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Stone implements from Java and Flores: A history of the discoveries

Les outils de pierre de Java et de Florès : histoire des découvertes

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ABSTRACT

In 1970, Verhoeven and Maringer found stone implements on the surface of Mengeruda (an area including the sites Boaleza, Lembahmenge and Matamenge) and Ola Bula on Flores, which were similar to those found in Sangiran by von Koenigswald and Ghosh on Java. This, among other things, led von Koenigswald and Ghosh to compare the findings from Flores with those from Java, the Ngebung site. They thought that the *Stegodon* fossil from Mengeruda was the same species as the one from Java and, therefore, of a similar age. von Koenigswald and Ghosh were the first to accept that the artefact findings of Flores were *in situ*. They drew the right conclusions regarding the crossing to Flores by *Homo erectus*. And their ideas have now, almost 40 years later, been confirmed by the find of *Homo floresiensis* on Flores.

Mots clés :
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Ola Bula (Florès)
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RÉSUMÉ

En 1970, Verhoeven et Maringer découvraient des outils de pierre en surface à Mengeruda (une aire géographique incluant les sites de Boaleza, Lembahmenge et Matamenge), et à Ola Bula sur l'île de Florès, similaires à ceux découverts à Sangiran sur l'île de Java par von Koenigswald et Ghosh. Cela conduisit von Koenigswald et Ghosh à comparer les découvertes de Florès avec celles de Java, provenant du site de Ngebung. Ils considéraient que le *Stegodon* fossile de Mengeruda de Florès appartenait à la même espèce que celle présente à Java, et en déduisirent que les sites étaient de même âge. von Koenigswald et Ghosh furent les premiers à reconnaître que les artéfacts de Florès avaient été découverts *in situ*. Ils en tirèrent les bonnes conclusions quant à la traversée vers Florès d'*Homo erectus*. Quarante ans plus tard, leurs idées étaient confirmées par la découverte de *Homo floresiensis* sur cette île.

1. Introduction

The Sangiran area is located 12 km north of Surakarta City, central Java, at about 7.5° S latitude and 110.8° E longitude. The area, which is 8 km from north to south and

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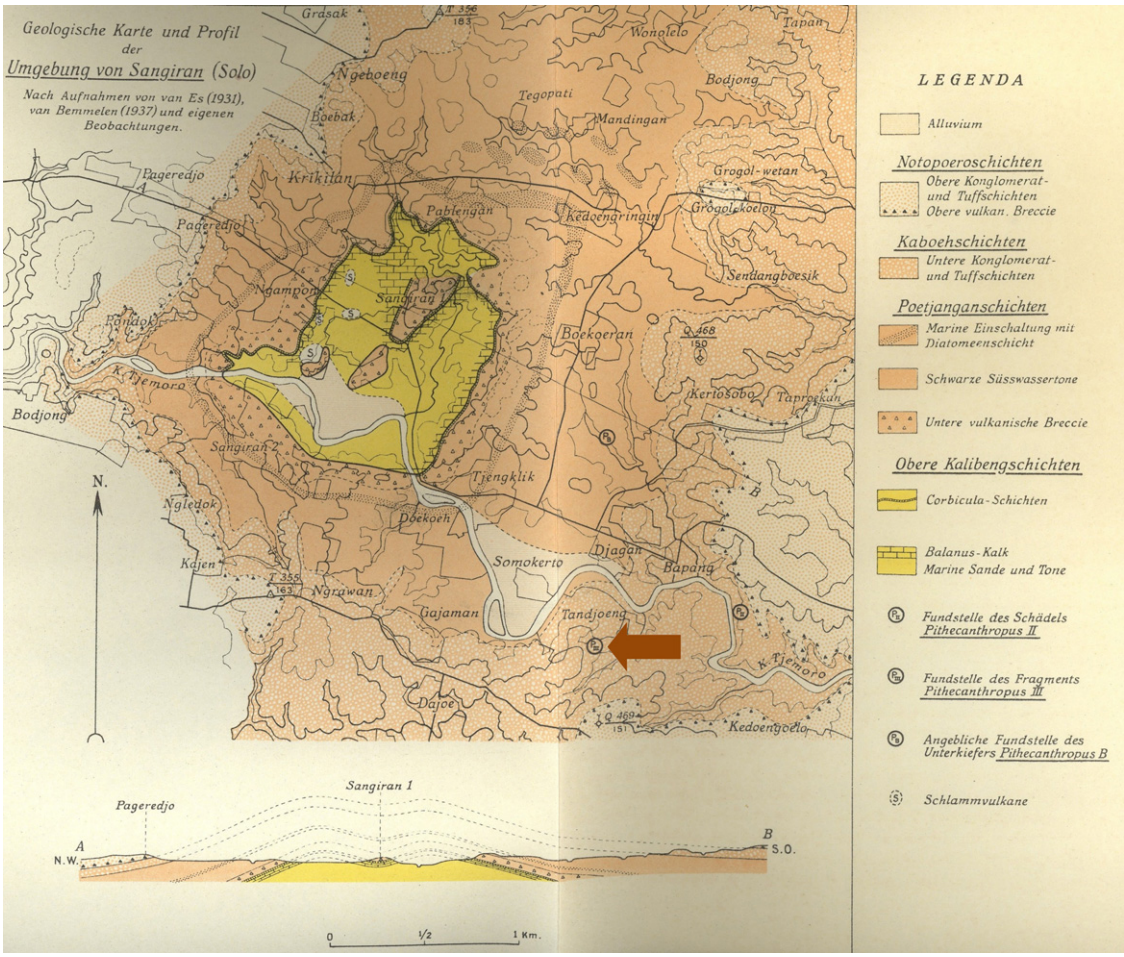

Fig. 1. Geological map and profile of the area around Sangiran (Java). The arrow indicates the site where *Pithecanthropus III* was found, near Kampong Tandjoeng.
Fig. 1. Carte géologique et coupe de la zone autour de Sangiran (Java). La flèche indique l'emplacement du site où fut découvert *Pithecanthropus III*, près de Kampong Tandjoeng.
Modified after von Koenigswald (1940).

4 km from east to west, is characterised by a dome structure which is truncated by erosion (Duyfjes, 1936; von Koenigswald, 1934; Storm, 2001) (Fig. 1). von Koenigswald discovered stone implements in June 1934 (von Koenigswald, 1934), although von Koenigswald and Ghosh (1973) wrote that it was late 1934. The artefacts consisted of flakes and were crude, but appeared to be worked. According to von Koenigswald and Ghosh (1973), a limited excavation was subsequently carried out at Ngebung, probably in January 1935. The site that von Koenigswald and Ghosh (1973) selected for excavations was on the hill top, directly north of Kampong Ngebung (Kampong is the Indonesian word for village or a settlement smaller than a town) and covered by a conglomerate. This excavation yielded 123 lithic specimens (von Koenigswald and Ghosh, 1973) and tektites (von Koenigswald, 1935). Some specimens belonging to the industry from Sangiran were figured for the first time in 1939 (von Koenigswald, 1939, p. 42, Fig. 3) (Fig. 2), and van Heekeren (1957, p. 15) illustrated some other specimens.

According to von Koenigswald (1939, p. 42), the artefacts originated from the upper part of the profile, whereas the fossils came from lower levels. However, in 1973 von Koenigswald and Ghosh (1973) stated that some remains of *Axis lydekkeri* and *Stegodon trigonocephalus* were also found during the excavation. von Koenigswald considered *A. lydekkeri* and *S. trigonocephalus* to be guide fossils for the Trinil fauna, where *Pithecanthropus erectus* (now considered a member of the genus *Homo*) was found.

According to von Koenigswald and Ghosh (1973), a fragmentary skull of *Homo erectus, Pithecanthropus III* was found at Ngebung in 1938. However, in 1940, von Koenigswald had written and indicated on a map (von Koenigswald, 1940, p. 102) that the skull fragments from *Pithecanthropus III* were surface finds and were coming from the Kampong Tandjoeng (indicated with an arrow in

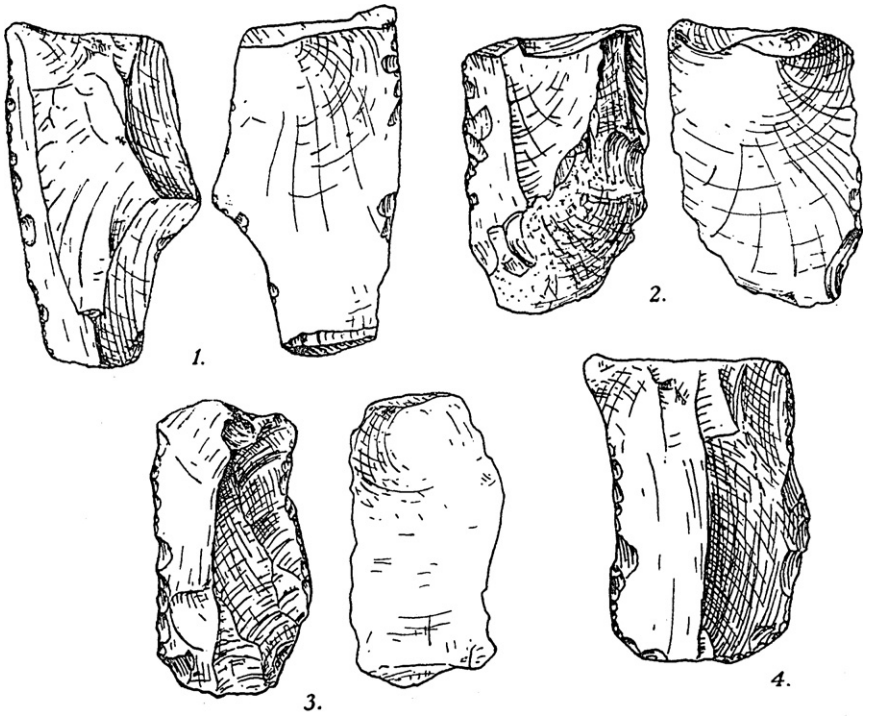

Fig. 2. The artefacts from Sangiran (Java) as figured by von Koenigswald (1939, p. 42, figure 3).
Fig. 2. Les artéfacts de Sangiran (Java) tels qu'ils ont été figurés par von Koenigswald (1939, p. 42, figure 3).

Fig. 1), which is situated southeast of Ngebung at the other side of the Sangiran dome.

In 1970, Verhoeven and Maringer found crude flakes on the surface of Mengeruda (an area including the sites Boaleza, Lembahmenge and Matamenge) and Ola Bula on Flores (Fig. 3), which were typologically similar to those found in Sangiran. This, together with a *Stegodon* find and a tektite, led von Koenigswald and Ghosh (1973) to compare these findings with those of Ngebung. In their 1973 paper, von Koenigswald and Ghosh described the stone implements from Ngebung, Sangiran, as surface finds, and also mentioned the surface finds of tektites, both coming from the so called Trinil Beds of Sangiran. They considered the *Stegodon* fossil from Mengeruda to be the same species as

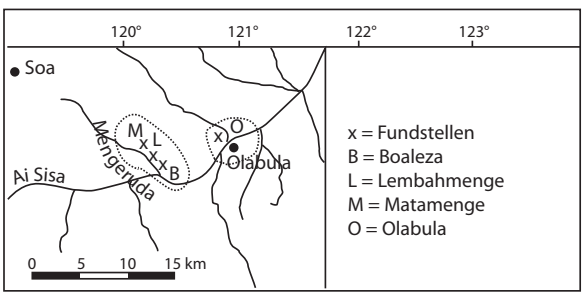

Fig. 3. Map of the area around Mengeruda and Ola Bula (Flores). The symbol x marks archaeological and palaeontological sites.
Fig. 3. Carte de la zone autour de Mengeruda et Ola Bula (Florès). Les croix marquent l'emplacement des sites archéologiques et paléontologiques.
Reproduced after Maringer and Verhoeven (1970a).

the one from Java and, therefore, estimated the two localities to be of a similar age. A tektite yielded an absolute date of 500–830 ka (von Koenigswald and Ghosh, 1973).

According to von Koenigswald and Ghosh (1973), this was additional proof indicating that in spite of criticism, the Sangiran flake industry was of Trinil age and made by *H. erectus*. They concluded that: "This study on the stone implements from the *Pithecanthropus* Beds of Sangiran shows, together with the collections made recently from the contemporaneous *Stegodon*-Beds from Flores by Maringer and Verhoeven (1970a, 1970b), that the industry from the Middle Pleistocene of Java and Flores is essentially a *flake industry* without hand axes" (italics in original). They continue: "The absolute date for the Trinil Beds can now be given as 500.000–830.000 years".

von Koenigswald and Ghosh (1973) were the first to accept that the artefact findings of Flores were *in situ*. Their publication, however, was never taken seriously because the presence of the artefacts from Flores was considered as doubtful and the tektites were not found *in situ*. So, their paper was not generally referred to by other scientists.

Since the paper of von Koenigswald and Ghosh (1973), there has been a lot of discussion concerning the age of the artefacts from Ngebung. Additionally, during new excavations on Flores artefacts from Mata Menge were found *in situ*. Now, after almost 40 years with new evidence and new methods of research, the comparison is made again. The purpose of this paper is to give a historical overview of the events concerning the Ngebung and Flores artefacts and the value of the pioneering work of von Koenigswald and Ghosh (1973).

2. The finds from Java

The Satir fauna is the oldest recognisable faunal unit on Java. This fauna has an age of between 2 Ma and 1.5 Ma and indicates island conditions (van den Bergh et al., 1996).

Fairly isolated conditions seem to have prevailed until around 0.8 Ma as suggested by the unbalanced character of the Ci Saat and Trinil faunas (van den Bergh et al., 1996). The Trinil holotype skullcap and the Sangiran skull *Pithecanthropus II* were found in levels associated with the Trinil fauna (van den Bergh et al., 1996) indicating that *H. erectus* was able to reach Java during this time interval. More recently artefacts attributed to the Sangiran flake industry were excavated from the Grenzbank between the Kabuh and Pucangan layers dating to at least 800 ka (Widianto et al., 2001).

A major faunal immigration event is represented by the Kedung Brubus faunal stage (van den Bergh et al., 1996). The mandible from Kedung Brubus and the Sangiran skull *Pithecanthropus* VIII were found in layers associated with a Kedung Brubus fauna (van den Bergh et al., 1996). The Kedung Brubus Fauna, including *H. erectus*, represents an open woodland environment and is characterised by several new arrivals from the Asian mainland, such as *Elephas, Hyaena* and *Tapirus* (van den Bergh, 1999; Sondaar, 1984; Sondaar and de Vos, 1984). There is a maximum in species diversity during this faunal stage, indicating full exchange with the Asian mainland. This period of maximum faunal exchange can be correlated with the onset at 0.8 Ma of a period of highly fluctuating, but on average lower sea levels than the Early Pleistocene (Prentice and Denton, 1988).

The date of the Ngandong fauna is uncertain. There is still an ongoing debate on the age of the Ngandong fauna (Bartstra and Basoeki, 1989; Indriati et al., 2011; Storm, 2001; Swisher et al., 1996; Yokoyama et al., 2008), but according to the present authors, the age lies between Kedung Brubus (0.8 Ma) and Punung (128 ka), as is also stated by van den Bergh et al. (1996).

von Koenigswald (1936a, 1936b) mentions finding Palaeolithic stone implements in high terraced gravels at the Ngandong site, central Java, in 1932, and discovering the first famous Sangiran flakes in 1934. The Sangiran flake industry was reported by von Koenigswald (1936a,b) as an assemblage of surface finds of small sized siliceous artefacts from sediments capping the Ngebung hills at Sangiran. Not much later, Movius (1948) described the Ngandon industry as consisting of crude and small flakes and blades with a few cores present as well, which was later confirmed by Bartstra et al. (1988). Movius (1948) observed that the Ngandong and Sangiran flakes had to be contemporaneous. Much later, von Koenigswald and Ghosh (1973) described the Sangiran flake industry, noting again that it was based on surface finds. von Koenigswald and Ghosh (1973) considered the age of the Ngebung artefacts to be Middle Pleistocene and thought that the small sized stone artefacts were manufactured by *H. erectus*. Movius (1944, p. 90; 1948, p. 354) and van Heekeren (1972), however, have never believed that the implements are of such great antiquity, and they excluded the possibility of an association with Middle Pleistocene *H. erectus*. In their opinion, the top-gravel of Ngebung forms part of the youngest sediments in Sangiran, for which they refer to the field observations of De Terra (1943, p. 446).

Soejono (1982, p. 101; 1991) found an artefact, a chopper made of metamorphic rock, at Ngebung during his 1979 excavations. It was found 150 cm from the surface and was correlated by Soejono (1982, 1991) to the Kabuh layers. This find led Soejono (1982, 1991) and Sartono (1980) to wonder whether some of the artefacts found around Ngebung could perhaps be older than previously thought by Movius (1944, 1948) and van Heekeren (1972).

Bartstra wrote a series of papers in the eighties on the Palaeolithic of Java (1983, 1985, 1989). On the stratigraphy, he says that there may be a few Trinil fossils embedded in the Ngebung gravel, but that these are clearly abraded and thus reworked (Bartstra, 1983). The layers underlying the artefact bearing gravels show volcano-sedimentary facies and were originally attributed to the Kabuh beds (Watanabe and Kadar, 1985), but to the Kabuh-Notopuro complex by Bartstra (1983, 1985) and Bartstra and Basoeki (1989). According to Bartstra (1983), the artefacts of Ngebung can be divided into three different industries based on where they are from:

- *in situ* industry coming from the Old River Gravel, mainly flakes, which seldom exceed 5 cm in length. Some of these flakes clearly show retouching, and in a few cases it is possible to distinguish scrapers, gravers and borers. Bartstra (1983) considered the *in situ* implements of the "Old River Gravel" certainly of Upper Pleistocene age;
- a surface industry, which is characterised by various flakes and cores with a rather fresh appearance. To this surface industry of Ngebung belong a small polished axe and an arrowhead;
- at the lowest level of the low terrace are implements that appear to be absent on the top of the two hills and that, therefore, must (provisionally) be classified as a third lithic industry: elongated choppers, spherical balls (so called sling stones or bolas) and crude axes, all made of andesite. The larger stone tools, like the bolas are considered to be Upper Pleistocene/Lower Holocene of age.

The small flake based artefacts attributed to the Sangiran flake industry occurred primarily in the uppermost layers capping the Ngebung hills with a minimum estimated age of 135 ka Bartstra (1983, 1985) and Bartstra and Basoeki (1989).

Sémah et al. (1992) give a stratigraphic section of Ngebung. Their Ensemble A, contains a lot of large clastics, which granulometrically contrast with the sediment matrix: andesitic pebbles, artefacts (including bolas), and bigger and smaller broken bones. The scarcity of the pebbles, which are very often partly embedded in the underlying fine-grained clayey Ensemble O, suggests that their deposition is not natural (Sémah et al., 1992). In Ensemble A, during an excavation in 1990, Sémah et al. (1992) found a quartz pebble, which was interpreted as a hammer stone. They also reported the discovery of a Middle Pleistocene palaeosurface and other discrete archaeological floors containing small flake-based artefacts from the lower part of the Kabuh layers at Ngebung, but large artefacts were also present. Sémah et al. (1992) are cautious

about the age, but the stratigraphical observations suggest that the archaeological layers are not far from the lower part of the Kabuh beds at Ngebung. Such a position would imply an early Middle Pleistocene age and would also directly relate the archaeological remains with the *H. erectus* fossils found in Sangiran.

Available descriptions of the stone artefacts from the earliest deposits from Song Terus cave on Java, dated to approximately 180 ka (Sémah et al., 2004; Simanjuntak, 2004), imply that large flakes were brought into the cave from cores struck elsewhere, because the assemblage contains no large flaked pebbles or cores.

Another major faunal turnover event is recorded in the Late Pleistocene Punung fauna, which represents the first tropical rainforest on Java and includes *H. sapiens* (van den Bergh et al., 1996). The Punung fauna was established on Java around 128 ka (Westaway et al., 2007), when the sea level was fluctuating between 40 m and 65 m below present-day sea level, thus permitting overland dispersal to Java, in combination with more warm and humid conditions.

von Koenigswald (1936) described the Pacitanian industry based on his work in the Baksoka river valley on southern Java. He argued that the Pacitanian knappers were focused on core tool production dismissing the role of flakes in the industry. Later, Movius (1944, 1948) drew attention to the significant proportion of flakes, but argued that the unretouched flakes in the industry were unwanted by products of core tool manufacturing. Due to a lack of fossils, Bartstra (1983) dated the Baksoka terrace deposits geo-morphologically to the last phases of the Pleistocene and the beginning of the Holocene. This meant that only Wajak Man (*H. sapiens*) could be considered as the maker of the Pacitanian stone tools. Bartstra (1983) stated that 'a more "functional" approach certainly appears to be more promising', but it would take until the 21st century before this approach would be applied to the stone tools from Southeast Asia (e.g., Moore et al., 2009).

3. The finds from Flores

The fossil localities discussed below can all be placed in the Ola Bula Formation (Fig. 3), which is characterised by white tuffs containing pumice in the lower part, gradually becoming sandier higher up (Hartono, 1961). The formation shows horizontal bedding and is up to 80 m thick in the south-eastern part of the Soa basin, gradually becoming thinner towards the north-west. The Ola Bula Formation was deposited in a small basin surrounded by volcanoes in the west, south and east. Some of these volcanoes are still active at present. The Ola Bula Formation unconformably overlies a sequence of tilted volcanic breccias named the Ola Kile Formation (Hartono, 1961). At the top of the Ola Bula Formation, thin bedded lacustrine limestones are developed (Hartono, 1961).

On Flores, remains of a large proboscidean were first recovered in December 1956 by the Raja of Nagekeo, Josef Dapangole. They were reported to the late Father Verhoeven and originated from near the village Ola Bula. They were sent to the National Museum of Natural History in Leiden, the Netherlands, where Hooijer (1957) attributed it to *Stegodon trigonocephalus florensis*, a somewhat more advanced, but slightly smaller subspecies of the large *S. trigonocephalus* from Java. More fossil finds followed from several localities (Hooijer, 1964, 1972), mostly attributed to *Stegodon trigonocephalus florensis*, lately redescribed as *Stegodon florensis* by van den Bergh (1999). Two milk-molars of a pygmy *Stegodon* were found as well. Unfortunately, the exact stratigraphic level of these was unknown. In 1999, van den Bergh described these as *Stegodon sondaari*. In addition to these, the remains of a giant rat were found in Ola Bula and Boa leza, which were later described by Musser (1981) as *Hooijeromys nusatenggara*. The stone artefacts that were excavated with the *Stegodon* fossils in the fifties and sixties by Father Verhoeven were thought to be of Middle Pleistocene age (Maringer and Verhoeven, 1975).

In 1970, primitive-looking stone artefacts were discovered in association with *S. florensis* at Mata Menge and Boa Leza, which were described as pebble tools and retouched flakes of volcanic rock (Maringer and Verhoeven, 1970a, 1970b, 1970c). von Koenigswald and Ghosh (1973) suggested a relation between the artefacts from Ngebung and those from Flores. And based on the association with *S. florensis*, the artefacts were thought to be of Middle or Late Pleistocene age and Maringer and Verhoeven (1970c) speculated that *H. erectus* might have been able to reach the Lesser Sunda Islands. The claims of Maringer and Verhoeven (1970c) were largely dismissed by archaeologists at the time for several reasons: there were doubts about whether the artefacts were actually artefacts or natural stones, the association between the artefacts and *Stegodon* was uncertain, and the timing of the extinction of *Stegodon* on Flores was unknown (e.g. Allen, 1991; Bartstra and Basoeki, 1989; Bellwood, 1985, p. 66). According to Bartstra and Basoeki (1989), the fossils even clearly predated the artefacts. And, Bellwood (1985) pointed to the necessity of further research in order to ascertain the age of the artefact bearing layers.

In 1980, a new locality Tangi Talo, in the vicinity of Bhisu Sau, was discovered 2 km east of Mata Menge and 250 m southeast of Ola Bula. At Tangi Talo, 80 fossils of a giant tortoise and a pygmy *Stegodon* were discovered. The fossiliferous layer appeared to be relatively older than the Ola Bula layer excavated earlier by Verhoeven. The contrasting lack of tortoise and pygmy *Stegodon* in the younger association known from Ola Bula, Mata Menge and Boa leza, was explained as due to the arrival of early Man on the island of Flores (Sondaar, 1987).

In November 1991 and 1992, Indonesian-Dutch joint (the Indonesian Geological Research and Development Centre and The National Museum of Natural History, The Netherlands) expeditions were organised to the Soa plateau area in central Flores. The purpose was to relocate the excavation sites mentioned by Maringer and Verhoeven (1970a, 1970b, 1970c), where they claimed to have found *in situ* artefacts associated with the remains of a large extinct proboscidean of "continental size" (van den Bergh, 1999). During the same campaign, the 1980 discovery site was also revisited, which was located in the same area with fossils belonging to a typical endemic island fauna, including a pygmy proboscidean and a giant tortoise (Sondaar, 1987), and samples for dating were taken (Sondaar et al.,

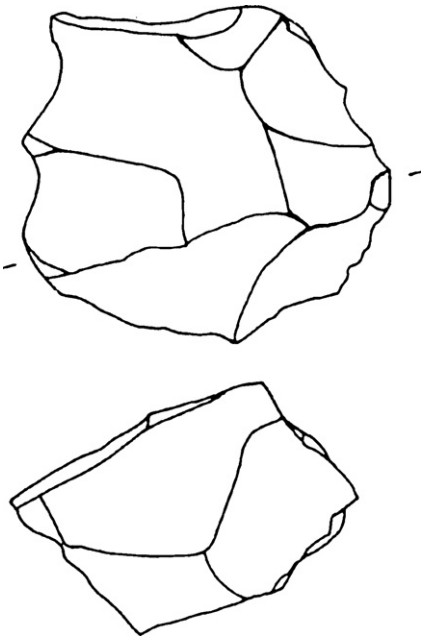

Fig. 4. A stone piece (MM 4010) identified as an artefact from the 1994 excavation at Mata Menge (Flores), reproduced with permission of the authors.
Fig. 4. Outil de pierre (MM 4010) identifié comme étant un artéfact, découvert pendant la fouille de 1994 à Mata Menge (Florès), reproduit avec l'aimable autorisation des auteurs.
(Morwood et al., 1997, fig. 10h).

1996). Forty-five stone pieces and large-sized *Stegodon* were found *in situ* at Mata Menge in 1994 (Morwood et al., 1997). Morwood et al. (1997) studied these stone pieces and concluded that at least 14 had characteristics suggestive of being artefacts based on well-defined flake scars, ring cracks, bulbs of percussion and systematic edge damage suggestive of retouch. One of them, a chopper, MM 4020 (Morwood et al., 1997, fig. 10h) (Fig. 4) was very similar to some of the stone pieces collected and identified as artefacts by Maringer and Verhoeven (1970a, p. 237, Plate 1, figs. b, c) (Fig. 5). Mata Menge has recently been dated to between 880 and 800 ka (Brumm et al., 2006; Moore and Brumm, 2007; Morwood et al., 1998).

Recent analyses of the stone artefact assemblage from Liang Bua, the cave where *Homo floresiensis* was found (Brown et al., 2004), which consists mostly of flakes, showed that the most parsimonious explanation is that large flake blanks were mostly produced off-site and that suitable large flakes were transported to Liang Bua for further reduction (Moore and Brumm, 2007; Moore et al., 2009). The large cores resulting from blank flake production were predicted to be located on the landscape outside the cave and are probably bifacial or multiplatform cores or single platform cores with the platform surface formed by the removal of one or more large flakes (Moore and Brumm, 2007; Moore et al., 2009). Soejono (1982) had precisely documented these sorts of artefacts in undated channel deposits and elevated terrace surfaces and had described them as massive and similar to the Pacitanian.

In the 21st century, papers were again published on the artefacts from Mata Menge inspired by the hominin find from Liang Bua, and the artefacts finally received their well-deserved attention (Brumm et al., 2006, 2010a, 2009, 2010b). In 2006, Brumm et al. demonstrated that the stone tools found at Mata Menge were comparable to those found at Liang Bua and that neither are sophisticated enough to be attributed to *H. sapiens*. The Mata Menge artefacts were reduced mostly bifacially, resulting in radial cores, but unifacially retouched pebbles and multiplatform cores are also present (Moore and Brumm, 2007). The blanks for the modified flakes were struck from cobbles abandoned elsewhere in the Soa Basin. The reduction sequences from both Liang Bua and Mata Menge involved reducing large blocks of stone into more manageable pieces for transport elsewhere, a pattern which persisted on Flores for over 700.000 years (Moore and Brumm, 2007; Moore et al., 2009). Brumm et al. (2009, 2010b) and Moore et al. (2009) sketch a brief outline of the technological behaviour in the Early Pleistocene of the Soa Basin. Their analysis (Brumm et al., 2009, 2010b; Moore et al., 2009) suggest that Early Pleistocene hominins in the Soa Basin acquired stones at various fluvial sources. After blank flake reduction, they removed only the smaller more manageable pieces and left

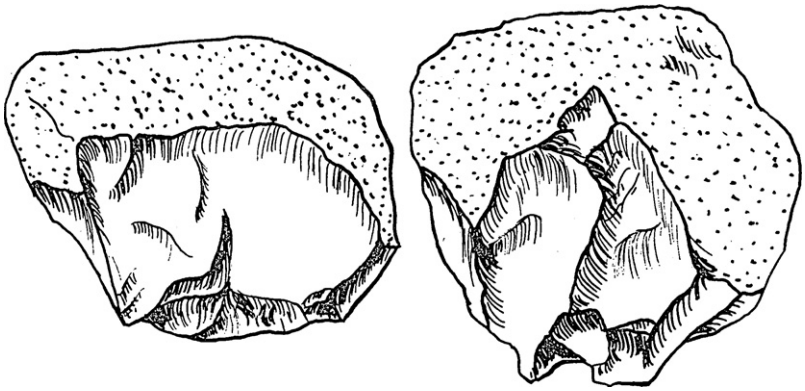

Fig. 5. Stone pieces identified as artefacts from Flores.
Fig. 5. Outils de pierre identifiés comme étant des artéfacts, découverts à Florès.
As figured in Maringer and Verhoeven (1970a, p. 237, plate 1, figures b (left) and c (right)).

the larger cores at the source. Their technological analysis (Brumm et al., 2009, 2010b; Moore et al., 2009) shows a focus on bifacial and centripetal reduction of stones at Mata Menge, producing radial cores not unlike those found in the earliest Oldowan stone assemblages. Bifacial radial core reduction is also a characteristic of the lithic assemblage associated with *H. floresiensis* from Liang Bua (Brumm et al., 2006), suggesting long term continuity on Flores.

Wolo Sege is a relatively new archaeological site in the Soa Basin, discovered in 2005, that has *in situ* stone artefacts and lies stratigraphically below Mata Menge (Brumm et al., 2010a). The Wolo Sege yielded no faunal remains (Brumm et al., 2010a). The Wolo Sege stone artefacts are predominantly small and morphologically undifferentiated flakes struck from cobbles by direct hard hammer percussion, but include a bifacially and centripetally worked radial core similar to those characteristic of the Mata Menge assemblage (Brumm et al., 2010a). Brumm et al. (2010a) dated an ignimbrite overlying the artefact layers providing a new minimum age for hominins on Flores of approximately 1 Ma.

4. The relationship between the finds from Java and Flores

Fission track datings of stone tools and fossils were done by Morwood et al. (1998). They show that Tangi Talo yielded a date of 0.9 ± 0.07 Ma, whereas two samples of Mata Menge yielded dates of 0.88 ± 0.07 and 0.80 ± 0.07 Ma, respectively. These closely match the dates previously suggested on the basis of palaeomagnetic determination (Sondaar et al., 1996), biostratigraphy (Maringer and Verhoeven, 1975) and the presence of tektites (von Koenigswald, 1957).

The availability of absolute dates makes it possible to compare the Pleistocene endemic unbalanced island fauna of Flores with the continental fauna of similar age from Java. The time-span represented by the Kedung Brubus stage on Java roughly falls between 0.8 and 0.7 Ma (van den Bergh et al., 1996). This particular time-span also corresponds with the period in which the two Flores faunas succeed each other.

Recently, the find of *H. floresiensis* (Brown et al., 2004; Morwood et al., 2005) has proven that Man did cross to Flores as was claimed by von Koenigswald and Ghosh (1973). A land connection between Flores and Java at this time, however, is unlikely, considering the faunal evidence. The existence of a former land bridge connection between Flores and the Sunda Shelf is not supported either by the present-day bathymetry. Even a lowering of sea level of 200 m relative to today would not result in land connections between Bali and Lombok or between Sumbawa and Flores. In addition, Flores is presently subject to a strong uplift as evidenced by raised coastal terraces. The lack of land bridges connecting Flores to the mainland or other islands has caused the fauna to be isolated and undergo physiological changes. Man was not exempt from this and the descendents of *H. erectus*, rather quickly, dwarfed into *H. floresiensis* (van Heteren, 2008, this issue; van Heteren and Sankhyan, 2009; van Heteren and de Vos, 2007). There are also alternative theories about the type specimen of *H. floresiensis*, LB1 (Aiello, 2010), which is that it is pathological and several different diseases have been proposed and subsequently refuted, or that it is a descendent of an early Australopithecine-like Asian ancestor, whose existence remains to be proven. An elaborate discussion on these possibilities is given elsewhere in this volume, which concludes that it is most plausible that *H. floresiensis* is an insular dwarf derived from *H. erectu*.

5. Conclusions

The conclusions of von Koenigswald and Ghosh (1973) were that:

- the artefacts from Java and Flores are real;
- the artefacts from Sangiran and Flores are contemporaneous;
- the absolute age of these artefacts can be considered to be 500–830 ka.

Almost 40 years after their generally dismissed publication, it has finally been proven that von Koenigswald and Ghosh (1973) were on the right track, based on new discoveries and new dating possibilities. Many prehistorians back then (e.g. Allen, 1991; Bellwood, 1985) ignored the new findings, because they did not conform to the established model that *H. sapiens* was the first to cross these sea barriers. von Koenigswald and Ghosh (1973), however, did not make the same mistake. The Middle Pleistocene artefacts of Flores discovered by Father Verhoeven already indicated that *H. erectus* had crossed to Flores as well. Later (Brown et al., 2004; Morwood et al., 2005), fossil evidence showed that *H. erectus* on Flores had been subjected to island dwarfing and that its descendent, *H. floresiensis*, was the tool maker.

A lot of progress has been made in the last 40 years and faunal evolution in the Indonesian archipelago is much better understood now than previously. Accurate field studies have been and are still being carried out by several international teams (e.g., Indonesian-Japanese, Indonesian-Dutch and Indonesian-Australian teams) to increase the knowledge further.

von Koenigswald and Ghosh (1973), however, turned out to be almost 40 years ahead of the current debate. Discussions concerning *H. floresiensis* are still ongoing (e.g. Aiello, 2010) but hopefully it will not take another 40 years for the scientific community to realise what the fossil finds from Flores really mean.

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