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HOMO ERECTUS NGANDONGENSIS: THE POSSIBLE MAKER OF THE "SANGIRAN FLAKES"

INTRODUCTION

Much have already been written about Sangiran in Central Java (Indonesia) regarding its geology, paleontology, archeology, relative dating of beds and on human evolution. And yet, the more it is known from the area the more varied are the problems arising from the increasing knowledge concerning those field.

In the past few years researches have focussed their attention at special topics such as pollen analysis, radiometric dating, biostratigraphy and environmental studies of Pleistocene man. Most of the results of these investigations have not been published yet.

This paper deals solely on the stratigraphic position of the so-called "Sangiran flakes" and the association of these artefacts with certain Pleistocene human fossils of Sangiran. There are still widely divided opinions regarding these artefacts, which mainly center around the following questions:

- a) Are the "Sangiran flakes" pseudo-artefacts or are they real ones.
- b) How are the "Sangiran flakes" distributed in the Pleistocene sediments of Sangiran.
- c) Is there any connection between the "Sangiran flakes" and a certain species of Pleistocene man of Sangiran.

For the purpose of this research a thorough investigation has been carried out on the stratigraphy of Sangiran as far as Bengawan (River) Solo in the east, furthermore also in Simo and Klego as well as in Bringinan areas, Sambungmacan and Ngandong (*fig. 1*).

Contradictory opinions about the age of Pucangan and Kabuh as well as Notopuro formations put forward by various authors will not be discussed in this paper because those are out of the scope of it. In this paper the vertebrate stratigraphy as is currently used in Indonesia will be maintained, i.e. a Lower Pleistocene age for the Pucangan formation and a Middle Pleistocene age for both Kabuh-Notopuro formations while the Ngandong terraces along Solo river are regarded as Upper Pleistocene.

STRATIGRAPHY

As a base for this stratigraphic research were used maps of van Es (1931), of van Koenigswald (1940) and Sartono (1978), as well as those made by a team of students supervised by author himself (Budiarto 1977, Djubiantono 1977, Gurniwa 1977, Hermawan 1977, Nasution 1977, Raupu 1977, Simanjuntak 1977). A compiled general stratigraphic correlation has been made and shown in *figure 2*.

From the above figure can be seen that the so-called Kabuh formation is found only in Sangiran and Bringinan areas, whereas to the west and to the northwest it wedges out. On the other hand the Pucangan and Notopuro formations are well represented in those areas. Another stratigraphic phenomenon is that while the lithofacies of the Pucangan formation is equally the same in all those areas but lithologically very different from the Kabuh as well as from Notopuro formations, the lithofacies of these

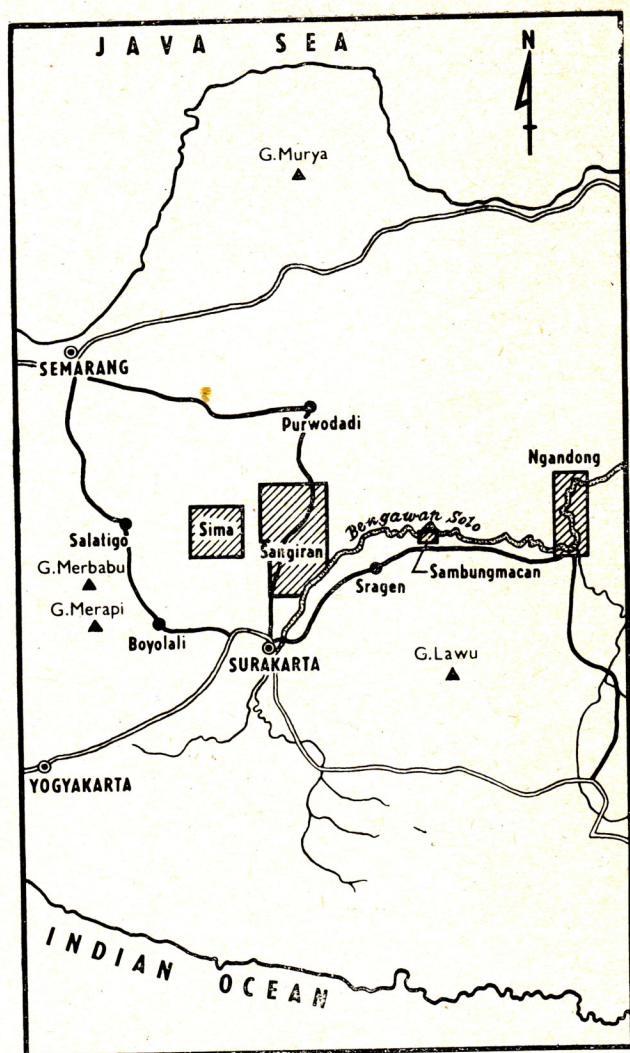


FIG. 1. Location of Investigated Areas

two last formations are similar to each other everywhere in those areas. These phenomena give rise to the question whether it is stratigraphically justified to separate the Kabuh formation from the Notopuro formation.

Furthermore while in general the Pucangan formation can be separated easily from the overlying "Kabuh-Notopuro" formations, it shows within itself strong lateral variations in lithofacies over a distance of tenths of kilometers. For example the border bed (the so-called Grenzbank of van Koenigswald 1940), taken as a distinct marker bed separating two distinct sedimentary environments i.e. a marine facies of Pucangan and a fluvial one of the Kabuh formation, may in certain places be entirely lacking or become very thin and negligible, or it may even develop into more than one thin beds. This makes a stratigraphic study of the above formations more complicated than expected before. But whatever it is, in the broadest sense, it is in general litho-stratigraphically easy to separate those formations from each other. Chrono-stratigraphically however, they may differ from one place to the other, especially over great distances.

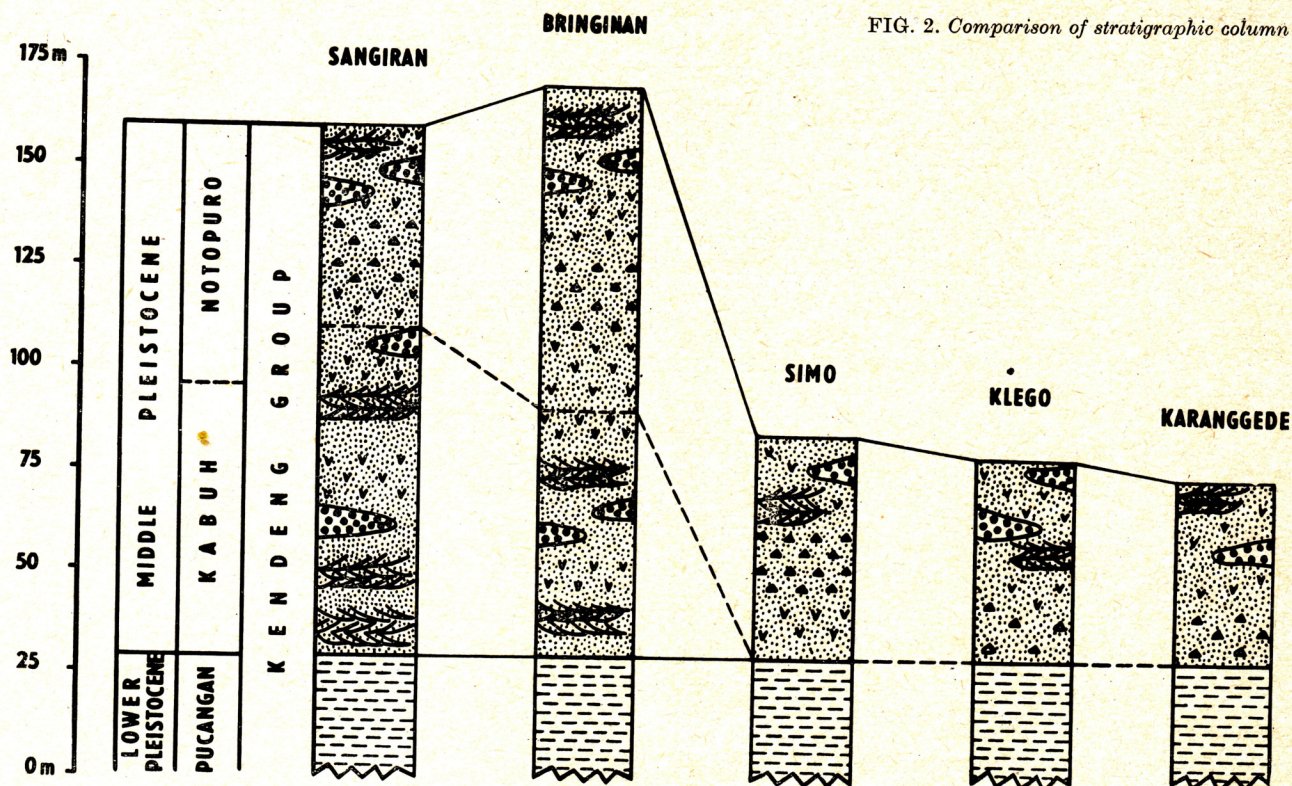
To the north and to the west as well as to the eastern direction, the formations either become thinner or wedge out. Also it is not an unusual phenomenon that it is not easy to separate one formation from the other based on lithologic characters alone, especially to the west as well as to the east of Sangiran. It seems that the area of Sangiran has a special and unique stratigraphic development which is different from the areas west and east of it. Very likely the area forms a separate basin limited by some sort of a high to the east and to the west causing the difference in the sedimentary facies.

For a detailed stratigraphic study on the Kabuh and Notopuro formations in connection with the "Sangiran flakes", a detailed measured section has been made in the vicinity of the village Ngebung exactly on the site of the triangulation point T $\frac{356}{183}$ (figs. 3 and 4). This site is the most unique in Sangiran in having a complete succession of Pucangan, Kabuh and Notopuro formations, tectites, "Sangiran flakes", and human as well as non-human vertebrate fossils.

For the purpose of this paper only the Kabuh and Notopuro formations will be discussed. Both of these formations mainly consist of sandstones of a fluvial facies with thin gravel lenses and cross-bedded sandstone layers. Vertebrate fossils are also found in both formations, and this is also the case for the calchedony pebbles and artefacts, the so-called "Sangiran flakes". Both of these last materials are found only near the top of the Kabuh and the bottom of the Notopuro formation. The interesting thing is that those artefacts are concentrated directly below as well as above the boundary between both formations. This boundary is a disconformity formed by an erosional surface, which gives an impression that it is caused by a lowering of the general base level of denudation of the area before the overlying Notopuro formation was deposited. Most likely this lowering had some connection with the formation of the erosional surface between Kabuh and Notopuro formations (Sartono 1969). The relationship of the dividing plane between both formations and the existence of "Sangiran flakes" near this plane is important. According to van Es (1931) the lower conglomerate-tuff series (i.e. the top layer of Kabuh formation) cannot be separated easily from the lower part of the Upper Conglomerate-boulder and Breccia-tuff series (i.e. lower part of Notopuro formation). This statement is understandable, and this phenomenon can also be observed in Ngebung section as well as outside Sangiran area as for instance in Simo, Klego, Karanggede, and Bringinan.

In the stratigraphic profile made by von Koenigswald (1940 fig. 2) there is lithologically speaking not much difference between Kabuh and Notopuro formations, except that both of these formations are separated by a disconformity. Von Koenigswald (1940 p. 36) took the lahar bed as the base of Notopuro formation and as such recognized it as the border between the Kabuh and

FIG. 2. Comparison of stratigraphic column



Notopuro formations, although he admitted that on certain places this bed is absent and in this case the Notopuro bed directly overlies the Kabuh bed. Like von Koenigswald (1940), van Bemmelen (1949 p. 566) also took the lahar bed as the base of the Notopuro formation, although in certain places he also ascribed the layers underlying the above lahar bed as being part of the Notopuro formation itself. From this statement can be deduced that stratigraphically speaking there is an uncertainty about the boundary between the Kabuh and Notopuro formations.

Although there is a considerable difference in opinion on the precise boundary between Kabuh and Notopuro formations among investigators of the Javanese Pleistocene stratigraphy, all of them agree that there exists a disconformity or a pseudo-conformity indicating a break of sedimentation between both beds.

From results obtained during the field works author comes to the following conclusions:

1. That the disconformity between Kabuh and Notopuro beds should not be regarded as a formational boundary in strict stratigraphic sense.
2. The boundary between the Kabuh and Notopuro formations is an erosional surface which is possibly caused by a lowering of the general base level of denudation of the area.
3. In the broadest sense, the Kabuh and Notopuro formations have been deposited in the same environmental conditions.
4. Lithologically speaking, the Kabuh and Notopuro formations should be regarded as belonging to

one and the same formation. For this latter, the name of Kendeng group is proposed to include Pucangan, Kabuh and Notopuro formations as was given by K. Martin in 1900 (op. cit. Marks 1961, 67—69).

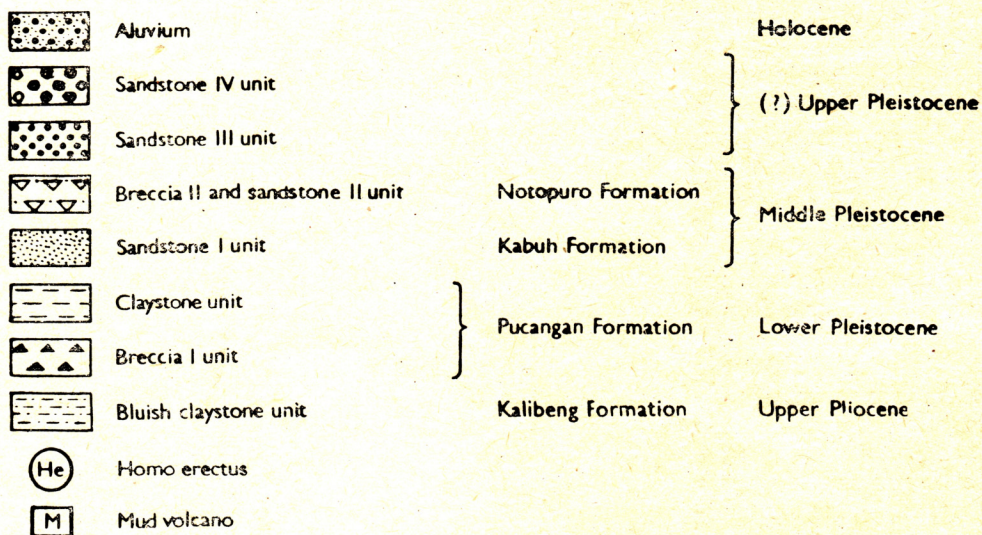
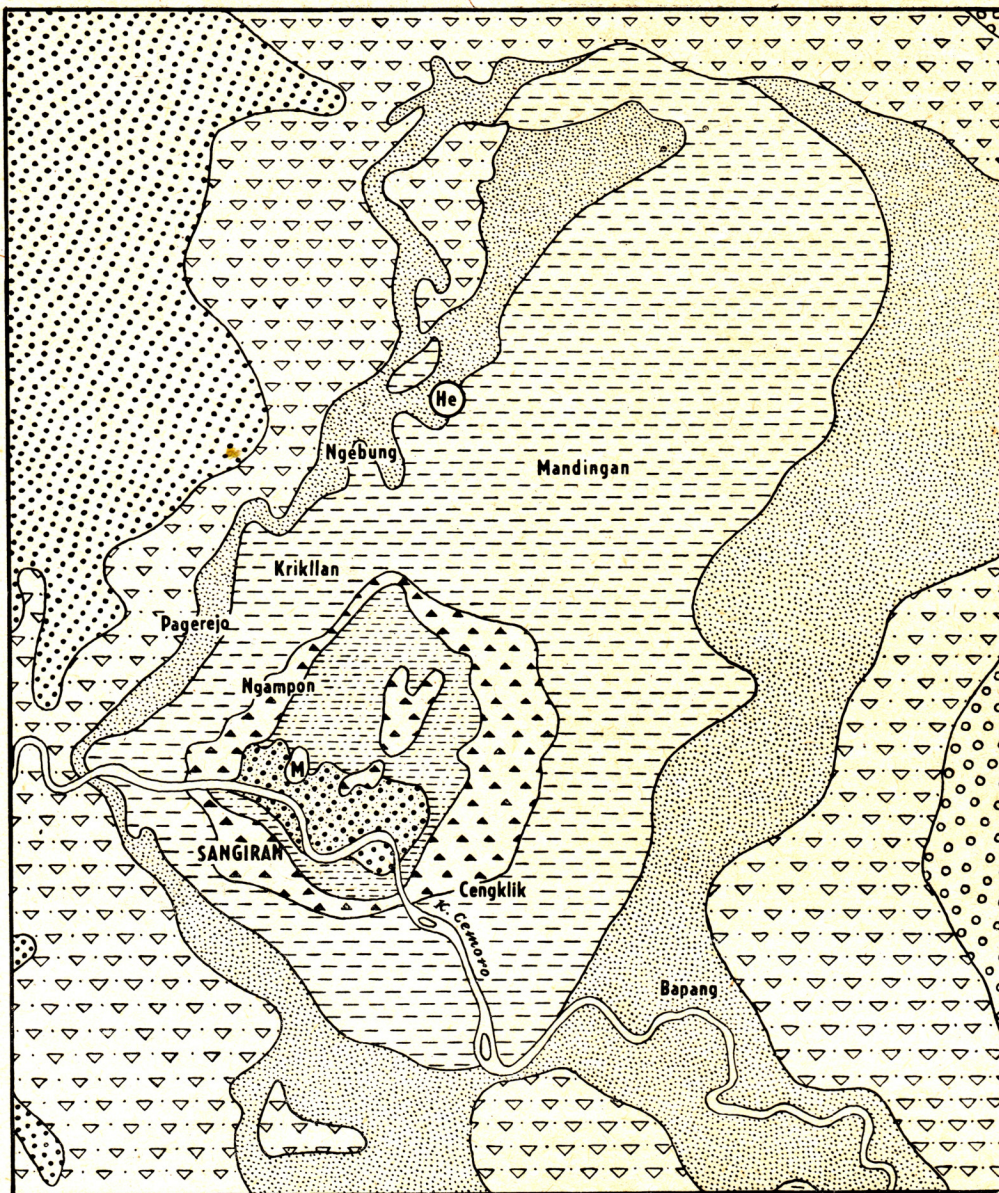
THE "SANGIRAN FLAKES"

The first discovery of the artefacts from Sangiran had been done by von Koenigswald in 1934 (Koenigswald 1936), later on published jointly by von Koenigswald and Gosh (1973). There are however still conflicting ideas about these artefacts regarding their nature, age, stratigraphic location, as well as typological resemblance with artefacts from other Indonesian sites. A detailed discussion about these artefacts lies outside the scope of this paper; readers are referred to the various publications concerning them. It is well within the scheme of this paper to discuss the relation between these artefacts and their stratigraphic locations.

As mentioned above, there is still no agreement as to where the artefacts are located stratigraphically. The opinions about this range as follow:

- a) in the "untere Konglomerat- und Tuffschichten" of the Kabuh formation (Koenigswald 1940 p. 35),
- b) in the "obere Konglomerat- und Tuffschichten" of the Notopuro formation (Koenigswald 1940 p. 36),
- c) near the boundary between the Kabuh and Notopuro formations,
- d) in the uppermost bed of Notopuro formation (de Terra 1943 p. 456).

FIG. 3.
Geology
of Sangiran
area.



NOTE: For the geological map of the central part of Sangiran Dome see Sartono (1978).

It is therefore assumed that the "Sangiran flakes" are embedded solely in the Kabuh formation or in the Notopuro formation, or within both Kabuh-Notopuro formations, or restricted only near the boundary between Kabuh and Notopuro formation.

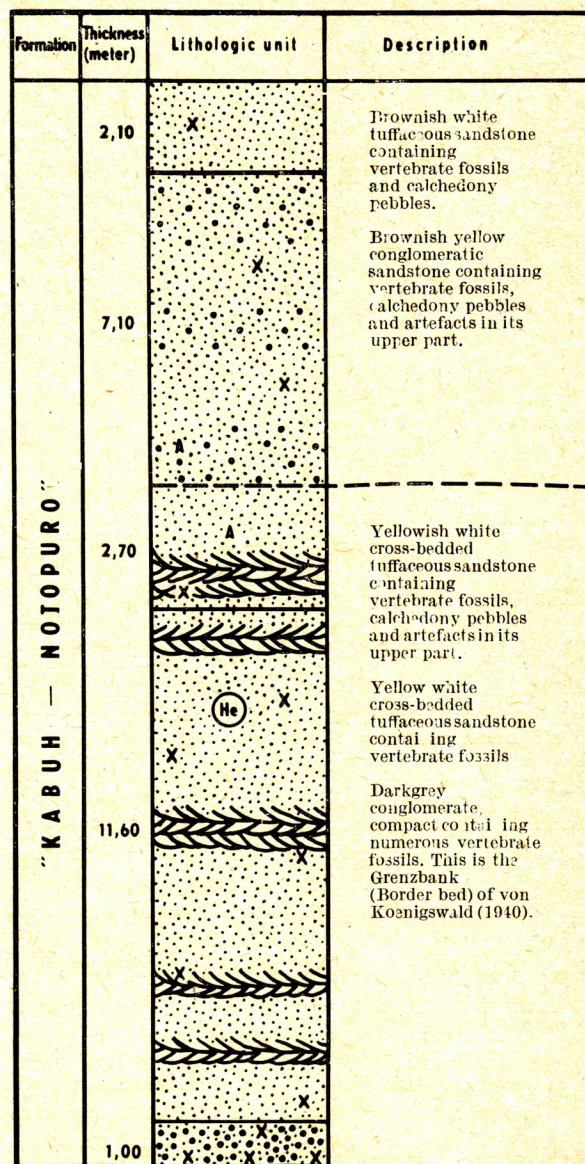
To add more to the above stratigraphic confusion is the fact that to some investigators many of the Sangiran flakes, even most of them, are pseudo-artefacts or no artefacts at all. During author's investigation near Ngebung, only three artefacts have been found among eighty three calchedony pebbles, thus about a mere 3.6 percent. But this small percentage is important in the sense that those artefacts are found *in situ*, and their exact stratigraphic positions are known, i.e. they are restricted near the boundary between the Kabuh and Notopuro formations (fig. 4). Efforts to collect artefacts from the lower parts of Kabuh formation or from the upper part of Notopuro formation have failed so far.

The size and the nature of the material of the artefacts are interesting too. They are generally fairly small and not exceeding 5—7 centimeters in dimension (fig. 5). This is in great contrast to the dimension of artefacts from Baksoko (Pacitan), Flores, Timor, or South Celebes. However, during a recent investigation in the Sangiran area, a large flake tool was collected near Ngebung measuring about 9.5×8.5×3 cm. This artefact is not made from the usual calchedony material. It is a pity that the stratigraphic position of this artefact is not known, and so far it is the first artefact found in Sangiran being different from the usual "Sangiran flakes", in size as well as in material. A special report will be given on this artefact in the near future.

In Central Java calchedon rocks are found in the Southern Mountain, i.e. in the Gunung Sewu. The calchedon material from which the "Sangiran flakes" had been produced most probably originated from that area. They might be transported by the Pleistocene Bengawan Solo (Solo River), which had changed its course from flowing to the south into the Indian ocean during the early Pleistocene to the northern direction in the following late Pleistocene epoch. The southern course of the early Pleistocene Bengawan Solo is now indicated by the dry valley of Goritontro (Sartono 1975). The change of the direction was most probably caused by a lowering of the general base level of denudation of the area as the consequence of an ice age occurring toward the end of the deposition of Kabuh formation, indicated by the presence of an erosional surface between this formation and Notopuro formation (fig. 7).

THE HUMAN FOSSILS

In this chapter only human fossils of Pleistocene age will be considered. So far, there are also differences of opinion regarding the taxonomy of the early men from Java. Even the conservative notion like *Pithecanthropus* is still in use by certain investigators on human paleontology. From the



LEGEND: He — *Homo erectus* fossil.
A — Artefact.
X — Vertebrate fossil.

FIG. 4. Measured section of "Kabuh-Notopuro" formation near Ngebung (Sangiran).

original two genera of Pleistocene man consisting of *Pithecanthropus* and *Meganthropus*, the taxonomy of these early men evolved into 3 types of *Pithecanthropus* while *Meganthropus* remains as it is (Koenigswald 1968).

Recently, a reappraisal has been carried out on the taxonomic status of the Javanese Pleistocene hominids which suggests the existence of one genus of *Homo* only consisting of two species, these are *Homo erectus* (the former *Pithecanthropus*) and *Homo palaeojavanicus* (the former *Meganthropus palaeojavanicus*) (Sartono 1975b, 1976). Each of these species again consists of two subspecies. They are *Homo erectus ngandongensis* and *Homo erectus trinilensis*, while the second species comprises *Homo palaeojavanicus sangiranensis* and *Ho-*

FIG. 5. "Sangiran flakes" from Ngebung (Sangiran).



mo palaeojavanicus modjokertensis (fig. 6a). If the various subspecies of the Pleistocene man are put in their respective stratigraphic positions, then the following scheme will be obtained, i.e. the progressive *Homo erectus ngandongensis* with the larger brain and fragile mandible was the late one evolving from the earlier primitive *Homo erectus trinitensis* having a smaller brain volume but a more robust mandible. This latter in turn may evolve from the earlier *Homo palaeojavanicus modjokertensis* with the more fragile mandibles than the more robust mandible of the earliest *Homo palaeojavanicus sangiranensis* (Sartono 1976 fig. 12, 1979a fig. 2).

Author admits that the above taxonomic scheme is not a final one. Future discoveries on the Javanese Pleistocene hominids will surely add more to our knowledge of these early men. Especially of great importance for human evolution is to know the relationship between *Homo erectus* and *Homo palaeojavanicus*.

When this paper was finished, in July 1979 author obtained a skull from Central Java which morphologically is entirely different from the skull of *Homo erectus*. This specimen originated from the Lower Pleistocene Pucangan formation. Since this skull is also different from the *Homo palaeojavanicus modjokertensis* (syn.: *Pithecanthropus robustus*, *Pithecanthropus modjokertensis*, *Pithecanthropus IV*), author temporarily assigned the specimen to *Homo palaeojavanicus sangiranensis* (syn.: *Meganthropus palaeojavanicus*, *Meganthropus A*) until new data come up of this very exciting discovery.

THE ENVIRONMENT

It is strange that in Sangiran artefacts are found only near the top part of the Kabuh formation and the bottom of Notopuro formation, although early human remains are obtained also in lower levels of Kabuh formation and way down in the underlying Pucangan formation. *Homo paleoja-*

vanicus remains, (syn. *Meganthropus palaeojavanicus*), for instance, are confined only to the Pucangan formation while the primitive small-brained *Homo erectus* remains are found in the upper parts of Pucangan formation up to the lower levels of Kabuh formations. So far an explanation for the absence of artefacts in the lower levels of Kabuh formation and in the underlying Pucangan formation cannot be given yet, but there are several possibilities for this, i.e.:

- a) That *Homo palaeojavanicus* (syn. *Meganthropus palaeojavanicus*) and the primitive small-brained *Homo erectus* still were not able to produce stone artefacts. Maybe they only knew the art of making artefacts from wood or from other rather soft materials which easily decayed and were difficult to be preserved in nature in the course of time.
- b) The above early hominids did not yet know the technics of how to make artefacts at all, made of stone or any other materials.
- c) We do not yet hit the right spot of those artefacts produced by the above early hominids.

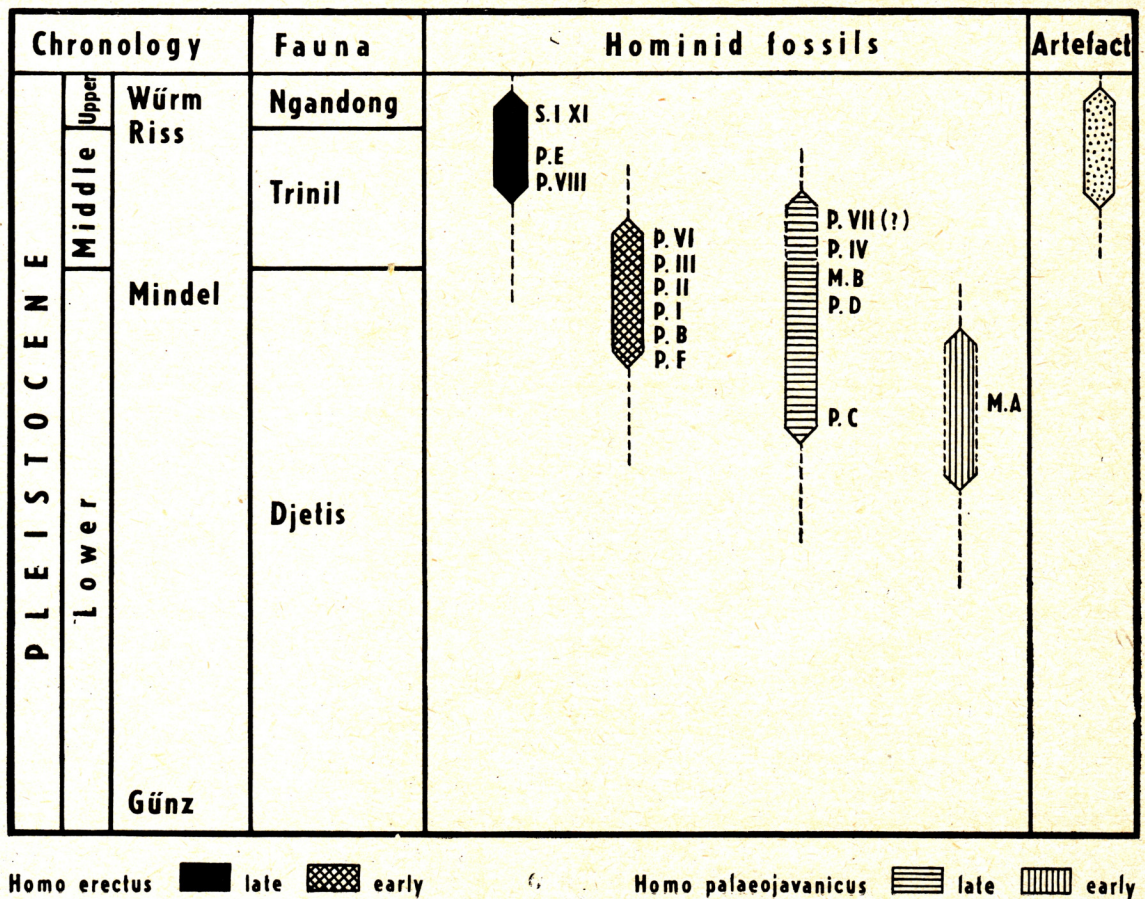
Of those three possibilities put forward the most plausible one is the last, because seen from the fact that early Pleistocene hominid fossils are found in that area it is difficult to understand that late Pleistocene artefacts suddenly appear in the Sangiran stratigraphy without having an earlier history.

If the last possibility is the most acceptable one, then where should we focus our attention to find the artefacts of *Homo palaeojavanicus* (syn. *Meganthropus palaeojavanicus*) and of the primitive small-brained *Homo erectus*? For this purpose, we should first take a look at the distribution pattern of Kabuh as well as Pucangan formations, in other words a paleogeographic reconstruction should be made first of both formations in space as well as in time, and then to locate the fossils concerned and eventually their associated artefacts. However, this is not so easy because in the first place both for-

GENUS	SPECIES	SUBSPECIES	SPECIMEN	FORM
Homo	H. erectus	H. e. ngandongensis	Javanthropus soloensis I-XII Pithecanthropus VIII " E " A (probably)	Late
		H. e. trinilensis	Pithecanthropus I " II " III " VI " VII (probably) " B " F	Early
	H. palaeojavanicus	H. p. modjokertensis	Pithecanthropus IV (maxilla) " IV (cranium probably) " V (probably) " VII (probably) " C " D Meganthropus B	Late
		H. p. sangiranensis	Meganthropus A	Early

FIG. 6a) Taxonomy of Javanese Pleistocene hominids (after Sartono 1976)

FIG. 6b) Stratigraphic position of artefacts and hominids in Sangiran (Sartono 1979)



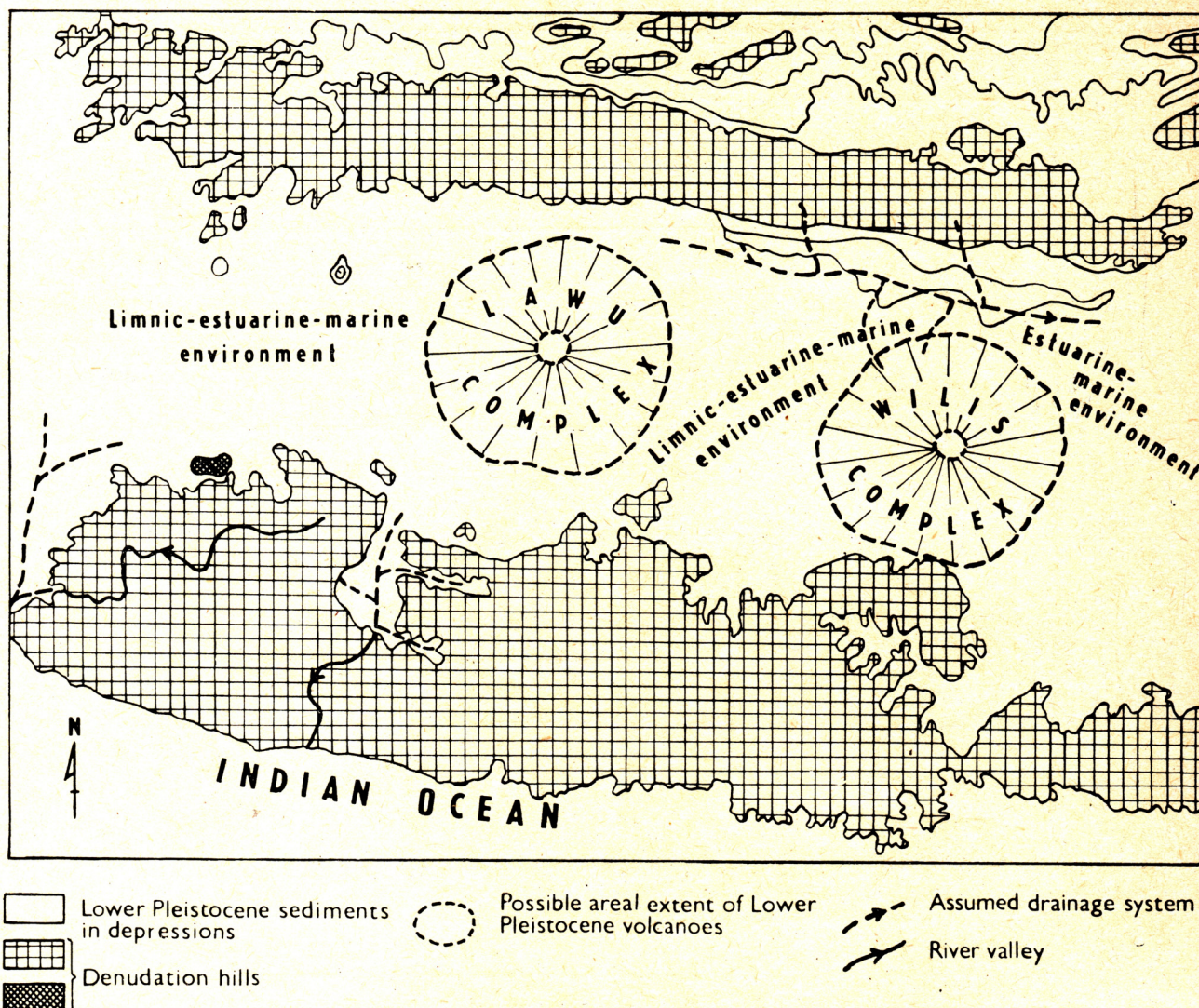


FIG. 7a) Lower Pleistocene Paleogeography of the upper reaches of Bengawan Solo (After Sartono 1975)

mations are covered by thick young Holocene volcanics and/or young alluvial sediments.

A Lower Pleistocene palaeogeographic reconstruction is shown in figure 7a (Sartono 1975) which shows that during this period the area of Sangiran was still inundated by shallow sea or estuarine and lakes. These are indicated by the facies of Lower Pleistocene sediments of the investigated area. This almost flat low-lying area is called the Solo Zone which was bounded in the north as well as in the south by respectively the Kendeng Hill range and the Southern Mountain range. Somewhat in the middle of the flat zone were two volcano complexes, i.e. the Lawu volcano in the west and the Wilis volcano in the east. To the east the Solo Zone faced an open sea while to the west it is not known for sure whether its limitation was also an open sea because of the thick cover of young volcanoes. A part of the zone surrounding Sangiran was occupied by the Sangiran basin with its special facial development.

The stratigraphically lowest site of human fossil ever recorded in Sangiran is the gracile *Homo*

palaeojavanicus (syn. *Pithecanthropus modjokertensis*, *Pithecanthropus C*) which was found at a height of about 0.7 of the thickness of Pucangan formation measured from its base (Sartono 1970). On the other hand non-human vertebrate fossils have been obtained even at the lowest levels of Pucangan formation and *Mastodon* (*Trilophodon*) *bumiajuensis* has been reported from Sangiran possibly from the *Corbicula*-beds (Koenigswald 1940). This specimen is typical from the late Pliocene Kaliglagah fauna in Bumiayu region. From these it may be concluded that the Sangiran basin may not be habitable for the early hominids during the earlier part of the early Pleistocene period. The whole area may be still a vast low-lying marshy land with coastal lakes, and now and again inundated by the early Pleistocene sea. In such conditions only water animals as for instance *Crocodylus*, *Gavialis*, *Trionyx*, *Chitra*, and large land animals such as *Mastodon*, *Stegodon* and *Hippopotamus* could inhabit the area. Early Pleistocene men in general may still be confined to the shallower parts of the basin such as the shores of the bordering Kendeng Hill range

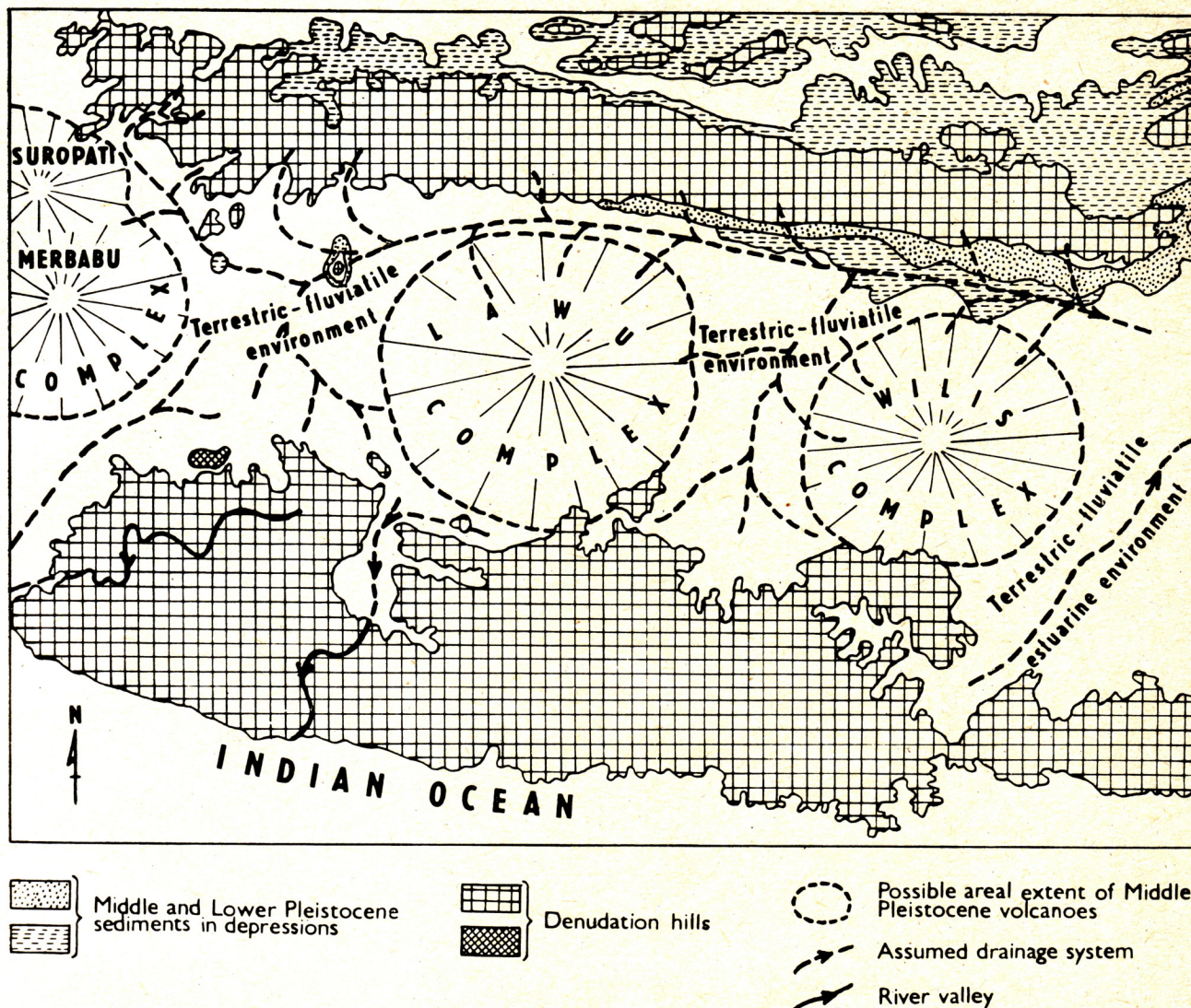


FIG. 7b) Middle pleistocene paleogeography of the upper reaches of Bengawan Solo (After Sartono 1975)

in the north and the Southern Mountain range in the south, although some of them may venture into this inhospitable area and perished there as indicated by the few fossil remains of early Pleistocene men found in the Sangiran area.

The above picture changed dramatically during the later parts of the Pleistocene epoch in which the deposition of Kabuh and Notopuro formations took place. In this period the Solo Zone became dry land (fig. 7b and c), very likely because of the regression of the sea caused by an ice age instigating the decrease of the sea level and the accompanying lowering of the general base level of denudation of the area. Fluvial and lahar deposits characterized the whole sedimentation of the basin. During this period late Pleistocene men could swarm into the central parts of the Solo Zone basin, which was not possible before during the early Pleistocene.

It seemed that the change of environment had a decisive influence on the life of the primitive *Homo palaeojavanicus*. They perished at the end of the early Pleistocene. On the other hand, the pri-

mitive small-brained *Homo erectus trinilensis* which already existed during the later part of the early Pleistocene could survive a little longer till the early part of the late Pleistocene period, then afterwards they met their extinction too. There are indications that *Homo erectus trinilensis* replaced the more primitive *Homo palaeojavanicus* sometime toward the end of the early Pleistocene. Of these primitive small-brained *Homo erectus* no remains of their artefacts have been discovered so far, neither are those of *Homo palaeojavanicus*.

Towards the end of the late Pleistocene epoch occurred an invasion of another more progressive human group, i.e. the large-brained *Homo erectus ngandongensis*. They seemed to be the forerunner of the more progressive *Homo sapiens neanderthalensis*, with which they share many morphological similarities. These similarities are so striking that they have been classified by certain authors as a neanderthaloid (Weidenreich 1951). Their living sites seemed to be concentrated near early rivers during the Upper Pleistocene. This is substan-

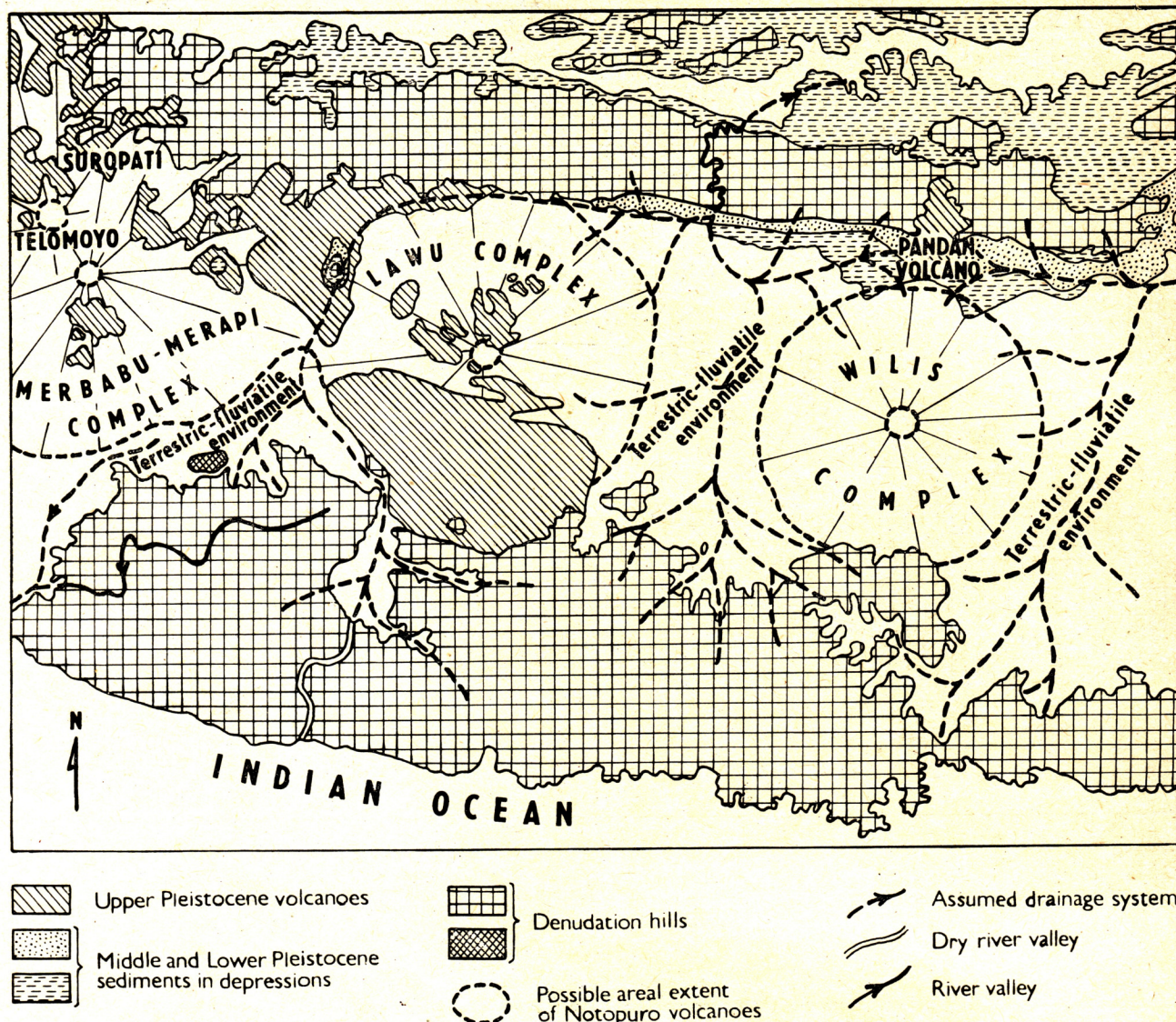


FIG. 7c) Upper pleistocene paleogeography of the upper reaches of Bengawan Solo (After Sartono 1975)

tiated by the fluvial facies of the localities in which they have been unearthed, among others the crania in the Upper Pleistocene Solo terraces in the village of Ngandong (Haar 1931, Oppenoorth 1932), the site of Sambungmacan formerly assumed as Middle Pleistocene (Jacob, Soejono, Freeman, Brown 1978) but later on established as Upper Pleistocene (Sartono 1979b), and the site of *Homo erectus* skull VIII (Sartono 1978). All of these progressive late Pleistocene *Homo erectus* are found in association of artefacts, which in Sangiran is known as "Sangiran flakes" (fig. 6b). The sites of early men clearly indicate that the environment changed from the early Pleistocene lacustrine-estuarine-marine into late Pleistocene terrestrial facies. This may explain also why artefacts are found in the central parts of the Solo Zone during the late Pleistocene epoch, whereas early Pleistocene artefacts are absent in the Sangiran basin, so far.

CONCLUDING REMARKS

All available data of the Sangiran area so far concerning the geology in general, the stratigraphy, the non-human and the human fossils as well as the artefacts suggest the following picture (fig. 7).

The so-called "Sangiran flakes" are found only in relation with one particular human group, i.e. the progressive *Homo erectus ngandongensis*. In this paper it is therefore suggested that this latest representative of the Javanese Pleistocene early man was the most probable producer or maker of the artefacts from Sangiran. So far, nowhere in the Sangiran stratigraphy have been found artefacts in the lower parts of the Kabuh formation or in the underlying Pucangan formation, and neither are they discovered in the higher levels of Notopuro formation.

Whether the primitive *Homo erectus trinilensis* and *Homo palaeojavanicus* already knew how to make artefacts is still a matter of conjecture.