Notes about Sangiran (Java, Indonesia)

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with Pl. I

Sangiran is situated some ten kilometers North of Surakarta in Middle Java (Indonesia; Fig. 1). The place is known as a rich site of fossil vertebrates, among which hominids. In 1936 a mandibular fragment of *Pithecanthropus erectus* was found here, and in 1937 a calvarium (Von Koenigswald, 1940). Since then new finds have been made regularly (e. g. Jacob, 1967). The remnants of *Meganthropus palaeojavanicus* (mandibular fragments 1939, 1941, 1953) have also been found at Sangiran.

In 1934 stone implements were found for the first time at Sangiran. However, not much more than a few notes were written about them; only recently a more extensive study has been published about a collection of artifacts from Sangiran, in which it is stated that the implements are of Middle Pleistocene age (Von Koenigswald and Ghosh, 1973).

But when one tries to find out from the existing literature where exactly in the Sangiran profile the artifacts are found and exactly how old they are thought to be, the data are confusing. Hence this brief survey, which will only deal with the main aspects.

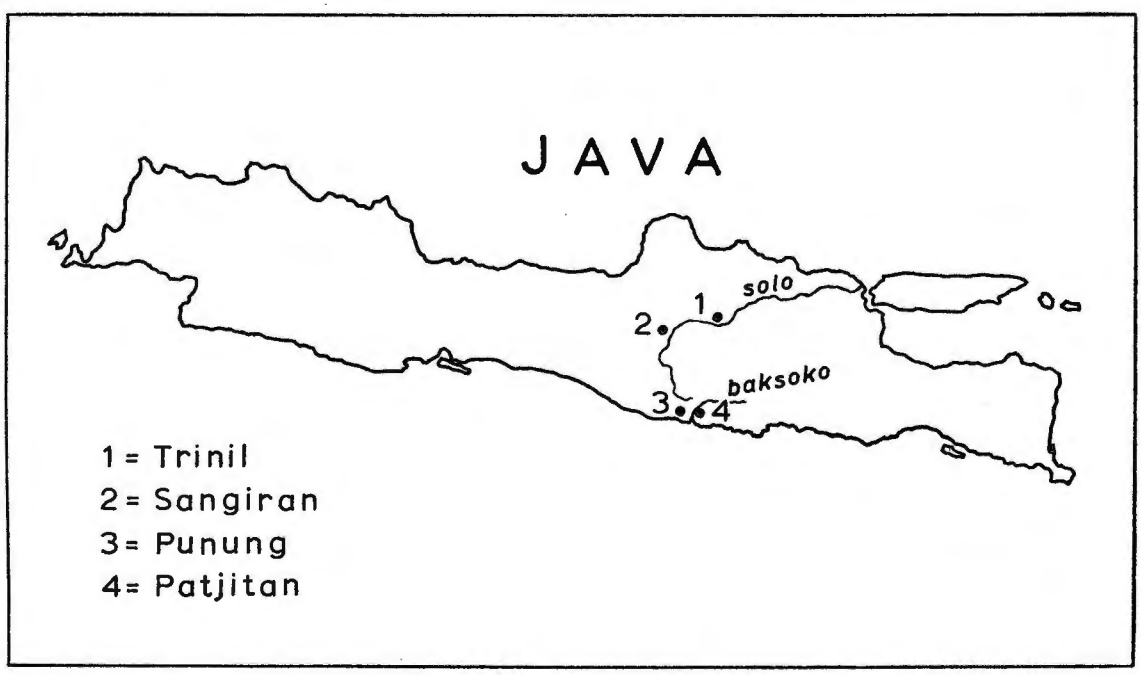

Fig. 1. Map of Java, Indonesia.

Furthermore, two points will be emphasized:

First, one has to be very cautious when considering the "flake industries" of Sangiran, as many of these stones are pseudo-artifacts.

Secondly, there are also some real artifacts to be found at Sangiran, but their presumed Middle Pleistocene age must be doubted.

Finally, I wish to express here my thanks to Dr. H. R. van Heekeren, Mr. G. Ording, and to the members of the National Archaeological Institute of Indonesia, especially to Drs. R. P. Soejono, Drs. T. Asmar and Mr. Basoeki –, to them all in memory of long and intriguing discussions.

Stratigraphy

Sangiran is actually the name of a Javanese village, a "desa". But this same name is also used to indicate the entire remarkable geological structure, with the desa in its centre.

Upon approaching Sangiran, one sees a low range of hills. When one has arrived at the top, one sees that the range of hills forms a circle which encloses an ellipse-shaped valley with a diameter of at most six kilometers and at least four. Within this valley, the eroded top of an anticline, Young Neogene and Pleistocene layers are exposed.

The stratigraphy of Sangiran has been described in detail by Van Es (1931), later confirmed and added to by Von Koenigswald (1940) and Van Bemmelen (1949). From these the following profile appears (Pl. I; Fig. 2): A is a number of layers of heterogenous composition and of Neogene age. Although these sediments are of great palaeontological interest, particularly in connection with the Plio-Pleistocene boundary in Southeast Asia, they are not relevant to this study.

B is definitely Pleistocene and consists of an impressive succesion of many meters of black clays, which have settled into a lake. The volcanic activity, as evidenced by the top layer of A, must have definitely closed off the area from the sea, thus giving rise to a large fresh-water basin.

The sea broke through only once, as can be seen from a marine intercalation into the black clays of diatomaceous layers (actually estuarine facies, Reinhold, 1937, p. 66) and a yellow clay with molluscs (an "impoverished marine fauna", Van Es, 1931, p. 41 etc.). Many of the molluscs have been overgrown with Balanids, indicating littoral conditions.

In the black clays fresh-water molluscs can be found, as well as vertebrates; particularly of course water animals such as turtles, crocodiles and hippopotami, but also many land animals which somehow got into the water. *Pithecanthropus* and *Meganthropus* occur for the first time in these deposits. The molluscs are absent in the top layers, while lime concretions and gypsum are found there, indicating that sometimes the basin ran dry. Locally small tuff strata are found in the black clays. The deposits as a whole are known as Putjangan Beds.

C is of a totally different nature from B. Whereas the latter is a quiet sediment of lacustrine facies, C consists of fluviatile deposits of a fast-changing nature: the final filling of the fresh-water basin. Van Es designates C as "lower conglomerate-tuff series", as does Von Koenigswald, who also refers to them as Kabuh Beds.

The transition from B to C is formed by a so-called "Borderbed" ("Grenzbank", Von Koenigswald), a several meters' thick calcified conglomerate bank.

The Borderbed is followed by some tens of meters of fluviatile sediment, rich in fossils, i. e. few molluscs and many vertebrates. According to Van Bemmelen the material in C consists both of erosion products of the Kendeng Hills North of Sangiran, and detritus from the Southern Mountains rising in the South. Van Es (p. 66) makes the following comment: "It is to be noted that the coarseness of the material and the thickness of each individual layer seems to increase in SE direction, etc."

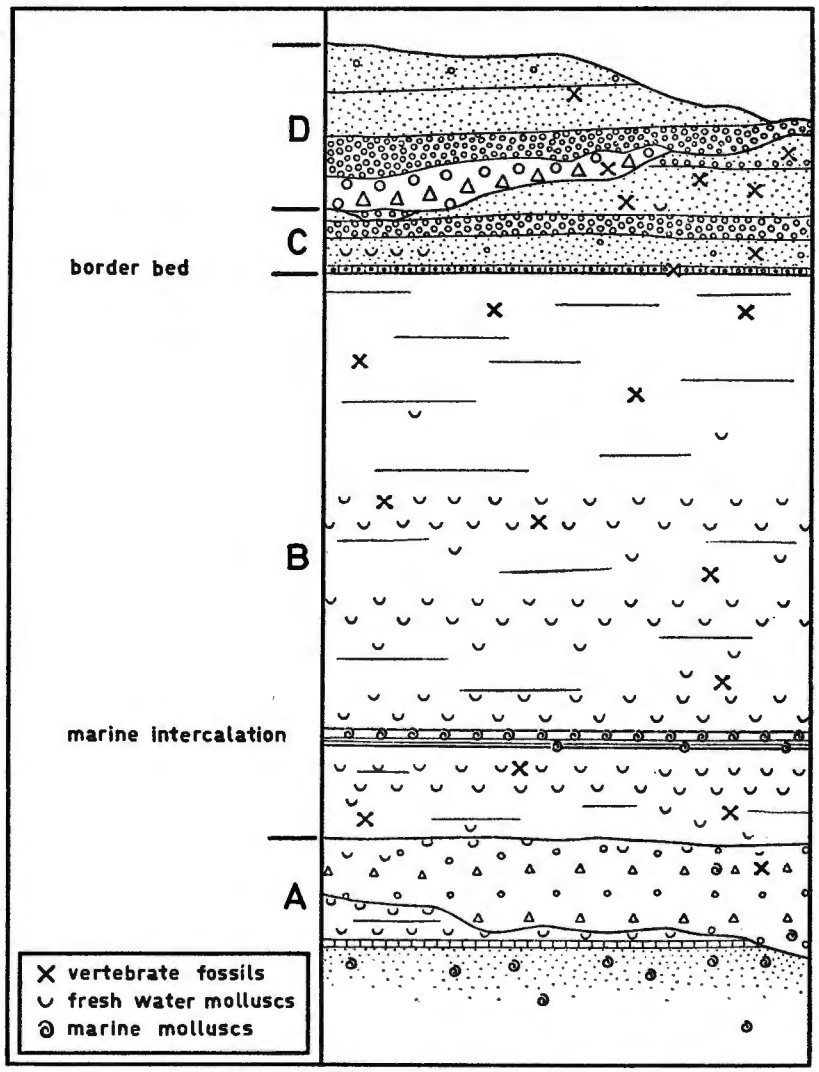

Fig. 2. Profile of Sangiran (after Von Koenigswald).

The rivers which brought down this southern material, also deposited at Sangiran many remnants of a rich vertebrate fauna, "which populated the foothills of the great volcanic range in the south" (De Terra, 1943, p. 446). *Pithecanthropus* was part of that fauna.

D forms the closing of the Sangiran profile, the "upper conglomerate-boulder breccia-tuff series", thicker in the western part of the dome than in the East, mentioned by Van Es, who already compares them with the Notopuro Beds, at least as regards the higher horizons.

There is a considerable difference of opinion on the exact boundary between the Kabuh- and Notopuro Beds. Van Es (p. 66) already indicates the uncertainty: "The lower conglomerate-tuff series, together, with the lower part of the upper conglomerate-boulder breccia-tuff series, from which it cannot be easily separated, etc." Von Koenigswald (p. 36) tends to take a lahar horizon as border, although he adds that underneath "... sich stellenweise, undeutlich gegen die tieferen Schichten abgegrenzt, Konglo-

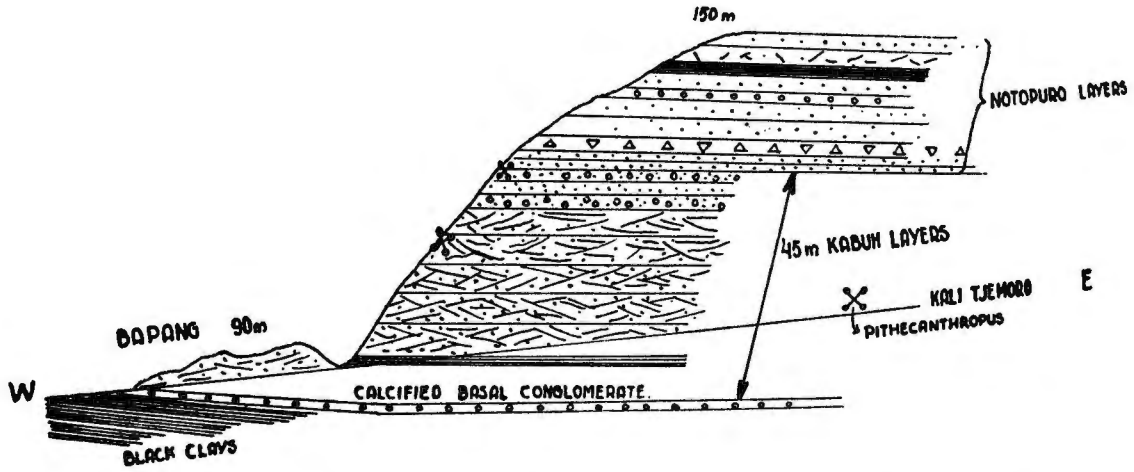

Fig. 3. Section of the East flank of the Sangiran dome near Bapang (after Van Bemmelen).

merate befinden, die wohl auch noch zur oberen Abteilung gerechnet werden müssen." Van Bemmelen (p. 566) also considers the lahar formation as the base of the Notopuro Beds, but admits that the deposits directly underneath may also be Notopuro.

Everybody agrees, however, that there is an interruption in the sedimentation, although there is no question of an angular unconformity between C and D, but only of a disconformity. The richness in fossils which characterises the deeper-lying layers, is completely lacking in the Notopuro Beds. Only in the basal layers do we find occasional vertebrate fossils. Lithologically the Notopuro Beds differ from the Kabuh Beds by their coarser composition. De Terra (1934, p. 446) notes in the field "a prominent cliff" (the "Notopuro escarpment" of Van Heekeren, 1972, p. 48).

For a closer study of these most recent deposits the site of the first Sangiran *Pithecanthropus* calvarium (1937) is eminently suitable. It is situated within the dome, near the desa Bapang. In that spot a small river, the Tjemoro, has cut itself so far into the soil as to expose layers over a depth of more than 60 meters. During rainfall much is washed away, thus uncovering many fossils. Profile descriptions are to be found in De Terra (1943) and Van Bemmelen (1949). Fig. 3 shows the profile of Bapang. At the base one sees here the four meters' thick calcified conglomerate bank, which forms the boundary between the Putjangan- and the Kabuh Layers. De Terra also mentions fresh-water gastropods in this deposit.

This is followed by nearly thirty meters of tuffaceous, crossbedded riversands, grey-green in colour, with various fine gravel lenses, and a layer of clay at the base. These deposits are very rich in fossils; among them the aforementioned *Pithecanthropus* calvarium was found.

The Kabuh Beds are closed off at the top by some ten meters of much coarser, crossbedded sandstones and conglomerates, with, according to De Terra (p. 446) "clayey silt containing plant remains above" (he correlates this layer with the Trinil plantbed). At the base of this series of deposits near Tandjung, also on the Tjemoro river but further upstream, the remains of another *Pithecanthropus* skull were found in the Thirties.

At Bapang the Notopuro Layers are about twenty meters thick. They are thought to begin here with a volcanic breccia, which according to Van Bemmelen lies "pseudo- conformably" on the Kabuh Layers. On this breccia we find fluviatile sands and gravels, growing coarser towards the top. According to De Terra (p. 446) these top layers indicate an "abrupt change of relief somewhere in the upper reaches of the stream".

The fast-changing character of the fluviatile deposits at Sangiran, with little uniformity horizontally or vertically, becomes evident when we compare the Bapang stratigraphy with that of the sites of the *Pithecanthropus* remains at Putjung (e. g. Sartono, 1968, 1971).These new sites lie South of the dome, an area growing in importance for palaeontological research.

Dating

For the dating of the Sangiran profile Van Es (1931) mainly uses a molluscs percentage method, where the age of a mollusc fauna is determined by the relation between living and extinct species. On that basis he considers the Putjangan Beds, for instance, as Young Pliocene; for him the Pleistocene starts with the "lower conglomerate-tuff series".

Von Koenigswald (1940) when dating the profile, considers the vertebrates found at Sangiran of great importance, besides the mollusc stratigraphy.

Already in the Thirties Von Koenigswald is examining vertebrate fossils of Java, in order to "die Grundlagen für eine Stratigraphie und Einteilung des Jüngsttertiärs und des Diluviums für den Feldgeologen zu schaffen" (Von Koenigswald, 1933. p. 5). Because of the extensive new material (e. g. as a result of excavations in the Solo terraces near Ngandong, "Solodurchbruchstal", started in 1931 on the site of *Homo soloënsis*), he considers the time to have come for a chronological classification of the faunas of the different sites. Gradually the stratigraphical ideas of Von Koenigswald take shape, and finally he divides the Javanese Pleistocene into three parts: a succession of three faunas, characterised by guiding fossils and named after the principal sites.

Cosijn (1931, 1932) reported the first fossil vertebrates from the hills North of Modjokerto (near Djetis, East-Java). Von Koenigswald judges this fauna to be earlier than that excavated by Dubois near Trinil: it contains more extinct genera, while for instance, the proboscideans are more primitive. On those grounds he considers the Djetis fauna to belong to the Old Pleistocene and the Trinil fauna to the Middle Pleistocene. The Ngandong fauna from the Solo terraces, finally, is Young Pleistocene.

Although with Von Koenigswald one notices a preference for datings with vertebrates, he has never gone so far as to consider datings with molluscs as definitely unreliable. On the contrary, he wants "mit Hilfe der Vertebraten nun dem Martinschen Schema eine festere Basis geben" (von Koenigswald, 1939, p. 30). And, although he remains critical of the mollusc method (e. g. 1940, p. 30: "ihre meist sehr einseitige Anwendung"), he still goes on using it (e. g. 1956, p. 11: "The ... age ... is in my opinion still underlined by a marine mollusc fauna").

Precisely because Von Koenigswald considers the mollusc evidence to be important, he has been heavily critised, among others by Hooijer (e. g. 1951, 1956, 1962). Hooijer dismisses the mollusc dating as unreliable, and he dates with vertebrates only, thus reaching different results. An extensive description of the discussion between Von Koenigswald and Hooijer would be out of line here; some points only should be considered.

Hooijer points out that the Pleistocene fauna division into three parts by Von Koenigswald is too cataclysmic. When this division was made in the Thirties, it might appear to be correct, because so few fossil vertebrates were still known at that time. However, as the material increases, "the faunal differences between the Lower, Middle and Upper divisions will dwindle more and more" (1951, p. 275). Thus the differences between the Djetis- and the Trinil fauna appear to be relatively small: "Full lists of the Java faunas, by genera, ... show that, out of 45 mammalian genera, the Djetis and Trinil faunas have 27 genera in common" (1956, p. 7). Finally Hooijer, when dating a fauna, attaches greater importance to new invading elements than to the persistence of old ones: "A fauna can be no older than its

youngest components" (1962, p. 485). And the Djetis fauna contains many invading elements which are characteristic of the *Stegodon-Ailuropoda* fauna from the cave- and fissure deposits in South China (Colbert & Hooijer, 1953); a fauna which Von Koenigswald (1940) already connects with the Trinil stage ("sinomalayische Fauna"). For that reason Hooijer places Djetis as well as Trinil in the Middle Pleistocene.

As regards Sangiran: the black clays of the Putjangan Beds contain vertebrate fossils which according to Von Koenigswald are characteristic of the Old Pleistocene Djetis fauna. The fossils in the Kabuh Layers, on the other hand, belong to the Middle Pleistocene Trinil fauna.

In the Notopuro Layers fossils are extremely rare. Those that were found in the basal layers are typical Trinil vertebrates, according to Von Koenigswald. And because a fossil of the Ngandong fauna has never been found in the Notopuro Layers at Sangiran, von Koenigswald (1940, p. 36) believes that Kabuh- and Notopuro Beds there "trotz der Diskordanz faunistisch eine Einheit bilden". He (p. 54) does suggest the possibility, however, that within the Notopuro Beds on Java there are two complexes, an older one with a Trinil fauna, and a younger one with a Ngandong fauna. In any case we find the first Middle Pleistocene complex at Sangiran.

Van Bemmelen (1949) seems to have a different opinion on this, as he calls the Notopuro Layers Young Pleistocene. He (p. 567) does this, however, "for the sake of clearness", for in Sangiran, at any rate, the question is really more complicated. The sedimentation of the basal conglomerates may have started already in the Middle Pleistocene, so that the Notopuro stage stage at Sangiran contains both the upper part of the Middle Pleistocene and the lower part of the Young Pleistocene. And in this Van Bemmelen does not after all, differ very much from Von Koenigswald.

The difference lies in the fact that Von Koenigswald reaches his conclusions on palaeontological grounds, with which Van Bemmelen does not agree. The latter (p. 566) states that all vertebrates in the most recent deposits are "very badly preserved" and "might occur on secondary sites being derived from the underlying Kabuh Beds". Thus in any case the fossils do not prove that the layers are of Middle Pleistocene Trinil age.

Several attempts have been made to date the Sangiran profile on the basis of lithological units and certain geomorphological events. Smit Sibinga (1949), for instance, tries to fit the stratigraphy into the alpine glacial system, using the classic four-division of Penck and Brückner. The four glacials have caused world-wide fluctuations of the sea-level, the effect of which can be traced even in the profile of Sangiran.

A first critical remark concerns the fact that any correlations whatever of the Javanese Pleistocene with that of Europe are still very premature, apart from the fact that the scheme of reference of an alpine four-division is obsolete. A second remark is formulated by De Terra (1943, p. 333) and later by Van Bemmelen (1949, p. 301): in theory it should be possible to trace these eustatic movements in the profile, but in actual fact the result is obscured by the extensive Quaternary epirogenesis on Java.

According to Smit Sibinga the lacustrine black Putjangan clays have been formed during the Günz- and Mindel regressions. The intermediate interglacial transgression is visible in the marine intercalation of diatomaceous beds and yellow clay.

At the height of the Mindel period the lake had already practically dried out, as can be seen from the absence of molluscs in the upper Putjangan sediments and the occurrence of small lime concretions and crystals of gypsum.

Van Bemmelen (1949) however, is of an entirely different opinion. The large fresh-water lake in the Surakarta plain was not the result of searegressions, but of epirogenesis and volcanism. During the Old Pleistocene the Western Kendeng Hills rose in the North out of the sea; and the large basin which was then formed between those hills and the Southern Mountains already formed in the South (in Van Bem-

melen's terminology: the synclinal basin of the Ngawi Subzone) was closed off in the East by lahar streams of the Old-Willis, thus forming a large fresh-water lake (cf. also: Lehmann, 1936, p. 71).

Van Bemmelen also criticises Smit Sibinga for his interpretations of the Kabuh Beds. Although according to the latter the basal sediments still show a regressive (Mindel) character, the greater part of the Kabuh Layers is the result of the second interglacial transgression. But according to Van Bemmelen the formation of sandstones and conglomerates of the Kabuh Layers is a typical synorogenic phenomenon, probably formed during a further uplift of the Southern Mountains.

Sartono (1969) also tries to detect in the Sangiran stratigraphy re- and transgressions of the sea. His views are somewhat different from those of Smit Sibinga, although he also takes four alpine glacials as a starting-point. It is interesting to note that in the Border Bed he sees evidence of a sea transgression (Mindel-Riss), because of the remains of *Globigerina* and *Globigerina* limestone found there.

In our opinion, however, these are rounded and could very well be erosion products from elsewhere, without indicating a transgression. In Sartono's view the interglacial transgressions coincided with periods of sedimentation, the glacial regressions can be observed in the various un- and disconformities.

In conclusion: mollusc dating, vertebrate dating, nor dating by means of geomorphological events lead to any definite conclusion. This can only be reached by means of chronometric dating. Von Koenigswald (1968) gives a date of 710,000 years for the Kabuh Layers (KAr- date of tektites), which is confirmed by a recent KAr-date of Upper Kabuh tuffs: 830,000 years (Jacob, 1972). The chronometric dating of the Sangiran profile is only just beginning. Nevertheless the discussion about the age of the various layers will be settled only when more absolute dates become available.

Artifacts

The first stone artifacts were found at Sangiran in 1934 by Von Koenigswald (e. g. 1936, p. 52): ..."small blades, points and scrapers ... were found associated with a fauna typical of the Trinil horizon." He not only collects the artifacts in different places, but also carries out in 1935 a small excavation on a hill near the desa Ngebung. We would like to point out here that the Sangiran artifacts are fairly small, never exceeding a maximum dimension of 5 centimeters, which is a rather striking characteristic.

Von Koenigswald (e. g. 1936, p. 731; 1938, p. 200) repeatedly emphasizes that the finds come from layers with fossils of the Trinil fauna, although he later points out that the Sangiran artifacts come from a higher level than the layers with *Pithecanthropus* fragments (e. g. 1938, p. 205; 1939, p. 42).

In 1940, during an extensive discussion of the Sangiran profile, Von Koenigswald gives more details. From that it can be gathered that the artifacts in question come from various places within the dome of Sangiran and of at least two horizons. When discussing the "untere Konglomerat- und Tuffschichten" (the Kabuh Layers), Von Koenigswald (p. 35, 36) literally says: "Die Schichten enthalten ferner Stückchen von Chalcedon, verkieselten Kalk und verkieseltes Holz, und vereinzelte daraus verfertigte offensichtlich als Werkzeug gebrauchte Abschläge."

These flakes in the Kabuh Layers should be distinguished from the artifacts mentioned by Von Koenigswald (p. 36) during the discussion of the "obere Konglomerat- und Tuffschichten" (the Notopuro Layers): "In der basalen Schicht fanden sich nördlich bei Ngeboeng sehr zahlreiche Chalcedon-Stückchen, von denen sich eine ganze Reihe als primitive Werkzeuge erwiesen, etc."

The fact that the artifacts seem to occur near the boundary between the Kabuh and Notopuro Layers, lead to considerable confusion, while the boundary itself, as was mentioned before, is still a point of discussion. But it has also been said that Von Koenigswald considers the lower and upper conglomerate-

tuff series to belong to one and the same faunal unit, on the basis of the fossils of the Trinil fauna found in both layers. And that is precisely the reason why Von Koenigswald considers the Sangiran artifacts to be of Middle Pleistocene age.

In the beginning of 1936 Teilhard de Chardin visits the dome of Sangiran; the notes made of his travels are published in 1937. He combines the Kabuh and Notopuro Beds at Sangiran under the term "couches de Trinil", probably under the influence of the palaeontological argument of Von Koenigswald. From these layers he mentions palaeolithic artifacts, while at the same time wondering whether "les graviers contenant l'industrie soient du Trinil remanié" (p. 29). Teilhard is doubtful about the presumed Middle Pleistocene age of the layers.

In the spring of 1938 Sangiran is visited by the participants in the Joint American Southeast Asia Expedition for Early Man (1937–1938), among whom also Teilhard, De Terra and Movius. The doubts uttered by Teilhard now seem to be confirmed.

For according to De Terra (1943, p. 456), artifacts in Sangiran occur exclusively in the uppermost Notopuro gravels, and precisely because they occur only in the top of the profile, he doubts very much if the implements are Middle Pleistocene. He also states that the chalcedony and jasper, of which the artifacts are made, occur only in the Notopuro Beds in large quantities.

Movius (1944, 1949) also suggests that the artifacts come from the Notopuro gravels and that therefore they are Young Pleistocene. In 1955 (p. 529) he indicates exactly where: "... the archaeological material occurs in situ in the upper gravel of the Notopuro Beds at a point where the latter rest 'disconformably on the cross-bedded sands and gravels (Kabuh Beds) which make a compact and more resistant cap above the soft underlying beds'." The latter is a quotation from De Terra (1943, p. 446).

The above statement by Movius, however, gives rise to confusion. It can be concluded from this that the artifacts were found along the boundary between the Kabuh and Notopuro Beds, which opinion is certainly not shared by De Terra. De Terra emphatically means only the top layer of the Notopuro Beds, "the uppermost part of the cliff section at Sangiran" (1943, pl. XXXV, fig. 3). Van Heekeren (1972, p. 49) on the other hand, who during the Fifties collected artifacts in various places within the dome, states with great emphasis: "All tools were exclusively found in the lower portion of the Notopuro Beds."

Summarising it therefore seems that it is not at all easy to find out from the existing literature where exactly in the Sangiran profile the artifacts are found and particularly how old they are.

In 1973 the study by Von Koenigswald and Ghosh about stone implements from the Trinil Beds of Sangiran is published, in which a collection is described in the Senckenbergmuseum (Frankfurt a. M.), which had been collected before the war in Sangiran.

Most important is the term Trinil Beds; it shows that Von Koenigswald is still interested in the palaeontological argument. As has been explained, he understands by Trinil Beds not only the Kabuh Layers, but also at least the basal part of the Notopuro Layers. Even when artifacts are found in the latter deposits, they still remain Middle Pleistocene. Von Koenigswald still doubts the presumed Young Pleistocene age of the Notopuro Beds at Sangiran.

Nevertheless, the lithological argument (e. g. van Bemmelen, 1949, p. 558) favours a distinction. The Kabuh Layers are synorogenic, formed during the uplift of the Southern Mountains. This uplift took place during the Middle Pleistocene, in any case before the time of the active "Old Lawu" volcano, as the Kabuh Layers do not have any ejectamenta from this. In Sangiran the activity of "Old Lawu" is only visible in the upper volcanic breccie, i. e. the Notopuro Lahar.

There is indeed a lithological difference between Kabuh and Notopuro Layers, while also, according to some experts, the vertebrate fossils in the Notopuro Layers are derived.

On the other hand, it has been pointed out above that according to Van Bemmelen the sedimentation of

the basal Notopuro conglomerates might already be Middle Pleistocene, which leads us to the conclusion that if stone implements were found at Sangiran near the boundary between Kabuh and Notopuro Beds, a Middle Pleistocene age is not impossible. However, there is some doubt whether in that spot in the Sangiran profile convincing artifacts do indeed occur.

The present author has never done extensive fieldwork at Sangiran, but he visited the place several times during recent years and was also able to make a few reconnaissance trips. The following theories are therefore really ideas which will have to be tested more extensively in the future.

It should first be pointed out that small pieces of chalcedony occur in the entire fluviatile part of the Sangiran profile. De Terra (1943, p. 457) is wrong therefore in stating that chalcedony only occurs in the Notopuro Beds. Von Koenigswald (1940, p. 35) already indicated chalcedony in the Kabuh Layers.

In these Kabuh Layers at Sangiran one can collect the chalcedony pieces in many forms, among others as small flakes, some even with a bulb of percussion or retouche, so that they appear to be artificial. They are not so, however: the small chalcedony flakes found up to now in the Kabuh Layers are pseudo-artifacts.

We do not intend in this article to discuss in detail the extensive literature on "eoliths", except for a single point. The occurrence of a bulb of percussion is not always an indication that the flake is artificial, particularly when the bulb is flat and hardly visible. Flakes with a strongly curved striking platform are especially dubious, as are flakes on which there is no striking platform at all. Sometimes also, the ripples are much too pronounced and do not run parallel. Under the magnifying glass the retouche also reveals suspect features. This is often extremely irregular, blunt and alternating, i. e. alternatively on both sides of the flake.

In the Notopuro Layers at Sangiran these pseudo-artifacts also occur, which is not surprising. A study of a collection of artifact-like pieces of chalcedony and jasper in Jakarta, found during recent excavations in the Notopuro Beds, revealed that only 10 out of the 113 stones turned out to be possibly artificial. Of these, 2 were undoubtedly real artifacts; when studied more closely, they also proved to have been manufactured of silicified limestone. These numbers show that one should be very cautious in the interpretation of the Sangiran artifacts. On the other hand they also indicate the occurrence of real artifacts within the dome.

While exploring the fields of Sangiran, however, it nowhere becomes clear that the real implements might find their origin in the basal Notopuro Layers. On the contrary, they are to be found only in the top layer just underneath the surface (thus confirming De Terra's remarks); in colluvial deposits; in recent sediments of the rivulets; or on the surface. All of which makes a presumed Middle Pleistocene age highly improbable.

In 1935 Von Koenigswald carried out a small excavation in the hill of Ngebung, but unfortunately the information concerning the place of the excavation profile where convincing artifacts were found, has been lost. In any case Von Koenigswald and Ghosh (1973, p. 2) clearly state that the collection described by them "has been collected entirely from the surface".

The crucial point is that these surface collections of Sangiran are suspect. Apart from a percentage of pseudo-artifacts which can be detected, the collections consist of a mixture of probable Palaeolithic, but also later (up to Neolithic?) industries. From the surface gravel of Ngebung an arrow-head and a tanged point also came.

The question is which part of the total collection is Pleistocene. Elaborate future research will have to decide that. Fortunately much attention is being paid to Sangiran within the framework of the National Palaeoanthropological Research Project in Indonesia (Jacob, 1972; Soejono, 1972). Most interesting will be the exploration of the coarse gravel deposits at Sangiran, in search of bigger core tools. In any case the Sangiran chalcedony artifacts are completely different from the undoubtedly Palaeolithic as-

semblage from the Baksoko valley on the southcoast of Java (the "Patjitan Culture"), while neither is there any marked resemblance with the artifacts from the valley of the river Wallanae on Sulawesi (the "Tjabengè Culture"): claims of a resemblance are certainly not justified.

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Kabuh Layers at Sangiran (photo G. Ording).