Sangiran For The Archaeologist A Short Guide For Students

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SANGIRAN FOR THE ARCHAEOLOGIST

A SHORT GUIDE FOR STUDENTS

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Introduction

To-day the most important locality of Pleistocene hominids in Southeast Asia is Sangiran (fig. 1). This is where **Homo erectus** fossils come from, to which species the famous **Pithecanthropus** and **Meganthropus** belong. Geographically or physiographically the area of Sangiran can be described as a basin surrounded by hills, of which the highest summits lie about 180 m above sea level. From a geological point of view, however, Sangiran is a dome, where different deposits have been pushed upwards. As a result of subsequent erosion splendid stratigraphic sections are to be found, where Pleistocene and older deposits are exposed (fig. 2).

The dome of Sangiran came into existence as a result of the gravitational collapse of the Old Lawu cone. Details of this process are given by Van Bemmelen (1949) and Itihara **et al.** (1985a), among others. In the Upper Pleistocene the cone of the Old or First Lawu volcano broke up, part of it 'sliding' northward. The resulting compression forces caused the land to 'ripple', as it were, thus giving rise to the hills of Sangiran. The present Lawu that can be seen on clear days to the southeast of Sangiran, towering in its majestic splendour, became built up after the collapse of the old one.

Sangiran is in fact the name of a desa, situated more or less in the centre of the dome. By extension the name is used to indicate the whole area around it, from the kali Brangkal in the north to the kali Pohjajar in the south (fig. 3). The oldest deposits are to be found in the centre of this area; these are the grey and black clays of the Kalibeng and Pucangan sediments, respect-

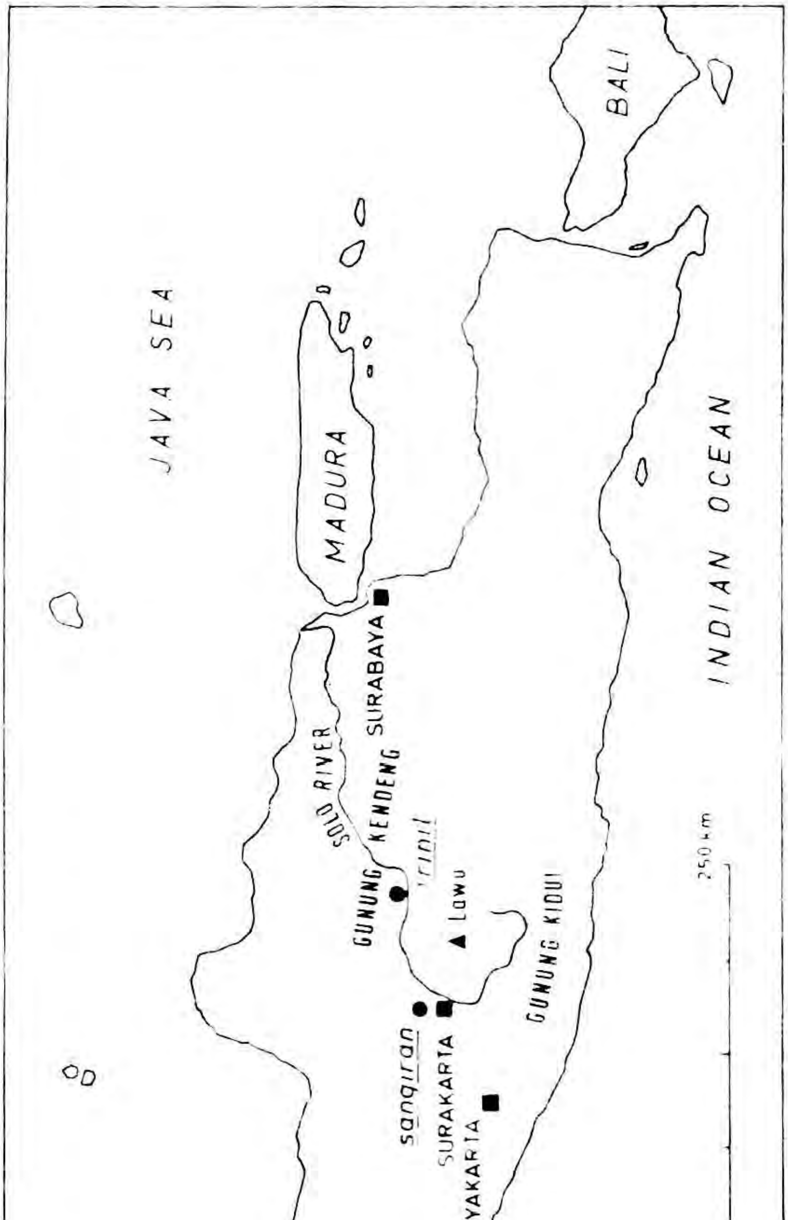

fig. 1. The locality of Sangiran in Central Java.

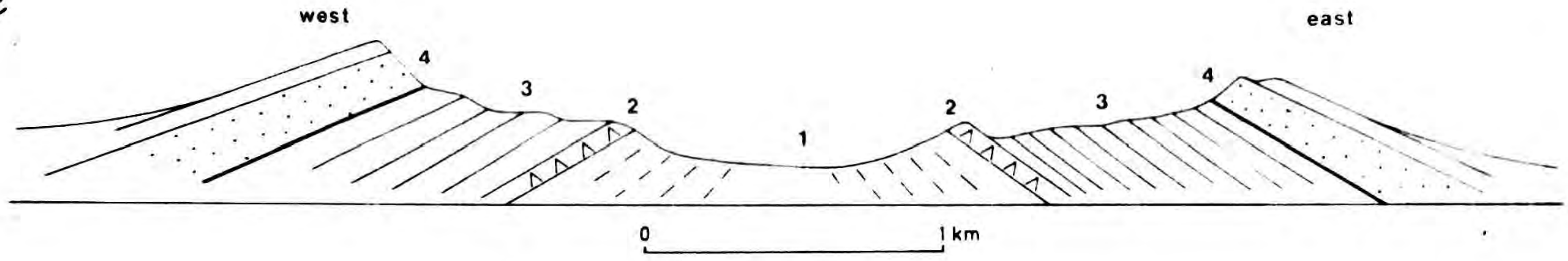

fig. 2. Simplified cross-section of Sangiran.
1 = Kalibeng beds; 2 = Basal Pucangan lahar deposit; 3 = Pucangan clays; 4 = the Sangiran 'rim', consisting of Kabuh, Notopuro, and younger sediments.

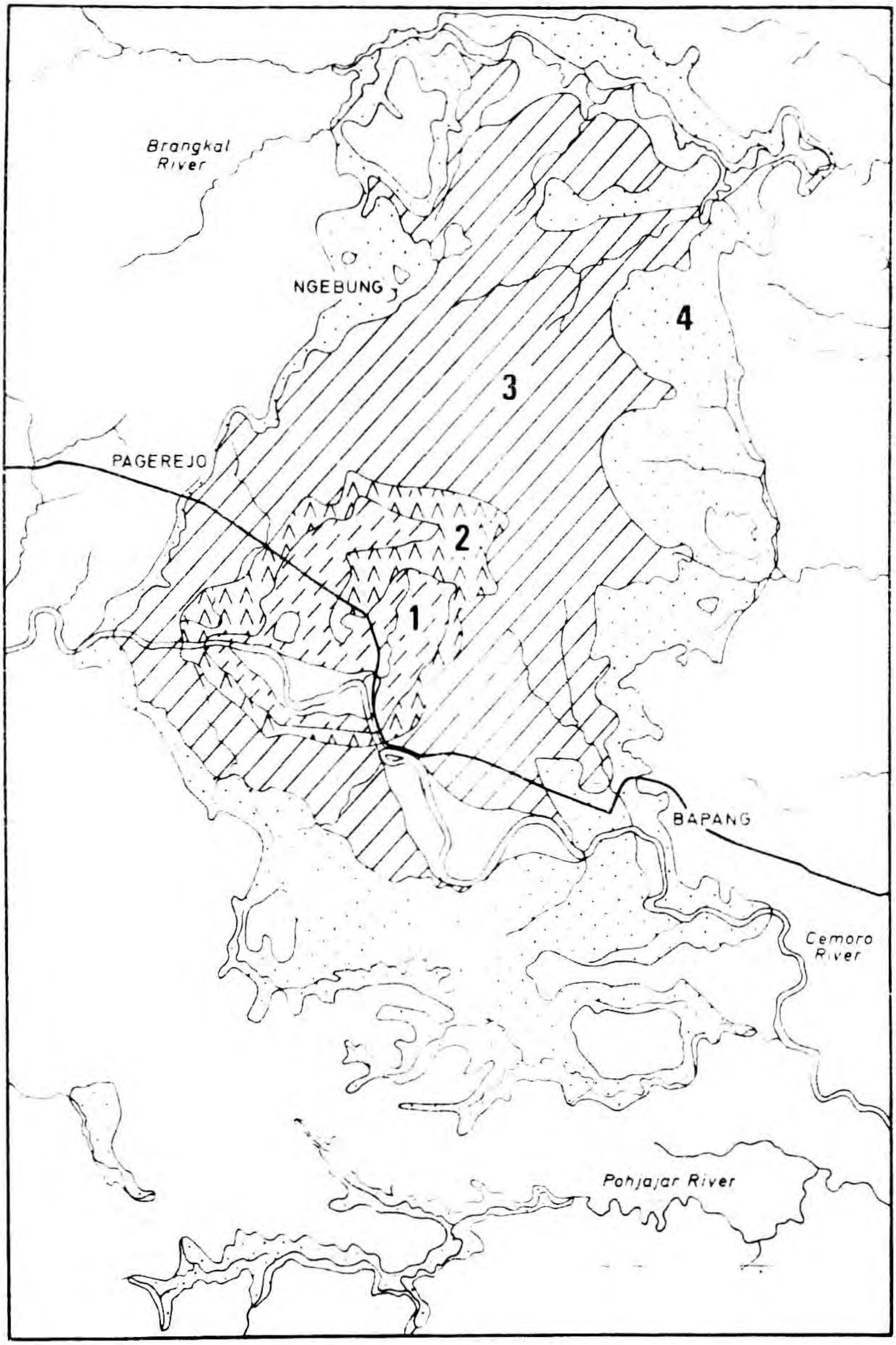

fig. 3. Simplified geologic map of the Sangiran area.
1 to 4: see fig. 2.

ively. These date from the Pliocene and Lower Pleistocene, when the area of Sangiran was still a great expanse of water, sometimes a lake, sometimes connected to the open sea. This is attested by the many molluscs that can be found in these clays. The clay-areas of Sangiran are fertile: here the desas and sawahs are situated. The land changes, however, towards the high rim: yellowish and reddish stream sediments crop out, with steep escarpments and deeply incised ravines. The vegetation here is less luxuriant. This is the area of the Kabuh, Notopuro and younger deposits, of which the sedimentation began at the end of the Lower Pleistocene, when the shrinking lake of Sangiran became filled by erosion products, transported by rivers, of the rising anticlines of Central Java: the Gunung Kidul and the Gunung Kendeng.

It is easy to reach Sangiran today. Just take the road from Solo northward to Purwodadi. About two kilometres beyond the village of Kalioso make a turn to the right, along a small asphalt road, towards Sangiran. When driving in hard-top or hi-ace, one should spare a thought for legendary predecessors: Von Koenigswald, Marks, and 'Uncle Bob' van Heekeren; or for tutors when they were still young and daring: Pak Soejono, Pak Sartono, and Pak Jacob. They had to walk from Kalioso to Sangiran, along a hot and dusty trail, for there was no asphalt road. It took hours to reach the outcrops with hominid and artifact-bearing sediments.

The hominid finds

One can become rather confused in trying to distinguish between the different finds of fossil man of Java. An established system of classification is to indicate crania or fragments of crania by means of a Roman cipher. Thus for example PII refers to the second known **Pithecanthropus** skull of Java, the so-called 'Bapang skull', found in 1936 in the area of Sangiran near the desa of Bapang (Von Koenigswald 1940). So PI refers to the first calvaria found in Java, the famous skull cap of Trinil (Dubois 1894); and for example MII refers to the second calvaria fragment of **Meganthropus** (Sartono 1982). With this system using Roman numerals the site is of less importance, the fossils themselves being the primary concern: **Pithecanthropus** (P) or **Meganthropus** (M).

However, it will be clear that errors can be made. One can lose count of the items, especially if more and more hominid material becomes available, that is studied by different researchers.

As a consequence another classification system has been made use of in recent years, in which the locality is of importance. No distinction is made any longer between fragments of calvariae and of mandibles. Thus S9 refers to the ninth hominid fossil found in Sangiran (S); T1 refers to the first hominid fragment from Trinil (T). In this system S31, for example, becomes the new code for MII, the above mentioned second-known **Meganthropus** calvaria fragment, found in Sangiran. An advantage of this classification system is that taxonomic difficulties are avoided, for what one person would call **Meganthropus,** another might call **Pithecanthropus,** and vice versa. Moreover, the term **Pithecanthropus** has fallen into disuse in the international literature; the official designation now is **Homo erectus** (see further: Day 1986).

The Kabuh beds

The name Kabuh has become very familiar to geologists, anthropologists and archaeologists, because in the Kabuh strata many hominid fossils have been found. Recently a new name has been proposed for these deposits, at least with reference to the area of Sangiran, namely Bapang deposits, or Bapang Formation (Itihara **et al.** 1985b). Whatever good reasons the authors may have had for proposing this new name, I do not think that we should adopt it unreservedly. The name Kabuh is deeply entrenched in the existing geological literature and in the minds of researchers. There is no sense in abolishing this name, and the situation in the field remains unchanged, in any case. Anyone climbing the hills of Sangiran knows exactly when he is entering 'Kabuh-country', because of the transition from the black clays to yellowish sands. So for all practical purposes, let us stick to the old, magical name of Kabuh.

Kabuh strata are stream-deposits: sandy layers, with a predominantly whitish to yellowish colour, in which clay lenses may be present, and gravel-seams, usually containing small pebbles of soft volcanic rock. These pebbles are smooth and rounded, indicating river transport. Also in the Kabuh beds one may observe cross-bedding, another characteristic feature of river-sediment (fig. 4). One may therefore conclude that the Kabuh-strata, in Sangiran approaching a thickness of 60 m, were deposited by rivers over a period of hundreds of thousands of years. These rivers carried as channel-load the erosion products of the Gunung Kidul, the mountain range along the south coast of Java. This Gunung Kidul is built up out of Tertiary volcanic rocks and limestone (Sartono 1964). We must therefore assume that in the Kabuh strata in Sangiran much old (Tertiary) volcanic material lies accumulated, varying from tuffaceous products to pebbly debris. On the other hand, according to some researchers the Kabuh layers also show contemporaneous volcanic activity, that is to say at the time when they were being deposited there must have been one or more active volcanoes in Central Java (Itihara **et al.** 1985c; Semah 1982; 1986).

This mixture of young and old volcanic material can lead to problems if one tries to date the Kabuh strata radiometrically. The samples for the laboratory have to be selected with great care, and different techniques have to be applied (Potassium-Argon, Fission Track, U-series) in order to rule out any sources of

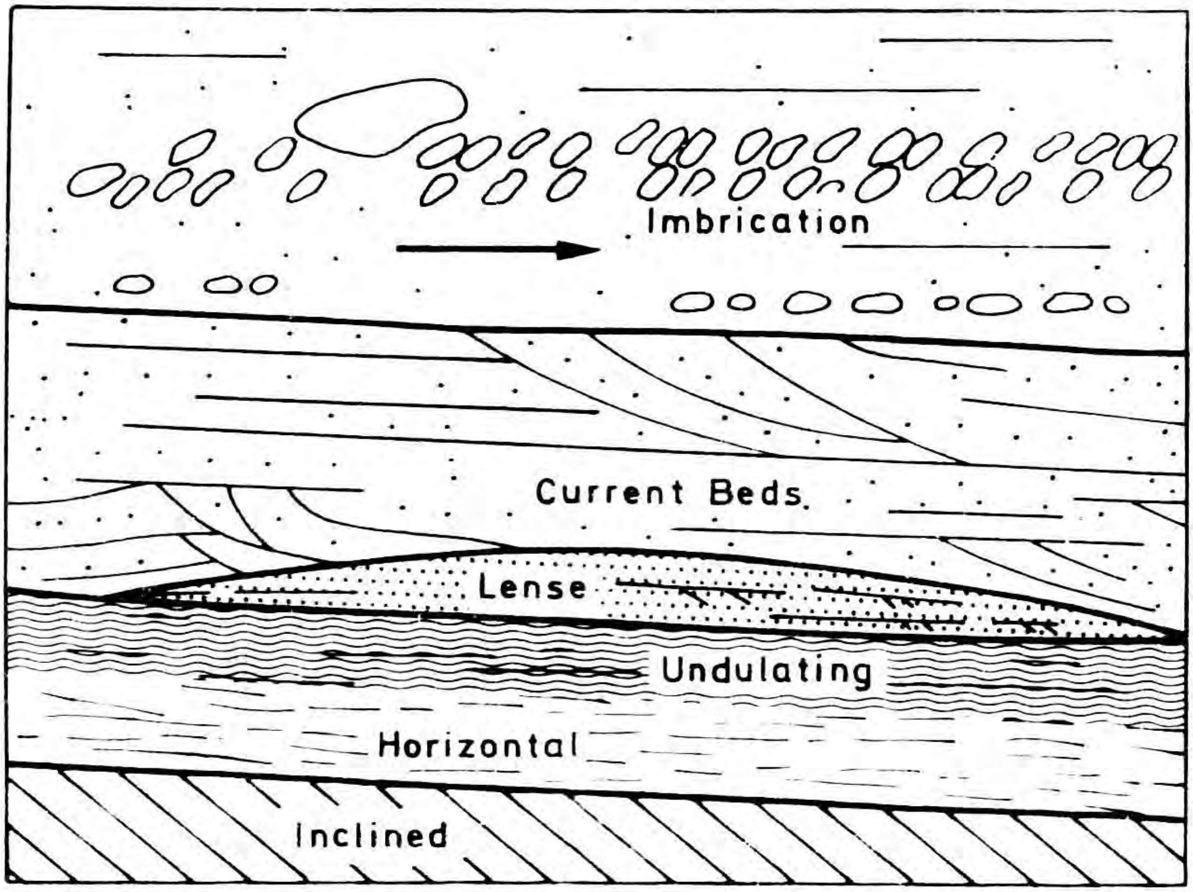

fig. 4. Characteristic features of river-sediment. Redrawn after: K.W. Butzer, 1976.

error. Generally speaking, one can say that the age of the Kabuh beds is more or less congruent with the Middle Pleistocene, the period between roughly 715,000 and 125,000 years ago. Some authors, however, place the beginning of the Kabuh-sedimentation as far back as the Lower Pleistocene, i.e. even earlier than 715,000 years ago. The attempts at chronometric dating are still in progress, however, and as results will be obtained only gradually it will some time before the upper and lower limits of the Kabuh sedimentation are known.

For the archaeologist the Kabuh beds in Sangiran are a kind of enigma. One finds vertebrate fossils, including hominid fossils, but never artifacts. All stone implements that have been found until now in the area of Sangiran come from deposits that are younger than the Kabuh beds. It is not easy to find an explanation for this. Some researchers are of the opinion that **Homo erectus** on Java never had any stone tools (Puech 1983). Others say that **Home erectus** on Java mainly used tools made of bone or bamboo (Van Heekeren 1972; Bellwood 1985). As for myself, I suspect there are stone tools waiting to be discovered that can be associated with **Homo erectus.** But they have simply not been found yet. Thus there is a challenging task awaiting the archaeologist in Central Java: try to find Kabuh-artifacts!

Good exposures of the Kabuh beds are to be found everywhere in Sangiran. To get a good first overall view one should stop at the road cutting near Pagerejo, at the point where the asphalt road to the centre of the dome cuts through the rim. Here one should take note especially of the cross-bedding of the fine-grained fluviatile Kabuh beds. Another interesting outcrop is to be found in the hills of Ngebung. There the deposits immediately below the top-gravel are said to be 'Middle'-Kabuh (Itihara **et al.** 1985c).

The Notopuro beds

At the end of the Middle Pleistocene the accumulation of river-sediment temporarily came to a halt. In the area of Sangiran erosion followed, culminating in the catastrophic removal of much Kabuh sediment as the result of a huge lahar flow, which entered from the southeast. This lahar marks the base of the so-called Notopuro beds.

A lahar can be described as a volcanic mudflow. This deposit is recognizable as a consolidated mass of sub-angular cobbles and boulders in a sandy tuffaceous matrix. Because such lahar deposits (and especially lahar deposits subject to erosion) are very conspicuous in the field, many authors have emphasized the volcanic character of the Notopuro beds, in order to be able to distinguish them from the underlying fine-grained fluviatile Kabuh layers. and superimposed coarser terrace clastics (Duyfjes 1936; Bartstra 1985). On the orther hand, we should take into consideration the fact that in Sangiran fluviatile sand and gravel deposits are to be found, that do not belong to the Kabuh layers or to the terraces, and that should therefore be regarded as a kind of 'fluvial Notopuro'. Van Es (1931) and Von Koenigswald (1940) grappled with this problem already, and they spoke of 'upper conglomerates' or 'obere Konglomeraten' with a distinct stream-laid character.

At present, even more emphasis is laid by geologists on these Notopura stream-deposits; and one could say that in the Kabuh-Notopuro sequence they see in fact the same geological sequence, with a few volcanic marker beds in the top part (Sartono 1984; Itihara **et al.** 1985c).Such a point of view can be defended when one sees in the marker beds short and catastrophic intercalations, that over a period of hundreds of thousands of years could hardly have disturbed the normal pattern of fluviatile sedimentation in the basin of Sangiran.

The most conspicuous marker bed or key bed is the huge lahar flow from the southeast mentioned above. This so-called 'Upper Lahar' is generally regarded as the base of the Notopuro beds in Sangiran. This lahar is overlain by gravel, sand and clay of very variable thickness, ranging from half a metre to more than ten metres. But the sequence is clearly fluviatile, and forms part of the fluvial Notopuro. The volcano that was responsible for the Upper Lahar (very probably the 'Old' Lawu, although the 'Old' Merbabu was in existence at the same time, see Van Bemmelen, 1949) was evidently still active when these deposits were being laid down, because a few bands of tuff are present in this fluvial Notopuro.

In the stratigraphic column a second Notopuro marker bed can be traced in the form of an 'Uppermost Lahar', although this one is less conspicuous than the base lahar. Overlying this Uppermost Lahar there are fluvial Notopuro beds once again, followed by tuff and pumice layers. For a detailed description of the sequence see Itihara **et al.** (1985c); but whether a pattern of cyclic Notopuro sedimentation can be observed so clearly everywhere in Sangiran, as these authors suggest, I find rather doubtful.

For the archaeologists the Notopuro lahar and tuff deposits are less important than the gravel-seams and lenses incorporated in the sandy fluviatile part, for it is here that one can expect to find fossils and artifacts. Fossil fragments of vertebrates from the Notopuro beds were previously mentioned by Von Koenigswald (1939), but other researchers were of the opinion that these fossils represented reworked components, originating from the Kabuh beds (de Terra 1943; Movius 1944). Whether this is really the case still remains to be seen. For the discussion between Von Koenigswald, de Terra and Movius concerned surface gravel on the hills of Ngebung, which they incorrectly interpreted as Notopuro (Bartstra 1985). In any case, Itihara **et al.** (1985c) mention vertebrate fossils from the fluvial Notopuro. So far no artifacts have been found in the Notopuro beds.

To get a good overall view of the Notopuro lahars, sands and gravels one should go to the south of the dome, to the valley of the Pohjajar river. The proposed new name for the Notopuro beds in the area of Sangiran is thus also Pohjajar beds; but it has already been explained why one should not welcome this new name. In the Pohjajar valley it is not difficult to find the lahar deposits, and also the fluvial Notopuro is clearly exposed. In some places the stream-deposits are consolidated or cemented, and cross-bedded wheathered outcrops have acquired a characteristic appearance because the more resistant laminae (iron, manganese) stand out in relief. In a sandy matrix one finds rounded pebbles of igneous rock. Sometimes these pebbles have been eroded out, and they are then to be found in the form of lag gravels on the slopes of the Pohjajar valley. Rounded pebbles of silicified rock are very rarely to be found, and this is an important characteristic feature of the fluvial Notopuro. Small pieces of subangular chalcedony do occur occasionally.

One Fission-Track date has been obtained for pumice pebbles from the upper part of the Notopuro sequence in the Pohjajar valley: 0.25 ± 0.07 Ma (Suzuki **et al.** 1985). A single date is by no means conclusive, however; it is possible that the sampled pumice has been reworked and now lies in a secondary position. To be on the safe side one might assume that the age of the Notopuro beds lies somewhere between 0.25 and 0.08 Ma (Upper Middle Pleistocene up to and including Basal Upper Pleistocene; fig. 6).

The Old River Gravel

I have already mentioned the surface gravel on the hills of Ngebung. There is a sharp contrast between this gravel and the underlying Kabuh beds; this becomes clear if one looks at the section of the first hill of Ngebung, at the spot where the triangulation station T356 was formerly situated. This surface gravel also differs from the gravel in the fluvial Notopuro in the south and east of the dome. Therefore I have given the surface gravel of Ngebung the separate name 'Old River Gravel' (Bartstra 1985).

The Old River Gravel shows that upstream of the river or rivers that transported the channel-load much erosion was taking place. The difference with the Kabuh beds is therefore in the first place the size of the components. Kabuh beds consist for the most part of sandy layers with little pebbly material, whereas the Old River Gravel is a typical coarse clastic deposit. But there is also a difference in composition. The occasional Kabuh gravel seams can be described as 'monotonous' or 'poor', showing volcanic pebbles, with very seldom fragments of silicified rock. The Old River Gravel, on the other hand, is truly polymict, consisting of volcanic pebbles together with a wealth of harder rock types, such as silicified coral limestone (often referred to by prehistorians as 'chalcedony'), quartz, jasper, chalcedony (in the 'true' lithological sense), and less frequently silicified tuff. This difference in composition distinguishes the Old River Gravel also from the fluvial Notopuro, that like the Kabuh beds consists almost exclusively of volcanic constituents, with only small amounts of silicified rock.

In the area of Sangiran the Old River Gravel is to be found in patches on the top of the rim. In the general stratigraphic column the Old River Gravel was thus the last fluviatile sediment to be deposited, before the arching of the Sangiran anticline took place. I am inclined to partly equate the Old River Gravel with the highest (alluvial) terrace of the Solo river. The source are of the hard rock material in the Old River Gravel could then have been the Gunung Kidul, where in the surroundings of the valley of Tirtomoyo, at the source of the Solo, much silicified rock occurs in interlacing (limestone/tuff) Neogene strata (Sartono 1964). The present-day Solo flows just to the east of Sangiran; in the Upper Pleistocene its course may have lain farther to the west (which could explain the Old River Gravel at Ngebung), or alternatively, there may have existed eastward directed tributaries. Anyway the geomorphological position of the Old River Gravel is clear: a coarse stream deposit that is not connected with any existing drainage pattern within the dome of Sangiran (fig. 5).

For the archaeologist the Old River Gravel is important, because stone tools have been found in it. Von Koenigswald (1936) first found such tools, in June, 1934, on the first hill of Ngebung. In January 1935 he had a small excavation carried out there. It was not until

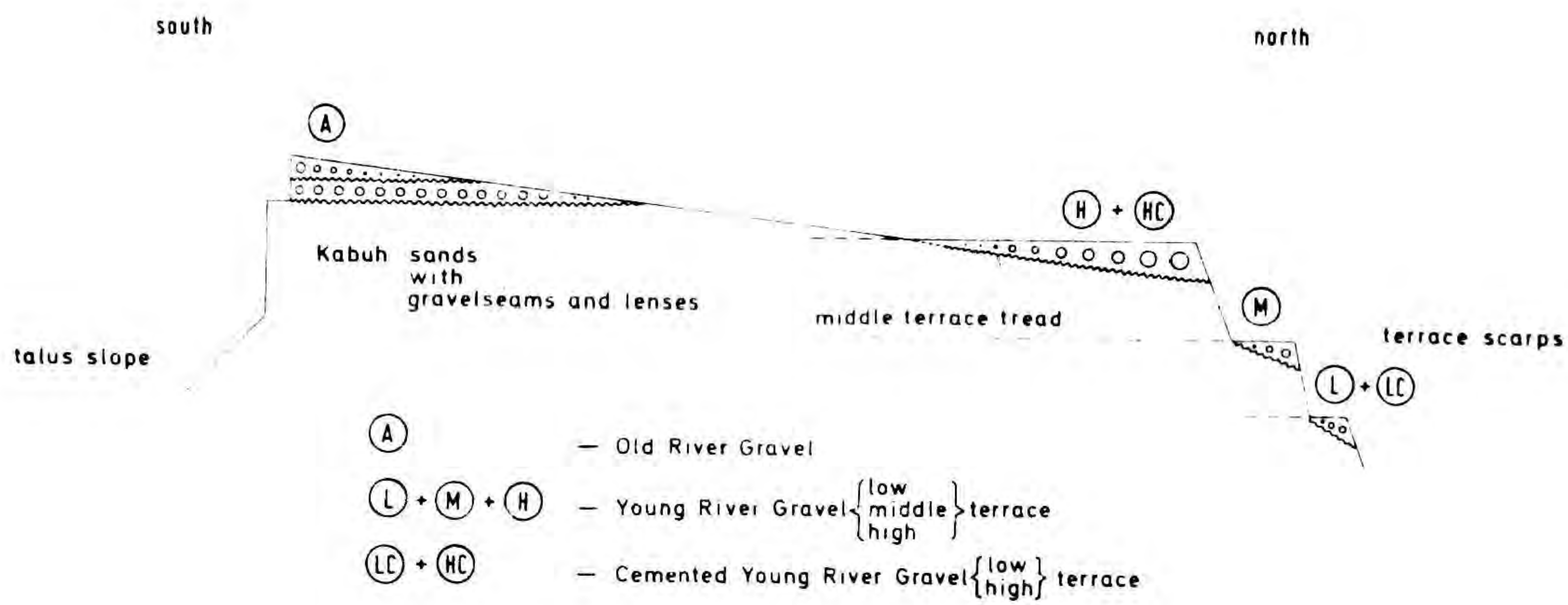

fig. 5. Simplified stratigraphy of the Ngebung hills. Redrawn after: G.-J. Bartstra, 1985.

much later that the artifacts collected by Von Koenigswald were described (Von Koenigswald & Ghosh 1973). 'Uncle Bob' van Heekeren also roamed around near Ngebung, together with Pak Soejono; just as I myself have done with Pak Bas. The stone tools to be found there are intriguing.

As said, the material of the Ngebung artifacts is often referred to as 'chalcedony'. In fact the material concerned is silicified coral limestone. Less frequently jasper was used, and rarely silicified tuff. Always river pebbles have formed the starting material for the production of the artifacts.

The artifacts themselves are mainly flakes, seldom exceeding a length of around 5 cm. A small percentage could be called blades. Cores occur occasionally. The artifacts are to be found in all stages of rounding, and the usually show water-gloss. True tools can be discerned, mainly scrapers. These tools are neither primitive nor crude, but merely simple. Therefore, I have my doubts whether an extensive tool classification based on typology like that made by Ghosh (in Von Koenigswald & Ghosh, 1973) is worthwhile; in my opinion the definition of a few broad tool categories is sufficient.

In 1985 I made a distinction between two different archaeological industries from the Ngebung top-gravel, albeit with some reserve (Bartstra, 1985). That reserve has developed into doubt, especially after the study of Von Koenigswald's collection from the excavation in 1935. I now think that it is very difficult to distinguish between a Pleistocene **in situ** industry and a Pleistocene surface industry. For the time being I should like to assume that all Pleistocene artifacts from Ngebung are contemporary with the deposition of the top-gravel. Only the small stone axe and a few arrow-heads which were collected at one time from the top of the first hill of Ngebung can be regarded as a later Holocene surface industry.

If the Ngebung top-gravel is more or less equivalent to the highest Solo terrace, then we have a few radiometric ages at our disposal. Bone material from a small excavation in the highest Solo terrace near Ngandong has yielded U-series ages of between 82 ± 7 ka and 31 ± 3/2 ka* (Bartstra **et al.** 1988; Bartstra, 1988). The Ngebung top-gravel, that for the time being I regard as post-Notopuro (Bartstra & Basoeki, 1989), is then Upper Pleistocene (fig. 6).

The Young River Gravel

This term is used to describe all gravel deposits in Sangiran that can be associated with the existing drainage pattern. Thus it is geomorphology that helps one to recognize these gravels. In the first place there are recent terrace gravels that accompany the existing rivers, the Brangkal, Cemoro, and Pohjajar, in their courses. In the second place there are more ancient terrace gravels (often in the form of thin veneers), that are to be found against the slopes of what are now dry valleys, or valleys through which at most a minor stream (small feeder of a bigger river) seeks its way.

Also in these Young River Gravel deposits artifacts are to be found. These include andesite bola balls, of which many are present in the museum of Sangiran. Occasionally one finds large choppers, made out of the same material (Bartstra, 1985; Bartstra & Basoeki, 1989). 'Chalcedony' flakes are also found in Young River Gravel, but some of these may have been reworked.

Concerning the age of the Young River Gravel not much more can be said than that the various sediments must be Final Pleistocene and Holocene < 30 ka. Much depends on the geomorphological interpretation of the diverse remnants : a base-gravel from a Cemoro low terrace bordering the present stream is at most a couple of centuries old; on the other hand the age of some Brangkal high-terrace gravels must be Final Pleistocene.

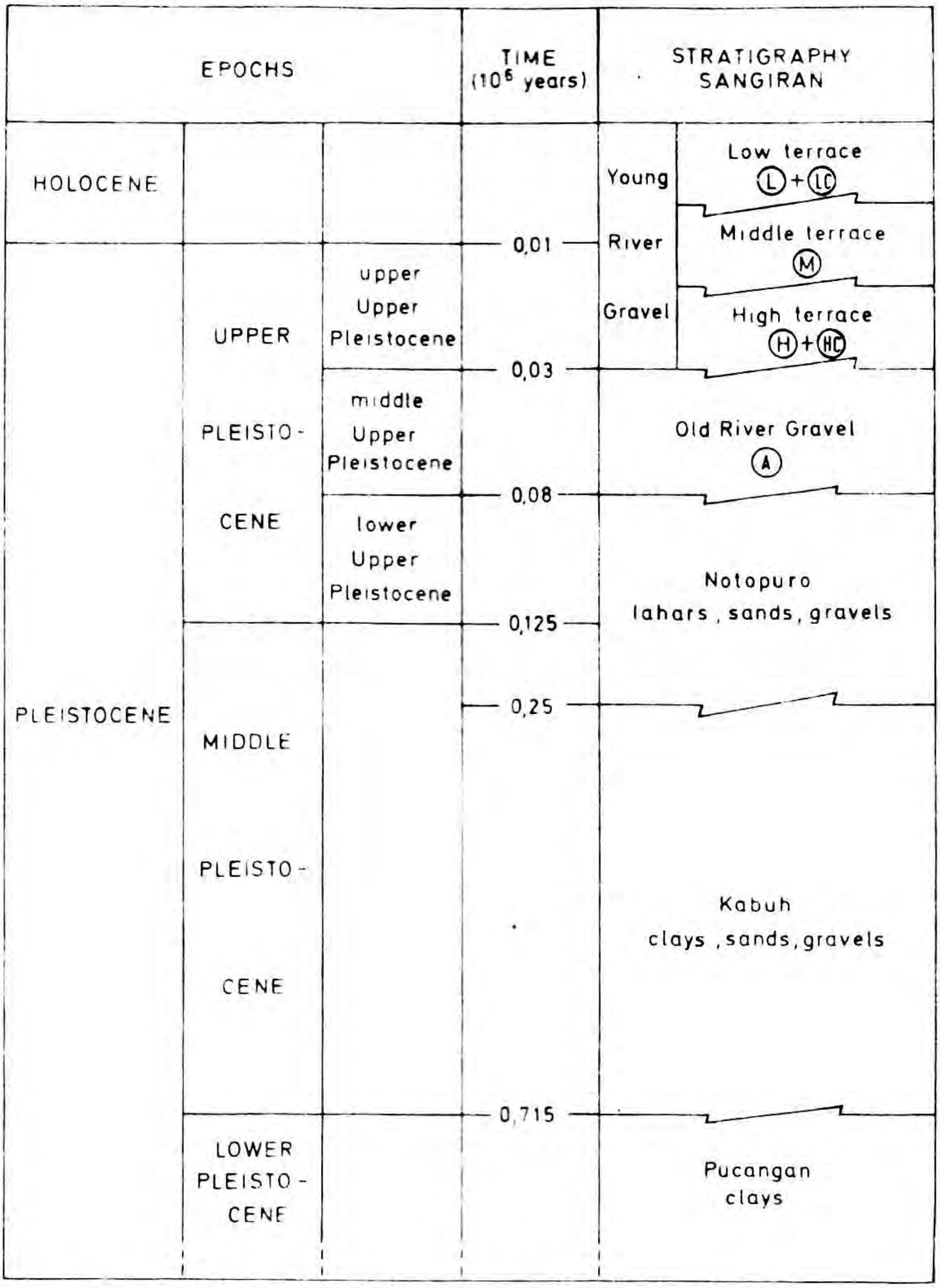

fig. 6. Age of the various Sangiran deposits.

Epilogue

This archaeological guide for Sangiran is broad and far from complete. Only a few points and ideas have been given which the archaeologist can digest before going into the field. Anyone wanting to be really well-informed should consult the existing literature on Sangiran, and especially the geological literature. The Palaeolithic of Sangiran, and in fact of the whole of Central Java, can only be studied properly from a geological viewpoint. To approach the subject in any other way will prove to be a waste of effort.

Note

* In the first publication about the Ngandong U-series ages, one additional age is given, namely of 101 + 12/10 ka (Bartstra **et al.,** 1988). New laboratory research has shown, however, that the analyzed sample is probably not bone (M. Day, personal communication). If one excludes this particular sample then the next oldest age is: 82 + 7 ka.

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