

delta is based on the outermost palaeo-channels (earlier river courses) and beach ridges¹⁴. The western margin of the delta is not uniform in both the sectors on either side of the present river course. Laterites bound the western (landward) margin of the Penner delta.

A number of archaeological tools like handaxes and flake tools were collected mainly from Gollapalem and Kammapalem during the present investigation. Handaxes were collected from Gollapalem site, which is about 2 km from Buchireddypalem. Kanigiri reservoir is situated on the left of the site. Secondary laterites are exposed in the area. Acheulian handaxes belonging to Lower Palaeolithic were collected from these laterites. Kammapalem is another site located about 12 km north-east of Gollapalem. The present paper is an attempt to understand the distribution of laterites along the landward margin of the Penner delta with particular reference to stratigraphy and cultural evolution.

The laterites of Nellore coastal regions are surrounded by coastal alluvium in the east and crystalline rocks (migmatized gneisses/schists) in the west. Quartzitic rocks are formed as isolated mounds which rise to 20 m elevation and continue in the form of ridges, running in NE-SW direction (Figure 1) rising about 60 m above msl. Most of the coastal regions of Nellore have a thick cover of recent alluvium of Penner deltaic system and such surface geology is rather obscure. The generalized stratigraphy of the study area is given in Table 1.

Extensive lateritic horizons are extended along the western margins of the Cauvery, the Penner, and the Mahanadi deltas, while a few patches occur in the Krishna-Godavari delta margins and along the Visakhapatnam coast. While explaining the significance of cliffs, wave-cut terraces and sea caves on north and south of Visakhapatnam coast against the prevalence of depositional landforms on the rest of the coast, Thimma Reddy¹⁵

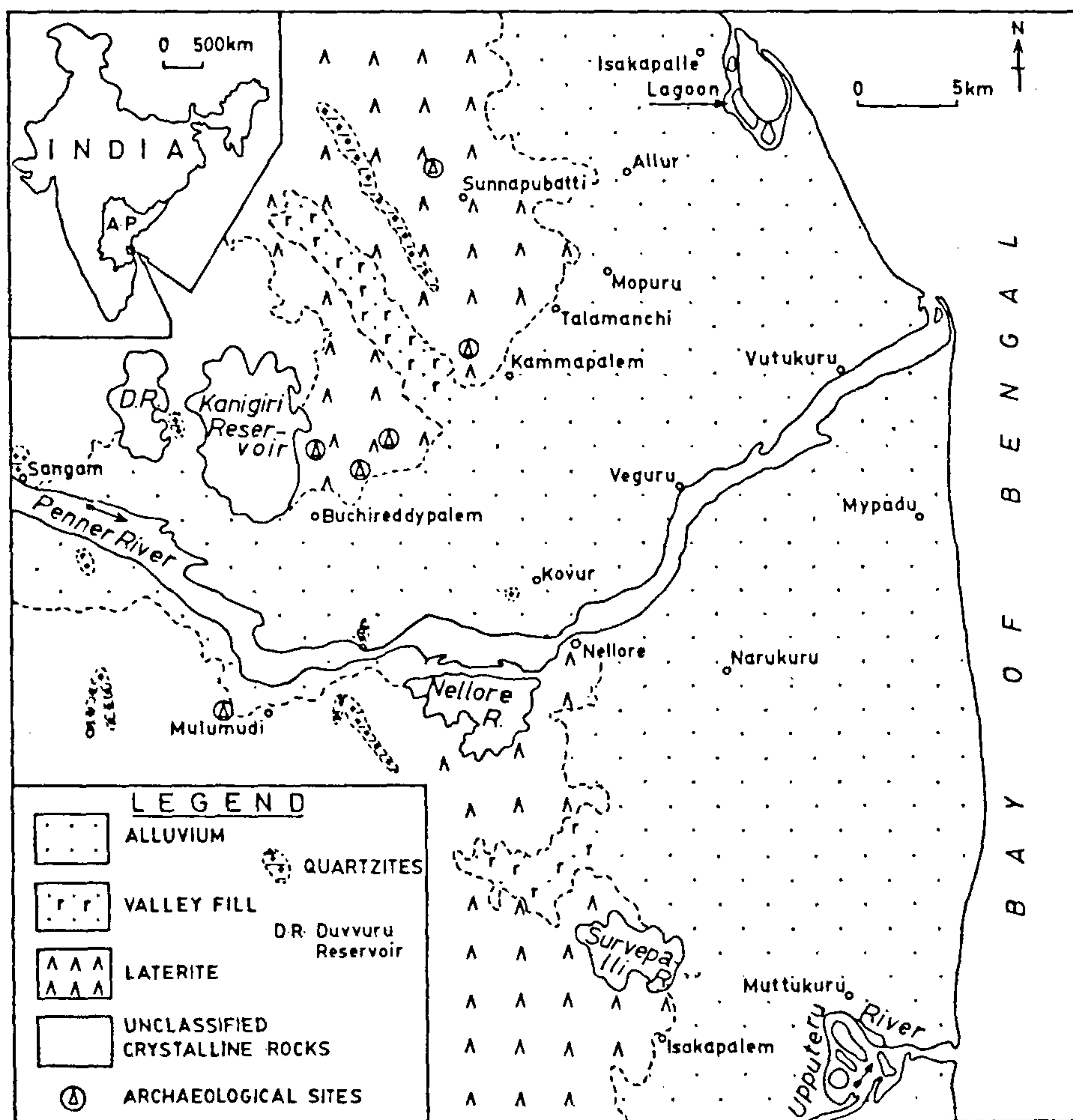


Figure 1. Location of archaeological sites and geology of Nellore area, east coast of India.

quoted Selivanov¹⁶, who identified rock terraces and caves of marine origin at an elevation of about 7 m as products of the Riss/Wurm interglacial (3rd interglacial), when the sea level was estimated to be 7 m above the present in many parts of the world. This could be one of the terraces associated with north Andhra Pradesh and also of Chennai.

Out of the two types of laterites occurring in the area, primary laterites or *in situ* laterites are around Kammappalem west of Allur. These are about 20 km from the present coastline and rise to an elevation of about 20 m above the msl. The primary hard and compact laterites are extensively quarried for building materials. Laterites are directly resting on the granitic gneisses/schists and form flat monotonous plains, gently sloping towards the east. Geographical extension of these laterite deposits is restricted to the Nellore area in the absence of prominent drainage development over these laterites. There are a few ephemeral streams draining over these laterites and joining into the Penner river. Mostly, flake tools are collected from the surface of primary laterites, near Kammappalem and Sunnapubatti villages (Figure 1).

Secondary laterites are of detrital nature and are made of pebble gravels, shining reddish-brown in colour and

occasionally mixed with yellowish-brown sand. These are at some places resting directly on the primary laterites north of Kammappalem and they rise about 30 m above the msl. Lateritized pebble to conglomeritic zone is observed north of Buchireddypalem, which extends to a length of 2 km in east-west direction. Thick boulder conglomerate of about 5 to 8 m thick is clearly observed from the well sections west of Isakapalem (Figure 1). The boulder conglomerate zone further extends to the south of the present study area. This is more or less a continuous zone, the pebbles are well rounded and are derived from Cuddapah (Nagari) quartzites¹⁷. Secondary type gravel/boulder zones are encountered in the sub-surface bore holes at the middle part of the Penner delta at a depth of 45 to 50 m at Veguru, Kuditipalem and Mypadu villages¹⁸ (Figure 2).

Handaxes were normally made of quartzite which is coarse grained. Some of these handaxes as well as flake tools might represent the mixed conditions. Handaxes might correspond to laterites, while flake tools may be brought from a nearby source, by transportation or left over remains from the upper regolith cover after they are washed away.

Handaxes and flake tools are two different characteristic elements belonging to two different cultural phases.

Table 1. Generalized stratigraphy of the study area in the Nellore region

Age	Gross lithology	Maximum thickness (m)	Depositional environment
Overlap			
Holocene	Alluvial sands, clays and kankar	40 +	Alluvial and deltaic
Early Holocene	Marine and estuarine alluvium with clay containing many Lamellibranchs and Gastropods	15-20	Deltaic-shallow marine
Pleistocene*	Laterite and lateritic conglomerate containing quartzite/gneiss pebbles (artifacts of Acheulian age recovered)	15	Fluvial
Undefined Tertiary (Paleogene)	Black claystone, clayey sand stone and bands of sand stone known from bore holes only	450-500	Deltaic to shallow marine
Nonconformity			
Archaean	Igneous and metamorphic basement (Nellore supra crustal rocks)		

*Pleistocene - Geoarchaeological subdivisions²⁰

P A L A E O L I T H I C	Upper	P L E I S T O C E N E	Upper	Potwar	Ice Age	Narmada
	Middle			T ₄	4th Glaciation	Gravel of the Regur Group
				T ₃	Interglacial	Orange silt
			Middle	T ₂	3rd Glaciation	Sandy gravel
				T ₁	Interglacial	Pink silt
				Boulder congl.	2nd Glaciation	Basal gravel
	Lower		Lower	Pinjaur	Interglacial	Wet phase resulting in Lateritic formation
				Tatrot	1st Glaciation or Villafranchian	

They also belonged to two different periods, Lower and Middle Palaeolithic. These two characteristic tool types (Figures 3 and 4) were collected in different sites from the western margin of the Penner delta.

Seven handaxes were picked up from the secondary lateritic surface. These are advanced types as indicated by their shape, size, technique of manufacture and working edge. There are three types of handaxes having different shapes. They are ovate, cordate and lanceolate (Figure 3). There are 174 unfinished artifacts such as handaxes which were in the process of being made, simple cores, flakes, etc. (Table 2).

Flake scars on these tools are conspicuous and the flakes appeared to have been detached by the use of developed technology like cylinder hammer technique for finishing. Except lanceolates, which are fresh, the other handaxes are heavily patinated. In the Indian context, all these can be brought under acheulian tool type of early Upper Pleistocene. For digging plant roots and hunting early man could have collected water-worn pebbles in the river valleys and prepared implements such as handaxes and flake tools. Penner river with its various expanded palaeo channels (older river courses) must have attracted biotic community as a main water resource¹⁹.

Occurrence of the flake tools like scrapers, points and borers on the western margin of the Penner delta indicates a different cultural horizon. A shift from the usage of a heavy tool tradition to flake tools is an indirect evidence for evolved form of *Homo erectus* (Pre-Neanderthal

species) which got adapted to new climate. In the changed environment, movement of new animal species, availability of medium to fine grained quartzite and chert and introduction of advanced techniques for the production of hunting inventory took place. As huge acheulian tools were manufactured and used during the period contemporaneous to early Upper Pleistocene, flake tools occupied a prominent place thereafter. If flake tool complex of typological series II is dated to approximately 39,000–23,000 BC (ref. 20), acheulian handaxes can be dated far below that date.

Since the formation of laterites involves a long geological process, this process in the region could have begun during early Pleistocene period. Lateritic reddish-brown colour patination can also be seen on the acheulian tools (Figure 3).

The length, breadth and thickness of the ovate handaxes specimen is 15.05 cm × 10.1 cm × 4.25 cm. There are

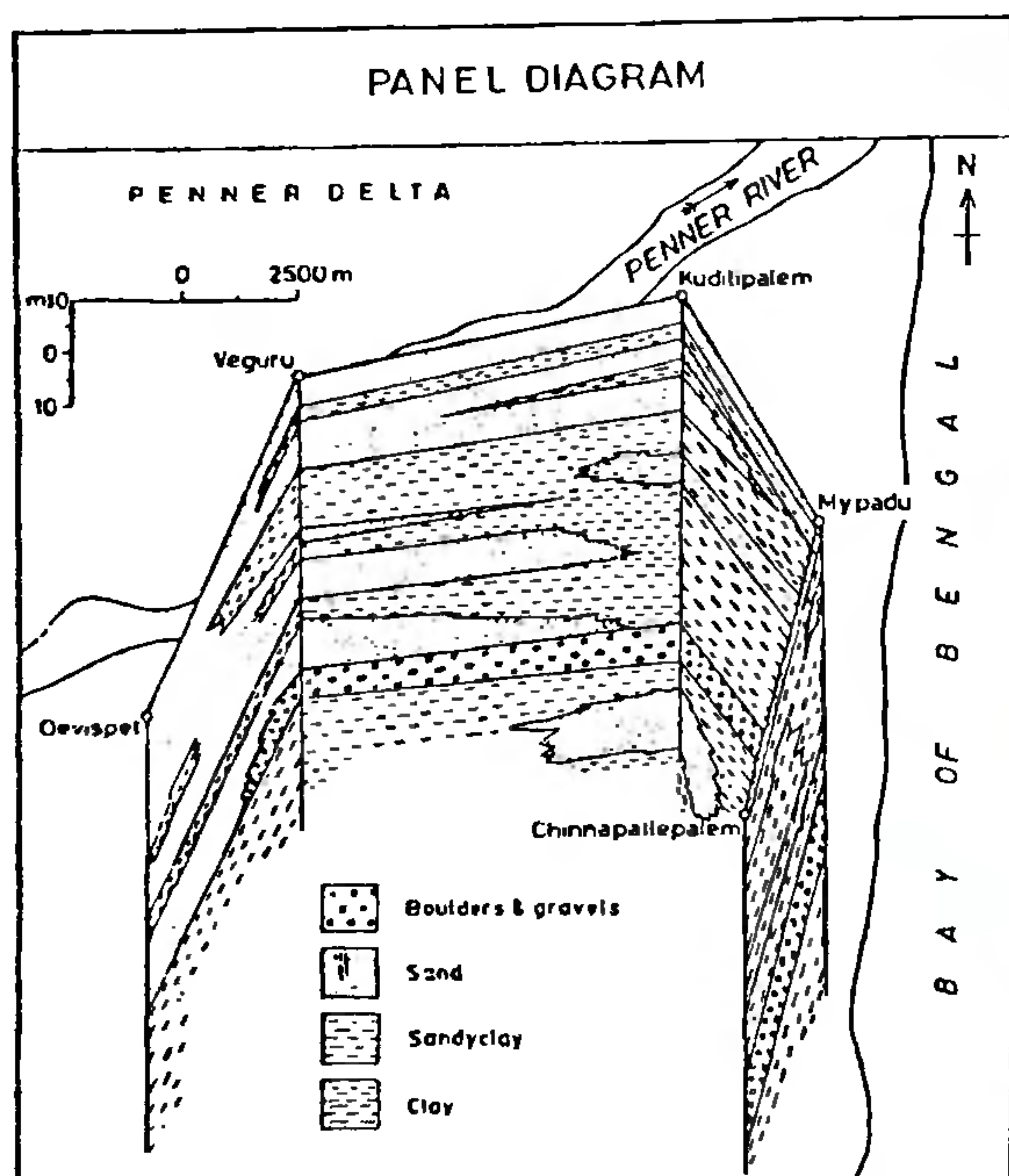


Figure 2. Panel diagram showing the subsurface pattern of boulder and gravel bed disposition in the Penner delta.



Figure 3. Acheulian handaxes collected from north of Buchi-reddipalem.



Figure 4. Flake tools collected from Mulumidi, Kammapalem and Sunnapubatti in Nellore area.

about 8 flake scars on the upper surface while a few are found on the other surface (Figure 5 *a*). The edges around the periphery are regular. It is slightly patinated to red and also it looks slightly weathered (Figure 3). It is made of coarse-grained quartzite. This ovate handaxe must have been prepared on elongated split nodule as indicated by its plain base on the ventral surface. The surface is comparatively smooth, the outlines symmetrical and the section is in the shape of a lens. Positive bulb of percussion can be clearly seen on the same surface. Direct percussion and cylinder hammer techniques could have been used for tool making. Such ovate handaxes, which evolved from abbevillian handaxe type were used by acheulian man during Lower Pleistocene. Singh²¹ opined that the sharp-pointed and edged handaxes and all-round sharp-edged ovates might have been used not only as spears but also as knives and missiles to attack animals and tear and shear their flesh. But Leakey and Arkell²² have in fact showed that some forms of acheulin handaxe are excellent for skinning game. Jefferys²³ has suggested that the elongated edged ovates could have been used as weapons (bolts) against flocks of water fowl. Fagan²⁴

called handaxes as multipurpose tools. Sankalia²⁵ opined that the heavy butted handaxes were used as all-purpose tools, including digging.

Except the shape (heart), the function of the cordate handaxes is almost similar to the ovate. It measures 13.45 cm × 8.35 cm × 4.1 cm. There are about five flake scars on both the surfaces and the flakes seem to be removed from the center to the periphery. The cutting edge is regular and it has a pointed tip to the left at the proximal end of the specimen (Figure 5 *b*). In order to get a pointed tip, small flakes were removed at the proximal end of the ventral surface, which is also plain. It is symmetrical with broad, rounded butt. The section is symmetrically bi-convex. A small portion of the cortex at the butt-end is left unworked. It is slightly patinated to a greyish colour and this also looks slightly weathered (Figure 3).

The maximum length, breadth and thickness of the lanceolate handaxes are 10.55 cm × 5.5 cm × 2.5 cm. This tool is of pointed type (Figure 5 *c*). Such acheulian tools with notches in the lateral sides might have been hafted in a bone or wood handle²⁶ in order to use them as spears. The raw material used for the manufacture of this tool is

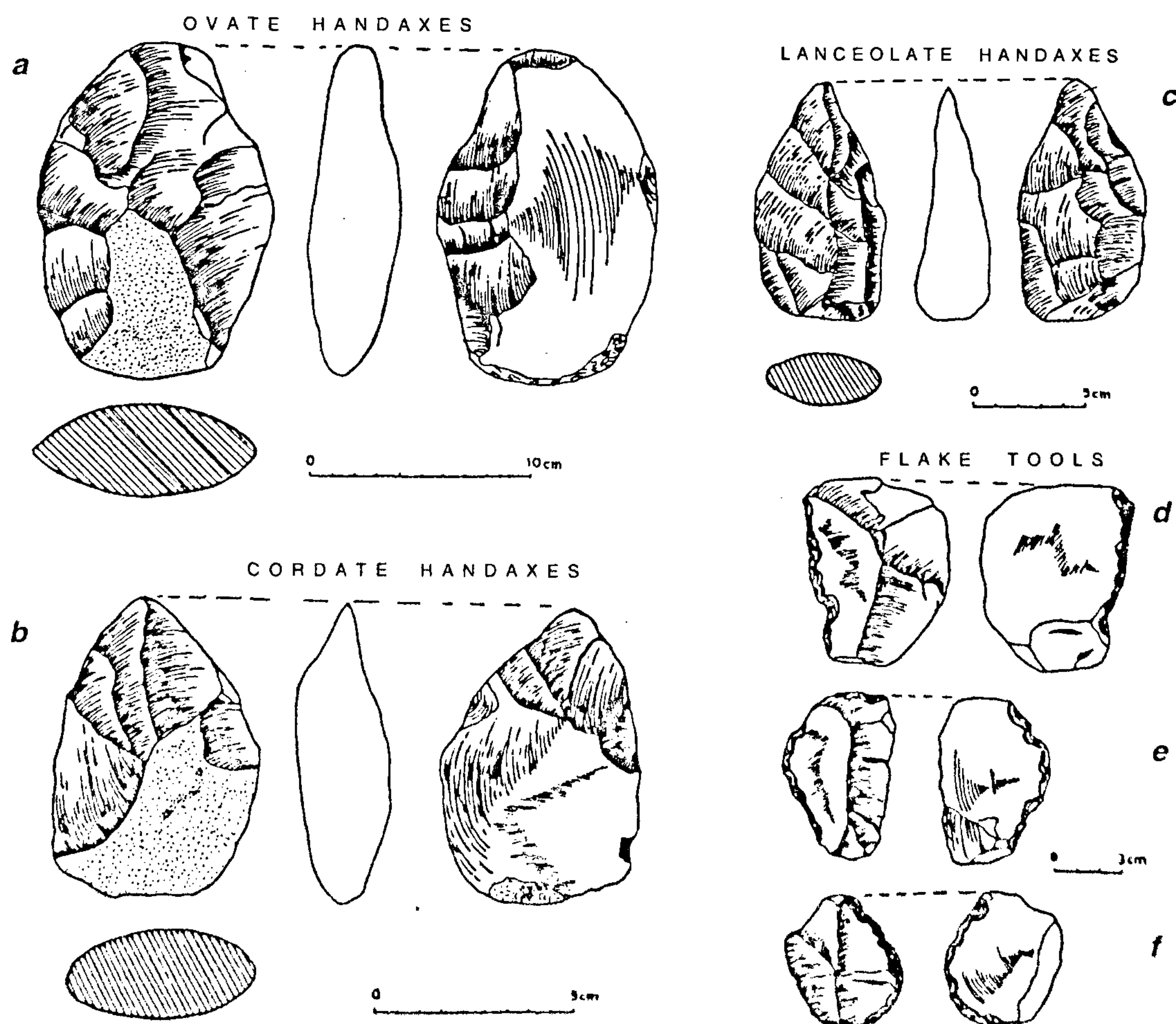


Figure 5. Illustrations of archaeological tools from Nellore area. *a*, Ovate handaxes (15.05 cm × 10.10 cm × 4.25 cm); *b*, Cordate handaxes (13.45 cm × 8.35 cm × 4.10 cm); *c*, Lanceolate handaxes (10.55 cm × 5.5 cm × 2.5 cm); Dimensions of flake tools *d*, 8.45 cm × 5.96 cm × 2.2 cm, *e*, 7.7 cm × 4.7 cm × 0.95 cm; *f*, 5.75 cm × 4.9 cm × 2.6 cm.

coarse-grained quartzite and the flakes were removed on both surfaces. The regularity of the tool and its pointed end gave an appearance of a laurel leaf.

Generally middle Palaeolithic is characterized by flake tool complex. Preparation of implements on flakes began after slight climatic changes occurred during Upper Pleistocene. New techniques were also developed. Tools made by 'levellois' or 'prepared core' technique were mostly used. Selection of raw material, and quartzite of a better quality for preparation of flake tools is interesting. Different types of scrapers, borers and points were manufactured on medium to fine-grained quartzite for use in the changed environment. This can be examined from the texture of the raw material.

A few examples that were collected (Figure 4) in the western margin of the Penner delta are described here as follows: From Kammapalem, 26 finished and 93 unfinished artifacts were collected. The former type includes scrapers (17), points (6) and borers (2). There are 7 straight-sided, 7 convex and 3 notched scrapers. Triangular-shaped points (6) and one-leaf shaped point are also seen. The unfinished artifacts (93) consist of core flakes, levellois flakes and chips (Table 2). The working edge is confined to only one side and these scrapers might have been used for scraping skin or cutting the flesh, etc. Borers could have been used for making holes and points might have been used as arrow heads in bow and arrow for hunting.

Figure 5 *d* shows a flake tool whose upper surface has four flake scars. It is more or less rectangular in shape. The ventral surface is plain with a small depression at its distal end indicating that it is removed from a medium-grained quartzite core by using an intermediary tool like punch. On one side, the scraping edge is prepared which is straight except for a small notch at its distal end.

Figure 5 *e* shows a convex scraper as indicated by its scraping edge on one side. It is thin and flat and looks like a levelloisian flake. Bulbar region can be seen on the ventral surface. Raw material used is quartzite.

Figure 5 *f* shows a levelloisian flake. There are five flake scars on the upper surface, whose ridges meet at the center. Its scraping edge is prepared on one side. It has a convex shape and is made of chert. Its function could be the same as that of the other scrapers.

The archaeological material collected from the surface of the laterites has a lot of significance on the settlement pattern of early man. A similar situation can be seen in the neighbouring regions. Zeuner's expedition along the Gundlakamma river in the Kurnool district of Andhra Pradesh yielded a rich harvest of Lower Palaeolithic sites²⁰. Evidences of Lower and Middle Palaeolithic from the terraces of +20 m and +8 m formed by sea level fluctuations were also identified at the same place²⁷. In the Nellore district itself, a number of archaeological sites exposing mostly Lower Palaeolithic and Middle Palaeolithic artifacts (Table 3) were identified^{28,29}. Terraces at Vadamadurai and Attirampakkam have exposed abbevillian-acheulian handaxes and flake tools, respectively from boulder conglomerate and loam layers. De Terra and Paterson³⁰ opine that the boulder conglomerate and the laterite belong to the Middle Pleistocene. These Kortallayar river terraces in Tamil Nadu formed at the height of 60, 20 and 8 ft, respectively on the coastal plain have yielded sequence of early Palaeolithic culture consisting of three groups. All these three groups, namely the earliest group, the second group and the third group have exposed tools from abbevillian to acheulian stages. Prehistoric reinvestigations in the Kortallayar basin³¹ revealed that the composite Quaternary stratigraphic sequence consisting of ferricritized/ferruginous gravels and ferricretes, exposed acheulian to Middle Palaeolithic tools.

The succession of handaxe industry by flake industry as that of Attirampakkam is evident from Gudiyam (GDM-3) excavation at Srikrishnapuram village. Here, the top portion of the lateritic murum has yielded late acheulian handaxes, while the top layer of pebbly lateritic soil has exposed a Middle Palaeolithic industry along with the late acheulian handaxes^{32,33}. Banerjee's survey on the east

Table 2. Type-wise classification of artefacts collected from the study area

<i>Gollapalem – Lower Palaeolithic artifacts (174)</i>								
Finished artifacts (7)				Unfinished artifacts (167)				
Handaxes			Handaxes in the process of being made	Simple cores	Simple flakes	Non-descriptive	Chips	
Cordate	Lanceolate	Ovate						
1	3	3	11	27	39	12	78	
<i>Kammapalem – Middle Palaeolithic artifacts (119)</i>								
Finished artifacts (26)					Unfinished artifacts (93)			
Scrapers			Points		Borers	Core flakes	Levellois flakes	Chips
Straight sided	Convex	Notched	Triangular	Leaf shape				
7	7	3	6	1	2	21	9	63

Table 3. Distribution of Lower and Middle Palaeolithic artifacts from Nellore district²⁸

Sites	AGR	AMC	APL	BMR	CDP	CMN	CTP	DKL	INK	RCP	KLC	KLV	KNP	MDP	NLM	PNB	RMP	SDL	SDP	SMS	SPM	TNV	VDP	VGP	ZNK	Total
Lower Palaeolithic artifacts																										
SPTs	-	-	10	6	-	-	7	2	5	5	-	3	6	6	7	-	7	1	1	1	6	2	-	3	1	79
HAS	12	1	9	7	1	2	9	17	6	17	-	6	10	3	8	6	44	9	-	1	2	5	-	1	-	176
CLE	-	-	3	-	-	-	-	-	-	-	1	-	-	1	-	-	2	-	-	-	-	-	-	-	-	7
DIS	-	-	2	2	-	1	-	-	-	-	-	1	-	-	1	-	2	-	-	-	-	-	-	1	-	10
ETs	-	-	42	6	4	5	3	1	8	-	-	4	4	4	15	-	9	-	-	1	23	1	4	6	-	140
FLA	-	-	21	-	-	-	-	-	-	168	-	-	-	64	-	-	34	-	-	-	-	-	-	-	11	298
COR	-	-	8	1	-	1	-	-	15	76	-	6	2	36	5	-	12	-	-	1	-	-	-	-	-	163
Total	12	1	95	22	5	9	19	20	34	266	1	20	22	114	36	6	110	10	1	4	31	8	4	11	12	873
Middle Palaeolithic artifacts																										
BIF	-	3	6	1	1	2	10	2	-	1	-	2	2	1	13	-	5	2	1	-	3	-	-	4	-	59
ETs	18	-	97	3	5	50	48	7	5	5	18	4	3	4	16	-	3	-	7	2	46	2	20	14	1	378
CLE	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	3
POI	5	1	31	2	2	9	13	4	3	1	5	-	-	1	2	4	6	2	3	-	8	1	1	3	-	107
BOR	-	-	6	-	-	2	2	-	-	-	2	-	-	-	-	1	1	2	-	-	2	-	1	-	-	19
BET	-	-	2	-	-	1	1	-	-	-	1	-	-	1	1	-	1	-	-	-	1	-	-	-	-	9
BUR	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	4
FLA	19	-	165	3	20	165	71	76	36	220	86	3	8	114	15	29	46	6	7	5	37	3	62	27	13	1236
COR	2	-	70	8	2	13	22	10	3	35	3	5	1	31	13	7	15	-	1	2	11	7	12	4	-	277
Total	44	4	378	17	30	242	167	100	47	262	115	14	14	152	60	41	79	14	19	9	108	13	96	52	15	2092

Sites: AGR – Agraharam, AMC – Amacherla, APL – Ambayapalem, BMR – Brahmeswaram, CDP – Chandrapadiya, CMN – Chandramoulinagar, CTP – Chintalapalem, DKL – Dakkili, INK – Inkurti, RCP – Rachapalem, KLC – Kalichedu, KLV – Kaluvayi, KNP – Kanupurupalle, MDP – Maddurupalle, NLM – Nellorepalem, PNB – Penubarthi, RMP – Ramayapalle, SDL – Saidadulapalle, SDP – Saidapuram, SMS – Somasila, SPM – Siripuram, TNV – Tarunvayi, VDP – Vedayapalem, VGP – Velagapadu, ZNK – Zaladanki.
Artifacts: SPTs – Split Pebble Tools, HAS – Handaxes, CLE – Cleavers, DIS – Discoids, ETs – Edged Tools, FLA – Flakes, COR – Cores, BIF – Bifaces, POI – Points, BOR – Borers, BET – Borers cum edged tools, BUR – Buring.

coast from Madras to Nellore disclosed clear terraces of peneplanation due to the sinking of the east coast and gradual eastward movement of the sea. In this shifting, huge blocks of laterite have been moved and have covered the older tool-bearing deposits. In this process, four terraces at a height of 73 m, 45 m, 30 m, and 17 m, respectively, from the present sea level were noticed. Lower Palaeolithic artifacts were recovered from 2nd and 3rd terraces and Middle Palaeolithic tools were collected from the 4th terrace. The occurrence of handaxes and flake tools recovered from a number of sites in other parts of the Nellore district^{28,29} indicates the same Quaternary lateritic context as that of the western margin of the Penner delta. Specially, pebbly-conglomeritic zone appeared to be the habitat of the advanced acheulians. Thereafter, Middle Palaeolithic men could have occupied the area after a sufficient lapse of time when some soil deposition too would have taken place on the secondary lateritic horizon as indicated by the development of drainage of a few ephemeral streams.

The evidence of flake tools on the surface of the primary laterites is accidental. These flake tools being light in weight could have been transported from the top layer of secondary laterites elsewhere and may have settled on the surface of the primary laterites. If, due to water transportation, acheulian tools are found associated with flake tools, these need not be considered as belonging to the same stratigraphic layer. Such archaeological situations have occurred often. For instance, the geoarchaeological studies around Bap-Malar Playa, Jodhpur district, Rajasthan³⁴, revealed that the late acheulian tools and Middle Palaeolithic flake tools (both made of quartzitic sand stone) are found in mixed condition and are collected from regolithic context. Micro-stratigraphic studies revealed true stratified context of their occurrence.

Thus, the surface from which the Lower Palaeolithic tools were collected from Penner delta could have been belonged to the terrace-3. The Middle Palaeolithic tools collected from the other surface could be related to the bottom terrace.

Present geoarchaeological studies in the Penner delta throw light on the cultural development of Stone Age man. The water source, fauna, the type of vegetation and the availability of raw material like quartzite attracted prehistoric man to inhabit this deltaic region right from the early Upper Pleistocene. Handaxes that were manufactured employing different stone tool techniques must have been used for grubbing up edible roots that formed an essential part of the Palaeolithic diet. In the changed environment after the acheulian times, new type of tools like flake tools were prepared by evolved human species and used for different functions such as skinning, scraping, cutting animal skin, flesh, etc.

Nevertheless, test excavation is needed for confirming the exact geo-chronology of different cultural horizons in a stratified context.

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ACKNOWLEDGEMENTS. We thank Prof. S. N. Rao, Department of Archaeology, University of Asmara, Eritrea (NE Africa) and the referees for valuable suggestions for improving the manuscript. K.S.R. is grateful to the Council of Scientific and Industrial Research, New Delhi for providing Research Associateship. We also thank Dr Ch. Udayabhaskara Rao for his help in photography.

Received 25 May 1999; revised accepted 24 August 1999