raised, to repay them with a proportional result.</p> <p>The difficulties I faced were much larger than I could have suspected and on top of that it turned out that I largely overestimated the working ability of the forced labourers.</p>

Code	Date	Description
		<p>At first the preliminary examination of the terrain that the controller had recommended to me, and which took a month to do, hardly led to anything. The Malaysians, who look in the caves for gold and potassium nitrate feared that the 'Company' was going to compete with them or had other reasons for distrust with the consequence that without guides I could hardly find any suitable cave, although the area is much richer in caves than many an area in Europe. Later I did track some down and heard afterwards from more than one chief that they had known their existence but kept silent out of fear for the above-mentioned reasons.</p> <p>I tried now to find as many of them as I could myself and did succeed to some extent and did get some help later from some chiefs after they had renewed encouragement from the controller. But the</p> <p>[33-552]</p> <p>finds remained sporadic and I did not succeed in getting a good overview of the existing caves to choose the ones most appropriate. I had to make do with what was there. Beside this the terrain itself also caused great difficulties, not just in finding the caves, but also in getting enough supplies to support the forced labourers which again excluded a number of caves that would have been worthwhile for research but were too far into the jungle.</p> <p>But the largest adversity was caused by my means of research. I had largely overestimated the real working ability of the forced labourers. Without proper overseeing the largest amount of their working capacity remains latent and as I could only be present at one of the three places where we were working at one time, supervision was permanently insufficient and as a result on average half of the forced labourers were doing almost nothing, meaning that after subtracting overseers, cooks, those ill, and the ones that had run off, only a tiny number of the fifty forced labourers appointed to me were effectively working.</p> <p>I did not have much luck with the workers from the Engineer Corps either, one of the two was doing excellently but died within a couple of months and the other turned out to be completely useless and was subsequently replaced upon my request by the first engineer officer t.K. For more than one half month now I still have to cope with only one engineer worker. I do feel obliged to say however, that both with the replacement as well as before, when my tools had not arrived yet from the Department of Education, Religion and Trade, the engineer Corps were the ones who supported me most and offered me tools willingly. When the inadequate engineer was just replaced and the other one had just died I myself became gravely ill so that</p> <p>[33-550]</p> <p>other than the recently arrived engineer for some time there was no European overseeing the work.</p> <p>I will not bother you any longer with complaints, but it saddens me to see how little has yet been done and I am convinced that <u>because of that</u>, so little has been found. More than once I have felt remorse that I did not follow your advice to come to Java straightaway although there were a number of counterarguments. All the difficulties that I have faced here would certainly not have arisen there and what is leaning on me most is that because of the humble results here the Government might hold back on continuing the research on Java, so the treasures you already know to be there are not to be lifted by me.</p>
33-665	5 June 1890	<p>[Letter from Dubois to Jentink]</p> <p>The last while on Sumatra was the end of a period and the first time on Java was the beginning of a new period for me and the transition seems to equal that between geological periods for having huge changes taking place; I went from being unwell to mortally ill to healthy.</p> <p>Whilst travelling to Padang in order to ship to Java I fell ill and have for about a month with my wife and children and without goods (for all had been sent ahead already) been compelled to remain in a ruinous [illegible: merchant?] house, where I eventually lost the fever, but not the cachexia, so that when I arrived in Padang (after a difficult [illegible: cart?]-travel of 8.30 AM to midnight because of accidents to the vehicles and poor horses) was taken for a stranger by old acquaintances.</p>

Code	Date	Description																																										
40-446 40-473		See file Sumatra notebooks doi.org/10.6084/m9.figshare.22154882																																										
43-073 43-074		See file Sumatra notebooks doi.org/10.6084/m9.figshare.22154882																																										
46-003 46-006		See file Sumatra notebooks doi.org/10.6084/m9.figshare.22154882																																										
46-117 46-118		See file Sumatra notebooks doi.org/10.6084/m9.figshare.22154882																																										
49-264 49-265		See file Sumatra notebooks doi.org/10.6084/m9.figshare.22154882																																										
50-005	25 March 1889	[Letter from Dubois to the governor of Sumatra's West Coast] I therefore have taken the liberty to address your Noble severe Sir politely with the request to already have the 50 forced labourers, that have been put at my disposal earlier, be sent here.																																										
50-006	28 March 2889	[Letter from Dubois to the Director of Education, Religion and Trade] The Assistant-Resident of Tanah-Datar had the benevolence of sending me an extensive list of the most well-known caves, in his department from which it became apparent that in this government the Department Tanah-Datar—as I had also learned from other sources, has by far the largest number of caves, so that will give much possibility for research. Within Tanah-Datar the sub-departments Bua and Lintan, covering a large part of the Ngalau-Saribu-mountain range, looked the most promising in this respect. These subdepartments alone list 120 caves and by analogy to what I have found in Payakumbuh, the true number of existing caves can easily be estimated to be double that number.																																										
50-007	28 March 1889	[Attachment to letter from Dubois to the Director of Education, Religion and Trade] Tools needed for the palaeontological research at Sumatra's west coast <table><tr><td>kind of tools</td><td>number</td></tr><tr><td>Hand and axes of several sizes</td><td>12</td></tr><tr><td>Goloks</td><td>24</td></tr><tr><td>Sledgehammers</td><td>10</td></tr><tr><td>Crowbars</td><td>12</td></tr><tr><td>Patjols</td><td>24</td></tr><tr><td>Rock drills</td><td>12</td></tr><tr><td>Clearance spoons¹</td><td>6</td></tr><tr><td>Hammers</td><td>6</td></tr><tr><td>Pliers for percussions</td><td>3</td></tr><tr><td>Pickaxes (double)</td><td>24</td></tr><tr><td>Shovels</td><td>18</td></tr><tr><td>Spades</td><td>24</td></tr><tr><td>Whetstones (round)</td><td>2</td></tr><tr><td>Files (large)</td><td>6</td></tr><tr><td>Hand saws</td><td>4</td></tr><tr><td>Chisels</td><td>12</td></tr><tr><td>Small hammers</td><td>4</td></tr><tr><td>Blocks (a few) and rigging</td><td>4</td></tr><tr><td>Sink buckets</td><td>12</td></tr><tr><td>Lamps with equipment</td><td>12</td></tr></table>	kind of tools	number	Hand and axes of several sizes	12	Goloks	24	Sledgehammers	10	Crowbars	12	Patjols	24	Rock drills	12	Clearance spoons¹	6	Hammers	6	Pliers for percussions	3	Pickaxes (double)	24	Shovels	18	Spades	24	Whetstones (round)	2	Files (large)	6	Hand saws	4	Chisels	12	Small hammers	4	Blocks (a few) and rigging	4	Sink buckets	12	Lamps with equipment	12
kind of tools	number																																											
Hand and axes of several sizes	12																																											
Goloks	24																																											
Sledgehammers	10																																											
Crowbars	12																																											
Patjols	24																																											
Rock drills	12																																											
Clearance spoons¹	6																																											
Hammers	6																																											
Pliers for percussions	3																																											
Pickaxes (double)	24																																											
Shovels	18																																											
Spades	24																																											
Whetstones (round)	2																																											
Files (large)	6																																											
Hand saws	4																																											
Chisels	12																																											
Small hammers	4																																											
Blocks (a few) and rigging	4																																											
Sink buckets	12																																											
Lamps with equipment	12																																											

¹ To clear the drill holes before dynamite can be put in.

Code	Date	Description
		<p>Consumables that possibly could be provided</p> <p>Petrol for ½ a year 24 chests</p> <p>Dynamite for ½ year 4 chests</p> <p>Candles for ½ year 250 items</p> <p>White glue 3 kilos</p>
50-009	18 April 1889	<p>[Letter from Dubois to the Director of Education, Religion and Trade]</p> <p>[The engineer workmen] Franke and van de Nesse that have been put at my disposal have arrived here on the 1st and 10th of April respectively.</p>
50-010	2 May 1889	<p>[Letter from Dubois to the Director of Education, Religion and Trade]</p> <p>I have the honour to inform your very Noble severe Sir that as of today I have passed on my medical duties and from this moment on will be able to fully dedicate myself to the assignment you have given me.</p>
50-011	5 May 1889	<p>[Monthly report for April; see Duval et al. (2021: figure 3), www.openquaternary.com/articles/10.5334/oq.96/]</p>
50-013	30 July 1889	<p>[Letter from Dubois to the Director of Education, Religion and Trade]</p> <p>Serious indisposition (heavy fevers and the consequences thereof) did not allow me to present this any earlier than I do now. I therefore politely request your noble severe Sir to please forgive this late presentation.</p>
50-032 50-033 50-034 50-035 50-036 50-037 50-039	15 October 1888 [monthly report September]	<p>Preliminary report about the palaeontological explorations in caves near Payakumbuh (Padang Highlands).</p> <p>Whilst already for a long time great importance has been assigned to prehistoric and palaeontological research, for which limestone caves of Europe and other parts of the world have proven to be very fruitful, up to now in the Dutch Indies this area of research has only seen a few futile attempts.</p> <p>Such explorations demand too much time and undivided dedication to be also taken on as a responsibility for the mining department, to which science already has so much to be grateful for, or to be taken on by zoologists and other nature researchers travelling through the archipelago, who already have enough to do in the areas they are specialised in.</p> <p>It is obvious that in a land such as the Indies, where nature is so infinitely rich, that, which is most at hand and most easily accessible, will also be the first subject of study. And this is a likely explanation, that in spite of the highly important results, that just here could be expected of such research, our, on related areas already so fruitfully examined colonies are in this respect still a <u>terra incognita</u>.</p> <p>From the, by the way much less richly endowed my nature, Indian mainland however, more is already known and the only recently published description of a Pliocene fauna from Java, which is completely analogous with the northwest Siwalik fauna, has now importantly strengthened the opinion, that the union of the mainland of India with the archipelago in that sense must also have existed in earlier geological times.</p> <p>[50-033]</p> <p>It furthermore gives a base to the opinion that also the diluvial animal world of the archipelago, which is currently known from the caves of northwest India will be compatible and as well as the famous Siwalik fauna form a connection to animals currently alive.</p> <p>That further substantially increases the importance for cave research in our colonies, especially also, there is justified reason to expect that here – even more so than in North West India – during diluvial times, there was richly developed animal life.</p> <p>After by accident in the caves of the Kamul district in North West India bones had been found, Professor Huxley considered the matter important enough to urge that the British Government would pursue further exploration of these caves, with the result, that since 1883 regular excavations have taken place, which already brought forth important results, both to anthropology and to palaeontology and which are still being continued.</p>

Code	Date	Description
		<p>These and the discoveries which Lund did in caves in Brazil already more than half a century ago, where giant diluvial Edentata and other peculiar shapes (e.g., of the horse that was indigenous there at the time) and whereby also humans have been found, deliver direct proof, that diluvial animals and diluvial men too don't fail to be present in the grottoes of the tropics, where the ice age did not have a direct impact. These are facts, which are even more pleasing, as they leave all the more reason to assume, that in particular the tropics might deliver important results and be key to the solution of more than one important palaeontological and anthropological question.</p> <p>These considerations, put forward in an essay, which was published in the second issue of the current year</p> <p>[50-034]</p> <p>of the Natural History Journal of the Dutch Indies, partly treated more extensively, made me decide to try to start examinations myself hoping that by doing so, to deliver the practical proof for the existence of such remains and therewith create more special interest in this branch of nature research.</p> <p>As far as my duties allowed me I visited all the caves and crevices in the vicinity of Payakumbuh, that I could find. By acquiring knowledge about their location in relation to the surrounding terrain, their internal structure and their formation I just tried to decide, whether analogous with those of other countries, truly fossils could be expected in them and whether they could be retrieved without too much difficulty.</p> <p>These case studies turned out to be very instructive in this tropical country. Here the process of formation is fully active and one can see caves in all stages of emergence.</p> <p>[You can see] Small crevices in the rock which, by the dissolving properties of the water, are widening into spacious canals in which a stream is taking its course, and next to that smaller and larger caves, which are now out of reach of the current water level, completely drained dry, but yet showing the clear markings of their formation by the eroding work of the water, and sometimes still consisting of clear canals. Here [you can see] the formation of stalactites or of a stalagmite floor, certainly by a third dissolvment of the walls of an originally dry cave, because rainwater has found its way in through a more recent point of access, then again apparent complete rest, [and] like after the flash of these enormous masses of earth, the shape of these giant drip stones are the products of earlier, lively productivity, now have gone into an eternal, sleep, mute witnesses of days long gone.</p> <p>[50-035]</p> <p>These preliminary studies were also very instructive for the way these holes in the earth get filled up, and how animal remains can get in there and be conserved.</p> <p>It became apparent to me, that they were in no way different from the caves in Belgium, Germany, England and France, which have become famous for the fossils which were found in them and that, yes even although for a number the influence of the tropics with its extreme weathering had taken its effect, there were still those, which upon closer inspection would not pose any larger practical concerns then there would be for any European cave.</p> <p>These encouraging results urged me to request further support from his Excellency the Governor of Sumatra's West Coast, with whose prior knowledge and approval I had started these explorations, and which were also most benevolently supplied to me. With some workers put at my disposal by his Excellency and the Assistant-Resident of L. Kota and providing other necessities out of my own means, on the 18th of July 1888 the actual research started with an excavation in the so-called Ngalau lida ajer. A priori this cave met all the demands to be a bone cave, it had all the hallmarks of great age, and after exploratory drilling, seemed the best place to start given the modest means I had available.</p>

Code	Date	Description
		<p>The <u>Ngalau lida ajer</u> ('water-tongue-cave', named after the tongue-shaped stalactites which are still dripping), is located in the lime mass, which in the geological atlas of Verbeek is drawn south of the <i>kampung</i> [village] Situdju betul. The entrances are about ± 150 M height above the valley floor. A small brook, the <u>Batang Babuwe</u>, coming from the <u>G. Sago</u>, rushing to the <u>Batang Agam</u>, has dug itself a bed in this valley. There must have been, according to the thick layers of gravel, that can be seen at some places, a much more considerable flow of water. The whole terrain bears the marks of being much changed by erosion. Even though the entrance of the cave is at the middle of a slope of a mountain, estimated at about 150 m above the nearest level of water, it is still very possible that once, when the landscape had quite different proportions, a small stream took its course through the cave. The state of its walls, as far as they have not yet been covered with dripstones, and more so the sandy layers which are at hand, but which are lacking in the immediate vicinity of the cave, are more direct proof for this hypothesis. The entrance is porch shaped and rather large. It leads to a spacious, round high chamber (of about 8 M width) in which heavy stalactites of all kinds of shapes beautifully cover the walls and the ceiling, whilst also a few stalagmite cones stick up out of the rather even earthy surface of the floor. This chamber seems to be the end of the cave, because a colossal, largely double, dripstone wall has formed, which prevents the eye from examining it further. One can however pierce through this double wall and get into the actual inner cave. This is more longitudinal shaped (15 M long and 6-8 M wide) rather high and only has a few dripstone columns along the sides and near the wall, parting it from the front chamber. The floor was flat, but had a shallow dip towards the back and consisted at the surface of a loose brownish-yellow clay-like soil, on which along the wall locally present dripstone columns rested their wide stalagmite feet and over which at the front and back along the wall there was also an amount of stalagmite breccia. It is of importance, that these mentioned stalagmite masses were all located at about the same level and that many pieces of that mass</p> <p>[50-036]</p> <p>were found just below the surface, when we started to dig a hole in the middle of the cave.</p> <p>The suspicion is therefore obvious, that they used to be a more fully covering stalagmite cover, which has later dissolved again; in later times in visible cracks must have formed in the ceiling, through which now at several points water is dripping down to the floor, such that there is even a pool present. The speed with which this water is coming through the ceiling, not yet saturated with chalk, will have had its dissolving effect on the mentioned stalactite cover on the floor.</p> <p>The whole cave bears signs of great age. Not just by its location out of reach of every water stream, but also by its gigantic dripstone shapes and the immense amount of soil, which is present inside and which must have been deposited there under completely different circumstances as are present now, thereby proving its age.</p> <p>As, given the limited means available but mostly also because of the limited time given the nature of my job, a systematic research, like removing all the earth out of the cave layer by layer, was out of the question, so I started with having a hole dug in the middle of the inner cave.</p> <p>Apart from the above mentioned, almost immediately at the surface located plate-shaped pieces of stalagmite and locally present layers of soil glued with chalk were found in the middle of the cave with at its top about 45 cm underneath the original surface, a gigantic crudely crystalline very hard stalagmite cone, of which the foot turned into a stalagmite mass which seemed to expand over the whole cave.</p> <p>At 1 M. depth near this foot we found a large piece of charcoal covered with limestone, of which I do not think it is daring to assume, that this points to the presence of humans in days long gone by. This and a shard of turned pottery, of the same shape as is still in use nowadays, which was found at the topmost layer of the soil, are so far the only objects found, that point to an earlier presence of men.</p>

Code	Date	Description
		<p>As now the stalagmite mass had to be cleared with gunpowder and dynamite, but as it – as far as I could see – spread as a thick layer over the whole cave and the space available and, as the work continued deeper, was automatically getting narrower, we soon faced the necessity to enlarge the hole up to the back end of the cave. To this purpose we had to break out the stalagmite breccia, which spanned almost over the complete width of the cave and was lying as a mass extending up to 1 m inward with a thickness of 70 cm on top of the earth and it now turned out too that this so far neglected breccia, except for both sharp and rounded pieces of limestone also contained andesite pebbles and terrestrial snails, and also a large number of teeth and some fragments of bones of several mammals. Also within the platelike pedestals of the dripstone columns in the back part of the cave these were numerous and in particular the soil underneath was extremely rich of these remains.</p> <p>So on the 17th of August 1888 for the first time remains of a fossil cave fauna had been found, as far as I know, for the first time in the Dutch Indies. That the objects found were truly fossil was apparent from the state in which they were found: a stone-like hardness, a partial translucency sometimes, and that they stick to the tongue are characteristics,</p> <p>[50-037]</p> <p>which are valued much [as evidence of fossil status], and their orientation is consistent with it.</p> <p>The work here was now continued and the earth was removed up to a maximum depth of 4 M. The wealth of fossils—predominantly molars—did not diminish. Bones cropped up only rarely, but it also became clearer and clearer what the cause of that was. Almost all bones and many roots of teeth had been gnawed on, even to such extent, that of many teeth only the crowns had remained whilst of some pipe bones only a very small piece like a bead had remained. One could clearly recognise on the roots of the teeth as well as on the bones parallel traces of the incisors of a large rodent. The suspicion was obvious, that, as in British India, also here porcupines were the culprits of this vandal's work. Their incisors and molars—the first largely still having their peculiar orange colour—were found in great amounts, from which it is apparent that these animals in earlier days, probably earlier than those from which the other remains originate, have lived in the cave in great numbers and have dug through the soil. Experiments whereby a living porcupine was offered bones resulted in completely analogous results, thereby delivering the final convincing proof that porcupines had been the destructors of the bones here. A short distance of Ngalau lida ajer is the Ngalau gundja (porcupine cave), in which even now innumerable traces of these animals are proof of their quite recent stay.</p> <p>At about 2 M. depth below the original surface there were layers of a sand-like soil (with numerous shimmers). To what extent this consists of pumice tuff I did not yet have time to examine. Below this sand-like layer of ±60 cm thickness, which in any case points to flowing water, there is another brownish clay similar to the one above that. Teeth and bones are also present in these deeper layers.</p> <p>At 3 M depth we found in the back wall of the cave a ±80 cm wide opening which, as well as the hallway of which this was the start, was completely filled with earth. After this had been removed, up to a depth of 4 M. below the original level, one got into the mentioned small hallway, which after it extended 2 M further in the direction of the inner cave turned into a similar but only partly filled up hallway more to the left and upwards.</p>

Code	Date	Description
		<p>In the latter we found many teeth, amongst which two beautiful, completely intact elephant molars, lying on top of the soil; others were excavated. With some difficulty now, this long hallway which is going down strongly, was followed for some 10 m, until it widened into a room, which though spacious, was almost filled up to the ceiling. The air supply here was so insufficient that our candles did not want to burn any more, so for the time being further research had to be ceased. Before reaching this room another interesting fact could be observed. Of two little stalactite columns the surfaces turned to each other had been like buffed and polished, as like in the English hyena caves must have happened by numerous passing by and grinding of large animals, which in earlier times, when the 4 M. thick layer of soil had not yet been deposited, therewith closing the entrance, must have lived in the cave.</p> <p>The large gathering of bones, predominantly teeth, pointing to thousands of animals, most of which large or even very large species, cannot be otherwise explained than that they are the remains of quarry which has been dragged in for many, long years by large predators, which have lived in this cave. Finding polished dripstone shapes is a surprising confirmation of that. What predators these must have been, I do not yet dare to decide. Some teeth of tigers have been found as well as of a small type of bear but I do not think to it is yet justifiable to decide that these have been the former inhabitants who brought in their quarry.</p> <p>Although the work, on which there has been insufficient supervision, has only progressed depressingly slowly, already thousands of teeth and very many fragments of bone have been found. An accurate list of species I will have to postpone until later, but I can already establish the presence of a number of species:</p> <p><i>Simia</i>, probably <i>Simia satyrus</i>, the orangutan. There are however large differences amongst the remains found. Some teeth are gigantic, larger than ever known of the largest orangutans, others, although originating from an old animal, are only mediocre in size. Also the shape varies much,</p> <p><i>Hylobates</i>, likely of more than one species,</p> <p><i>Semnopithecus</i>,</p> <p><i>Macacus</i>,</p> <p><i>Cercocebus</i>,</p> <p><i>Felis</i>, of a tiger and maybe also of a smaller species,</p> <p><i>Elephas</i>, probably two species,</p> <p><i>Rhinoceros</i>,</p> <p><i>Tapirus</i>,</p> <p><i>Sus</i>, probably more than one species,</p> <p><i>Bos</i> or <i>Bubalus</i>,</p> <p><i>Cervus</i>, probably distinguishable species,</p> <p>other ruminants,</p> <p><i>Hystrix</i>,</p> <p>other rodents.</p> <p>Although before establishing well-founded conclusions with regard to the right time and the condition of the land, when all these animals were living here, it would be good to await further results, one can however already assume that their presence implies the existence of enormous forests, which are currently completely absent.</p> <p>In particular the numerous presence of orangutan, of which we now have already dug up about 600 teeth, point to completely different circumstances than are currently here. As this animal exclusively seems to live in swampy jungles one has to assume that these were formerly here in the vicinity of the cave and it cannot but be that the whole flat of Payakumbuh, which is now built-up and densely populated must have been covered with one forest.</p>

Code	Date	Description
		<p>The orangutan is currently on Sumatra only known from the swampy forests of Tapanulie and Aceh, but its large distribution on Borneo and its presence in northwest India during the Pliocene, already raised the suspicion, that the distribution of this species in earlier times must have been much wider. These finds are now a pleasing confirmation of that. Should it moreover turn out, that truly amongst the species found, next to the common orangutan, there are also remains of related species, this would herewith become a fact of higher significance. I allow myself to also in this respect refer to my earlier mentioned essay.</p> <p>Although about these and other fossils still little can be said with certainty, the suspicion will yet not be unfounded, that amongst the species that are still living today, also some extinct or new species will be found.</p> <p>[50-039]</p> <p>In any case it has now been proven that there are truly fossils to be found in the caves of the Dutch Indies. With limited means, one [of them] has now been examined, albeit only partially, and was shown to be relatively richer than most of the known bone caves.</p> <p>A preliminary research of other caves learned that its content originates from a very old time. At 200 M. distance of the <i>Ngalau lida ajer</i> and at the same height in the same mountain lies the earlier already mentioned <i>Ngalau gundja</i>. In a beautiful chamber of this cave I had an incision made in the soil that forms the floor of it. In it at a depth of 75 cM a rather horizontal layer of pumice tuff of 80–90 cM thickness was found, under which there was a reddish-brown clay similar to that which currently forms the surface.</p> <p>In the same mountain slightly below the top at about 300 M. height above the valley lies a natural pit of ± 15 M. depth. This pit widens below to a beautiful cave and in the corner of this cave, almost directly below the surface of a very thin layer of clay, a layer of pumice tuff of about $\frac{1}{2}$ M. thickness was found.</p> <p>This pumice tuff, which must have been deposited here in a time when the terrain was completely different with regard to heights and, one can assume, as Dupont did for the Belgian caves, that these layers have been deposited here at the same time as those outside, and therefore these pumice tuff layers must be as old as for instance those present in the Payakumbuh-valley, which Verbeek presumes to have a diluvial character.</p> <p>From these facts one can, not without reason, hope that a research on a larger scale of the caves that are so immensely abundant in the Padang Highlands of which I was only granted to visit a few, may bring forth more shining results than cave research has delivered anywhere else in the world.</p> <p>Payakumbuh, 15 October 1888 Eug Dubois.</p>
50-039 50-040	6 June 1889 [monthly report May]	<p>Short overview of the work done for the palaeontological research on Sumatra's West Coast during the month of May 1889</p> <p>Arriving in Bua on 3 May, the first thing to do was to arrange quarters for the forced labourers, so we could not leave before the 7th on our journey to the <i>Ngalau saribu mountains</i> to visit a number of the caves known to the natives as well as possibly find others. With the help of guides, who constantly had to be changed by others, acquainted with other parts of the jungle, we got an overview of the aforementioned mountains between Bua and Sidjunjung and I could form an opinion about the nature of the terrain and the location of the caves.</p>

Code	Date	Description
		<p>This terrain turned out to pose many difficulties for eventual working in caves, both by its remoteness and the extremely difficult traffic with inhabited areas as well as because of the colossal <i>rimbu</i> [dense forest], with which it is covered everywhere. Some points closer to the roads or the larger rivers were found more suitable in this respect. In general the number of visited and useful caves was much less than the name of the mountains would suggest. Some natives assured that the name in fact was <i>Gunung saribu</i>, after the great abundance of tops, out of which this range is composed. Furthermore it is custom in this area to call every overhanging rock, without any trace of a true cave, <i>ngalau</i> and finally in the thick <i>rimbu</i> it is difficult to find caves, even for the natives, who within the forest always follow the same paths. The time of <i>puasa</i> [lent], in which this journey took place, was also not favourably timed; the indolence of the natives is then particularly large.</p> <p>After returning on 18 May, I soon made another trip to the northern part of the Ngalau saribu mountains and to the limestone mountains west of Bua. Over there were also a relatively few number of caves suitable to be opened up and as there was nothing else to expect, than that in such an expansive terrain of limestone mountains, caves—as everywhere else—should be abundant and they were here only more difficult to find and less well known, I now decided to have the work started at two points and from these two points slowly track down new caves myself.</p> <p>[50-040]</p> <p>On the 23rd, 21 forced labourers under the supervision of the engineer workman Franke were directed to Sibalen where the <i>Ngalau kapala sawah liat</i> because of its location in the vicinity of a navigable river and because of its nature could without great difficulty with a chance of success be opened, whilst the remaining forced labourers with the engineer workman van de Nesse were put to work in the well-known cave of Bua—<i>Ngalau bateng pangean</i>. The first-mentioned cave is an about 30 M. deep wide corridor with a largely flat earthen floor, at ± 1 KM of the right bank of the Bateng sumpur; it is completely dry.</p> <p>The cave of Bua, through which the Bateng pangean flows, only has a relatively small dry spot, which however is a higher positioned corridor to the side, which makes it not improbable, that it is an older part, from the time when the Bateng Pangean did not have its current route through the cave.</p> <p>After at both locations barracks for the forced labourers and the engineer workmen had been erected, at 1 June excavations could make a start.</p>
50-040 50-047 50-048	30 July 1889 [monthly report June]	<p>Short overview of the work done for the palaeontological research at Sumatra's West Coast during the month of June 1889.</p> <p>The <i>Ngalau kapala sawah liat</i> or <i>Ng pandjang</i> near Sibalin turned out upon accurate inspection to have a length of 45 M and a corridor going from north to south with an average width of 5 M; only at the entrance and at about a depth of 30 M is it somewhat widened to form a chamber (respectively 8.50 and 10 M). One cannot actually say the cave ends but rather that it is not further accessible; in truth it continues with small openings further into the mountain and old Malay people are sure that the mountain is completely pierced through and that the connection to the other side is only broken by a cave-in. Going through it and the gentle rise of the floor inwards confirms what the examination of the floor suggested: that this once was the route along which water flowed from the other side of the mountain to this side.</p> <p>We now started excavating at three different points, 10 M apart from each other and we found thereby almost completely similar layers of soil. As we went deeper these soon turned out to be of such nature, that all workforce had to be brought together to one point and therefore after 10 days all the available forced labourers were put to work in the widened part.</p>

Code	Date	Description
		<p>[50-047]</p> <p>The layers we encountered were here: 0.30 M yellow clay. Further down the cave this was covered with a 0.25 M thick widely extended dripstone plate [speleothem]. Next was a very hard mass, a conglomerate of pebbles of different sizes, gravel and pieces of limestone, with here and there thin layers of sand interspersed with very hard clay, and locally sometimes thin layers of dripstone. This reached a thickness of 2–3 M. Next to that on some parts we already hit rock bottom, otherwise yellow clay which mainly expanded far into a small hollow left of the entrance. This corridor is shaped like a small hollow starting at a depth of 4.75 M and continuing in a diagonal southeast direction into the mountain. Whilst in the clay at the surface only a few incisors of the common porcupine were found, apparently of rather recent date, more bones were found in this deep clay, of which a greater age cannot be doubted. In the mentioned small hollow a number of bones, predominantly of rodents and bats were found. An important find however was done on 30 June at a depth of 3.75 M in the middle of the chamber at the entrance, being the humerus of a species of Rhinoceros, which judging from the size of the bone was significantly larger than the current Sumatran species. Further identification of the species, as well as of the animals, to which the smaller bones belong, will have to be postponed for the moment because of the lack of material for comparison; it is however not unlikely that this rhinoceros is closely related or identical to the species which is currently living in the mainland of India.</p> <p>The cave of Bua, <i>Ngalau batang pangian</i> already had to be abandoned after 12 days, because on average 30–40% of the workmen were suffering there from fevers. They were therefore put to work in the cave that I had meanwhile visited <i>Ngalau monsiu</i> (= gunpowder cave, named for the saltpetre, which the Malay people used to prepare out of the excrements of the bats that were found in there). It is located at 4 paal [\pm 5 km] distance of Bua on the opposite side of the Sinamar-river in the Gugung andjieng. It is a very deep cave; its main corridor is estimated to be 150–200 m long. It is connected to a cave at a lower level, through which the Batang Janki flows and it surely at one point was itself the conduct for this or some other river.</p> <p>We started excavating here close to the entrance on 15 June and we found a 0.50 M layer of sand lithified by impregnation with chalk, 1.60 M yellow loam, 0.20 [M] conglomerate of silicates and pieces of limestone; all deposited in horizontal layers, apparent water deposits. In the loam a few molars of a species of pig, a few incisors of the common porcupine and two molars of a deer were found.</p> <p>We excavated yet at another point in the cave and there we met with</p> <p>[50-048]</p> <p>about the same layers, it is just that here on the surface there were still blocks of a similar conglomerate to that further up the cave. Animal remains were not found.</p> <p>I continued tracking down other caves, without however finding many like <i>Ngalau bulan</i> near Sibalen and the <i>Ngalau bandar</i> near Bua, that were suitable to be opened.</p> <p>Having received information, that near Muara (subdepartment Sidungjung) years ago, whilst looking for gold, many bones had been found in the <i>Ngalau tambang sa puluk</i>, I started out on the 26th to travel there in the company of an old Malay, who used to wash gold there and claimed to know the way there very well. Three days long we have been looking with full effort for this palaeontological goldmine, without having any success in the thick <i>rimbu</i>, where every trace of a previous road had been eradicated. A test to examine the cave of <i>Muka-muka</i> near Muara was unsuccessful, because the workmen were suffering too much from fevers.</p>

Code	Date	Description
50-048	23 August 1889 [monthly report July]	<p>Short overview of the work done for the palaeontological research at Sumatra's West Coast during the month of July 1889.</p> <p>After it had become apparent that the <i>Ngalau mansiu</i> on the opposite side of the Sinamar River was not yielding any fossils the work there was abandoned and excavations were started in the [in pencil: 15 July] <i>Ngalau bandar</i> (also known as <i>Ngalau batang chiparok</i>). This cave thanks its name to a <i>bandar</i> = water conduit which transports water from the Bateng Sangtei to the sawahs. It is a small and shallow only about 8 m deep cave, which just like the <i>Ngalau mansiu</i> is located in the Gunung andjeng, at the right bank of the Bateng Sangtei, about 12 M. above the river bed of this mountain stream. Particularly at the back, at its deepest half, it is very low, because a strong erosion mainly affected the ceiling, with the result that the more spacious hollow of the cave has in earlier days become largely filled up with large and small rocks and gravel. The floor therefore also—apart from a very shallow surface layer—up to the largest excavated depth (of 2 M) almost completely consisted of limestone blocks that had fallen out of the ceiling and which, only with very little soil, had connected to a moderately vast and hard breccia. Completely at the surface underneath only a few centimetres of loose clay there was a 15 cm thick layer of wood ashes, in which shards of pottery of more recent shapes appeared as well as some bones of the common goat and larger birds, of which some were clearly carrying the marks of being cut with a knife, proving the cave has been in use by men and the important thickness of the ash layer makes us assume that for a number of years this cave has been inhabited and used up to recently as a temporary or permanent stay, probably for Malay people.</p> <p>Up to the end of this month the limestone breccia did not deliver many bones. Just a few teeth of pigs, deer and porcupines and of a tiger, were found, next to the remains of bats.</p> <p>In the <i>Ngalau pandjang</i> near Sibalin work was continued up to a maximum depth of 8 M. where rock bottom of the cave was reached. Underneath the yellow clay that was reached last month, locally a layer of gravel impregnated with chalk was found, which was resting at the bottom of the cave. Fossils of any importance were not found, with the exception of a plastron of tortoise, which however upon removing the hardened clay mass by carelessness of the workmen was broken in many pieces.</p> <p>The relatively low amount of fossils in this cave, as in that of <i>Ngalau mansiu</i> and in the caves I examined earlier near Balei-pandjang (L Kota), which at best only delivered a few scattered bones or fragments, seems with certainty to be explained by the fact that these caves, only have been dry for short intermittent periods, and during their existence up to recent times have had a brook running its course through them (as is still the case in many caves).</p> <p>In general it seems that the presence of animal remains in caves of Sumatra, as far as the origin is concerned, leads to another conclusion than is the case in Europe. Equally to what research in the Karnul caves in tropical British India seems to have taught us, here, much less than in Europe, where the ice age has had its direct influence, water seems not to have played such an important role in transporting bones into the caves, but a rather more important role, however, was played by large predators. Important stashes of diluvial fossils here will likely only have been brought about that way.</p> <p>What role men might have played in that respect is still unclear as, with the exception of the peculiar human skull found in Kediri and the manmade stone object I found in <i>Ngalau lida ajer</i> near Payakumbuh, as far as is known to me, in no cave of the archipelago have traces of prehistoric man ever been discovered. –</p> <p>Since 20 July <i>Ngalau pandjang</i>, where we have now reached the bottom, was abandoned and the men were put at work at close distance in the <i>Ngalau bulan</i> (also called <i>Ngalau pandjang</i> too) which apart from some molars of pigs close to the surface in the loose black earth and some bones of little bats did not bring anything of importance.</p>

Code	Date	Description
		<p>Because of being indisposed I was not able to continue tracking down new caves during the larger part of this month. A Kampong chief however informed me about the existence of some so far unknown caves near Tapi-Sello and in one of these, the <i>Ngalau Jambu</i>, on 31 July the Kampong chief together with one of the forced labourers, who was already more able in finding fossils, brought from there a great many teeth. They are of the same species, and in the same relative numbers towards each other and in the same state of conservation as those I found earlier in <i>Ngalau Lida ajer</i>, near Payakumbuh; many teeth of pigs and of orangutan, further tapirs, rhinoceroses, elephants, deer, buffaloes, lower monkeys and porcupines are also here in abundance.</p>
50-049	8 September 1889 [monthly report August]	<p>Short overview of the work done for the palaeontological research at Sumatra's West Coast during the month of August 1889.</p> <p>In the <i>Ngalau bandar</i> (<i>Ngalau batang chiparok</i>) near Bua work was continued. The sediment found, a breccia of limestone mixed with only very little soil, not hard enough to be fruitfully removed with dynamite, but then again so hard that removing it with ordinary tools results in very slow progress, which was partly the cause that this month we only reached a maximal depth of 2.75 M. The bones found were few in number and mostly small and broken into unidentifiable fragments, by the way apparently from the same animal species as we used to find before.</p> <p>Also the <i>Ngalau bulan</i> (<i>Ngalau pandjang II</i>) near Sibalín did not bring anything peculiar. Although rather many bones were found in the top, 0.60 M thick layer of loose black earth, these were also almost all broken into such tiny parts, that for most of them (at least for the time being) there can be no thought of having them identified. Most seem to be originating from small animals and must, after predators brought them in, have been shattered by porcupines whilst digging through the earth. They are however no big loss, as they are without doubt bones of a recent date.</p> <p>Upon further digging we came into 1.15 M of yellow clay, which at greater depth turns into a fine gravel. This yellow clay did contain some teeth of the ordinary wild pig (<i>Sus vittatus</i>), of the tapir (<i>Tapirus indicus</i>) and of the ordinary Karo (<i>Cercopithecus cynomolgus</i>), and a few bones of the Kidjang (<i>Cervulus muntjac</i>), all species still living today.</p> <p>More important results were almost immediately obtained in the <i>Ngalau Jambu</i> near Tapi-Sello. This cave is located at a short distance [thereof], north of the old little volcano Kuliet-monies, West of the brook Muara-panas, close to the top of the limestone mountain. It comprises two rather spacious chambers, which are in connection to each other by a high narrow opening. The front chamber is open to the outside and receives full daylight. Its floor entirely consists of heavy limestone blocks that have fallen from the ceiling. The inner chamber is completely devoid of daylight, it contains a few similar rocks like in the front chamber but in between the floor is flat and covered with an up to 0.50 cM. thick layer of earth.</p> <p>Already in this dark red soil, which is of the same kind as is covering the old slate layers everywhere in this area, a great many teeth were found, which, as I already had the opportunity to note in my previous report, originated from the same species, and at about in the same ratio and the same state of conservation as those which were collected earlier in <i>Ngalau lida ajer</i> near Payakumbuh. Underneath this layer we had a very irregular stalagmite mass which partly enveloped limestone blocks and which was followed to a maximum depth of 1.80 M. In its upper part there were still similar fossils present as in the red earth; further down these were completely lacking. We yet continued removing this mass, as there was the possibility that it was covering a deeper fossil-bearing layer or other soil.</p>

Code	Date	Description
50-049 50-050	17 October 1889 [monthly report September]	<p>Brief overview of the palaeontological research on Sumatra's West Coast during the month September 1889.</p> <p>Also in this month the excavation of the <i>Ngalau bandar</i> (<i>batang chiparok</i>) was continued; the work however was progressing slowly both because of the nature of the stony mass that had to be removed as well as the large number of forced labourers suffering from fever. In the earlier described breccia we found yet a very few more</p> <p>[50-050]</p> <p>teeth of the ordinary wild hog (<i>Sus vittatus</i>) of the tapir (<i>Tapirus indicus</i>), the deer (<i>Cervus equinus</i>), the forest goat (<i>Antilope sumatrensis</i>) and the porcupine (<i>Hystrix mülleri</i>) all animals still present here today. Underneath the breccia we finally at 3.50 M found a brownish-red clay, of which we by the end of September had only removed a few centimetres.</p> <p>In the <i>Ngalau Bulan</i> near Sibalín no fossils were found this month. Underneath the deepest layer of fine gravel we found in the previous month, which had a thickness of 30 to 40 cm, we found again a darkish yellow clay earth which we followed up to a depth of more than 5 m without finding anything important. This result and even more so the strong increase of fever amongst the workmen in this moist cave (up to 50% of the number of forced labourers was suffering from fevers) make me decide to quit the work here and start on 1 October in a meanwhile discovered cave at a short distance from the <i>dusun</i> Sibalín. This cave, of which the local name is not known to me, is located in the same valley at the right bank of the Sumpur as the other caves examined here so far, ± 40 m above the floor of it and consists of a 150-m long corridor with an average width of 7 m whilst its yellowish clay floor is rather even and almost horizontal.</p> <p>Also in the <i>Ngalau Jambu</i> near the Tapi Sello excavations were ceased by the end of the month, after a depth of almost 3 m a solid rock mass was encountered and therefore the bottom of the cave had been reached. No more fossils had been found. The forced labourers who became available were added to the ones working in the <i>Ngalau bandar</i>.</p> <p>Some Malay, who claimed that whilst searching for gold they had found huge bones some years ago in a deep pit, the <i>Ngalau lebawah</i> near Sisawah accompanied me there at the start of the month. On the right side of the road to the <i>dusun</i> Kabun, a few hours away from d.s. on top of a mountain ridge, this cave, which is a natural pit in which I climbed down along a rattan ladder for 28 M. until I had reached its apparent floor; along a sideways crevice I could, from resting place to resting place, on rocks pointing out, climb down a further 25–30 M. until I had reached its true floor. In there was like a very small bowl, in which there was hardly room for two people, but on the floor $\pm \frac{1}{2}$ M. of fine gravel mixed with earth, which looked very much tossed over and on top of it was a truly large bone, a thighbone, of which both the distal ends were missing and that turned out to be of an elephant. It had completely calcified, was very heavy and partly covered with a dripstone layer; there can be no doubt about its great age and fossil state, but lacking material for comparison it can for the time being not be ascertained as to which species of elephant it belongs; it is surely not of any other family than <i>Elephas</i>. Other remains were not found here although they might yet have been present in higher layers of earth (the top floor) of this pit; it is probably yet likely that this animal has fallen down this pit alive (like the complete Rhinoceros skeleton found in the Dream-cave near Wirksworth in England, who had fallen in the cave similarly). Quick attempts to find these gave no results and for a systematic exploration this cave is unsuitable given its location on a mountain ridge hours away from any <i>kampung</i> and drinking water. So here we experienced again to what extent the terrain is limiting the number of caves suitable to be opened in these areas.</p>

Code	Date	Description
50-050 50-051	8 November 1889 [monthly report October]	<p>Short overview of the palaeontological research at Sumatra's West Coast, during the month October 1889.</p> <p>The brownish-red clay which we encountered by the end of the previous month in the Ng. bandar at a depth of 3.50 M turned out to be mixed with small pieces of limestone for 0.60 M until we encountered for 0.50 M. Pure clay and finally 1 M. clayish quartz sand (originating from weathered Tertiary conglomerates); so now we have reached at a total depth of 5.60 M. below the original surface floor the bottom of the cave. No more bones had been found and looking for them came to an unexpected end. It had already been noted lately that small cracks had appeared in the ceiling and when these started to increase I had the work stopped. Happily in time, for soon after a large part of the ceiling collapsed (some hundreds of cubic metres). Thus work that had taken a long time remained fruitless.</p> <p>As meanwhile the attempts to find suitable caves in the mountain range near Tandjung Banei had failed and no others were known to me, the forced labourers that had become available here were also put to work in the large cave at Sisawah.</p> <p>This cave turned out to be the earlier southern extension of the <i>Ngalau pandjang</i> (<i>Ngalau kapala sawah luat</i>), with which it was connected by a narrow passage, which now could be slightly widened.</p> <p>[50-051]</p> <p>The entrance of the cave is located 20 M. above the valley floor (erroneously in the previous report it was stated to be 40 m) and it is facing Southward; it consists of 150-m long corridor in north-northwest direction, which is on average 6–8 m wide, but at the end widens to a 40-m long and in the middle 20-m wide chamber.</p> <p>It's smooth and almost horizontal floor consists of a thick layer of chalk tuff, which at some spots is absent. Only near the entrance (up to 15–20 M), this column mass is missing and the floor consists of a surface 2 m further down of yellow clay.</p> <p>Excavations were started at two points; [first] near the entrance, and here by the end of October they had reached a depth of 3.50 M, while the soil remained to be the same clay. An excavation was further started at 30 m distance from the entrance where they encountered: 1.35 m chalktuff, a 0.30 M. Breccia of small limestone parts and fine quartz gravel, baked together by the hard chalk tuff, 20 cm fine gravel mixed with clay and finally (at 1.85 M.) yellow clay. Fossils had not been found by the end of October.</p>
50-051 50-044 50-045	2 December 1889 [monthly report November]	<p>Brief overview of the palaeontological research on Sumatra's West Coast during the month November 1889.</p> <p>In the south extension of the <i>Ngalau pandjang</i> near Sisawah teeth and bones were found in the yellow clay next to the entrance at a depth between 4.20 M. and 5.50 M. The latter however were in such bad state of conservation that the main part of them consisted of mere fragments which for the time being cannot be identified. They chiefly originate from elephant, rhinoceros, tapir, pig, porcupine (<i>Hystrix</i>) and the orangutan (<i>S. satyrus</i>), so represent the same species, of which the existence also became apparent in other caves that have been examined.</p> <p>The geological age of these fossils cannot rightly be ascertained and can only somewhat be established by comparison with others. The greatest depth by the end of November was 5.75 m. From 4.50 m down the yellow clay of earlier was found to be strongly mixed with a moderately fine gravel delivered by weathering of tertiary conglomerate.</p> <p>The hole we dug at 30 M. distance of the entrance of the cave with the size of 6.50 m by 5.50 m delivered the following profile starting from the top: 1.35 chalktuff, 0.30 breccia of limestone pieces</p> <p>[50-044]</p> <p>and fine quartz gravel baked together by chalk tuff, 0.20 M. fine gravel mixed with clay; underneath this—in total 1.85 M. thick—top layer, the same yellow clay was found as near the entrance, at 2.75 the bottom of the cave was found, which only along its east wall was covered with a maximally 0.75 M. thick layer of stones.</p> <p>It was regrettable that the mentioned clay did not contain any fossils, as especially here one could have expected, underneath the strong limestone coverage that they would have conserved well by calcification.</p>

Code	Date	Description
		<p>At a short distance from the southern <i>Ngalau pandjang</i> and completely at the same height a small hole found in the rocks at the east side of the valley was further examined. Although it was only 0.80 M long and 0.60 M. high, it seems to be the remains of an earlier cave which had become filled up in later times with pointy limestone pieces and boulders glued together to a conglomerate by the chalk. After this conglomerate breccia was broken away to the west the entrance of a small cave opened up, however only 3 m wide and 1.80 m high. Against the ceiling a 25 cm thick layer of hardened clay had remained which contained a number of teeth and some bones, most of which had completely calcified. By further breaking away of the mentioned stone mass we could finally enter up to 20 m deep, where the cave seems to end, after it had widened but it remained as low as near the entrance.</p> <p>The teeth and bones originated from a Rhinoceros, a Tapir, a kind of buffalo (<i>Bos</i>), a deer (<i>Cervus</i>), one or more species of pig (<i>Sus</i>), the orangutan (<i>Simia</i>) and a common Karo-monkey (<i>Cercopithecus</i>) or some species closely related to that; so here yet again the same company we found everywhere. This is now however of great significance and confirms again the great age of this fauna. It is namely a peculiar phenomenon that here at a height of about 20 M. above the floor, where both these caves are located and at many places apparently in the same horizon crevices in the rock can be observed which are of the same nature like for instance those along the Kuantan near Muka-Muka at the height of the water level. Surely the water must have gnawed out these crevices and is now busy depositing pebbles and gravel and clay in them. This must also have been the case for the caves we have examined. The small cave is but an extension of such a crevice and also the southern <i>Ngalau pandjang</i> shows this at the entrance.</p> <p>[50-045]</p> <p>In this valley, which now does not even have a brook any more, the water level must have been 20 m above the current valley floor, and this will certainly not have been a small brook, for the crevices can be found along the whole length of the valley and quite strongly so. The water must also have deposited the boulders, the gravel and the fossil-bearing clay and such large changes demand a very long time which contributes to the determination of a substantial age of the fossils.</p> <p>It is furthermore noteworthy, that higher up in the valley there is a rock wall in which there are three such crevices with a distance between them of 8-10 m and that the same phenomenon can be seen where the valley of the Sisawah leads in southeastern direction towards the tarata Kabun.</p> <p>Traces of such higher water levels and the rerouting of rivers are well-known phenomena and a consequence of the erosion doing its work over the whole globe, but what is noteworthy here is that these phenomena seem to have some periodicity.</p> <p>Up to 3 or four times at least the water level was able to do its erosive action for a longer time (because the formation of these crevices must have taken quite some time), after which every time an abrupt decrease of the water level took place. Note it is not completely sure whether this water, which was a river, was as far from the shore as it is now. If it turns out, that during the diluvial times as assumed by Verbeek on the west coast of Sumatra the sea was yet covering part of the current land (up to a height of 180 m) then the phenomenon observed here might be related to these changes of the sea-level and the here observed repeated rather local changes might have bearing on the work that by Inesz has been turned into a <i>question coulante</i> on the changes of the beach lines and the borders between sea and land and may be of no little significance. But this is only a suspicion, which I however not thought I should keep quiet, because the observed phenomena might deserve further investigation at other locations.</p> <p>[In left margin rewrite:]</p> <p>Should it turn out, that the drop, which Verbeek assumes for the west coast of Sumatra during diluvial times also expands towards the eastern shores, then the phenomenon observed here might be related to the changes in the level of the sea,—</p>

Code	Date	Description
50-051	23 January 1890 [monthly report December]	<p>Short overview of the palaeontological research at Sumatra's West Coast during the month December 1889.</p> <p>Already at the start of the month the fossils in the southern extension of the <i>Ngalau pandjang</i> near Sisawah were getting scarce, such that it was soon to be expected that further work would be fruitless. The little cave close by was already abandoned for the same reasons.</p> <p>As there soon would be no more caves within the vicinity of Bua suitable for the purpose and as currently the terrains of the lake of Singkarah seem to be the most rewarding, a proposition was made to your Noble severe Sir to have the work transferred to that area. Meanwhile the work had to cease earlier than expected because already on the 5th we hit in the <i>Ngalau pandjang</i> on large boulders and subsequently on the bottom of the cave and I thought it wise not to lose any time even though your Noble severe Sir had not yet officially transferred me to Singkarah I transferred the whole operation there to be able to continue the work as soon as possible.</p> <p>On the 11th we started with exploring for caves starting firstly in the vicinity of Paningahan, where the most appeared to be, whilst the distance to Singkarah is relatively small. Only a few of the caves we visited with the help of guides turned out to be suitable; the famous cave of Paningahan (along the road from the pasar to the coffee storage) the least of all, as this cave is only 20 M. above the current water level of the lake and there are clear signs everywhere on several spots, that the level in recent times must have been at least 70 M. higher than it currently is.</p> <p>On the 20th the workmen were divided over two caves higher up; half of them were put at work at the <i>Ngalau siba bantu</i> ±120 M. above the lake on the bank of the Paningahan-brook, the other half in the <i>Ngalau pala pisang</i> ±250 M. above the lake on the left bank of the Bateng Paningahan. In the first cave we first had to remove a heavy rock, which was partly blocking the entrance, with dynamite, with which [task] they had not yet finished by the end of December. In the <i>Ngalau pala pisang</i> we encountered near the entrance a yellow clay mixed with pieces of limestone of which up to 1.50 M. was removed; further down at about 15 M. from the entrance inward in a spacious room bat guano was removed up to a depth of 2 M.</p>
50-045	8 February 1890 [monthly report January]	<p>Short overview of the palaeontological research at Sumatra's West Coast during the month of January 1890.</p> <p>On 20 January the <i>Ngalau pala pisang</i> near Paningahan was already abandoned, after the solid rock floor of the cave had been reached near the entrance without finding any fossils, whilst in the deeper 'hall' because of the meanwhile started heavy rains so much water had entered that working there became completely impossible. Not that there was much to look forward to for reward. The bat guano was reaching at least to a depth of 4 M. and the rock walls were converging in such a way, that the floor would soon have been reached.</p> <p>This <i>Ngalau pala pisang</i> is therefore one of the few caves that did not contain any mammal remains at all.</p> <p>Near to this cave in the ravine of the Batang Paningahan we found a hole in the rocks, too narrow to crawl in, which however after being widened, turned out to be the remainder of an old cave. In the yellow earth which was completely filling the space underneath a hanging dripstone a number of teeth were found of the already so often encountered Lida-ajer fauna. The yellow earth was covering river sand that had been hardened by impregnation of limestone, which therefore must be younger than the deposits of this sand by the Paningahan that is currently incised 25 m lower.</p> <p>The <i>Ngalau si babantu</i>, a beautiful small cave delivered a considerable amount of such remains like this hole in the rocks. After removing limestone blocks the black earth was dug through to a depth of 0.50 M to 1.25 M. and subsequently yellow earth, mixed with small pieces of limestone up to a depth of about 1 M. The latter contains numerous teeth, again richly representing the Lida-ajer fauna.</p>

Code	Date	Description
50-046	8 March 1890 [monthly report February]	<p>Short overview of the palaeontological research at Sumatra's West Coast during the month of February 1890.</p> <p>The small hole in the rocks in the ravine of the Batang Paningahan, which had been opened by the end of January, was already emptied at the start of this month, without the finds showing any important changes.</p> <p>The excavations in the <i>Ngalau Sibantu</i> were abandoned for the same reason. The cave did, however, still yield a rather large amount of teeth from animals which belong to the oft-mentioned Lida-ajer fauna.</p> <p>As the state of health of the personnel on this moist West side of the lake was again deteriorating and as there were no further caves at hand, the work was moved to the east side, which has a drier and more healthy climate. As usual we also had to find the caves here ourselves, but yet already on the 9th the digging could start in the <i>Ngalau agung agung</i>, about 2 paal east of the Kampong Sibrambang and on the 13th in the <i>Ngalau Sibatie</i> (Bukit Mengkapok).</p> <p>In the first our efforts were soon rewarded. After from the floor of this 11 m wide and 8 m deep cave some large dripstones which had fallen off or were growing to the floor, had been removed one could start taking out a thin layer of yellow clay ($\pm\frac{1}{2}$ M), which was covering a black soil. This black earth, of which by the end of February $2\frac{1}{2}$ M. has been dug up, was mixed with pieces of limestone and contained an immense amount of teeth and molars from the animals of the aforementioned fauna, in which now elephants and buffaloes were now more strongly represented than before. The remains of thousands of large animals must have been dragged in here and one cannot without amazement and wonder think about the rich animal life which must have once existed in an area where currently even the common Indian hog is rare.</p> <p>Contrary to that the work in the <i>Ngalau Sibatie</i>—actually 2 caves with the same name—remained without result up to the end of this month.</p>
50-046	26 March 1890 [monthly report March]	<p>March 1890.</p> <p>Halfway through this month the <i>Ngalau Sibatie</i> in the Bukit mentapok (Nagarie Sullied ajer) was completely emptied. This little cave with a depth of only 5 M and a width of 8 M contains underneath a 0.50 M. thick layer of black earth about 2.50 M. hard yellow clay mixed with smaller and larger pieces of limestone. In this breccia-like mass a few completely calcified but yet very much broken bones were found, presumably of a kind of deer.</p> <p>The <i>Ngalau agung-agung</i> near Sibrambang kept yielding a numerous amount of teeth and molars of the fauna mentioned in the previous report. However on the 25th of March at a depth of 3.50 M. below the original surface the rocky bottom was reached and as at another location within the cave up to [a depth of] 2.50 M no results of a different kind were encountered than had already been obtained, at the 26th of March this cave was also abandoned.</p>
56-142 56-144		See file Sumatra notebooks doi.org/10.6084/m9.figshare.22154882

Note: Dutch formulaic greetings, that may seem odd in English, have been translated literally, as they convey the status of the addressee; for instance, someone addressed as 'severe' has either studied law or holds a civil or military position of power.

Source: Dubois Archive, Naturalis Biodiversity Center, Leiden. The code numbers refer to those in the archive. For example, 6-310 refers to [MM774C-000006-310].

This text is taken from *Quaternary Palaeontology and Archaeology of Sumatra*, edited by Julien Louys, Paul C.H. Albers and Alexandra A.E. van der Geer, published 2024 by ANU Press, The Australian National University, Canberra, Australia.

doi.org/10.22459/TA56.2024.02