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THE PREHISTORY AND PROTOHISTORY OF SRI LANKA

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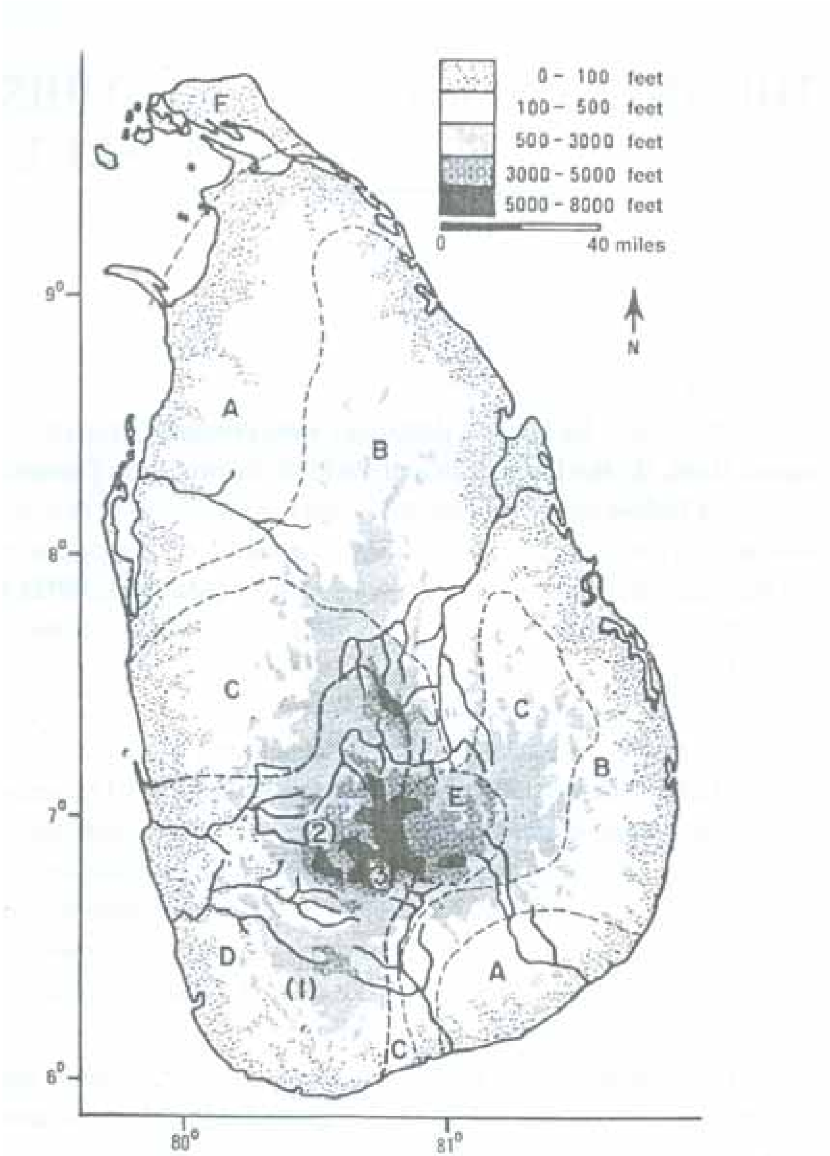
Introduction

The data pertaining to Sri Lanka's prehistory stem primarily from three sets: (a) the Ratnapura Beds, (b) the Iranamadu and Reddish Brown Earth Formations and (c) the caves and Bellan-bäňdi Palässa. Subsidiary information is available from the open-air sites of the uplands and highlands. The standard working document on the subject has been published in two editions (Deraniyagala 1988; 1992). Chapters 3-6 dealt with Sri Lanka's prehistoric chronology, palaeo-environment, prehistoric culture and hunter-gatherer ethnography, sequentially and discretely. These three assemblages of data were synthesised in chapter 7, so as to provide a unified view of the island's prehistory. The present paper constitutes a revised version of chapter 7, in the light of new evidence, particularly with regard to Quaternary chronology and environment. More specific syntheses and discussions than are set out below have been afforded in the concluding sub-headings in the above-mentioned publications under the headings of chronology, Quaternary environment, technology, subsistence and settlement, prehistory-protohistory transition and ethnography. These may be consulted for further details and for access to the basic data set out under their respective chapter sub-headings.

It will be evident that the prehistoric cultural data, frequently sparse in density, are being incorporated into hypotheses grounded in palaeo-environmental hypotheses coupled with ethnographic analogues. Hence, the present paper synthesises environmental and cultural data, both present and past, into a set of hypotheses involving the systemic interaction of prehistoric culture and environment, to be tested in the next mega-stage of the research design.

Chronology

Potentially, some of the oldest Quaternary deposits in Lanka comprise the Ratnapura Beds (ibid.:chap.3.2; Gunatilaka and Almond 2001; Manamendra-Arachchi et al. 2005). These are alluvial sediments filling the strike valleys in the lowlands of the south-western Wet Zone (ecozone D1 in Map 1). They consist of sands, silts and clays ranging up to 30m or more in depth, with gravel intercalations in the basal levels. These gravels have occasionally yielded artefacts of a non-descript ‘chopper’ industry, termed the Ratnapura Industry, made on quartz and chert (Fig.1).



Map 1. Lanka's ecozones: ***F*** arid lowlands; ***A*** semi-arid lowlands; ***B*** dry lowlands; ***C*** intermediate dry lowlands; ***E*** intermediate dry uplands; ***D*** wet ***1*** lowlands, ***2*** uplands and ***3*** highlands at 0-3,000, 3,000-5,000 and above 5,000 ft + msl respectively. *(Adapted from Gaussen et al. 1968. Mueller-Dombois 1968.)* Zones A-F coincide with vegetation Series A-E, ecozone F being within Series A.

The gravels also contain a fauna, the Ratnapura Fauna, which includes extinct forms, notably two palaeoloxodont elephants (*Elephas hysudricus* and *Elephas namadicus*; identification to be confirmed), two rhinoceri (species to be confirmed), lion, tiger and the hippopotamus *Hexaprotodon palaeindicus* (syn. *H. sinhaleyus*)[1]. *H. palaeindicus* occurs in the second major aggradational cycle of the Pleistocene alluvia in peninsular India, as on the central Narmada tract. This latter depositional episode has tentatively been dated by correlation with coastal tracts in southeast India and through the artefactual dating of its Mousterioid industrial complex (overlying Aggradation I with Acheulean artefacts) to ca. 200,000 - >25,000 BP (Deraniyagala 1992:67-8). A discovery of some significance in the Ratnapura Fauna is an incisor tooth of a probable hominoid, which has been compared to *Gigantopithecus*, and a (possibly) hominid premolar, in separate localities of the Ratnapura Beds[2]. Then there are bovine fossils, smaller than anything assignable to a water buffalo or gaur, which could be ancestral to modern *Bos indicus*.

However, despite the indubitably Pleistocene element in the Ratnapura Beds, the chrono-stratigraphy of these sediments is still far from clear. Certain artefactual and faunal inclusions, and somewhat dubious uranium assays, have indicated that some of the beds have undergone redeposition, thereby complicating the stratigraphy.

Moving on to another set of Quaternary sediments, the coastal tracts of the semi-arid ecozone A (particularly in the north) are characterised by large expanses of sheet-gravels capped by clayey sands which have undergone latosolic weathering resulting in a distinctive colour range of buff to crimson (Map 2, ibid.:chap.3.3). These two beds in combination are referred to as the Iranamadu Formation (I Fm). The sands have conclusively been identified as being ancient coastal dunes, weathered into latosolic aeoleanites. The basal gravels are coastal alluvia in facies, and thus hypothetically amenable to eustatic altimetric studies.

As per the sampling strategy (ibid.:chap.2), the present writer set out to ascertain the antiquity of three separate sets of deposits of the I Fm in and around Bundala in the south: Sites 45, 49 and 50. The selection of these sites for investigation was based on the absolute heights of their thalasso-static basal gravels above mean sea level - ca. 25m at Site 45, 15m at Site 50 and 8m at Site 49 – since it was hypothesised that each one of these levels represented a discrete altithermal (interglacial) episode during the Pleistocene[3].

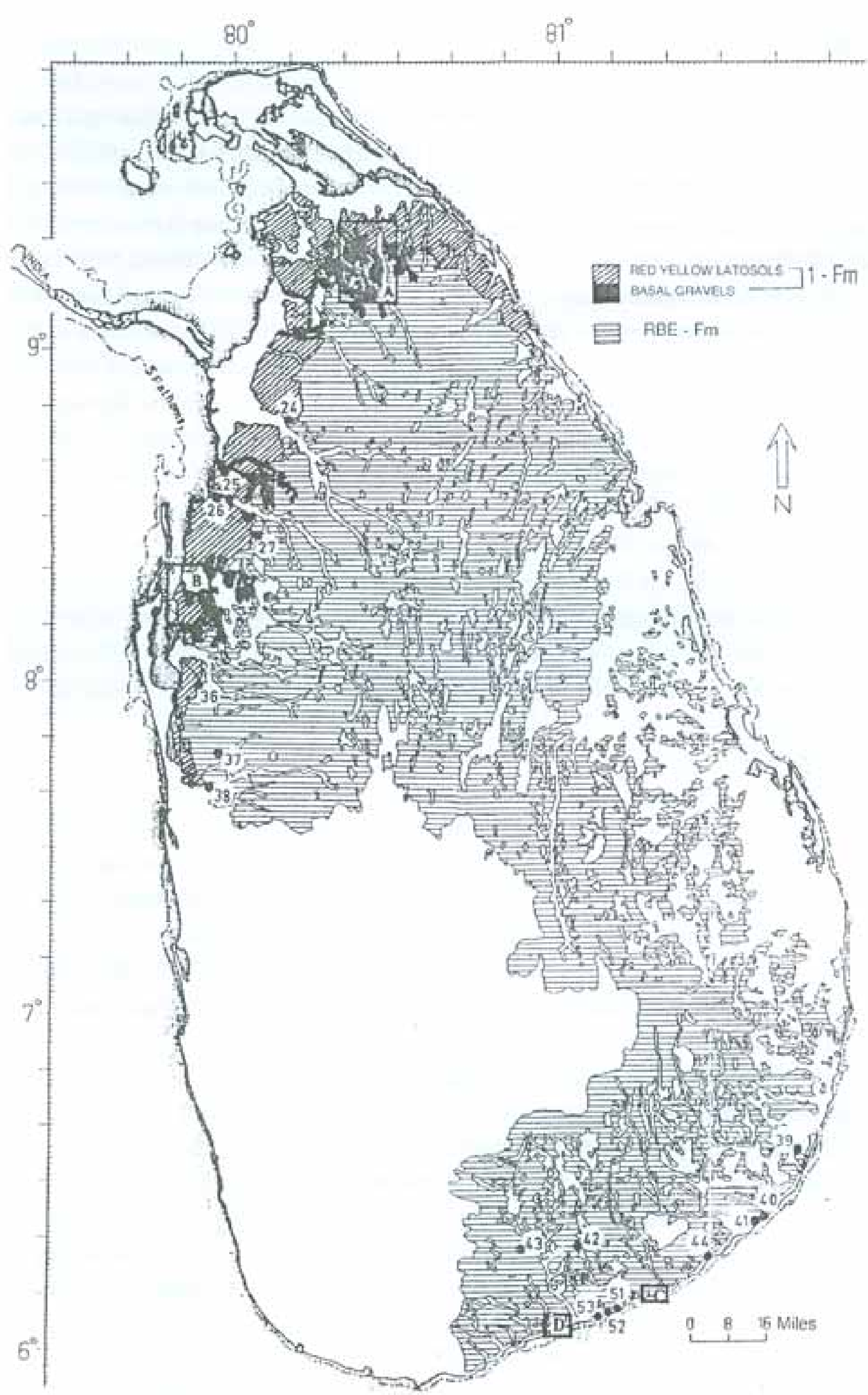
All three sets of sediments, comprising both the basal gravels and the overlying sands at each site, turned out to be implementiferous. The excavations (ibid.:app.III) yielded Optically Stimulated Luminescence (OSL) dates, a technique that is still somewhat experimental, for the basal gravels. The 15m basal gravel at Site 50 yielded an age of ca. 125,000 BP (M.Abeyratne 1996) while the 8m gravel at Site 49 has been dated to ca. 80,000 BP (Oxford Archaeological Laboratory). As for Site 45 (25m terrace), its complex depositional environment blurs its chrono-stratigraphic significance.

With regard to the latosolic dune sands overlying the basal gravels at the sites excavated (for stratigraphy v. Deraniyagala 1992:figs.48,50-3), as with the basal gravels no organic remains had been preserved, thus precluding radiocarbon assaying. However, the application of thermoluminescence (TL) and OSL to the dating of sand dunes has made it possible to date the aeoleanites in the I Fm. Samples were submitted for assaying from Sites 49 and 50 from locations in close proximity to and within the sections excavated in 1972 (now back-filled). The sands at Site 49 yielded an age of ca. 28,000 TL and OSL BP, as did the upper horizon of the sands at Site 50. The lower horizon of the latter provided dates of ca. 80,000-64,000 TL and OSL BP, and there are indications of a palaeosol occurring between the two levels at Site 50, suggesting a stratigraphic break (for details v. Singhvi et al. 1986; Abeyratne 1996, Oxford Archaeological Laboratory unpublished data). Samples were not submitted for Site 45 as its upper stratum (III) turned out to have secondary colluvial admixture.

The above data seem to suggest that a period of high sea level, represented by the +15m terrace of the last interglacial (ca. 125,000 BP), witnessed the alluvial deposition of the implementiferous basal gravels at Site 50, succeeded by a terrace at ca. +8m at ca. 80,000 BP represented by implementiferous basal gravels at Site 49. The gravels at Site 50 were sealed by coastal dunes containing prehistoric occupation deposits during a marine regression at ca. 80,000-64,000 BP and thereafter the dunes underwent pedogenesis. These and the coeval gravels at Site 49 were in turn sealed by coastal dunes with occupation deposits during a marine regression at ca. 28,000 BP. Note that the occupation deposits in the sands of Site 49 and 50 include *in situ* components, thus ensuring strict contemporaneity with dune deposition, as against infiltrated elements. Similarly, the artefacts found within the basal gravels would have had to be at least as old as the deposition of the gravels themselves, as some are water-worn and infiltration could not occur into such coarse sediments.

The evidence from Sites 49 and 50 does indicate that the latosolic sands of the I Fm are amenable to TL and OSL dating. It appears as if the elevations of the basal gravels within much of their range of distribution are quadri-modal at ca. 50, 30, 15 and 10-8m +msl (Deraniyagala 1992.app.III), with their respective heights being primarily the result of tectonic uplift. Hence, it could be hypothesised that the 50 and 30m deposits represent pre-Eem altithermals. There are signs that some these deposits, as at Site 40, are implementiferous. It can be concluded that the I Fm bears traces of human settlement in Sri Lanka from at least as early as the last interglacial, as evidenced at Site 50, with the possibility of the existence of evidence from several earlier altithermal episodes reaching back into the early Middle Pleistocene.

To the landward aspect of the I Fm in ecozones A, B and C, is another very characteristic set of sediments, the Reddish Brown Earth Formation (RBE Fm; Map 2). This comprises a basal member of gravels or a stone-line(s), representing a lag deposit, overlain by colluvial clayey loams of the Reddish Brown Earth soil group (ibid.:chap.3.3.3). The colluvia usually are of mixed facies, with artefacts of numerous phases frequently occurring in a single profile. However, some of the gravels are associated with prehistoric habitations, as at Anurādhapura and Site 43.Site 43a was excavated (ibid.:fig.47) with a view to securing a techno-stratigraphic correlate between the basal gravels of the RBE Fm at Site 43 and



Map 2. Distribution of I Fm and RBE Fm *(by courtesy, Soil Survey, Sri Lanka).* The sites are numbered from north to south. Insets A-D denote site concentrations.

those of the I Fm along the southern coast, so as to establish their contemporaneity, which is suggested by the geomorphology and sedimentology of the two sets of deposits appearing to form a continuum with the Hungama Fm constituting a transitional facies (eg, Sites 54,55,56, ibid.:map 15). The purpose behind establishing this chronological correlation was to be able to transpose the palaeo-environmental interpretation of the former to the latter which had for a long time proved resistant to such interpretation. However, the results of the excavations did not fulfill this goal. The artefacts from the basal gravels of the I Fm at Sites 49b,c and 50a were too non-descript as to permit a clear correlation, largely due to water-wear in the case of Sites 49b,c. On the other hand, the artefacts in the basal gravels of Site 43a (Fig.7) were in mint condition and found to tally very closely with the typological range of the material from the dune sands at 49b,c (Fig.6) which have subsequently been dated to ca. 28,000 TL, OSL BP. Hence, it can be postulated that the basal gravels of the RBE Fm at Site 43a, with *in situ* occupation material, are cross-datable to ca. 28,000 TL BP. This age appears to be approximately borne out by the radiocarbon dating of Batadomba-lena 7b to ca. 26,000 BP with its hypothetically diagnostic Balangoda Point category of artefacts (Fig. 12) which were also found in the basal gravels of 43a and in the dune sands of 49b,c. (For radiocarbon dating of the basal gravel of the RBE Fm at Anurādhapura to ca. 5,900 BP, v. ibid.:addendum I.)

Technologically, the lithic assemblages excavated from the dune sands of the I Fm at Sites 49b,c, the upper levels of the sands at 50a and the basal gravels of 43a are conspicuous for their geometric microlithic component of lunates, triangles and trapezoidals on quartz (a few being on chert). The lower horizon at 50a yielded backed and form-trimmed non-geometric microliths, which may be dated to 80,000-64,000 TL BP as postulated for the earlier phase of dune formation at Site 50.

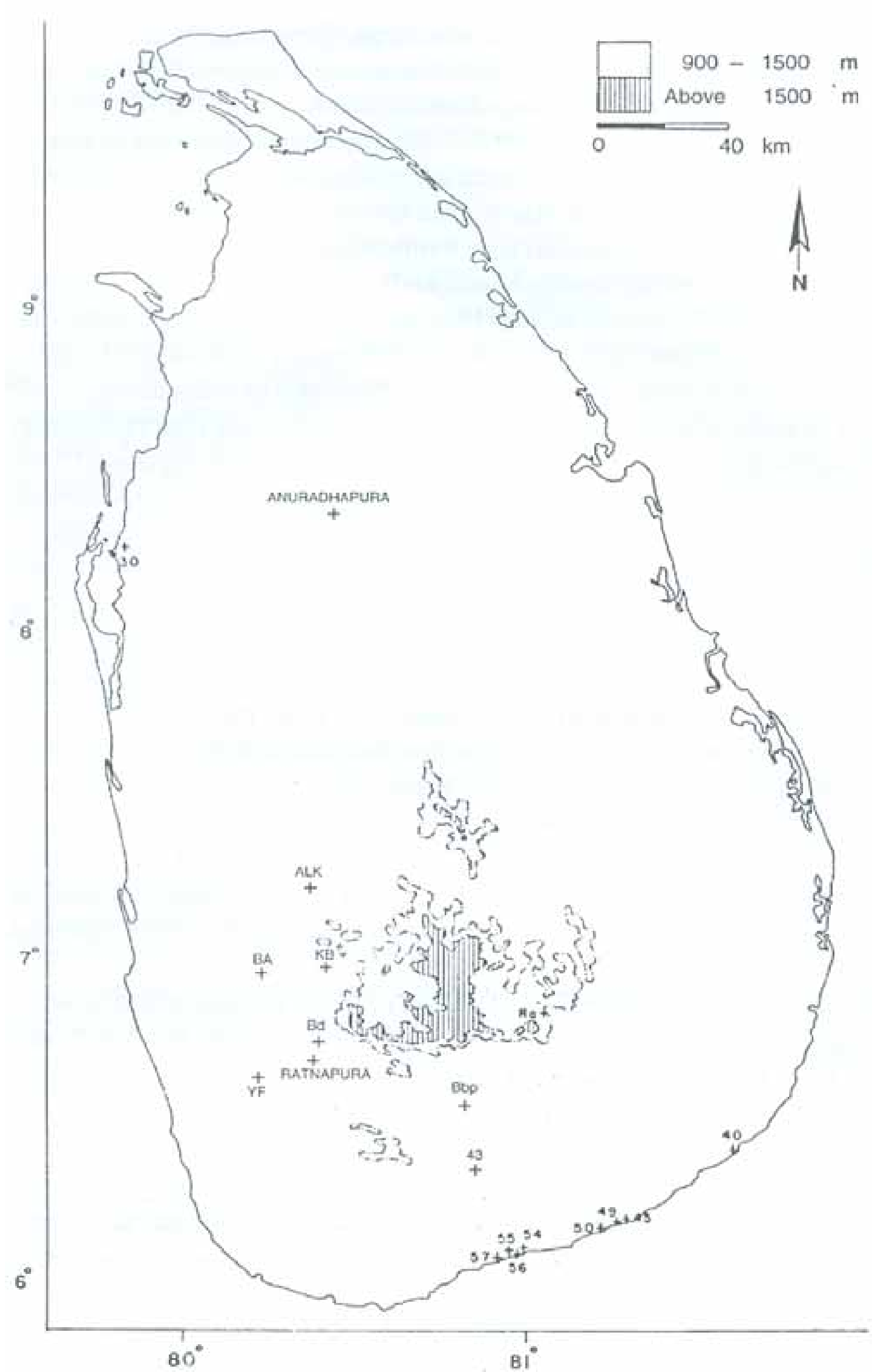
The presence of geometric microliths at ca. 28,000 TL and OSL BP at Sites 49b,c and 50a poses the problem as to how this techno-trait could be quite so early in Sri Lanka, whereas in Europe it does not come into prominence prior to ca. 12,000 BP with the final Upper Palaeolithic and early Mesolithic. However, there is no reason for concern, as radiocarbon dates on charcoal from Batadomba-lena and Kitulgala caves for strata with geometric microlithic assemblages corroborate the early dating assigned to the I Fm at Sites 49b,c and 50a, which is further corroborated by data from Africa and West Asia (ibid.:chap.5.3.14). It should be noted that the term Mesolithic is being applied in the context of Sri Lanka's prehistory in a purely technological sense, as signifying the occurrence of geometric microliths in noticeable proportions among the trimmed artefacts, and that it has no chronological or subsistence-related connotations.

The most reliable radiocarbon chronology for Sri Lanka's prehistoric habitations stems from the three series secured for Fa Hien-lena, Beli-lena Kitulgala and Batadomba-lena caves in the lowland Wet Zone (Map 3). The first yielded 7 dates on charcoal, ranging from ca. 38,000 to 5,500 cal BP. The second, a consistent series of 25 dates (on charcoal) for prehistoric strata. These range from >30,000 to ca. 9,000 cal BP (Perera 2007)[4]. The third, a series of 10 radiocarbon dates from Batadomba-lena, also on charcoal, range from ca. 36,000 to 13,000 cal

BP. There is no question about it, technologically Mesolithic assemblages date back at least to 36,000 BP and 28,000 TL BP in Sri Lanka, according to the reliable evidence from Kitulgala and Batadomba-lena and the TL and OSL dates from Sites 49 III and 50 (upper) III. Supporting evidence has been forthcoming from Matupi Cave in Zaire where geometric microliths have been radiocarbon dated to ca. 33,000 BP (charcoal; van Noten 1977). As van Noten (1983:pers. comm.) has aptly commented, "the term 'geometric microlith' has indeed lost its earlier chronological significance" and, certainly in the case of Sri Lanka, surface finds of such microliths may no longer be assigned as a matter of course to post-Pleistocene (or final Pleistocene) cultures unless there is firm evidence to indicate that they do not represent Upper Pleistocene cultural horizons. This naturally adds a new dimension to the viewing of surface finds in Sri Lanka and of course on the Indian sub-continent as well.

Further radiocarbon (calibrated) dates on charcoal are available for the Mesolithic in Sri Lanka; ca. 12,000 BP for Bellan-bäňdi Palässa (Perera 2007) in the lowland Dry Zone; and ca. 10,350 BP for Alu-lena Attanagoda, ca. 8,230 BP for Beli-lena Athula and ca. 7,680-4,835 BP for Batatota Dahayya-lena, Kuruwita, all three caves being located in the lowland Wet Zone (Map 3). Two rock-shelters at Sigiriya in the lowland Dry Zone have been dated on charcoal: Aligala at the base of Sigiriya rock, 5,500-4,100 BP; Potana, 5km east of Sigiriya, 5,800 BP (Adikari 1998). Excavations at the open-air site on Church Hill, Bandarawela, in the upland Dry Zone have yielded three dates ranging from ca. 7,300 to 4,150 BP[5]. Māntai in the coastal semi-arid lowlands of the northwest has yielded three dates of ca. 4,200-3,800 BP for the levels immediately preceding a Mesolithic (perhaps Chalcolithic) camp. Radiocarbon dates on lagoon molluscs are available for three middens which may in fact be associated with a Mesolithic stone tool technology: Site 50a IV on a Latosol of the I Fm , ca. 5,260 BP; Site 57 associated with a Grumusol (Deraniyagala 1992:map 15), ca. 3,200 BP, and Site 30 on a Latosol of the I Fm (ibid.:map 13), ca. 2,950 BP[6]. These dates are not very reliable (?too recent) considering the nature of the dating material, but they suffice to provide a clue as to the range of the more recent dates for the Mesolithic in Sri Lanka, for which evidence has as yet been sparse from the cave sites due to their upper horizons having been extracted or otherwise disturbed by guano diggers.

The upper boundary of Sri Lanka's Stone Age has yet to be chronologically defined. None of the contexts identified so far clearly represent the transition between the Stone Age and Protohistoric Iron Age (syn. Early Iron Age). In the caves the relevant layers have usually been stripped for fertilizer and all that remains are tantalising shreds of evidence of the erstwhile existence existence of such strata, as in the occurrence of Early Historic Black and Red Ware at Kitulgala and Rāvanälla caves. With regard to the Dry Zone, extensive surveys (e.g, Solheim and Deraniyagala 1972) have once again failed to isolate a transitional horizon,



Map 3. Prehistoric sites: *ALK* Attanagoda Alu-lena; *BA* Maniyangama Beli-lena Athula; *Bbp* Bellan-bäňdi Pălassa; *Bd* Kuruwita Baṭadoṁba-lena; *KB* Kitulgala Beli-lena; *Ra* Ravanailla; *YF* Yatagampitiya Fa Hien cave. The numbers indicate sites, mostlyin the I Fm,*(for details, v. Deraniyagala 1992)*.

while there is no dearth of discrete pre-, proto- and Early Historic contexts manifested in stone tool assemblages, Megalithic cemeteries, pottery sites and stone epigraphs.

The closest one can get to locating the chronological upper boundary of Sri Lanka's prehistory is to date the lower boundary of its Protohistoric Iron Age. This has been effected at the Anurādhapura Citadel, which was excavated in 1969 and 1984-9 (Deraniyagala 1972; 1992: addendum II; Deraniyagala and Abeyratne 2000). It has yielded radiocarbon dates on charcoal, ranging from the inception of the Iron Age at this locus up to the middle of the Early Historic Period: ca. 900-500 BC for the Protohistoric Iron Age, ca. 500-250 BC for the Lower Early Historic, ca. 250-100 AD for the Mid-Early Historic and ca. 100-300 AD for the Upper Early Historic periods. The last seems to terminate with the demise of the *Mahāvamsa* dynastic succession (which appears to have been synchronous with the end of the Black and Red Ware ceramic tradition and the rise of the *Cūlavamsa* dynasties). The radiocarbon chronology for the Lower and Mid-Early Historic episodes at Anurādhapura appears to be confirmed by the series of radiocarbon dates secured for Kandarõdai in the Jaffna peninsula (Deraniyagala 1992:addendum II), which, together with the new periodisation for the proto- and Early Historic episodes for Anurādhapura, revolutionises the existing concepts concerning the rise of urbanism in peninsular India.

The radiocarbon dates for the commencement of the Lower Early Historic of Anuradhapura establishes the accuracy of Sri Lanka's ancient chronicles with reference to the era prior to the formal introduction of Buddhism at ca. 250 BC (*Dīpavamsa*; *Mahavanasa*). (This is the first occasion on which the so far questioned accuracy of these texts with regard to the pre-Asokan period has been independently authenticated.) According to these chronicles, the ancestors of the present-day Väddas (i.e. morphologically, Balangoda Man, as represented at Bellan-bäňdi Palässa and cave deposits) and another ethnic group referred to as the Nagas (?Protohistoric Iron Age) were on the island until ca. 500 BC when Indo-European speaking settlers arrived from the mainland. This latter tradition receives support, as per the evidence from Anurādhapura: there was a basal Mesolithic horizon (RBE Fm), dated to ca. 5,900 BP (v. Deraniyagala 1992:addenda I,II), succeeded stratigraphically after an unconformity by a full-fledged, sophisticated, iron-using culture (?Nagas) with Black and Red Ware pottery, the horse, cattle and rice at ca. 900 BC, followed by the Early Historic period with writing and Indo-European Prakrit at ca. 500 BC. No stone tools were found in the Protohistoric Iron Age horizon. It seems reasonable therefore to assume that, as per the radiocarbon dates for Anurādhapura , the Stone Age in Sri Lanka terminated at ≥ 900 BC, although it is likely that relict populations continued in the island with stone tool technology until, progressively, iron technology totally superseded that of stone.

In summary of the foregoing account on the chronology of Sri Lanka's prehistoric period, some components of the implementiferous Ratnapura Beds may faunistically be cross-dated to ca. 200,000->25,000 BP. The Iranamadu Formation at Site 50 has a date of ca. 125,000 OSL BP for its implementiferous basal gravels and it has OSL and TL dates of ca. 80,000-64,000 BP for the lower levels of its coastal dunes. The basal gravels with artefacts at

Site 49 has an OSL date of ca. 80,000 BP. The upper levels of the dunes at Site 50, as well as the dunes at Site 49, have been dated to ca. 28,000 TL and OSL BP, and there is evidence of a buried soil separating the two depositional episodes at Site 50. It is probable that some of the high-level deposits of the I Fm in the north of Sri Lanka date back to the early Middle Pleistocene at > 400,000 BP and the ones at Site 40 in the south to the later Middle Pleistocene at ca. 225,000 BP. The radiocarbon dates on charcoal from Fa Hien-lena, Batadomba-lena and Beli-lena Kitulgala form three consistent series ranging from ca. 38,000 to 8,000 BP, while Bellan-bändi Pälässa, Alu-lena Attanagoda, Beli-lena Maniyangama and Māntai, date from ca. 12,000 to 3,800 BP, the last being possibly Chalcolithic. The earliest Protohistoric Iron Age contexts at Anurādhapura have been dated to ca. 900 BC, providing a *terminus ante quem* for Sri Lanka's Stone Age. There are some indications that stone tool technology persisted into the Early Historic period in areas of relative isolation, although this is a subject that requires further probing.

Quaternary Environment

The sedimentology of the Ratnapura Beds (ibid:chap.4.2.1) indicates that some of the gravels with an Upper Pleistocene fauna were deposited in a fluviatile environment with a significantly higher transport capacity than is prevalent today. While it is possible to hypothesise that these gravels represent depositional conditions marked by heavy denudation due to exceptionally heavy rainfall in the Wet Zone, it does not preclude the possibility of interpreting the genesis of these sediments on the basis of tectonic or eustatic rejuvenation of fluviatile profiles or of accentuated seasonality of rainfall leading to sparser (monsoon-forest) vegetation and thence more erosion. Until a detailed geomorphological survey has been conducted on the Ratnapura Beds, it would be premature to make climatic interpretations on the basis of the sediments.

As for the faunal and floral elements found in the Ratnapura Beds, they represent environments akin to those prevalent in ecozones D1 and D2 today, with the exception of a few finds, identified as spotted deer, lion and water buffalo, which would signify an environment that was drier than today's Wet Zone and perhaps akin to ecozone C. It is probable that the hog-deer *Axis porcinus*, a Wet Zone form, has at times been misidentified as the spotted deer.

Laterite, due to its apparently irreversible soil traits, constitutes a useful climatic indicator. Its distribution in Sri Lanka suggests that the climatic conditions during the Quaternary were such that climatic Sub-Zone 6 (ibid.:map 5) at below ca. 30m +msl did not exceed its present boundaries, although it could have been more constricted at times. This estimate lacks precision as it has yet to be established as to which of the present laterites are relicts as opposed to living soils undergoing pedogenesis. It is possible that some of the peripheral laterites are indeed relicts indicative of shifts in climatic boundaries; but it is unlikely that such shifts have been on a major scale.

The basal gravels of the I Fm represent altithermal episodes marked by high sea levels with which the gravels correlate thalasso-statically. It has been postulated (ibid.:chap.4.2.3) that the gravels, as well as the basal gravels and stone-lines of the RBE Fm, were laid down under conditions when atmospheric circulation was more active than it is today, marked by seasonal rainfall with longer periods of water deficit. It has been proposed that conditions drier than those of the present reduced the vegetation cover, leading to a corresponding increase in the rate of evaporation, a positive feedback situation, thereby exposing the ground to massive denudation. Since drought in the Dry Zone is primarily a result of the *Foehn* effect of the katabatic Southwest Monsoonal winds in the rain-shadow of the central mountains, it is possible to postulate that these dry episodes correlated with increased activity of the S.W. Monsoon during certain altithermals such as the Eem (eg, the sediments of Sites 49 and 50). Quantitative estimates of Pleistocene Trade Wind strength off West Africa have shown up wind speeds to have been ca. 50 per cent greater than they are today (Shackleton 1975), and these could refer to altithermal episodes as per the above model of correlating altithermals with increased circulation. Considering the genetic link between the Trades and the S.W. Monsoon, an increase in the former was probably paralleled by the latter, which leads to the corollary that Monsoonal wind speeds would have increased ca. 50 per cent above those of the present during certain altithermal episodes during the Pleistocene in Sri Lanka. There is some evidence that S.W. Monsoonal and tropical cyclonic activity is directly proportional to fluctuations in solar radiation as manifested in sunspot activity. This correlation can hypothetically be tied in with the Milankovitch radiation curves for the Pleistocene as a means of formulating propositions concerning the behaviour of Sri Lanka's climate during the Quaternary, although it could well have been modified in varying degrees by other factors such as ocean and atmospheric currents (v. IGBP 2001).

The erosion represented in the basal gravels of the I Fm and the RBE Fm would probably have been effected by increased cyclonic precipitation, as present-day evidence indicates a positive correlation between Monsoonal, convectional and cyclonic intensities. Winter cyclonic storms in the Dry Zone can precipitate over 760mm of rain in a day, leading to strong denudation.

The above data shed important light on the question as to whether tropical atmospheric circulation increased or decreased during Quaternary glacial/altithermal oscillations as registered in high latitudes. For the first time it is possible to gauge the effect of interglacial episodes on the Monsoon, which in turn can be extrapolated to the extensive tropical landmass affected by the Monsoonal system, from Africa to Asia. However, as has been amply demonstrated (Deraniyagala 1992:chap.4.4), the S.W. Monsoon is linked with weather phenomena at a global scale, as with the tropospheric jet-stream oscillating over the Himalayas and which is intimately associated with Monsoonal dynamics. The Monsoon is considered to be the most complex weather phenomenon in the world and it would be simplistic to reconstruct its behaviour during the Pleistocene except on a case-study basis within a reliable chronological framework. The sedimentological and pedological interpretation of Aggradation II in western India (ibid.:chap.4.5.1) suggests that the Monsoon had not intensified by more than 25-30 per cent during the Eem. It is probable that it was even less so in Sri Lanka, being at a lower latitude, and analyses on the lines of those undertaken in western India could usefully be undertaken on the sediments of the I Fm . Evidence from numerous sources indicates that average Eem temperatures in the tropics were about 1°C above that of the present (ibid.:chap.4.6.5) and this may be considered applicable to Sri Lanka as well.

The distinctive pedology of the Latosols of the I Fm (de Alwis 1971) has been determined primarily by the variable of rainfall, and the absence of gibbsite and goethite, and the scarcity of free aluminium oxide, indicate that subsequent to their deposition the coastal dune sands of the I Fm , some of which have been dated back to the final Eem (or perhaps even to an earlier altithermal) have not been subjected to annual precipitation in excess of 2,000mm when the chemistry would have been altered. On the other hand, the absence of fossil continental dunes in ecozones F and A indicates that annual rainfall during the Quaternary (at least during the Middle and Upper Pleistocene) had not decreased to less than ca. 200mm, even though Quaternary fluctuations in rainfall would have registered more in the Dry Zone than the Wet Zone, and within the Dry Zone they would have been most pronounced in ecozones F and A (for coefficient of rainfall variability v. Domrös 1974:fig.34). The patterns of discontinuous distribution of uropeltid burrowing snakes (C. Gans 1990:pers. comm. in Deraniyagala 1993) between the Wet Zone and South India do not suggest that the Dry Zone had, during the Quaternary, witnessed climatic conditions akin to those of the present Wet Zone with over 2,000mm of annual rainfall. Biotic correlation between Sri Lanka's highlands with those of South India indicates a very early phase that was cold (ca. 10-15°C lower than at present) and moist. But, on present evidence, none of these episodes are represented in the I Fm , although it is possible that soil profiles with gibbsite and goethite do exist among the Latosols or their variants in ecozone A. The pedological evidence from the I Fm is corroborated by that of the Dry Zone's fauna and flora which closely resemble those of Tamil Nadu in South India (cf. Wet Zone), indicating that climatic conditions during the terminal land connection at ca. 7,000 BP were similar in southeast India and Sri Lanka's Dry Zone to those of the present. The absence of the snail *Acavus* and the wild breadfruit *Artocarpus nobilis* in South India constitutes the basis of the hypothesis that during the Pleistocene Sri Lanka's Dry Zone never had the equivalent of today's Wet Zone rainfall and resultant biome, there having been a climatic barrier between the Wet Zone and South India which *Acavus* and *Artocarpus* could not circumvent. This hypothesis is supported by the distribution of certain other faunal elements as well (Bossuyt et al. 2004:481). The vertebrate fauna from Bellan-bäňdi Palässa indicates that climatic conditions were within the range of variation of the present lowland Dry Zone at ca. 12,000 BP in ecozone B.

As for the Wet Zone, intensified atmospheric circulation during interglacials and interstadials, as evidenced by the basal gravels of the I Fm during the Eem episode, probably meant more convectional rain during the intermonsoons, a stronger S.W. Monsoon, and possibly more cyclonic rains during the winter months.

The ombrogenic swamps of the Horton Plains in the highland Wet Zone have provided indicators (pollen and sediment analyses with radiocarbon chronology) for the Würm upper pleniglacial and Holocene climatic fluctuations in Sri Lanka. Mueller-Dombois and Perera

(1971:35) had postulated that in the past this ecozone witnessed rainfall considerably in excess of the present ca. 3,000mm per annum. Analyses of pollen and sediments from two swamps against a radiocarbon chronology of 21,000 - recent cal BP have produced the following indications (Premathilaka 2003):

2,000-present	^{14}C BP: dry, slight increase in precipitation at ca. 600 BP.
4,000-2,000	^{14}C BP (4,500-2.000 cal BP): strong pluvial (peak ca. 3,000^{14}C BP; ca. 3,200 cal BP).
6,500-4,000	^{14}C BP (7,500-4.500 cal BP): cool, dry (peak ca. 5,500^{14}C BP, ca. 6,400 cal BP).
8,000-6,500	^{14}C BP (9,000-7500 cal BP): pluvial (peak ca. 7,500^{14}C BP; ca. 8.300 cal BP).
10,500-8,000	^{14}C BP (12,300-9,000cal BP): cool, dry (peak ca. 9,000^{14}C BP; ca. 10,000 cal BP).
11,750-10,500	^{14}C BP (13,800-12.300 cal BP); strong pluvial (peak ca. 11.000^{14}C BP; ca. 13,000 cal BP).
12,500-11,750	^{14}C BP (14,500–13,800 cal BP); abrupt increase in precipitation, pluvial.
15,000-12,500	^{14}C BP (18,000-14,500 cal BP); still cool, very dry, but slight increase in precipitation.
18,000-15,000	^{14}C BP (21,500-18,000 cal BP); cool, dry; progressive decrease in precipitation to very dry.

Anthropogenic factors, in evidence from ca. 17,000 BP onwards, could modify the above interpretation of the pollen and sediments[7]. Pending further sampling, the major climatic cycles as presented are likely to be valid. It can be assumed that any climatic changes affecting the highlands of ecozone D3 would have registered in the rest of the Wet Zone as well.

The wet, pluvial episodes are correlated with altithermal-increased S.W. Monsoonal activity by Premathilake (ibid.), while the arid upper pleniglacial indicates depressed activity. This is in keeping with the numerous strands of evidence from other sources relating to the late Quaternary climates of South Asia (Deraniyagala 1992:chap.4.6), notably the Nilgiri highlands of South India (Sukumar et al. 1993, Sukhija et al. 1998, cited in Premathilake 2003)[8].

Increased precipitation in the Wet Zone, however, would not have altered the rain-forest biome, the increase in rainfall merely resulting in increased discharge into the drainage system. The snail fauna at Batadomba-lena (*Acavus phoenix*, *A. prosperus*) from ca. 36,000 to 13,000 BP and of Beli-lena Kitulgala (*A. roseolabiatus*), at ca. 15,000-12,000 BP, followed by Alu-lena Attanagoda at ca. 10,350 BP indicates that moisture conditions during this time-span of late Upper Pleistocene to early Holocene were scarcely drier than those prevailing today. This is corroborated by pedological criteria at ca. 36,000-23,500 BP at Batadomba-lena and at over 16,000 BP in the basal levels of Kitulgala, and by the presence of *Canarium zeylanicum* nuts and wild breadfruit in the same levels at Batadomba -lena and Kitulgala respectively. It is noteworthy that there is a considerable body of evidence that the Würm upper pleniglacial witnessed relative aridity at low latitudes (Deraniyagala 1992:chap.4.6.5); this has been established in Sri Lanka for the Horton Plains (Premathilake 2003). But it appears as if this did not cause a decrease in annual rainfull by over 25 per cent relative to today's totals in the lowland Wet Zone even at the height of the upper pleniglacial, as per the evidence of the snail fauna. The lack of dry grassland forms such as antelope and horse in the Ratnapura Fauna (vs. the Narmada Fauna) suggests that forests symptomatic of pronounced spells of water deficit annually had not prevailed in the lowland Wet Zone over the last 125,000 years.

With regard to temperature, it is estimated that the malacological and floral (ie, wild breadfruit) data from Batadomba-lena and Kitulgala indicate that the annual average could not have been depressed by more than ca. 6°C during the Würm upper pleniglacial. This is in agreement with evidence from Borneo, which is situated at a similar latitude to that of Sri Lanka, where the cooling has been through ca. 3-4°C below that of the present. In East Africa the lowering of temperature during the upper pleniglacial has been estimated at ca. 5-6°C, in Zambia at ca. 3-4°C and in the equatorial Indian and Atlantic Oceans at ca. 5°C (Deraniyagala 1992:chap.4,6.5; also v. van Zinderen Bakker 1967). The presence of *Acavus roseolabiatus*, with its highly selective habitat, at Kitulgala from over 16,000 up to ca. 12,000 BP indicates that its habitat during this time-span would have been effectively identical with that of today, with the temperature being not less than ca. 3°C below that of the present.

The Quaternary environments of Sri Lanka would have been integral with those of peninsular India, since it is the same basic weather phenomena that prevail in both instances. There are said to have been four major glacial episodes during the Pleistocene in the Himalayas, with what appear to be correlative fluviatile aggradations in the peninsula (Deraniyagala 1992:chap.4.5.1,2). This four-fold glacial scheme for India may correlate with the last four glacial/interglacial cycles from ca. 380,000 BP onwards (v. IGBP 2001 fig. 1: Bossuyt et al. 2004:479). The data from Burma and Kilimanjaro seem to be corroborative.

Sedimentological data from schematised Aggradations I-IV typical of peninsular India (Deraniyagala 1992.:chap.4.5.1) suggest a progressive decrease in pluvial intensity from the penultimate interglacial (Aggradation I) through Eem (Aggradation III), Würm interstadials (Aggradation III) and the Holocene (Aggradation IV). This is well exemplified in the Karnataka ecotone at Hunsgi Nullah. The gravels of Aggradation I, and to a lesser extent those of Aggradation II, seem to indicate marked seasonality in rainfall – which is in agreement with the evidence from the altithermal gravels of Sri Lanka's I Fm and RBE Fm. The faunas relating to the Indian aggradations do not suggest annual rainfall totals in excess of 2,000mm.

The discontinuous distribution of fauna and flora in India suggests a decrease in average annual temperatures by ca. 10-15°C in southern India during one or more of the glacial episodes. In view of the relatively mild intensity of Würm, this is likely to have occurred during earlier glacial episodes. The penultimate interglacial in the Himalayas was apparently of exceptionally long duration.

Geomorphological and pedological data from Rajasthan and Gujarat indicate an arid pre-Eem interpluvial succeeded by an Eem pluvial which was moister than the Holocene pluvial. Similar categories of data from Saurashtra and Maharashtra have been interpreted as indicative of the annual rainfall during the Eem pluvial not having been in excess of 25-30 per cent above that of the present, whereas during the Würm interpluvial it was not less than by a similar 25-30 per cent. Geomorphological and pedological evidence from the desert ecotones in Rajasthan and Gujarat points to a corroboration of the Himalayan periglacial data that Würm corresponded to a dry interpluvial, succeeded by moist pluvial conditions during the Holocene.

With regard to the Holocene, palynological investigations in Rajasthan (v. Fairbridge 1976:fig.4) have suggested that an arid interpluvial correlating with the Würm upper pleniglacial was followed by post-glacial pluvial optima at ca. 9,200-8,600, 7,000-6,600 and 6,300-5,300 BP, the latter two falling within the Atlantic optimum of Europe (cf. Deraniyagala 1992:addendum I). Dry Neoglacials I and II are thought to have occurred at ca. 5,300-4,500 and 3,600-3,400 BP respectively. The data for the Holocene from the Monsoon-dominated regions of Africa (Fairbridge 1976: table 1) may be considered a further model against which the Sri Lankan data can be compared, although it requires to be updated. The graph presented by Fairbridge (ibid.:fig.4) for Holocene climatic fluctuations in peninsular India is jagged, representing changes in the intensity of the Southwest Monsoon (which would also have affected Sri Lanka) as well as of cyclonic activity. There is geomorphological and biotic evidence to show that the predominant weather factor during the Quaternary in India has been the S.W. Monsoon (as it still is). There are no indications of its having been supplanted by any other wind system at any time during the Pleistocene. The climatic departures as presented by Fairbridge are thought to have occurred within the course of a century or so, thus making their delineation in the prehistoric sedimentary record a matter of considerable difficulty.

With reference to the application of the Indian data to the Sri Lankan scene, the amplitude of the pluvial/interpluvial fluctuations in peninsular India appears to have decreased with latitude. This could signify a small amplitude for Sri Lanka, compared for instance to Gujarat, Rajasthan or the Himalayas: temperature differences between the two extremes of glacial and altithermal conditions would have been mitigated by the cloud-cover caused by Sri Lanka's maritime environment supplemented by the tropical rain-forest canopy in the Wet Zone. As for rainfall, in the rain-forests of the Wet Zone even considerable changes in total rainfall would have made little difference to the biome, the only change registered would have been in the volume of surface run-off into the drainage system. With temperature changes, the altitude-determined boundaries of vegetation Series D1, D2, D3, and E (Deraniyagala 1992:app.I) would have fluctuated correspondingly. It is probable that several short-term fluctuations, lasting less than a few centuries at a time (v. Fairbridge 1976), were manifested in Sri Lanka in muted form.

On the basis of the global evidence (Deraniyagala 1992:chap.4.6.4-6), with special reference to the tropics, one could postulate in the case of Sri Lanka that during the Lower Pleistocene at 1,820,000-800,000 BP there had been an uncertain number (≥30) of pluvial/interpluvial oscillations which became progressively more pronounced towards the Middle Pleistocene. After ca. 800,000 BP, the onset of the Middle Pleistocene, at least eight pluvial/interpluvial cycles of ca 100,000 years appear to have occurred, of which a minimum of five interpluvials would have been relatively severe with lowering of temperatures in excess of 5°C below that of the present.

The evidence from the last interglacial, Eem, suggests that the temperature averaged around 1°C above that of the present in the tropics. The curves presented by IGBP (2001: fig.1) suffice to indicate the pattern which Sri Lanka's climate might have assumed, noting that cold would hypothetically have correlated with relative aridity and warm with pluvial conditions. The Würm upper pleniglacial at ca. 35,000-15,000 BP would have been relatively more arid than at present, as demonstrated on the Horton Plains in Sri Lanka. The pluvial correlating with the Eem apparently sufficed to cause the deposition of the distinctive basal gravels of the I Fm at Sites 50 and 49. The average temperature would have been 3-6°C cooler than the present during the upper pleniglacial, and the boundaries between ecozones D1, D2, D3, E and C depressed by ca. 500m[9].

Oxygen isotope data suggest that throughout the Pleistocene the warming up episodes were much more rapid than the cooling off ones (Flint 1971:425). However, climatically there would not have been a direct transition from Würm interpluvial to Holocene pluvial, but rather an irregular oscillation between moist and dry conditions leading up to an overall pluvial during the Holocene.

In terms of human ecology, it is probable that the East African evidence applied in large measure to Monsoon South Asia, and specifically to peninsular India and Sri Lanka with their frequent land links.

> The Omo-Rudolf record, seen in conjunction with the evidence for multiple, mid-Pleistocene glaciation of Mt. Kilimanjaro, cautions against over-generalization that the East African mid-Pleistocene was palaeo-climatically uneventful. However, the magnitude of the changes implied should also not be over-emphasised. The complex vertical and horizontal zonation of ecological opportunities in East Africa practically assures the survival of all basic eco-niches through climatic vicissitudes of the scale indicated in the later Pleistocene record. ...
>
> The details and rationale of [Pleistocene environmental change in East Africa] are still obscure, but ... the scale of any such changes was insufficient to change the fundamental ecological mosaic [Butzer 1975:869; also v. Isaac 1975*a*:508].

It is likely that peninsular India and Sri Lanka constituted a similar mosaic, but with low contrasts. The glacial/interglacial extremes would probably have been reflected in interpluvial/pluvial phenomena which were manifestly subdued owing to the proximity of the Indian Ocean and the protective barrier of the Himalayas.

Settlement and Subsistence

Having thus sketched the dynamics of Sri Lanka's environmental progression through the Quaternary (although somewhat speculatively for its pre-Eem episodes) it is necessary to consider how such environmental shifts would have influenced the effective environments of hunter-gatherers living there[10]. As mentioned above, the altitudinal boundaries between vegetation Series D1, D2, D3 and E on the one hand, and E and C on the other, would have shifted at the present lapse-rate of ca. 100m for every 0.65°C change on the western flank of the central mountains and 0.5°C for the eastern aspect (Deraniyagala 1992:app.I.4.3), with a possible increase in the lapse-rates as per the Southeast Asian evidence. These shifts in ecozonal boundaries could not have had a significant impact on human settlement and subsistence traits in ecozones D1, D2 and E relative to each other, since estimated carrying capacities for these zones have been considered approximately equal (ibid.:chap.6.2). But it has been hypothesised that D3 has a lower carrying capacity than the rest of the ecozones, and any extension or diminution of its area would have probably been reflected in the settlement configurations. However, the depression of the boundary by ca. 500m (or even 1,000m) during the last glaciation is unlikely to have made a major impact on prehistoric settlement in Sri Lanka as a whole, due to its mosaic of varied ecozones which can absorb a wide range of environmental fluctuations without their being reflected in the island's total demographic make-up (v. quotation on East Africa above). On the other hand, a decrease in temperature by ca. 10-15°C (?pre-Quaternary) as suggested by the discontinuous distribution of fauna and flora between India and Sri Lanka, could lower the carrying capacity for the entire island to that of the present ecozone D3 or lower still (except perhaps above a hypothetical tree-line, which might have existed at times within the present highlands, with an exceptionally high biomass of grazing ungulates).

The discovery of remains of spotted deer, lion and water buffalo in the Ratnapura Beds (K.Manamendra-Arachchi 2005:pers. comm.) suggests that during certain episodes in the Quaternary the lowland Wet Zone of Sri Lanka witnessed relative aridity resulting in a biome that was at least as 'dry' as that characterising ecozone C today. Since it has been proposed (and demonstrated on the Horton Plains) that precipitation in the Wet Zone would have diminished during glacial episodes, it can be hypothesised that the *Axis axis* remains and *Bubalus* from the Ratnapura Beds relate to an interpluvial(s) of considerable intensity. If this were so, by comparison with ecozone C, the carrying capacity of the entire Wet Zone is likely to have been two or three times as high as it is today and this would have been reflected in the density of the hunter-gatherer populations in ecozones D1, D2, and D3. This would certainly mean that any postulate concerning a low carrying capacity for the island during the glacial phases of the Middle Pleistocene has to be radically modified to propose a much higher carrying capacity than at present for the Wet Zone, at least during certain episodes when depressed precipitation could have been conducive to a higher ungulate biomass[11].

It has been postulated that interpluvials witnessed a more even water-balance in the Dry Zone than is prevalent today (Deraniyagala 1992:app.I.4.8), with shorter periods of drought annually. This is likely to have resulted in a type of lowland biome that was somewhat intermediate between those of ecozones C and D1 in the lowland Dry Zone. Considering the difference in carrying capacities between C and D1, it is possible that interpluvials were, in varying degrees, marked by carrying capacities that were intermediate between those of ecozones C and D1, with intense interpluvials as hypothesised for the Middle Pleistocene being represented in the lowland Dry Zone by carrying capacities closer to that of present-day D1 and the lesser interpluvials being closer to C. It is probable that with the hypothesised diminishing of the Southwest Monsoon during interpluvials the ecozonal differentiation of the lowland Dry Zone into A, B, C and F, as well as the basic differentiation between Wet and Dry Zones, were correspondingly reduced (as this zonation is primarily a function of the effects of the Monsoon) making for relative homogeneity between sub-zones and even between the macro-zones. The occurrence of Wet Zone-habitat molluscs in certain Mesolithic deposits in the Dry Zone (Bellan-bäňdi Palässa, Aligala shelter) could corroborate this proposition.

With regard to altithermal episodes, the geomorphology and sedimentology of the basal gravels of the I Fm and RBE Fm, and perhaps some of the coarse gravels of the Ratnapura Beds, indicate pluvial conditions which appear to have been brought about by an intensification of weather phenomena over Sri Lanka, namely S.W. Monsoonal, tropical cyclonic and convectional precipitation. Such intensification, however, is unlikely to have affected the rain-forest biome of the Wet Zone, and its carrying capacity would have remained much the same as it is today. On the other hand, the Dry Zone (including ecozone E) would have undergone much more intense and extended summer desiccation by the *Foehn* effect of the katabatic S.W. Monsoonal winds, in proportion to their degree of increased activity during the various altithermals. The sedimentology of the basal gravels at Sites 49 and 50 suggests that during the Eem altithermal the seasonal water deficit was such as to alter the vegetational configuration so as to expose the land surface in the lowland Dry Zone to massive denudation by seasonal cyclonic storms. On the basis of this evidence it is possible to hypothesise that this drier vegetation would have resembled the monsoon-forests typical of much of peninsular India, as in Madhya Pradesh, with numerous deciduous elements which left the ground exposed to erosion during the winter months when cyclonic weather prevailed[12].

While the lowland Dry Zone was being thus eroded, the sedimentological and stratigraphic evidence from the dry intermediate uplands (ecozone E) do not indicate that the same phenomenon had occurred. It is possible that the dry intermediate uplands underwent a less extreme desiccation and that its biome was only slightly modified into a drier facies (with a corresponding increase in herbivore density).

It can be postulated that during altithermal episodes, the more intense the atmospheric circulation the higher the carrying capacity of the Dry Zone, with the proviso that a synchronous depletion of exploitable water would probably have modified this one-to-one correlation, particularly in the instance of ecozone F with its deep aquifer in karstic terrain. The pre-Eem penultimate altithermal at ca. 225,000 BP, which in India appears to have been particularly intense and extended, was probably represented by an exceptionally high carrying capacity in Sri Lanka's lowland Dry Zone. The Eem, while less intense than the former, as per the Indian evidence, seems also to have been represented by a monsoon-forest biome in ecozone A (Sites 49,50 of the I Fm) suggesting a prehistoric carrying capacity during this episode which was roughly equivalent to that of India's Madhya Pradesh today. Considering the carrying capacity of monsoon-forests, as can be deduced from the herbivore densities of Madhya Pradesh (v. Schaller 1967; Eisenberg and Lockhart 1972), it appears to be at least treble that of Sri Lanka's lowland Dry Zone.

The densities for hunter-gatherer populations subsisting in the different ecozones in Sri Lanka, on the basis of ethnographic data on the Vädda of Sri Lanka, Kadar of Kerala, Chenchus of Andhra Pradesh, Andamanese and Semang of Malaya and Thailand have been estimated (here referred to as the 'Vädda et al.'; Deraniyagala 1992:chap.6). It has been hypothesised that, in general, the Wet Zone would support a much lower density than the Dry Zone, with ecozones D1 and D2 estimated at ca. 0.1 individuals per km and D3 being even sparser due to its poor resource base. The dry intermediate uplands, ecozone E, have been considered to have a carrying capacity similar to D1 and D2. As for the lowland Dry Zone, Vädda, Vanniya and Kadar data suggest population densities of ca. 0.3-0.4 persons per km^2. with localised ecologic densities that were much higher at sources of water during the dry months. The coastal Andamanese evidence for population concentration of up to 1.5 persons per km^2 has been considered analogous to the potential situation along the prograding coastal tracts of ecozones A, B and F with their rich resources.

On the basis of the above estimates of hunter-gatherer population densities for Sri Lanka's present ecozones, it is possible to further hypothesise concerning population densities for these ecozones during the Pleistocene while taking into consideration fluctuations in carrying capacities as postulated in the foregoing account. Technology is assumed to be a constant throughout the prehistoric period under survey, from ca. 800,000 BP to the Holocene, in the absence of substantive data to adjust for increasing exploitative efficiency from the Middle Pleistocene onwards. (For climates from ca. 400,000 to the Holocene v. IGBP 2001:fig.1.)

Exceptionally intense glacials (ca. 340,000, 140,000, 20,000 (Würm) BP)

Ecozones F, A, B, C: considerably less than the present; ca. 0.1-0.2 individuals per km^2.

Ecozone E: similar to the present; ca. 0.1 per km^2.

Ecozones D1, D2: higher than the present due to drier conditions; ca. 0.2-0.3 per km^2.

Ecozone D3: perhaps higher than the present; ca. 0.1 per km^2. There is a possibility that still higher densities were maintained at the highest elevations, above the tree-line.

Exceptionally intense interglacials/pluvials (ca. 410,000, 330,000, 125.000 (Eem) BP).

Ecozones F, A, B, C: possibly considerably higher density than at present; ≥0.8 per km^2 (monsoon-forest biome), with coastal niches supporting up to 1.5 per km^2

Ecozone E: higher than at present; ca. 0.4-0.8 per km^2.

Ecozones D1, D2: similar to the present; ca. 0.1 per km^2.

Ecozone D3: possibly somewhat higher than at present due to the biome being closer to those of D1 and D2; ca. 0.1 per km.

Medium-intense glacials/interpluvials (ca. 250.000 BP)

Ecozones F, A, B, C: Somewhat less than that of the present; ca. 0.2 per km^2. Ecozone E: similar to the present; ca. 0.1 per km^2.

Ecozones D1, D2: similar to the present, or possibly slightly higher; ca. 0.1-0.2 per km^2.

Ecozone D3: same as or somewhat higher than at present; ca. 0.1 per km^2.

Medium-intense interglacials/pluvials (≤ 11,600 (Holocene) BP)

There have been frequent and rapid climatic oscillations during this phase (ibid.:fig.6). Surveys in ecozones D2, D3 and E have shown up approximately similar densities of (?Holocene) site scatter in each of these ecozones (ibid.:chap.5.3.10), which might correlate with densities of synchronous sites.The latter, however (until site extents have been estimated), need not correlate with prehistoric population densities. It is noteworthy that in estimating site density, what is being observed are quartz scatters; sites comprising organic remains, as is likely to have been prevalent in Ecozone D3 with its ample supplies of bamboo conducive to a 'bamboo culture' as with the Semang, would scarcely be represented.

Modifications within the above set of general hypotheses would be required in the light of fluctuations of food resources along the prograding coasts of ecozones F, A and B. The warmer seas of the altithermals possibly witnessed an increase in resource density. Then there is the discovery that herding and incipient farming of barley and oats, and herding and farming of domesticated barley and oats occurred on the Horton Plains at 17,000 and 10,000 BP respectively (Premathilaka 2003). This would have increased the carrying capacities of the various ecozones, although perhaps not significantly.

The hypotheses presented above are clearly very speculative as there are basic assumptions which future research will show up to be simplistic. However, they constitute a heuristic device which provides direction to formulating research strategy, and they serve to narrow such strategy into a cohesive set with logic in its structure. It is expected that through the very controversy that is likely to arise from these postulates significant new light will be shed on these crucial aspects of cultural palaeo-ecology, which in itself is a worthwhile goal even if it means that the hypotheses themselves end up in tatters. Meanwhile, assuming the validity of these general hypotheses, pending their testing, it is now opportune to move into more particularistic fields of enquiry.

The ethnographic data on settlement (Deraniyagala 1992: chap.6.10.5) indicate that the minimum size of the hunter-gatherer bands in Sri Lanka during the Quaternary, or at least in so far as *Homo sapiens sapiens* was concerned, would have been 15-25 individuals, with the maximum being ca. 50. These critical values appear to constitute social organisational checks to ensure survival of the group and may validly be considered generally applicable to the Sri Lankan scene, given the low amplitude of environmental change postulated for its Quaternary.

The only data to have been forthcoming on settlement size in prehistoric Sri Lanka are from the surveys conducted in the I Fm , High Plains, Ūva basin and the Haňdapān-älla/Tangamalai Plains (ibid.:chap.5.3.3,6,8,9,10). These indicate a modal extent of ca. 50m^2 for the areas occupied by what seem to be base-camps. On either side of this extent range the extraction camps which tend to be much smaller and a few exceptionally large sites such as Church Hill at Bandārawela (>150m^2) and Bellan-bäňdi Palässa (>120m^2), although it is impossible to determine (on the extant evidence) whether these latter deposits were synchronous or in palimpsest[13]. Since Kolb's (1985:590) allocation of ca. 6m of camp space (inclusive of public space) per person appears to be ethnographically valid for the Väddas et al. (Deraniyagala 1992:chap.6.10.5), it can be hypothesised that the ca. 50m camp sites had been occupied by ca. 8 individuals constituting 1-2 nuclear families (on the basis of 5 individuals per family, v. Cook 1972). The exceptionally large sites at Bandarawela and Bellan-bäňdi Palässa could have held up to 25 individuals[14].

There is no chronological definition for the prehistoric sites indicated above with their modal extents of ca. 50m^2. Apart from a few of the sites in the I Fm , all the others are probably of Holocene or late Upper Pleistocene age. On this basis it suffices to interpret these data as indicative of the modal residence groups in ecozones A, E, D3 and D2 as having consisted of not more than two nuclear families. Since ecozones A to D3 cover almost the full range of variability in zonal carrying capacities, this modal range of 1-2 nuclear families may be considered applicable to the Holocene prehistory of the entire island. No doubt, further settlement surveys, which are in their infancy as yet in Sri Lanka, will bring to light more of the bigger camp sites such as Bandārawela or Bellan-bäňdi Palässa representing occupations during seasons of plenty. As per the ethnographic data, such camps are not likely to have serviced more than 50 individuals, which, on a per capita module of ca. 6m^2 floor area, would hypothetically imply that the largest of the camps would be ca. 300m^2. There are some indications of such sites existing in the dry dolines (*vembus*) of the I Fm, as at Site 40, although it is impossible to judge whether these spreads of artefacts are synchronous or in diachronous palimpsest. Camp sites with artefact scatter over areas less than the modal ca. 50m^2 are of frequent occurrence in all the ecozones. These could represent single families in their temporary camps during their main annual migratory season, or even transit stops of one or two individuals striking out into extended territory.

Given the hypothetical shifts in population density postulated above from the Middle Pleistocene onwards, with a range of <0.1 to 0.8 individuals per km^2 in the hinterland and up to 1.5 in the coastal Dry Zone, it is probable that these differential densities would have been expressed primarily in corresponding densities of the number of resident bands in a given area or ecozone. The size of each of these groups, 25-50 individuals per band, would have depended on the resource availability of their respective site-territories. The relatively high range of annual fluctuation of resource density in the drier biomes would, as per ethnographic analogues, have resulted in corresponding fluctuations in the numerical composition of resident groups; and the converse would have been true of the rain-forests with their low annual range of resource fluctuation. The coastal resources of the Dry Zone would have been exceptional in this regard, as they do not fluctuate appreciably during the course of the year, and hence it it likely that the numerical composition of the resident groups remained relatively constant throughout the year, as paralleled by the coastal Andamanese (ca. 40-50 individuals) who moved camp every 1-2 months in accordance with resource dynamics.

What one finds on the ground would be artefact scatters representing bands of up to 50 individuals, the upper numerical threshold; but these in themselves provide no clue as to the population density of a given ecozone at a particular point in time. The degree of chronological resolution that will have to be achieved to conclude on population density is scarcely feasible in Sri Lanka's prehistoric context, given the range of error of the radiocarbon, TL and OSL dating techniques. At best, what can be secured is a rough idea of differential population densities through time and space, to be viewed against the hypothetical densities set out above from the Middle Pleistocene onwards, with an acute awareness that there is differential visibility of sites in the various ecozones[16].

Having thus considered prehistoric population density, settlement density and settlement size in Sri Lanka, the factors concerning transhumance and the siting of camps may be assessed. The Väddas et al. have provided clear indications as to the extents of their respective annual territories. The richer the resource zone the more restricted in extent this is likely to be, as seen in the extreme case of the coastal Andamanese with an annual territory of ca. 26km^2, as against ca. 60-80km^2 for the Vâddas, 60-100 for the Kadar, 35-40 for the Chenchu and 250-500 for the Semang (Deraniyagala 1992:chap.6.10.5)[17]. Within the annual territory, as far as the Dry Zone is concerned, the summer dry season witnessed the coalescence of families in semi-permanent base-camps, being the season of plenty, while the winter rains saw them disperse following game that scattered with the now abundant sources of water. In the Wet Zone this seasonality is much less prominent; but it can be hypothesised that transhumance within the Wet Zone was nonetheless very pronounced as demonstrated by the extensive annual territory of the Semang in a correlative environment[18]. What has been stated (ibid.) on patterns of transhumance for the Väddas et al. may be considered applicable to Sri Lanka's prehistoric scene, with rain-forest biomes being represented by almost continuous movement in small groups of one or two families in a large annual territory, while the lowland Dry Zone biome had a smaller annual territory, which would have been smaller still in the coastal Dry Zone and during altithermals of exceptional intensity with resultant biomes in the lowland Dry Zone approximating to the monsoon-forests of peninsular India.

Inter-ecozone transhumance would have been a possibility in prehistoric Sri Lanka, despite the strong territoriality evidenced by the Väddas which might be a function of their having been relegated to relict status by the Sinhalese and Tamils. Ecotonal situations would almost certainly have witnessed inter-ecozonal transhumance, and it is probable that the zones with low carrying capacities, such as the Horton Plains (Maha-eliya) in D3 or Haňdapān-älla Plains in D2, were visited only seasonally, for instance by groups resident beneath the escarpment in the Valave plains or in the Dry Zone at the foot of the Rakwāna massif respectively. In the case of ecozone D3 (ibid.:chap.5.3.9), the groups could have moved up during the February drought when the grasslands could be fired to facilitate hunting, despite the low wild herbivore density. During the Neolithic it would have been a concomitant of herding and the cultivation of barley and oats. With the Haňdapān-älla Plains perhaps complementary plant resources such as the palms *Loxococcus rupicola* and *Caryota urens* were being harvested seasonally. The Vädda rate of transhumance at ca. 7km per day could be indicative as to the maximum range from which a tranhumant group could arrive at a given location. In mountainous terrain the rate of travel is likely to have been considerably less than 7km a day and possibly the number of hours of walking per day would be a better index. The lightness of the microlithic toolkit of Sri Lanka's prehistoric humans, at least from the Upper Pleistocene onwards, would have facilitated his movements – although apparently not adequately for him to settle in the Jaffna peninsula (with its sparse water and raw material resources) with any degree of intensity (ibid.:chap.5.3.2).

As regards the selection of sites for camping, there does not appear to have been any considerable urgency associated with the procurement of raw materials for tool manufacture, as it is ubiquitous in the island except in ecozone F (where no prehistoric sites have so far been found). It can thus be concluded that the influence of raw material procurement on settlement location would have been very secondary compared to that of the search for food and (in the Dry Zone) water.

Nearly all the sites in the Dry Zone occur in the open air. Extensive surveys conducted in the very habitable caves of this macro-zone have yielded scarcely any evidence of prehistoric habitations (id. in Solheim and Deraniyagala 1972); whereas numerous open-air sites have been found in close proximity to these caves (eg, Site 39 of the I Fm). One is at a loss to explain this anomaly, except through ethnographic analogy. The Dry Zone by definition is much drier than the Wet Zone and there is less necessity to seek shelter from rains. The Vaddas are known to have resorted to caves only during the winter rains when they followed the sambhur into the hills. During the rest of the year their huts of wattle and bark or simple lean-to shelters of branches with leaf thatching sufficed against the elements. There would in any case have been a preference for open-air habitations from the point of view of water procurement strategy, as they provide much greater flexibility in locating camps according to the precise whereabouts of optimum hunting and gathering during any one phase of the annual subsistence cycle. Such flexibility, naturally, would have been much more restricted in the case of caves and rock-shelters. It is noteworthy that the Semang too resorted to caves only during the rainy seasons, and that they moved camp practically every few days, with no fixed camping spots (cf. coastal Andamanese). The sterile inter-bedding of the prehistoric occupation deposit in Nilgala cave (ecozone C) is suggestive of seasonal occupation (ibid.:chap.5.3.3).

As for the location of prehistoric open-air camps in the lowland Dry Zone, those in the coastal dunes of the I Fm would obviously have been selected for their access to coastal food resources complemented by the availability of scarce fresh water in Sandy Regosols. The *vembus* of the I Fm bear ample evidence of numerous sites. While some of these may be lag deposits derived from the receding fossil dunes that overlie the basal gravels, others appear to have been factory sites exploiting the quartz and chert pebbles that occur on and in the *vembu* gravels (ibid.:chap.5.3.3). It is also probable that the exposed aspect of the *vembus* was considered an asset against marauding animals and humans and that, apart from extraction camps, base-camps were located in the *vembus* for this reason. The shell middens associated with the Mandakal-āru estuary, north of Māntai (ibid.), are located some distance away from the estuary, possibly to maximise on ecotonal exploitable biomass, as was the practice with the coastal Andamanese. The one at Palle Malala, ca. 4km east of Hambantota, is situated beside the lagoon, although the exploitation of a range of vertebrates is indicated amongst the numerous shells of *Meretrix casta* in the midden[19].

It is not possible to generalise on the siting of prehistoric camps in the RBE Fm due to the dearth of recorded sites. The latter factor is a result of the upper colluvial member of this formation blanketing such occurrences, giving perhaps a wrong impression of site scarcity in the RBE Fm. On the basis of the situation of Sites 42 and 43 (ibid.:app.III) it can be surmised that there was a preference for high ground, with exposures of gravels for artefact manufacture as in the case of the *vembus*. Such exposures would have facilitated visibility around the sites, as against the relatively dense vegetation that would have clothed the colluvial Reddish Brown Earths.

In ecozones E, D1, D2 and D3, open-air sites were preferentially located on hill-tops and saddles (ibid.:chap.5.3.6-9), and then on the eastern flanks of the hills, presumably for shelter against westerly Monsoonal winds and for the warming effect of the morning sun. This selection for hill-tops and saddles has been noted among the Chenchus and Andamanese (ibid.:chap.6.10.5). However, the Chenchus are known to have camped in sheltered hollows in forested environments, within which the Andamanese selected open glades for fear of falling branches. Such sites have rarely been encountered in a prehistoric context in Sri Lanka, except Bellan-bäňdi Palässa and perhaps a few on the Horton and Haňdapān-älla Plains where shelter would have been required against the cold, damp winds. The apparent scarcity of low-lying open-air sites in the Wet Zone and in ecozone E is possibly ascribable to their having been covered over by hill-wash sediments, as in the case of the RBE Fm (v. ibid.:chap.5.3.4,10). Subterranean caverns were not favoured – understandably, due to lack of light, their dampness and poor ventilation. It is probable that extraction camps were sited close to colonies of rock-bees on cliffs (cf. Vaddas) and that in the Wet Zone a certain degree of territoriality was attached to wild breadfruit trees, as with the Semang and their *durian* and *ipoh* trees.

The sites on the hill-tops and saddles of ecozones E and D3 are invariably associated with *dry* and *wet patana* grasslands respectively. The exceptionally high density of such sites in E could well be merely apparent, being a function of the relatively sparse grass cover exposing the sub-soil (ibid.:app.I.6.1).

The grasslands themselves in ecozones E and D3 appear almost certainly to be the result of clearing during the Stone Age, as possibly are the savanna *damanas* of ecozone C (ibid.:chap.5.3.5). The forest on the Horton Plains has been cleared since at least 17,000 BP (Premathilaka 2003). The location of sites in E and D3 at points affording long-distance views and at ecotones between forest and grassland (eg, Site 13 in the Horton Plains; Deraniyagala 1992:map 9) is indicative of the existence of grasslands when the camp-sites were selected. Since the grasslands of ecozones E and D3 are considered to be anthropogenic (Mueller-Dombois and Perera 1971:34-5; Deraniyagala 1992:chap.5.3.6.9), they would have been cleared in prehistoric times possibly by outright felling (cf. efficiency of Australians in cutting down trees with choppers) or by ring-barking and firing the dead stands during the droughts in the summer and February in ecozones E and D3 respectively. The concept of firing forests for increasing accessibility (e.g., Tasmanian trails (Butzer 1971:535)) and exploitable faunal and floral biomass – and hunting and gathering efficiency in general – has been widespread among hunter-gatherers throughout the world (eg, Väddas, Australians, American Indians (Deraniyagala 1992:chap.6.10.5)). It was probably practised ever since fire technology was acquired (eg, Peking Man) which in Sri Lanka has been radiocarbon dated at Fa Hien-lena to ca. 38,000 BP (ibid.:addendum I). Coring of the swamps in ecozone D3 has yielded important information on prehistoric man-induced vegetation changes within the framework of a radiocarbon chronology (Premathilaka 2003). It is noteworthy that the South Indian counterparts of ecozone D3 in the Nilgiri hills bear traces of apparent prehistoric firing (Deraniyagala 1992:chap.5.3.14) with cerealia pollen suggesting farming at ca. 10,000 BP (Gupta and Prasad 1985 cited in Premathilaka 2003).

There is no evidence concerning the site plans of prehistoric open-air settlements in Sri Lanka. The ethnographic norm for semi-permanent base-camps in South and Southeast Asia appears to have been a cluster of huts, one for each nuclear family, facing inwards about a communal space (Andamanese, Kadar; Deraniyagala 1992:chap.6.10.5). This appears to be more representative of settlements in rain-forest environments than elsewhere, and it may be hypothesised that base-camps in the Wet Zone of Sri Lanka were structured on these lines. However, since the carrying capacity of the Wet Zone is not likely to have permitted such nucleations except under very exceptional circumstances, the norm in this macro-zone throughout the later Quaternary is likely to have comprised one or two shelters at a time in any single locus, with preference being given to caves and rock-shelters when these were at hand. In the Dry Zone, base-camps comprising up to 10 huts (for a maximum of ca. 50 individuals) could have agglomerated during the dry season when ecologic density would have been at its peak, with wet-season camps consisting of single or dual units. It is unfortunate that no information is extant as to how the Väddas arranged their base-camps, but the evidence from among the Kadar indicates that 3-12 huts were clustered around a central public space and it can be hypothesised that prehistoric open-air settlements in Sri Lanka's Dry Zone were similarly arranged. The Andamanese (and occasionally the Semang) were noted for their communal houses, which represented an entire semi-permanent camp compacted into a single structure, with a central public space and discrete compartments, each with a hearth, for the nuclear families. It is probable that the resource-rich coastal ecozones F, A and B had parallels to the Andamanese semipermanent camps and communal houses, with accommodation for each family facing a central public area. A careful plotting of the floor-plans of occupations in the I Fm, as at Sites 49b,c III and 50a III, could conceivably clarify this point.

The excavations conducted in the caves of the Wet Zone have not been too enlightening as regards habitation configurations within the caves themselves. The Väddas et al. are known to have had discrete territorial units for each family within the larger communal caves or shelters (with an allocation of ca. 0.5m^2 per individual (ibid.:chap.6.10.5) and each family had its own cooking hearth, although food tended to be shared. There is evidence from Beli-lena cave at Kitulgala that such a practice was prevalent at this site in a horizon dated to ca. 15,000 BP. Traces were found of several discrete fireplaces (evinced by reddening of the underlying colluvial yellow loam) with each measuring ca. 1m in diameter (ibid.:chap.5.3.10). These fires would not have been large enough to have serviced more than a single nuclear family at a time. Should Beli-lena, which is perhaps one of the five largest caves in Sri Lanka, have held more than one family at a time[20], these hearths could be interpreted as indicating that, as with the Väddas et al. (ibid.:chap.6.10.5), the cooking was performed independently by each family and perhaps that each unit kept a fire burning all night for warmth and protection (v. Kadar). It is significant that the primary social module at ca. 15,000 BP at Beli-lena appears to have been the nuclear family – perhaps not surprisingly, given the low carrying capacity – as per the evidence from the hearths.

The only structural features to have been found in a prehistoric context in Sri Lanka are the rubble footing of a wall at Beli-lena Kitulgala, once again from the horizon dated to ca. 15,000 BP, and a rubble terrace wall at Batadomba-lena in an undated horizon which might correlate with Stratum 7b dated to ca. 26,000 BP. The wall at Beli-lena comprised a single course of rubble in what appears to be an elliptical plan, but which has only been partially exposed. It is probable that this footing supported a screen of branches and leaf cladding, although no post-holes were observed. The structure had been dry-laid, without mud mortar, as was the case with the terrace wall at Batadomba-lena. The latter, once again only partially exposed, is situated at the rear end of one of the subsidiary shelters attached to the main cave, and it appears to have been a retaining wall (of at least two courses) which served to support an earth terrace abutting against the back of the cave for levelling off an occupation floor. The structure in Beli-lena can be compared to the screened partitions erected by the Vaddas in their communal caves (ibid.:chap. 6.10.5), and the terrace at Batadomba-lena has a direct parallel in the manner in which the present floor of the main cave has been levelled by a Buddhist monk who was resident at the site until 1968.

It is known that among the warlike Jarawa-Andamanese look-out posts were located at strategic points in the site-territory of their base-camps (ibid.). On suspicion that a similar situation might have prevailed at Beli-lena, a knoll was selected that could have served as a look-out post and the ground examined. It did turn out to be a prehistoric camp site. As to its precise function, whether warlike or otherwise, it is indeterminate, but that it served as a spot from which to monitor the approaches to the cave is very likely – which is suggestive of relatively strong territoriality, at least regarding this particular location with its magnificent cave complex. A similar look-out position is located at Site 26 and perhaps Site 17 on the Horton Plains (ibid.:map 9, chap.5.3.9), with a panoramic view down the precipitous escarpment into the second and third peneplains below. It was probably required to monitor the movements of transhumant groups at considerable distances, perhaps through smoke signals. Platforms on trees, such as those used by the Väddas to avoid marauding elephants, might have served a similar function in the lowland Dry Zone where the elephant biomass is high enough to justify such measures.

With regard to subsistence practices, since the stone tools found in the Ratnapura Beds cannot be assigned to primary contexts, it is impossible to so much as speculate as to whether animals such as the hippopotamus and rhinoceros of the Ratnapura Fauna had been exploited for food by prehistoric man. The hippopotamus has a very wide tolerance of habitats (at least in the case of the living *H. amphibius*), and since the environmental fluctuations during the Quaternary in Sri Lanka are not thought to have been drastic, it may be proposed that the extinction of the animal on the island was due to over-exploitation by prehistoric man[21]. The same was probably true of the rhinoceros as well. As to when these extinctions were effected cannot be estimated. Rhinoceros bones from a gem pit at Lunugala, near Passara in ecozone E, have been dated to ca. 80,000 TL BP (M.Abeyratne 2000:pers. comm.). The faunal assemblage from the basal level of Batadomba-lena (ca. 36,000 BP) has not yielded remains of either animal, although non-representation due to the *schlepp* factor needs to be considered in this context.

The Iranamadu Formation has not produced any substantive data on prehistoric subsistence practices. The permeability of these sediments, coupled with humid equatorial climatic conditions, has led to the destruction of any organic remains there might have been within them. However, being a coastal environment, it is most likely that the rather considerable marine and estuarine resources (including the eggs and nestlings of colonies of aquatic birds) associated with the prograding coasts of ecozone A would have been intensively exploited by prehistoric humans living along these coasts and also on those of ecozones F and B. The tendency for the coasts of F and A to prograde today was probably true for most of the Quaternary, with ocean currents being the function of the S.W. Monsoon which dominated the weather pattern of the region since long before the Quaternary. The resultant lagoonal complexes would have been high in exploitable biomass. The occurrence of caliche nodules as heaps in association with the I Fm seems to indicate that these originated as shell middens which have subsequently undergone leaching and recrystallisation as nodules. The Latosol profile of Site 50a in the I Fm , with such nodules underlying a midden of lagoon shells, is corroborative of this hypothesis.

It is probable that a typical midden in the I Fm would have comprised species in proportions akin to those described for Mesolithic Site 50a IV (ca. 5,300 BP), with a preponderance of *Meretrix casta*, as was the case with Site 57 (ca. 3,200 BP) with remains of sambhur and the midden at Palle Malala with vertebrate bones indicating a mixed subsistence strategy (cf. coastal Andamanese exploiting coast/ hinterland ecotones). Site 30 (ca. 2,950 BP) had a predominance of *Arca* species (ibid.: chap.5.3.3, app.III). The midden excavated in the basal levels of Māntai (ca. 3,800 BP) included the remains of at least one dugong and several varieties of shellfish such as conch. The series of Stone Age middens near the estuary of the Mandakal-āru comprises almost entirely the estuarine oyster *Ostrea madrasensis.* The island's low tidal range, with a resultant restriction of shellfish availability, is probably responsible for the relative scarcity of prehistoric shell middens in Sri Lanka.

So far, the RBE Fm has yet to yield data on subsistence practices. As with the I Fm, the post-depositional environment of the RBE Fm is not conducive to the preservation of organic remains, and hence this lacuna. The circumscribed concentrations of caliche in the Kuttigala Series of the RBE Fm off Embilipitiya could represent ancient shell middens as with the I Fm. On the other hand, the unique site of Bellan-bäňdi Palässa has had its faunal remains preserved by the limestone bedrock and as such provides a clue as to the Mesolithic subsistence practices in RBE Fm country at ca. 12,000 BP (ibid.:chap.5.3.4). The range of animals exploited was very wide, with the extant evidence showing up a strong component of monkeys in particular and also of porcupines. However, there is a marked dearth of quantitative data for this site, and it is probable that cervids such as spotted deer were very significant as a dietary component although this predominance is not identified as such in the faunal assemblage (cf. *schlepp* factor and Chenchu, ibid.:chap.6.6.2). On the other hand, the Mesolithic horizon at Nilgala cave in ecozone C (ibid.:chap.5.3.5) has yielded a preponderance of spotted deer remains, sambhur taking second place, within a mixed assemblage of miscellaneous vertebrates. The anthropogenic *damana* parklands of ecozone C would have been particularly conducive to the exploitation of spotted deer, as appears to be indicated at Nilgala cave. However, the evidence from both Nilgala cave and Bellan-bäňdi Palässa suffice to indicate a broad-spectrum exploitation of vertebrates in the hinterland of the lowland Dry Zone, at least during the Holocene. Vädda hunting practice supports the view that spotted deer and sambhur would have met most of the meat requirements (ibid.:chap.6.3.2), and it is probable that the Vädda selection for grey langur (cf. Kadar), and monitor (cf. Chenchu) and pig could also have had its prehistoric analogue.

With regard to the uplands of Sri Lanka, there is scarcely any information concerning prehistoric subsistence practices. Rāvaṇälla cave in ecozone E has produced a large faunal assemblage, mostly of small vertebrates which have yet to be assigned their proper stratigraphic contexts and analysed (disposition: Colombo National Museum). These grasslands, once again postulated to be anthropogenic (as with the *damanas*), would have been conducive to the hunting of pig and perhaps sambhur and gaur, while the forested areas support an appreciable density of monkeys.

The bulk of the data on prehistoric subsistence in Sri Lanka has stemmed from the caves of the wet lowlands (ibid.:chap.5.3.7). Of these sites the three that have produced the best evidence are Fa Hien-lena, Beli-lena at Kitulgala and Batadomba-lena, and the range of species identified at these sites may be considered representative of the rest of ecozone D1 from ca. 38,000 BP onwards. Most of the forms found in the assemblages comprise the smaller vertebrates such as porcupine, mouse-deer (cf. Beli-galgē, Gurubavila), giant squirrel, flying squirrel, civet, pangolin and (prominently) monkeys. The larger species such as pig and sambhur are rare, and bovines rarer still, possibly as a function of the *schlepp* factor. The very occasional finds of tiger remains (Manamendra-Arachchi et al. 2005; Batadomba-lena, 16,500 BP) and elephant teeth could simply represent manuports brought in as curiosities, although scavenging and even the hunting of these animals cannot be discounted (cf. Vädda scavenging off carnivore kills). Then there are several varieties of birds (notably spur- and jungle fowl), snakes (e.g., python and rat-snake), hard- and soft-shelled terrapins, fish (ranging from tiny barbs to the large mahsier), freshwater crustacea and large quantities of arboreal and aquatic molluscs (*Acavus, Paludomus*). Once again, quantitative data are lacking in the literature concerning the lowland Wet Zone's prehistoric faunal assemblages, but these should be forthcoming for Fa Hien-lena, Beli-lena and Batadomba-lena from the results of the analyses of P.B. Karunaratne and his team. The preliminary indications from these three sites are that there has been no change in subsistence strategy from at least 38,000 BP onwards, as per their radiocarbon dating. The general impression is one of broad-spectrum, non-specialised exploitation, with direct analogues among the subsistence practices of the Sinhalese living in the remoter villages of the Sinharaja rain-forest today who do not hesitate to eat most animals (ibid.:chap.6.4; cf. Semang, also Wilton Complex of Southern Africa (Sampson 1974:330)).

With regard to food plants, none of the sites in the lowland Dry Zone has yielded traces of their exploitation in prehistoric times. This may be ascribed to poor preservation, as in the case of the open-air sites in the I Fm , and RBE Fm, and to inadequate sampling, as in the caves. The Vädda and Sinhalese ethnographic data (Deraniyagala 1992:app.IV) indicate a wide array of plants exploited for food in the lowland Dry Zone, with an acute awareness of their relative potentials: yams (predominant; *Dioscorea*); cambium (*Mangifera zeylanica*); kernels (*Terminalia belerica*, *Cycas* (cf. Andamanese); fruit (eg, *Manilkara hexandra, Hemicyclia sepiaria, Nephelium longana*) and flowers (*Bassia longifolia*; cf. *mohua* of Chenchu), as well as several masticatories. It is most improbable that these were not similarly exploited in prehistoric times: the relevant evidence, however incomplete, is likely to be forthcoming with more intensive sampling and phytolith analyses.

As for the uplands and highlands, ecozones E and D2 have not produced any evidence of prehistoric food plant exploitation. The open-air sites in the *wet* and *dry patanas* have no organic remains preserved; but adequate sampling of caves could yield positive results. In this regard, D3 has very few exploitable plants (eg, S. *kekatiya*, and possibly tree fern), while D2 and E are somewhat richer. However, as already mentioned (v. *Chronology* above), sediment cores from two swamps on the Horton Plains have been radiocarbon dated from ca. 21,500 BP up to recent times. This investigation conducted by Premathilake (2003)[22] has indicated the existence of herding[23] and the incipient cultivation of barley (*Hordeum*) and oats (*Avena*) at ca. 17,000 BP which is seen to develop into full-fledged herding and farming of domesticated barley and oats from ca. 10,000 to 7,500 BP. There is said to have been a progressive decline of this practice from ca. 7,500 to 3,000 BP. The samples do not display evidence of human activity thereafter until the appearance of wheat *Triticum* pollen at 800-200 BP (ibid.).

The size range of the 'Mesolithic' settlements found so far on the Horton Plain are no different from those elsewhere in the Wet Zone, suggesting that herding and farming practices were not manifested in large settlements ($>50\text{m}^2$)[24], indicating a dearth of surplus food.

It is the caves in the lowland Wet Zone (D1) that have yielded what little macroscopic evidence there is of prehistoric food plant exploitation (ibid.:chap.5.3.7). All of these caves, and the open-air site at Collure, have produced the carbonised shells of the nut *Canarium zeylanicum*. At Batadomba-lena there are clear indications of its exploitation from ca. 36,000 BP onwards, while at Beli-lena Kitulgala and Beli-lena Athula such shells have been dated to 18,500-13,000 and 7,900 BP respectively. At Batadomba-lena and Kitulgala the remains of the shell of *Elaeocarpus subvillosus* have been discovered, representing the exploitation of their kernels. At the latter site the wild breadfruit *Artocarpus nobilis* has been eaten, apparently baked in hearths, from well over 15,000 BP, and remains of the wild banana *Musa paradisica* have been identified from mixed strata. It is possible that the seeds of *Entada phaseoloides* (edible kernels; cf. Andamanese) and of *Nephelium longana* await discovery in prehistoric contexts. On the other hand, there are several food plants of the greatest significance to the gathering economy of the lowland Wet Zone that are yet to be identified in the prehistoric record, for instance the palms C*aryota urens, Loxococcus rupicola* and *Oncosperma fasciculatum* and of course the *Dioscorea* yams. Efficient utilisation of the palms could have added substantially to the carrying capacities of ecozones D1 and D2, thus compensating for the relative scarcity of yams and fruits in these regions[25]. It is probable that prehistoric humans of the Middle and early Upper Pleistocene in ecozone D1, as represented in some of the Ratnapura Beds, exploited a floral spectrum similar to that set out above.

The incidence of heavily worn teeth in Balangoda Man, as recorded from ecozones B, D1 and E, suggests that certain food plants had a high grit content or that they had been processed on gritty surfaces (ibid.:chap.5.3.4). The conspicuous absence of caries and dental abscesses in Balangoda Man could be at least partially due to the use of masticatories which apparently had this beneficial effect among the Väddas (cf. Spittel 1961:139). The lack of silica gloss on artefacts suggests that cereal harvesting was not of much significance in both the Dry and Wet Zones (Deraniyagala 1992:chap.5.3.10), although the new evidence from the Horton Plains indicates that greater scrutiny must be exercised in this regard. Finally, it requires to be pointed out that the general robusticity of the bones of Balangoda Man, for instance at ca. 18,500 and 12,000 BP at Batadomba-lena and Bellan-bäňdi Palässa respectively (ibid.:chap.5.3.4), indicates a subsistence strategy in homeostasis with the environment so as to provide a balanced range of nutrition, which certainly was not the case, apparently, with the relict Väddas of recent times.

At present there is insufficient data for the delineation of ecozonal differences in prehistoric faunal exploitation practices in Sri Lanka (ibid.:chap.5.3.10), apart from the obvious assertion that a characteristically Dry Zone fauna typified by spotted deer and grey langur (and occasionally star tortoise, water buffalo and sloth bear) was exploited in the Dry Zone, whereas in the Wet Zone there were the *Acavus* snails which typify the lowlands. In both instances a very wide faunal spectrum indeed had been exploited, although the larger forms such as elephant, gaur and water buffalo do not constitute a significant component of the evidence (perhaps due to the *schlepp* factor) as is also the case with carnivores, which even recent hunter-gatherers have had a distaste for (eg, Vädda, Kadar, Chenchu, Semang). Most of the bone remains are assignable to the smaller herbivores, and in the lowland Wet Zone the snail component (*Acavus, Paludomus*) is very pronounced (although in terms of meat weight they probably did not count for much; cf. Andamanese for whom molluscs were a critical resource). At Nilgala cave, as mentioned earlier, there are indications of spotted deer having been preferentially exploited, which agrees with Vädda practices and with the axiom that the larger ungulates provide the most meat with least effort.

As for food plants, barley and oats could only have been exploited in ecozone D3. Besides that, once again it is not feasible as yet to demonstrate differential exploitation in the various ecozones due to the unsatisfactory state of the data base; and with regard to honey, as with palm treacle, those very important sources of energy for South Asian hunter-gatherers, there is no evidence at all concerning the nature of their exploitation. Evidence of the utilisation of the nuts *C. zeylanicum*, the fruits of wild breadfruit and wild banana is mostly restricted to the lowland Wet Zone, since these forms do not grow in significant densities in the other ecozones.

In the cases of all three constituents of prehistoric subsistence, namely fauna, flora and honey, one could perhaps most profitably depend on ethnographic data and present-day estimates of differential resource potentials in the various ecozones to identify possible analogues for prehistoric subsistence traits in Sri Lanka. According to such a scheme, the lowland Dry Zone would have been exploited relatively more intensively than the other ecozones, its resource potential being estimated at roughly thrice that of the upland Dry Zone, upland Wet Zone and the lowland Wet Zone, with the highlands being poorest of all (ibid.:chap.6.2.6). In the lowland Dry Zone, particularly in the grassy *villus* and the anthropogenic parklands, it is probable that the gregarious herds of spotted deer were hunted intensively, whereas in forested situations meat was secured from whatever source was at hand. In the prograding coastal sectors of the Dry Zone (ecozones F, A, B), marine resources were probably intensively exploited on a basis analogous to the Andamanese hunter-gatherers, supplemented by terrestrial resources, particularly of the *Dioscorea* yams, *Cycas* kernels (cf. Andamanese) and honey, which are plentiful in the dry conditions of these ecozones. It is unlikely that the degrading coasts of the Wet Zone provided a comparably rich subsistence base, as per their present resource potential which is relatively low.

Macroscopic indications of animal and plant domesticates having been exploited appear with the Protohistoric Iron Age at ca. 900 BC (Anurādhapura) with horse, neat cattle and rice cultivation (Deraniyagala 1972; 1992:addendum II). Despite the occurrence of herding and farming from ca. 10,000 BP onwards, there appears to have been a rather abrupt transition from a primarily Stone Age hunting and gathering subsistence economy to a full-fledged Iron Age technology with irrigated agriculture at ca. 1,000-500 BC (id. 1992:chap.5.4). Skeletal remains of a domestic dog from Bellan-bäňdi Palässa at ca. 12,000 BP (K.Manamendra-Arachchi 2006:pers. comm.; Perera 2007) and perhaps from Nilgala cave in ecozone C (Deraniyagala 1992:chap.5.3.4,5) indicate that prehistoric man, in the later phases, kept domestic dogs for driving game, much as the Väddas et al. have done in recent times. The similarities between the modern indigenous domestic breed of Sri Lanka (Siṇhala hound), the Kadar dog, the Tengger of Java, the New Guinea dog (particularly), and perhaps the dingo of Australia serve to highlight the fact that they could be derived from a common domestic stock which diffused with prehistoric man (ibid.:chap.5.3.14).

Other candidates for domestication in prehistoric Sri Lanka would have been the jungle fowl *Gallus lafayetti*, pig, water buffalo, and perhaps some form of *Bos* which was possibly ancestral to the cattle being herded on the Horton Plains at ≤17,000 BP and to the almost dwarf Sinhala neat cattle which became extinct in the nineteen forties. Jungle fowl and water buffalo remains have been found in prehistoric contexts in ecozones D1 and C respectively, but no investigations have been conducted with a view to establishing their wild (vs. domestic) status. A fossil bovine, smaller than agaur or water buffalo, occurs in the Ratnapura Beds, and bovine remains have been found at Beli-lena Kitulgala and Batadomba-lena. It is premature to judge their taxonomic status relative to *Bos indicus*. There is a distinct possibility of peninsular India and Sri Lanka being an area of domestication of wild cattle and jungle fowl, and this important subject is urgently in need of investigation (ibid.:chap.5.3.7). As for water buffalo, it is noteworthy that the Väddas have been apathetic to the Sinhalese practice of noosing and taming wild specimens, which could suggest that it was not prevalent in prehistoric times (although not necessarily so). The distinctive domestic sheep of ecozones F and A, with their vestigial ears, probably had their source in the drier climes of India; but nothing is known of their first appearance in Sri Lanka. Osteological and DNA comparisons between this breed and the Neolithic sheep of peninsular India could be instructive. As for plants, the occurrence of the toddy palm (*Caryota urens*) and *Canarium zeylanicum* in certain restricted enclaves of the lowland Dry Zone raises the possibility of these Wet Zone species having been naturalised in the Dry Zone through the agency of prehistoric (or historical) man. The origins of the palmyrah palm in the drier parts of the Dry Zone and the coconut palm in the lowland Wet Zone are shrouded in mystery. There is a likelihood that these were introduced in very early (prehistoric) times from extraneous sources.

Hypothetical details of prehistoric subsistence practices for Sri Lanka may be gleaned from the ethnographic data (ibid.:chap.6) with correlates for ecozone D1 in the practices of the

Malapantaram and the Semang, for ecozone C among the Väddas and Kadar which apply more generally to the entirety of the lowland Dry Zone, and for the coastal niches of ecozones F, A and B among the Andamanese. On the basis of such data it is possible to postulate that prehistoric calorific intake in Sri Lanka was dominated by food plants, notably the *Dioscorea* yams, and honey, with the essential proteins being provided by a daily meat intake of ca. 200g (dressed wt) per individual or ca.1kg per nuclear family (ibid.:chap.6.10.4). There is evidence from world-wide ethnographic sources to indicate a mode of ca. 35 percent of the diet to have been derived from hunting (Lee 1968:42). Given the high species diversity in each of Sri Lanka's ecozones, it is unlikely that meat intake per capita deviated sharply from this mode, although the niches with a high ecologic density of gregarious ungulates, such as the villus or parklands, and those with rich coastal resources, might have sustained a higher intake of meat than the other sub-zones and niches in both the Dry and Wet Zones.

As per the analogy of the Väddas et al., hunting would have been performed by men, while women and children concentrated on the gathering. Meat was probably eaten raw, roasted or dried, and boiled food would have been the exception as suitable receptacles for boiling (except perhaps of wood or skin, with pot-boilers) were lacking. The hearths at Kitulgala (ca. 15,000 BP) were probably used for cooking, with each one servicing a nuclear family. Among the Väddas et al. it was general practice for each family to prepare its own food and then for the local group to share the meal. Such food-sharing would probably have been basic to prehistoric hunter-gatherers in Sri Lanka. It is impossible to assess whether resources were ever exploited to generate a sizeable surplus; the evidence from among the Väddas et al. does not suggest that it was so. Storage of meat, fish and fruit, such as it was, could have been effected by smoke- or sun-drying and perhaps subsequently conserving in honey. In coastal environments of ecozones F and A, with their natural salt evaporates, salting was also probably resorted to.

As for inter-zonal trade or exchange, the occurrence of marine molluscan shell fragments in Mesolithic deposits of ecozones B, E and D1 suggests that these had been introduced as items of trade (eg. Bellan-bäňdi Palässa, Ravanālla, Kabaragalgē, Beli-lena Kitulgala, Batadomba-lena; Deraniyagala 1992:chap.5.3.7). The evidence from Batadomba-lena indicates that such trade existed from the Upper Pleistocene, as evinced by the discovery of a marine ray's unaltered spine in Stratum 7a (dated to ca. 19,500 BP), and a large shell fragment was found in Stratum 5 dated to ca. 15,500 BP. Salt was probably in great demand in the hinterland, as it has been among the Forest Väddas, who prized it perhaps above all other commodities (cf. Gabel 1967:52). Corroboration of this proposition that salt would have constituted a major item of prehistoric barter in Sri Lanka exists in the discovery of the very small and inconspicuous lagoon snail *Potamides cingulatus* in one of the lower Mesolithic horizons (IIIc(1) at ca. 21,000 BP, Deraniyagala 1992:chap.5.3.7) in Beli-lena Kitulgala. This mollusc is often to be found in the unrefined rock-salt which forms in the coastal tracts of ecozones F and A, the nearest locality to Kitulgala being over 80km away. The presence of this mollusc at Kitulgala can only be accounted for by postulating its inclusion in salt brought to the site by prehistoric man.

Another item of prehistoric exchange appears to have been the tree-snail *Acavus*, which seems to have been transported to the Dry Zone, which is quite outside its natural habitat (ibid.:chap.5.3.10). *Acavus* species are restricted in their distribution to the Wet Zone, and since pedological evidence from the I Fm indicates that the Dry Zone never had a rainfall configuration akin to that of the Wet Zone (at least during the late Quaternary; (ibid.:chap.4.2.3), the occurrence of this snail, usually with a perforation in the body-whorl, within prehistoric occupation deposits of the Dry Zone can be construed as being the result of introduction through trade[26]. In fact, some of the specimens found at Bellan-bäňdi Palässa in ecozone B have been identified as being *Acavus roseolabiatus*, a form known to have an extremely restricted habitat range around Kitulgala and Deraniyagala in ecozone D1, encompassing a mere ca. 200km^2 in area. It is possible that these shells constituted a primitive currency *cum* ornament (ibid.:chap.5.3.10; cf. use of cowries as currency in India at ca. 300 BC, and *Pomatas olivierri* as shell currency *cum* ornament in Iran today). The remains of a sloth bear found at Kabara-galgē near Ratnapura seem to represent the reverse aspect of the exchange system, namely from the Dry to the Wet Zone.

The periodic land links with India during the Quaternary, the last being estimated at ca. 7,000 BP (ibid.:chap.4.5.3), would have greatly facilitated the movement of trade items over very long distances, while it may be hypothesised that, as per the evidence from Australia from over 50,000 BP, such contacts might in any case have been maintained during the late Quaternary, even in times of high sea level, by crossing the straits[27]. It would be well worth being alert to the discovery of ostrich shell and tusk-shell in Sri Lanka's prehistoric contexts, as these have been found in the peninsular Indian Upper Palaeolithic and western Indian Mesolithic/Neolithic respectively. Such a discovery would point to contacts with regions situated a considerable distance north in peninsular India itself. Indeed, it seems probable that the ostrich was never indigenous to peninsular India and that its shells would have been imported from desert regions to the far northwest in Upper Palaeolithic times (ibid.:chap.5.3.15).

The ethnographic data pertaining to the Väddas do not provide much information on hunter-gatherer exchange systems, primarily as these would have been effectively superseded by barter with the iron-using Sinhalese. However, the Andamanese evidence seems to point to an increase in the rate of such exchange in a given society in proportion to the relative affluence of that society; the Andamanese with their rich resource base were constantly exchanging items (ibid.:chap.6.8.2). It is hence possible to hypothesise that in prehistoric Sri Lanka the briskness of the rate of exchange was proportionate to the richness of the resources of the various ecozones and their sub-zones. In this regard, namely intra-ecozonal exchange, the coastal sub-zones in ecozones F and A could have matched the Andamanese situation, while the rank order of the remaining zones may thereafter be formulated as: *villu* country of A > hinterland of A ≥ B ≥ C > E ≥D 1 ≥ D2 > D 3 (for relative resource potential v.

ibid.:chap.6.2). As for inter-ecozonal exchange, salt would have been at a premium from coastal F and A into the hinterland, particularly into D. Honey, which is harvested during two different seasons in the Wet and Dry Zones respectively, could also have been an item of inter-zonal trade, as might have been the barley and oats from the Horton Plains. Otherwise, there is very little by way of natural resources which one zone has and another does not – which could thus stimulate trade – the differences being merely a matter of not very pronounced differences in resource density which would probably have been adjusted to primarily through demographic mechanisms as reflected in varying crude densities of human populations in the different ecozones (ibid.:chap.6.10.3). It is thus possible to hypothesise that hunter-gatherer exchange systems in Sri Lanka were relatively sluggish, except perhaps within special niches such as the coastal sub-zones of ecozones F and A, with inter-band trade occurring primarily as a function of uneven distribution of resources.

The substantive faunal evidence concerning the evolution of subsistence strategy in Sri Lanka during the Quaternary stem from the few sites with an adequate chronology and descriptions of food remains, namely Batadomba-lena (ca. 36,000-13,000 BP), Beli-lena Kitulgala (>30,000-9,000 BP) and Bellan-bäňdi Palässa (ca. 12,000 BP). The preliminary indications are that there have been no significant shifts in exploitative strategy for fauna during this entire time-span (apart from the indirect evidence of herding on the Horton Plains since ca. 17,000 BP); for instance, there is no apparent increase in the proportion of small game or invertebrates with the onset of the Holocene. In this regard it is significant that the Upper Palaeolithic faunal assemblages from the Kurnool caves of Andhra Pradesh in India, the Niah cave of Borneo, and the late Palaeolithic/Mesolithic sites of West Asia, Africa and south-eastern Europe resemble the Sri Lankan evidence in that there is no indication of evolutionary change in subsistence strategy with regard to fauna through the late Upper Pleistocene into the Holocene. It may be postulated that this is a reflection of the absence of drastic biotic changes during this time-span in these low-latitude regions.

On the other hand, the present writer has formulated hypotheses concerning the nature of the environmental shifts that might have occurred in Sri Lanka since the inception of the Middle Pleistocene, and thence estimating prehistoric population densities on the basis of these initial hypotheses (v. above). The prevalence of a monsoon-forest biome in the lowland Dry Zone during certain altithermals such as Eem or pre-Eem could have been accompanied by a faunistic configuration so different from that of the present that subsistence strategy would have adapted itself automatically towards a maximising of the increased carrying capacity with a greater preponderance of gregarious ungulates such as spotted deer and perhaps antelopes. Such a strategy could have had specialised traits not found in situations where the diversity of species exploited was high as in the case of the lowland Wet Zone from ca. 38,000 BP onwards. It is hypothesised that the exploitation of ungulates assumed special significance in the altithermals represented by a monsoon-forest biome in the dry lowlands, and also perhaps above a hypothetical tree-line in the highest mountains during glacial episodes of exceptional intensity. As to whether there was ever a period marked by exploitation of big game on a pronounced scale (cf. Acheulean subsistence traits (Butzer 1971:448-9)), as opposed to the diversity of smaller game from the late Upper Pleistocene onwards, cannot be answered just yet: relevant data require to be generated from hypothetical Lower and Middle Palaeolithic contexts in Sri Lanka.

It is unlikely that the strategy for the exploitation of food plants underwent any major changes from the Middle Pleistocene up to ca. 17,000 BP, and thereafter the management and subsequent cultivation of barley and oats in the highlands probably did not significantly alter the preceding subsistence pattern. During the drier altithermals, the procuring of water might have posed difficulties in ecozones F and A, except on a seasonal basis (although the ingenuity of the !Kung Bushmen of the Kalahari provides an example of how even extreme scarcity of water can be circumvented). The seasonal exploitation of honey and of invertebrates such as insect-larvae (cf. Chenchu, Andamanese; Deraniyagala 1992:chap.6.6.2; 6.8.2) could also have been affected during intense altithermals when the lowland Dry Zone would have been desiccated – it requires to be borne in mind that honey and larvae (e.g., of termites) can make very considerable differences to the carrying capacity of an ecozone (for termite-biomass in Vilpattu, v. Eisenberg and Lockhart 1972).

Technology

The subsistence technology that prehistoric man in Sri Lanka employed to adapt to varying environments during the Quaternary is, not surprisingly, represented almost entirely by lithic remains. Organic materials have not been preserved at all in the open-air sites, with the exception of Bellan-bäňdi Palässa and shell middens where the limestone bed-rock and calcareous matrix respectively have caused the neutralisation of destructive acids leaching the cultural deposits. The drier horizons of the caves have yielded bone, antler and shell artefacts in a good state of preservation, and fragmentary plant remains in a carbonised state. So far, none of the sites has produced a single artefact made of a plant-derived material. It is thus obvious that the prehistoric archaeological data from Sri Lanka constitute an extremely biased sample due to the poor preservation of organic, particularly plant, remains. The extent of this bias becomes apparent when one considers that the technologies of the Kadar, Malapantaram and the Semang were based exclusively on plant (ie, bamboo) artefacts with no lithic component, and that no trace of these would be visible in Sri Lanka's prehistoric record. Similarly, the shell and plant-fibre (e.g., netting) culture of the Andamanese would scarcely have survived in the porous dune sands of coastal ecozone A where it is possible that an analogous subsistence technology existed. Hence, any assessment of the total prehistoric technology of the island must necessarily be made with due allowance for the non-preservation of perhaps the bulk of the data. The results of the analyses on this biased sample of prehistoric artefacts from Sri Lanka (stone artefacts, n=>200,000) have been set out by the present writer (Deraniyagala 1992:chap.5) and these may be synthesised as follows.

The Ratnapura Industry (ibid.:chap.5.2.4) is indefinable typologically and its chrono-stratigraphy is far from secure, although a late Middle or early Upper Pleistocene component is probably present. The sample of artefacts from this 'industry' is very limited (n=<30) and *in situ* occurrences have yet to be observed. The extant sample qualifies as a chopper industry; but it is probable that sampling bias has excluded a significant flake component.

No artefacts assignable to the Acheulean tradition of biface manufacture, namely handaxes and cleavers, have so far been discovered in Sri Lanka. There have indeed been a few false alarms, but on closer scrutiny these specimens have turned out to bear mere spurious resemblances to handaxes (v. Fig.1). One is at a loss to account for this absence in Sri Lanka of a major techno-tradition in the Lower Palaeolithic of the Old World, particularly when there has been an epicentre around Madras. But it is noteworthy that the Acheulean is absent from the extreme south of India as well, south of the river Kaveri. It appears as if the primary check

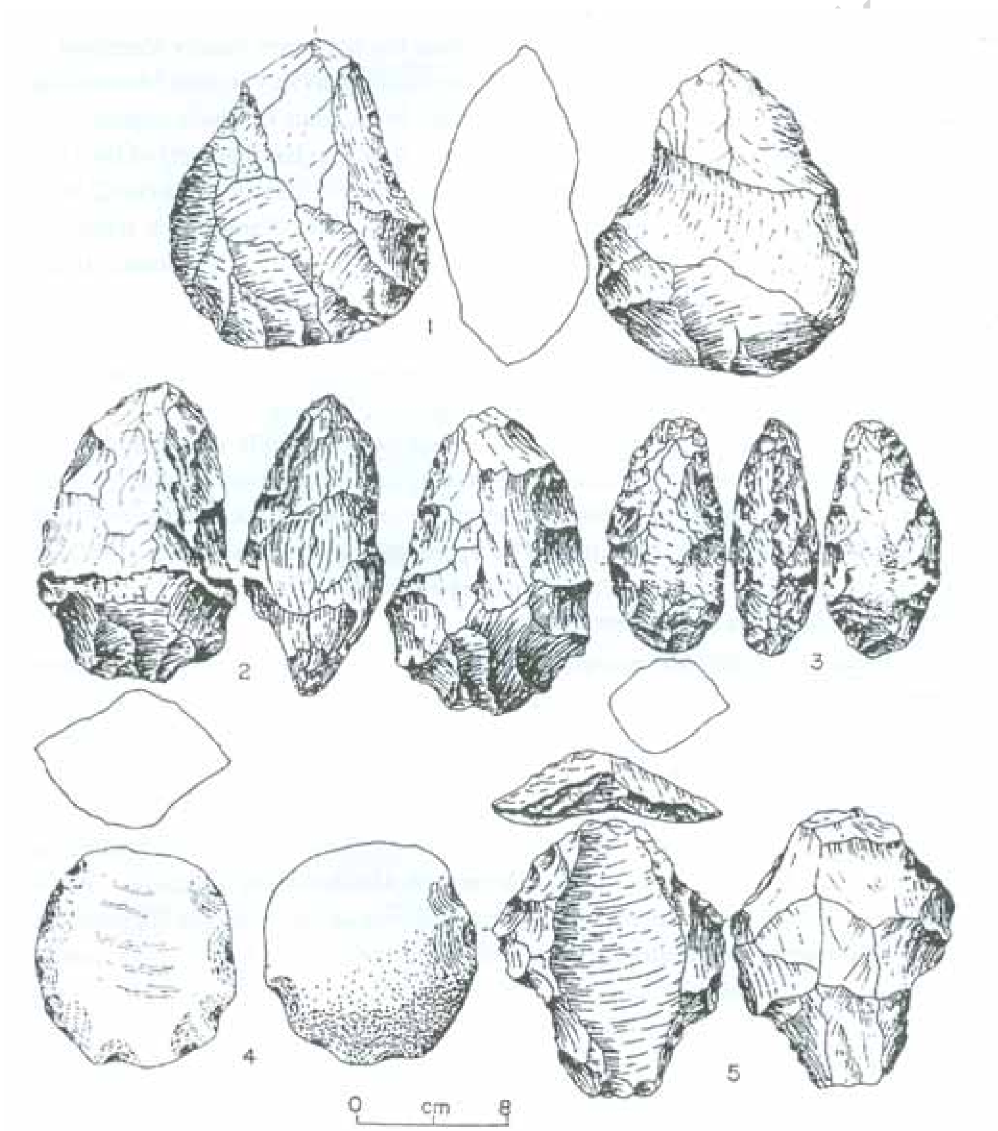


Fig. 1. Stone artefacts from the Ratnapura Beds, the Ratnapura Industry

against the diffusion of the Acheulean tradition to the extreme south of India and into Sri Lanka has been the absence of sedimentary quartzite - the raw material *par excellence* of the Madras Acheulean – and further that the faunal configurations, namely the lack of a high biomass of the larger herbivores, in this region added as a further disincentive to the spread of the Acheulean (for Acheulean ecology v. Butzer 1971:452-4). It has been established that 'Acheulean man' favoured open habitats in the tropics, such as savanna biomes, and it is probable that such a biome never existed in Sri Lanka during the Quaternary – if it had, perhaps Acheulean man would probably have made do with the occasional deposits of chert, and even the cruder quartz, for the manufacture of his handaxes and cleavers: quartz handaxes have been found in Bengal. However, Lower Palaeolithic chopper assemblages possibly occur in the I Fm's gravels (Figs.2,3).

A Middle Palaeolithic technological phase has now been clearly identified in Sri Lanka. The high-level deposits of the I Fm could conceivably contain Mousterioid industries as per the evidence of isolated surface finds, some of which display traits of a Mousterian in the Acheulean tradition (Figs.4,5). The basal gravels of the I Fm at Site 50a have been assigned an age of ca. 125,000 BP. The artefacts (n=12,004) excavated from these gravels are mostly non-distinctive, despite their relatively fresh condition (Deraniyagala 1992:chap.5.2.5). But of great significance is the discovery of two non-geometric (backed) microliths (ibid.:631-2). Small (<4.5cm) tools predominate (91.9% for levels 1,2) and most of the artefacts are on quartz (99.8% for levels 1,2). Blades and bladelets are conspicuously absent, as is the Levallois technique of flake production. The basal gravels at Site 49b of the I Fm, dated to ca. 80,000 BP, have yielded yet another typologically indeterminate assemblage (n=883), with fluviatile rolling having erased whatever diagnostic traits there might once have been on the artefacts. This assemblage, as with the one from the gravels of Site 50a, is characterised by a predominance of small artefacts (89.2% for levels 1,2) with quartz as the raw material (100% for levels 1,2). Once again, blades and bladelets are apparently lacking.

From ca. 36,000 BP onwards the geometric microlithic tradition has been firmly entrenched in Sri Lanka, as per the data from the I Fm in the dunes of 50a III and 49b,c III, Batadomba-lena 7c and Beli-lena Kitulgala (Figs. 6,13). The evidence is unequivocal, microlithic backed lunates, triangles and trapezoidals have been excavated from secure contexts at these sites, thus necessitating a revision of the chronology of the geometric microlithic techno-tradition (which is defined in the present work as being synonymous with the term Mesolithic) in South Asia. While India and Pakistan have yet to provide firm evidence of the existence of geometric microliths during the Pleistocene, the dating of the Mesolithic in Sri Lanka implies that geometric microlithic industries of similar antiquity await discovery on the sub-continent – after all, culture traits would have diffused between India and Sri Lanka by land during periods of low sea level (eg, the Würm upper pleniglacial), and possibly even by sea during the latter part of the Upper Pleistocene (by analogy with Australia). A fresh examination of the chrono-stratigraphy of the Mesolithic in India is an urgent necessity in the light of the Sri Lankan data: it would be foolhardy to assign all Mesolithic assemblages to the Holocene simply because the European model implies so. It is reassuring to note that geometric microlithic assemblages with an antiquity comparable to the early and earliest ones from Sri Lanka at ca. 36,000 BP have been found in West Asia (eg. Iran) and in Sub-Saharan Africa respectively (ibid.:chap.5.2.12; for India v. addendum IV).

It is premature to theorise about the causative factors behind the appearance of geometric microlithic technology during the Upper Pleistocene in Asia and Africa. The tendency towards diminution of artefact size has been widespread from the Middle Palaeolithic

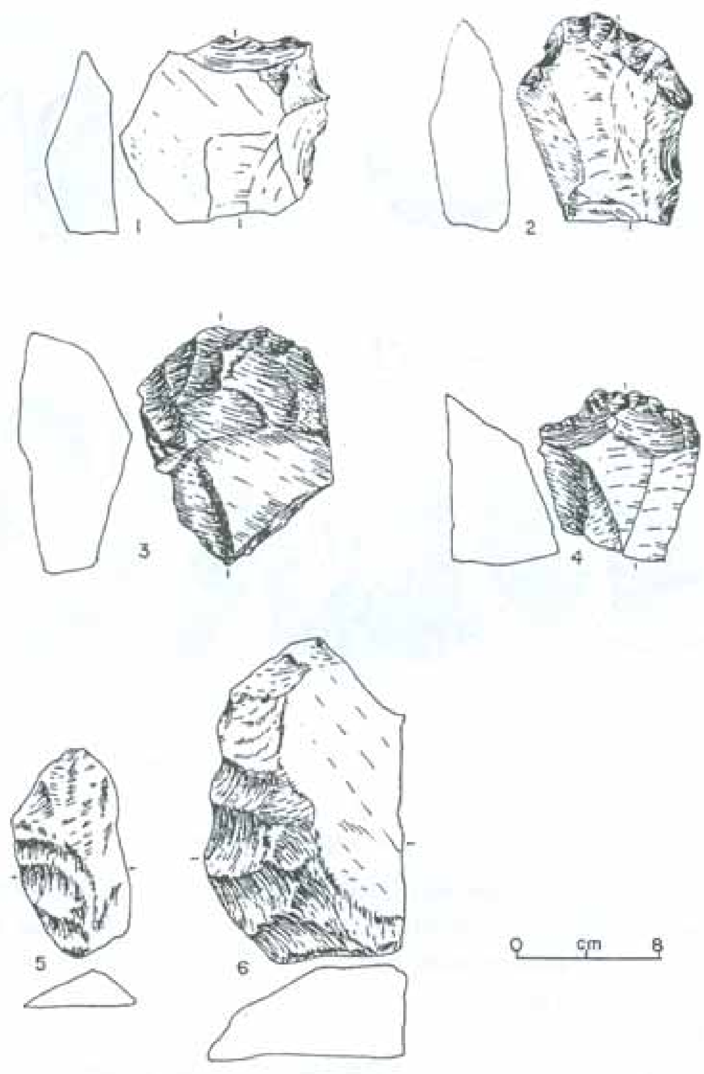


Fig. 2. Large stone artefacts from the I Fm

onwards in Europe, Africa and Asia, possibly as a function of increasingly efficient use of raw materials which would correspondingly have offered greater adaptability to marginal environments. The present indications are that the appearance of geometric microlithic, or Mesolithic, technology was a gradual process, as per the evidence from West Asia and perhaps Europe as well. In no instance is there evidence to support the hypothesis that the Mesolithic was an abrupt transformation; rather, it appears to have formed an integral part of the course of evolution of the preceding industries (eg, Baradostian in Iran, Magdalenian in Europe, Upper Palaeolithic in India).

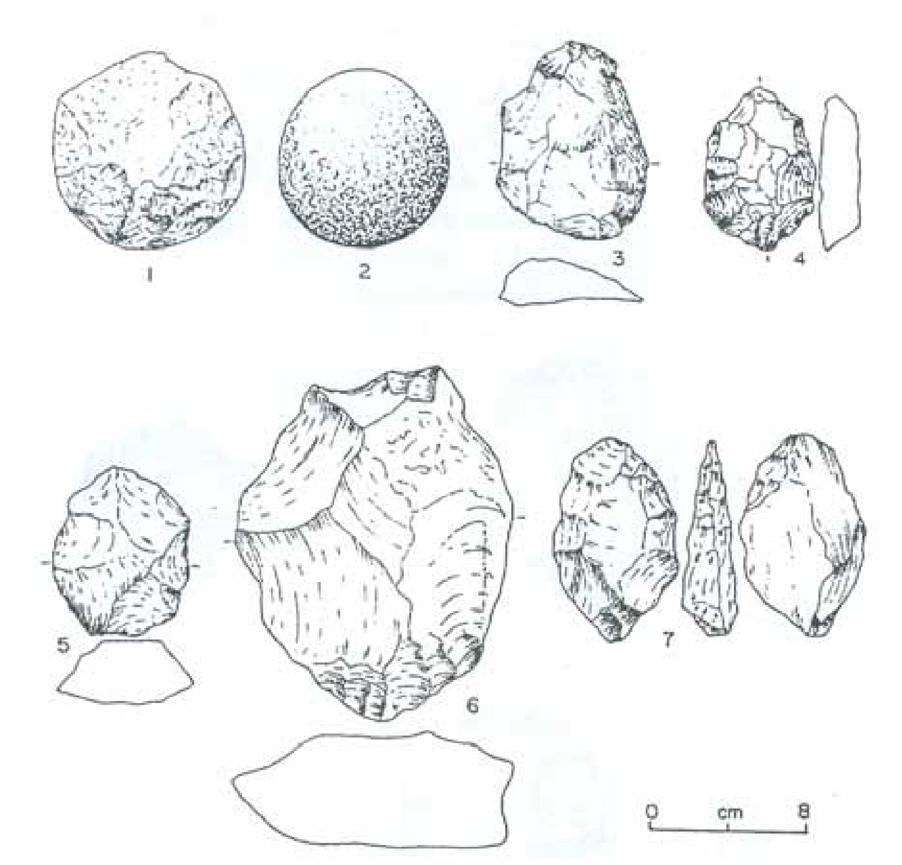


Fig. 3. Large stone artefacts from the I Fm

It has been hypothesised that the backing on microliths maximised their adhesion to the hafts (Allchin 1966:201,203), which would categorise this attribute-state as a functional consideration. As for the choice of the specific plan-forms of lunate, triangle and trapezoidal which, coupled with backing, constitute the hallmark of Mesolithic technology, one could venture to hypothesise that cultural choice was involved in their selection and that hence they are primarily stylistic traits which manifested themselves over considerable geographical expanses, apparently polycentrically, but more likely through a process of stimulus-diffusion from a core area.

The emergence of a geometric microlithic tradition in Europe has lagged behind that of Africa and Western and southern Asia – if one assumes that Chatelperron backed knives do not represent a part of this tradition – which requires to be taken into consideration in any evaluation of the origins of Mesolithic technology in Europe. The latter may no longer be plausibly considered a discrete phenomenon, despite anti-diffusionist expostulation: if Acheulean technology in Europe can be fitted into a diffusionist framework, there is no valid

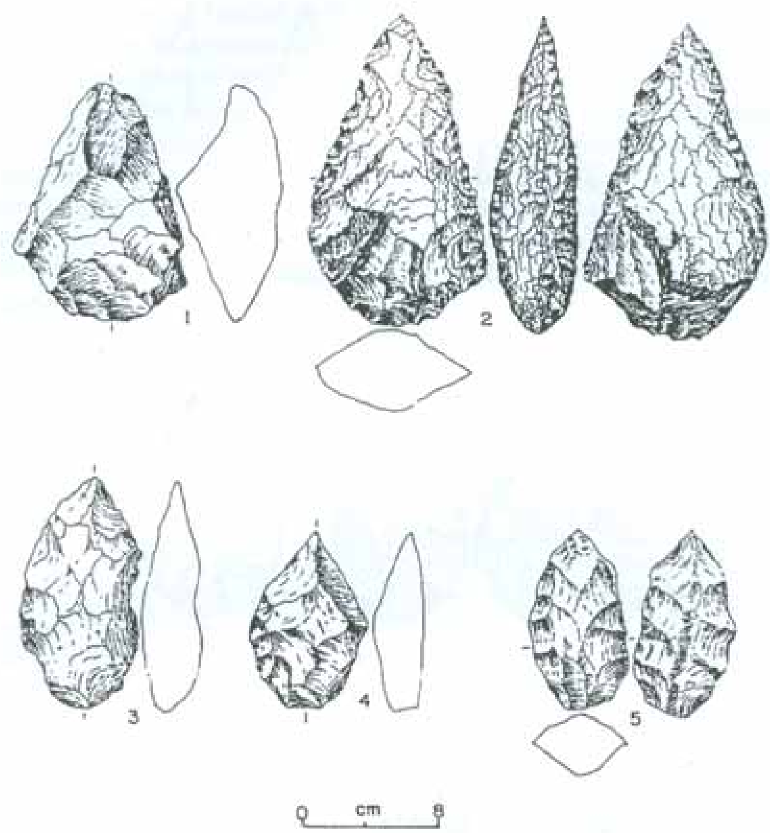


Fig. 4. Large stone artefacts from the I Fm

reason to exclude Mesolithic technology when human mobility was presumably more extensive (or at least potentially so due to increased adaptability to diverse environments). It may tentatively be hypothesised that the tradition of manufacturing geometric microliths, involving conspicuous stylistic traits, had its origin in the region encompassed by Africa, West Asia and South Asia, and that it diffused thence towards the end of the Pleistocene into Europe. It is also possible to postulate that the diffusion of the tradition eastward of India into Southeast Asia, culminating in Australia, occurred during the Holocene (Deraniyagala 1992:chap.5.2.12-3). This latter process is perhaps more difficult to explain than the former concerning Europe where climatic factors and the emergence of Holocene biomes with concomitant shifts in subsistence technology can be cited. In the case of Southeast Asia there would have been no significant change in effective environments in the transition from Pleistocene to Holocene, which thus compels one to think in terms of direct diffusion from India south-eastwards. It is of considerable interest that the geometric microlithic tradition disappeared in Australia after a brief sojourn (ca. 3,000-1,200 BP (Lambert 1971:64-70)), which is consonant with an intrusive trait dying a natural death in an alien cultural matrix.

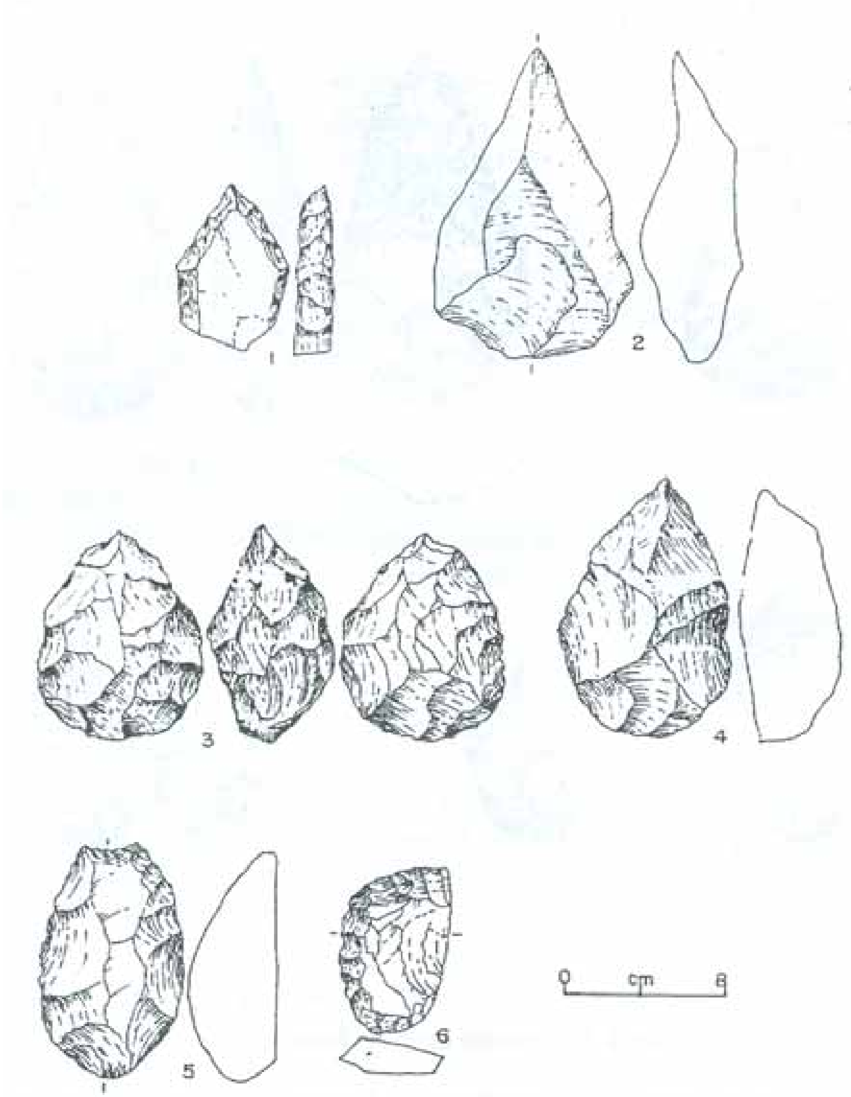


Fig. 5. Large stone artefacts from the I Fm

Apart from the small tool component, Sri Lanka's Mesolithic assemblages include relatively crude choppers which are indistinguishable from those of the Ratnapura Industry, and hammer-stones, grinders, grindstones, pestles, mortars, pitted hammer-stones and nut-stones on gneissic crystalline rocks and very occasionally on quartz.

Within the Mesolithic of Sri Lanka, it has so far not been possible to discern any evolution of artifact or assemblage types. This could well be a function of the relatively meagre database: adequacy has only been met in the assemblages from Sites 45a,b, 49b,c and 50a in the I Fm, 43a in the RBE Fm, Beli-lena Kitulgala and Batadomba-lena. However, the data from these assemblages suffice to highlight the extremely low proportion of trimmed artefacts characterising Mesolithic assemblages in Sri Lanka, frequently ca. 0.4-0.6 per cent of the artefact total, with form-trimmed tools (analytically the most useful) being a mere ca. 0.2 per cent. This sample deficiency in terms of analytically useful elements has no doubt contributed in large measure to the current lack of resolution concerning the evolution of stone tool technology in the island's Mesolithic. Nonetheless, there is not the slightest hint of typological change in the lunates, triangles and trapezoidals that define Sri Lanka's Mesolithic from ca. 36,000 to 3,800 BP (Batadomba-lena to Māntai) and probably right up to the commencement of the protohistoric Iron Age at ca. 2,800 BP. Within these microlithic assemblages there are several variants of non-geometric, backed and form-trimmed microliths such as tanged or shouldered points which might have chronological implications. A very conspicuous non-microlithic type (ie, without blunting retouch) comprises the Balangoda Points which resemble small Australian Pirri Points except that the former have frequently been trimmed bifacially. Balangoda Points (eg, Figs. 6(16,18), 7(14,18,19)) are small (often < 3cm), exquisitely trimmed points, with shallow trimming designed to control plan-form and cross-section, presumably for aero-dynamics; and they have been dated to ca. 28,000 BP at Site 49b of the I Fm and to ca. 26,000 BP at Batadomba-lena. Stylistically these artefacts are specialised, and it is worth noting that only one specimen was found from an assemblage totalling several hundred thousand artefacts at Batadombalena. Hence, it is conceivable that Balangoda Points have distinct chronological connotations, although this need not necessarily be so, and tool-specific analyses could be productive. But it has been estimated that a total artefact sample of over 2,000,000 specimens from chronologically secure contexts will be required to obtain ca. 5,000 form-trimmed specimens (as per the proportions of the latter at ca. 0.2 per cent) which would be the minimum prerequisite for a tool typology with chronological applications. Sri Lanka is still somewhat remote from achieving this goal; several more years of sampling are needed.

Sri Lanka's Mesolithic has been identified by the presence of geometric microliths[28]. It had not been apprehended that a Neolithic, Chalcolithic or even Iron Age subsistence *cum* technological component would occur with a Mesolithic tool kit on the island. The evidence from the Horton Plains indicates the occurrence of Neolithic subsistence practices commencing at ca. 17,000 BP, attaining maturity by ca. 10,000 BP. Then there is said to be pottery occurring with geometric microliths at Doravak-lena by 7,300 BP and the possibility of a Chalcolithic period at Māntai by 3,800 BP. It has been noted that in peninsular India, Neolithic/Chalcolithic stone artefacts display microlithic (Mesolithic) *vis à vis* blade (Neolithic/Chalcolithic) traits progressively as one moves southwards (Deraniyagala 1992:289-6,297; Allchin and Allchin 1974; 1974*a*). This is manifested in the Sri Lankan context where there does not appear to be any difference between the stone tool industry of 36,000-17.000 BP (pre-herding/farming) and 17.000-3000 BP (herding/farming encompassing Neolithic and perhaps Chalcolithic traits).

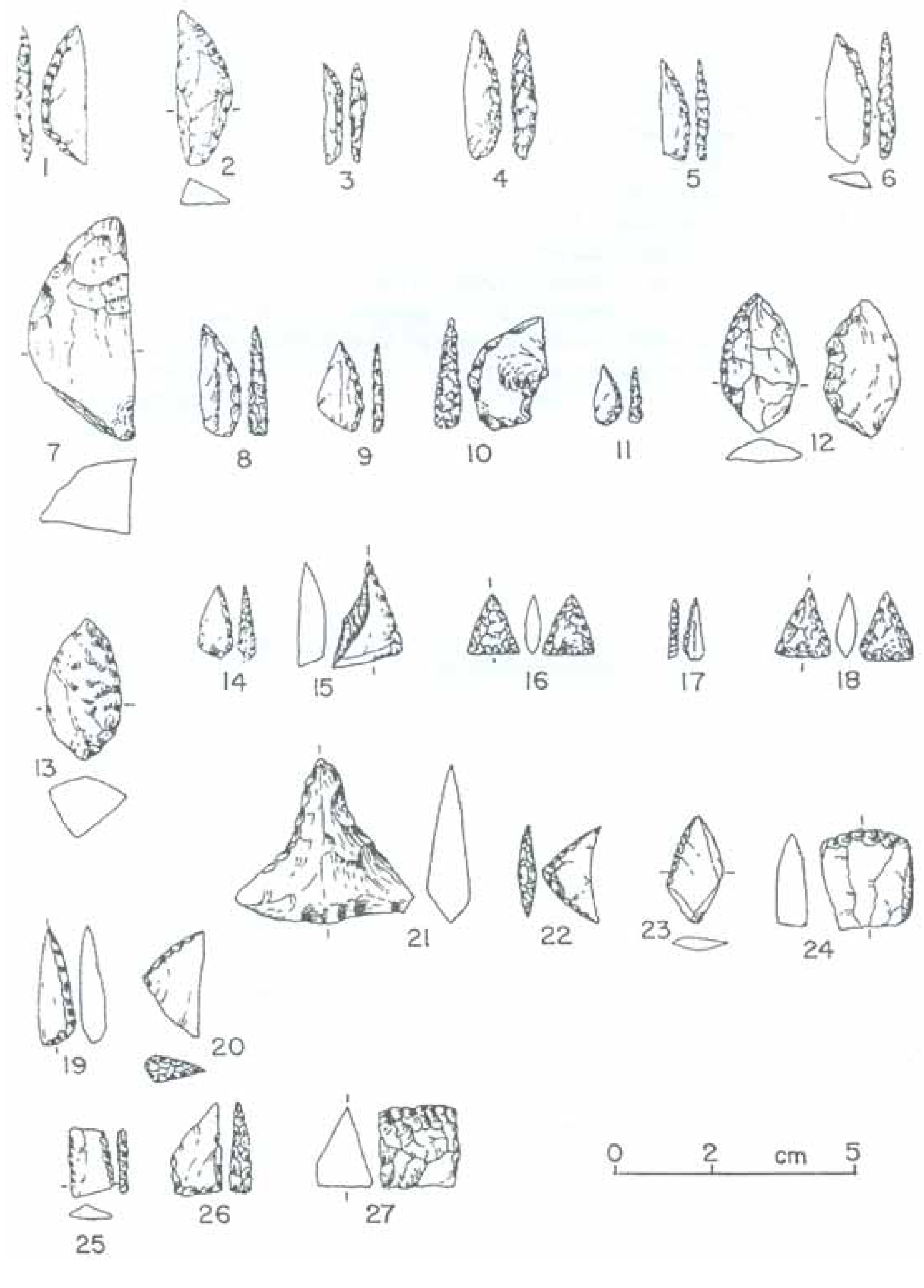


Fig. 6. Small stone artefacts excavated from Site 49, ca. 28,000 (TL/OSL) BP

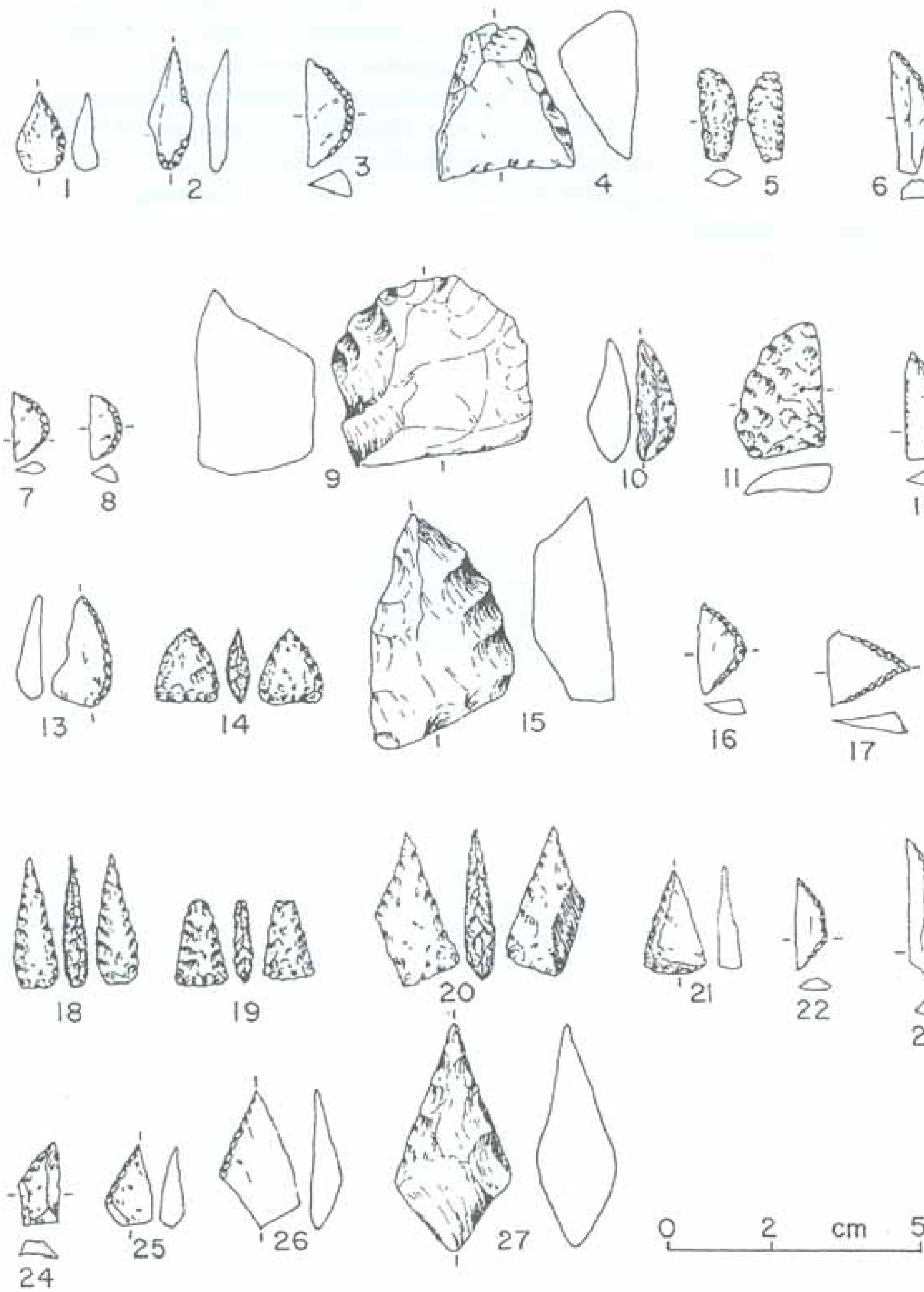


Fig. 7. Small stone artefacts from Sites 43 and 43a

It is more often than not impossible to ascertain whether a site with geometric microliths represented hunting and gathering Mesolithic or Neolithic/Chalcolithic subsistence/technological traits[29]. It is therefore proposed to modify the term Mesolithic (which merely signified the presence of a geometric microlithic component in the stone tool assemblage) to Lower Mesolithic pre-dating ca. 17,000 BP and Upper Mesolithic post-dating ca. 17,000 BP.

With regard to regional differentiation of the stone tool assemblages of Sri Lanka, the Mousterioid Middle Palaeolithic elements in the I Fm are, by virtue of their context in the I Fm , restricted to the lowland semi-arid ecozone A. It is noteworthy that bolas-stones are almost exclusively found in the lowland Dry Zone, which suggests that their primary function was as missiles in open country (eg, dry dolines of I Fm) much as the Patagonian Indians of South America have used them (Braidwood 1967:45; Sanders and Marino 1970:19). Then there are the nut-stones – flat slabs of rock with numerous dimple pits – which are restricted in their range of distribution to the island's lowland and upland Wet Zone (ecozones D1,2) which coincides with the distribution of the *Canarium zeylanicum* nut tree[30]. Hence, there is strong circumstantial evidence that the pattern of distribution of nut-stones has been functionally determined, and the use of similar artefacts by the Australians for cracking macadamia nuts corroborates this hypothesis. The other noteworthy category of lithic artefact showing differential distribution in Sri Lanka comprises the pitted hammer-stones, which the present writer postulates as having constituted the upper component of the fire-drill equipment used by prehistoric man by analogy with the Vädda use of a flat pebble, animal cranium or coconut shell for steadying the vertical stick that rotates. These pitted pebbles, often used as hammer-stones as well, are of frequent occurrence in the Wet Zone, and they appear to be much rarer in the Dry Zone (apart from their relative profusion at that exceptional site, Bellan-bäňdi Palässa). It is not possible to so much as speculate as to what this apparent differential distribution might signify: perhaps the relatively soft gneissic crystallines on which these artefacts are usually made have disintegrated in the open-air sites of the Dry Zone, whereas conditions of preservation have been superior in the Wet Zone's cave sites. It is noteworthy, that Bellan-bäňdi Palässa has had exceptionally good preservation for the Dry Zone and that the few specimens on gneiss that the present writer found in the I Fm were observed to be in a highly weathered state[31].

Concerning the technology of stone tool manufacture in prehistoric Sri Lanka, Levallois flakes and their nuclei and medium- to large-sized true blades on prismatic nuclei are absent in the inventories. Bladelets, and the prismatic nuclei from which they derive, are found only very occasionally in Mesolithic contexts – the large sample of artefacts from Batadomba-lena has yielded scarcely any – but the technique of bladelet production commencing with primary guide flakes (*lame à crête*) appears to have been unknown (which was also the case in Mesolithic India until its advent, possibly from a West Asian source, during the Neolithic). The non-adoption of blade technology in Sri Lanka may in large measure be ascribed to the intractability of the dominant raw material, quartz, which tends on percussion to fracture into short, rectiliner flakes. This probably slanted lithic technology almost exclusively towards flake production, over-riding any tendency towards blade production on the rare chert that is suitable for this purpose. The micro-burin technique of bladelet truncation that characterises certain European Mesolithic assemblages is not represented in Sri Lanka's Mesolithic (cf. prehistoric Australian analogue (Mulvaney 1969:127)). Given the tendency for quartz flakes to snap short in any case, such a specialised procedure would scarcely have been necessary. Apart from rare spheroidal nuclei, perhaps restricted to the I Fm (?Middle Palaeolithic), and the occasional fluted bladelet-nuclei in the Mesolithic, there are no distinctive nucleus-stypes in Sri Lanka's assemblages, there being a continuum from polyhedric to discoidal forms depending on the shape of the nucleus-to-be prior to knapping. It is not known whether heat-treatment has been employed on raw material so as to improve flaking behaviour (cf. Andamanese). Step-flaking is evident on some of the more Mousterioid specimens from the I Fm . Pressure-flaking has almost certainly been employed for trimming the Balangoda Points at ca. 28,000-26,000 BP, which is very early in terms of the inception of this technique in Europe.

As regards the functions performed by the stone artefacts constituting the flaked tool categories, nothing can be affirmed on the basis of the present evidence. It is probable that many of the stone tools had been used for wood-working (cf. Australians among whom it was the primary function (Mitchell 1949:14)), although denticulate edges are very rare indeed. The proportion of artefacts displaying macroscopic use marks is very low (ca. 0.2-0.5%), presumably due to the toughness of quartz, the dominant raw material. Silica gloss has not been observed on any of the very numerous specimens examined by the present writer, indicating that the harvesting of cereals was not of any great significance (although bamboo knives might have been preferable for this purpose; (for their efficiency in cutting meat among the Kukukuku of New Guinea v. Blackwood 1950:33). The grindstones found in Mesolithic contexts have definitely been used for grinding pigments such as red ochre and chalk; but it is quite possible that food plants were processed on them as well, although the Väddas are not known to have used them as such, apart from those with acculturated food habits (cf. Australians processing wild cereals on grindstones (Zeuner 1950:6)). It is noteworthy that mace-heads, known to have been used for weighting digging sticks among Bushmen (Allchin 1966:19), have not been found in an indubitably prehistoric context in Sri Lanka, the specimens from the Ratnapura Beds and Batadomba-lena being of questionable provenance. It is possible, as per the Kadar analogue, that digging sticks were tipped with stone, although this was not apparently necessary (cf. Väddas, Chenchu for whom the digging stick was perhaps the most important artefact of all), and there has been no evidence of fire-hardened wooden points being used as such (vs. Andamanese). The extreme rarity of stone celts (n=?3) in Sri Lanka, despite the occasional availability of fine-grained igneous rocks such as dolerite for their manufacture, suggests that functionally they were not essential for the subsistence economy: the felling of trees and the tilling of the ground were probably not vital operations, unlike in a Neolithic economy[32].

The formulation of the taxon of potential tools (Deraniyagala 1992:chap.5.2.2) has been amply validated by ethnographic accounts of hunter-gatherers generally using unretouched stone tools for most of their day to day needs (cf. Andamanese; Kukukuku (Blackwood 1950:31); Australians (Mitchell 1949:12-3; also v. Mason 1967:743)[33]. The proportion of potential tools in Sri Lanka's Mesolithic assemblages is also remarkably low (1.2-2.7%) which, when compared with that of waste (84.5-95.5%), is indicative of the difficulty encountered in controlling the fracture of quartz. Andamanese ethnography mentions that at least 50 per cent of the products of knapping constituted waste. This seems to imply that it was somewhat less than is found in Sri Lanka's Mesolithic, although the ethnographer's statement may not be taken literally. If this should be the case, it could be hypothesised that (a) heat-treatment which was being practised by the Andamanese was lacking in Sri Lanka, and that (b) the Andamanese performed their primary dressing of nuclei at the extraction camps themselves or at transit camps *en route* to the base-camps. It is probable that the analysis of the stone artefact assemblages from Beli-lena Kitulgala and Batadomba-lena will yield somewhat higher percentages of tools (vs. waste) than has been stated above for Sri Lanka; but the preliminary indications are that the percentages would not be significantly higher (if at all). Quartz is so readily procurable within the site-territories of most prehistoric base-camps in Sri Lanka that the raw material was probably being brought back *in toto* to such base-camps to be knapped at leisure. The incidence of debitage at quarry sites has been observed to be very low, thus corroborating the above hypothesis (v. Campbell and Edwards 1966:172-3 for data on Australians trimming nuclei prior to transport to base-camps).

Apart from the lithic component in Sri Lanka's prehistoric tool assemblages, there are the bone, antler and shell artefacts (Figs.8-13; Deraniyagala 1992:chap.5.2.11). These have, so far, been found only from Mesolithic contexts, wherever conditions have been favourable for the preservation of these materials – primarily the drier sedimentary facies of caves and at Bellan-bäňdi Palässa. Small single or rhomboidal points constitute the most common category, and these date from ca. 36,000 BP onwards at Batadomba-lena. They have been manufactured on slivers of bone or antler, which have subsequently been ground into shape. Then there are somewhat longer single points, spatulae in a variety of sizes, and picks (frequently of antler). Serrated, and at times grooved, spatulate objects from Belilena Kitulgala constitute a distinctive class, as do bone slivers with transverse grooving from Rāvanälla and Nilgala caves.

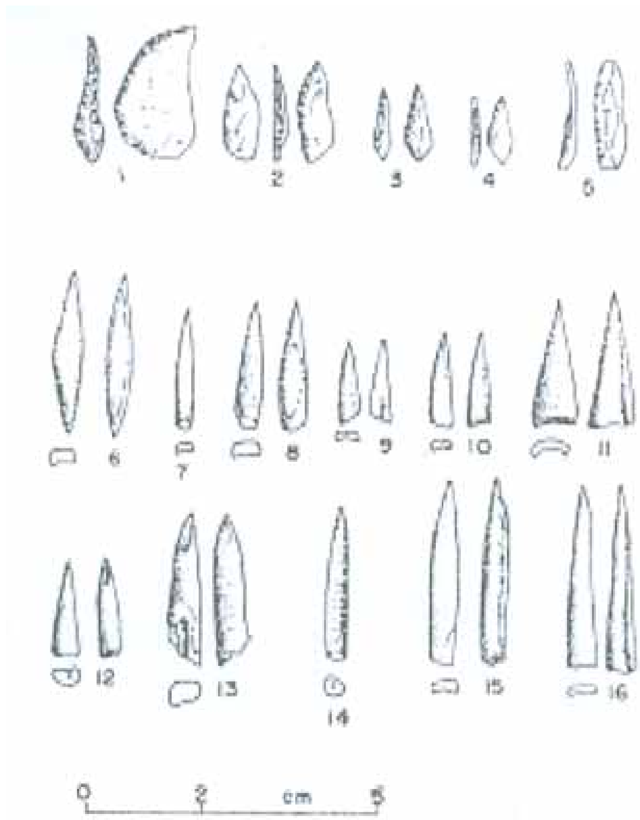


Fig. 8. Batadomba-lena Stratum 4, ca. 15,000-13,000 cal BP: *(1,3)* microlithic lunates; *(2,4)* microlithic semi-lunates; *(5)* bladelet; *(6-16)* bone points.

Although no harpoons have been discovered, the unaltered spine of a marine ray from Batadomba-lena (dated to ca. 19,500 BP;Fig.11) resembles one, with its double row of natural barbs (cf. Andamanese use of ray-spines to tip their fish-arrows).

The functions of the bone and antler points are difficult to assess. Mulvaney depicts an Australian fish-spear with rhomboidal bone points which are somewhat larger than the ones found in Sri Lanka (1975:105). The apparent association between small rhomboidal points and some of the human skeletons at Bellan-bäňdi Palässa has been interpreted as indicative of their use as projectile points (Deraniyagala 1958:231; cf. Vädda arrow-heads of Unio bivalves). Some of the hollow spatulae could have been used as marrow scoops (cf. Bushmen (Allchin 1966:38)). Eyed needles are conspicuously absent. Awls seem to have been fashioned from longitudinally split teeth of monkeys, and it is possible that the spurs on the shanks of jungle fowl and the jaws of pythons had been used for a similar purpose. It is significant that most of the Andamanese tools on shell were devoid of secondary trimming and as such would merely be diagnosed as potential shell tools in the archaeological record. The efficiency of shell as a raw material, even for heavy work such as chopping down trees and hollowing out canoes, has

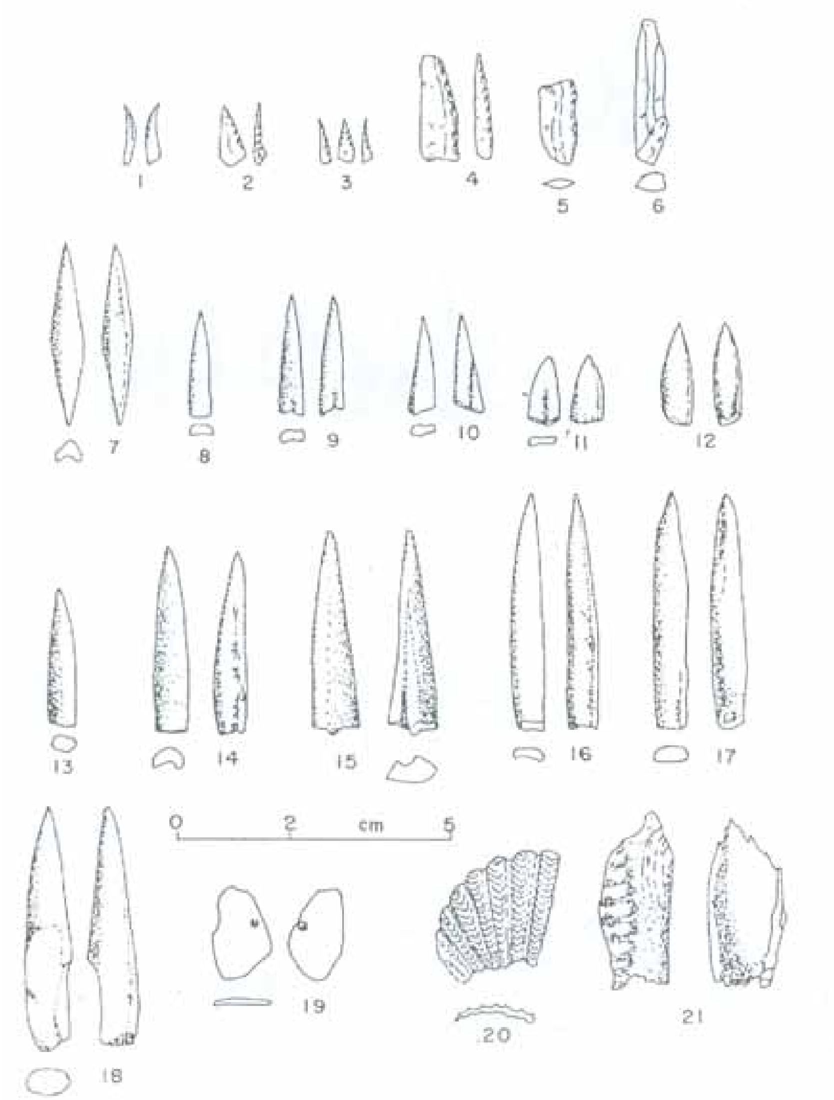


Fig. 9. Batadomba-lena Stratum 5, ca. 15,500 cal BP: *(1)* microlithic Semi-lunate; *(5)* backed bladelet; *(6)* bladelet; *(7-18)* bone points; *(19)* perforated shell; *(20)* marine bivalve; *(21)* cowrie.

been amply attested in the Andamanese ethnographies. In Sri Lanka, it is probable that the prograding coasts of ecozone F, A and B harboured prehistoric settlements to which the Andamanese technological analogues would apply in large measure. However, the porous nature of the sedimentary matrices, of the I Fm for instance, would preclude the preservation of any shell artefacts there might once have been incorporated in the cultural deposits.

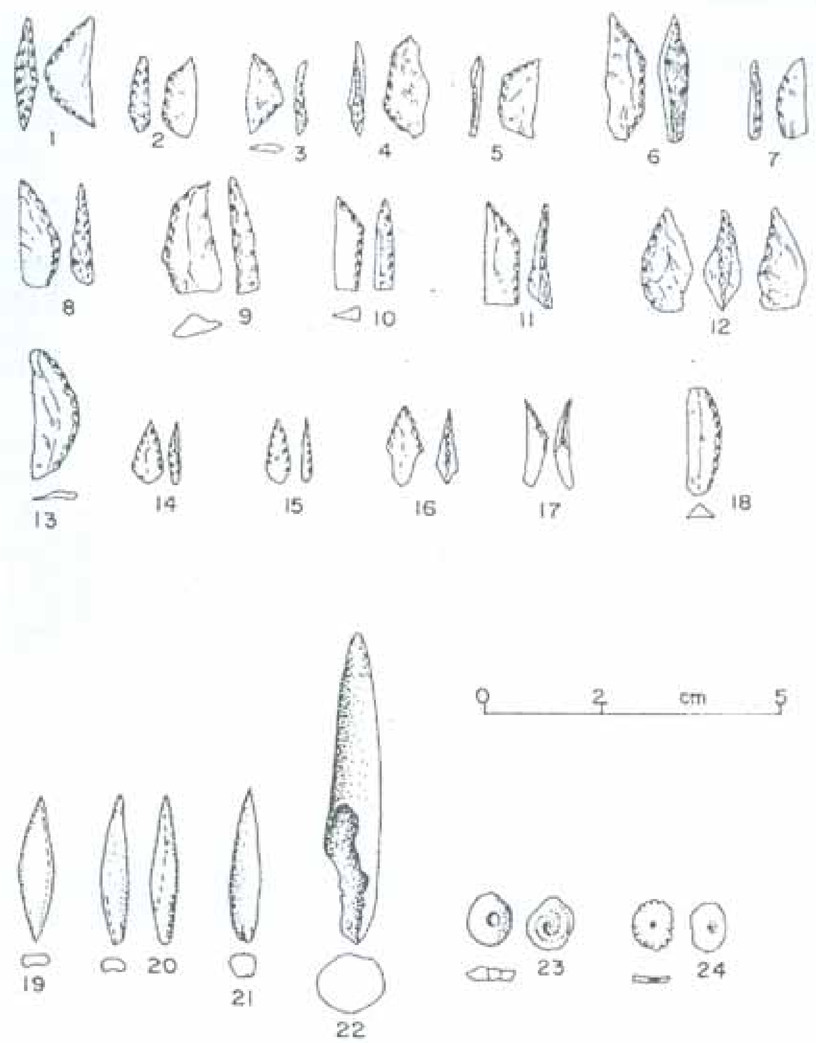


Fig. 10. Batadomba-lena Stratum 6, ca. 18,500-16,500 cal BP : *(l-4)* microlithic lunates; *(6)* microlithic trapezoidal; *(7-9)* microlithic semi-lunates; *(18)* backed bladelet; *(19-22)* bone points; *(23, 24)* marine shell beads.

Sri Lanka has not produced a single specimen of a prehistoric artefact made on plant materials, the post-depositional environments being unsuited to their preservation. In this regard one could only refer to the ethnographic literature (v. Deraniyagala 1992:chap.6) and hypothesise that prehistoric man possessed plant artefact technologies akin to those described for the Väddas et al.: bamboo knives for cutting and scraping (cf. Kadar, Semang); wooden points for hunting, particu larly of smaller game (cf. Vädda), basketry of cane or bamboo and netting of fibre for containers, fish-traps and fishing nets (cf. Andamanese, Semang); fibre ropes (and skin pouches) for honey gathering (cf. Vädda, Chenchu), palm leaf containers for

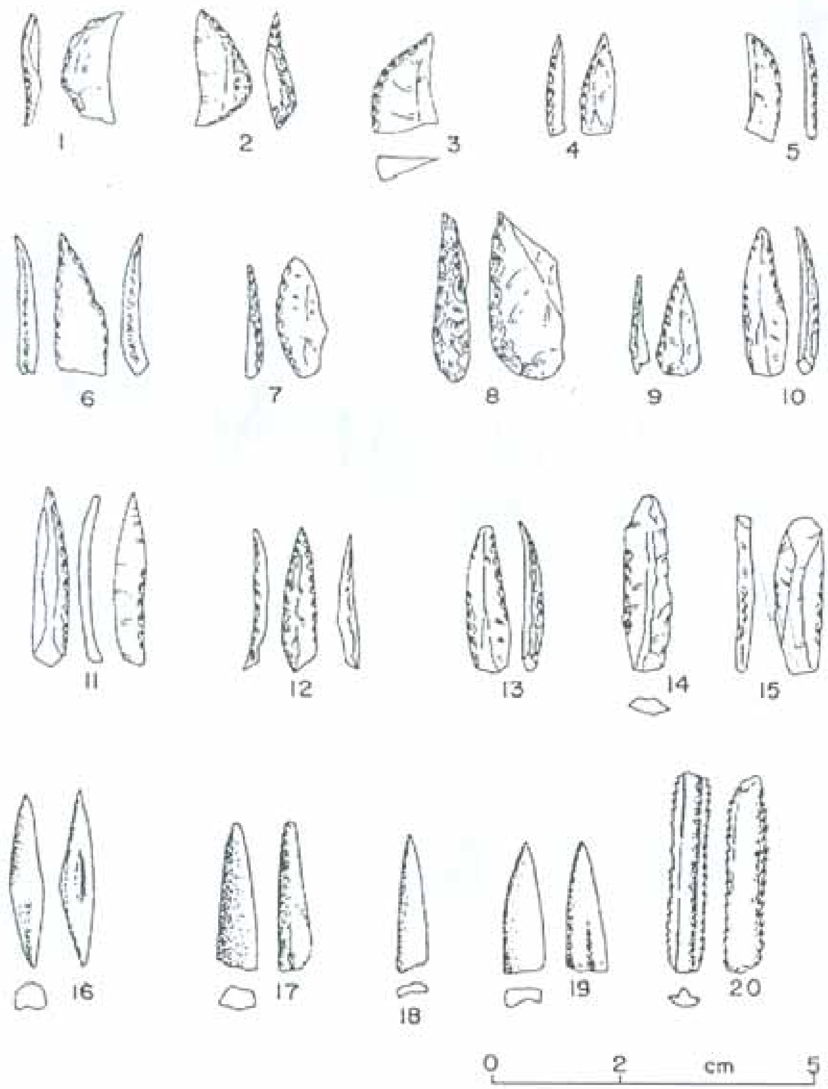


Fig. 11. Batadomba-lena Stratum 7a, ca. 19,500 cal BP: *(1-2)* microlithic lunates; *(3-6)* microlithic semi-lunates; *(10-11)* backed bladelets; *(16-19)* bone points; *(20)* ray's spine.

(cf. Sinhalese); bark of *Antiaris toxicaria* for clothing (cf. Malapantaram, Semang); and the ubiquitous vegetable poisons for freshwater fishing (cf. Väddas et al., Sinhalese). It would not be an exaggeration to affirm that plant technology was quite as important, if not more so, than lithic technology within the overall subsistence strategy of prehistoric man in Sri Lanka, the humid tropical vegetation in all its diversity being particularly amenable to such utilisation.

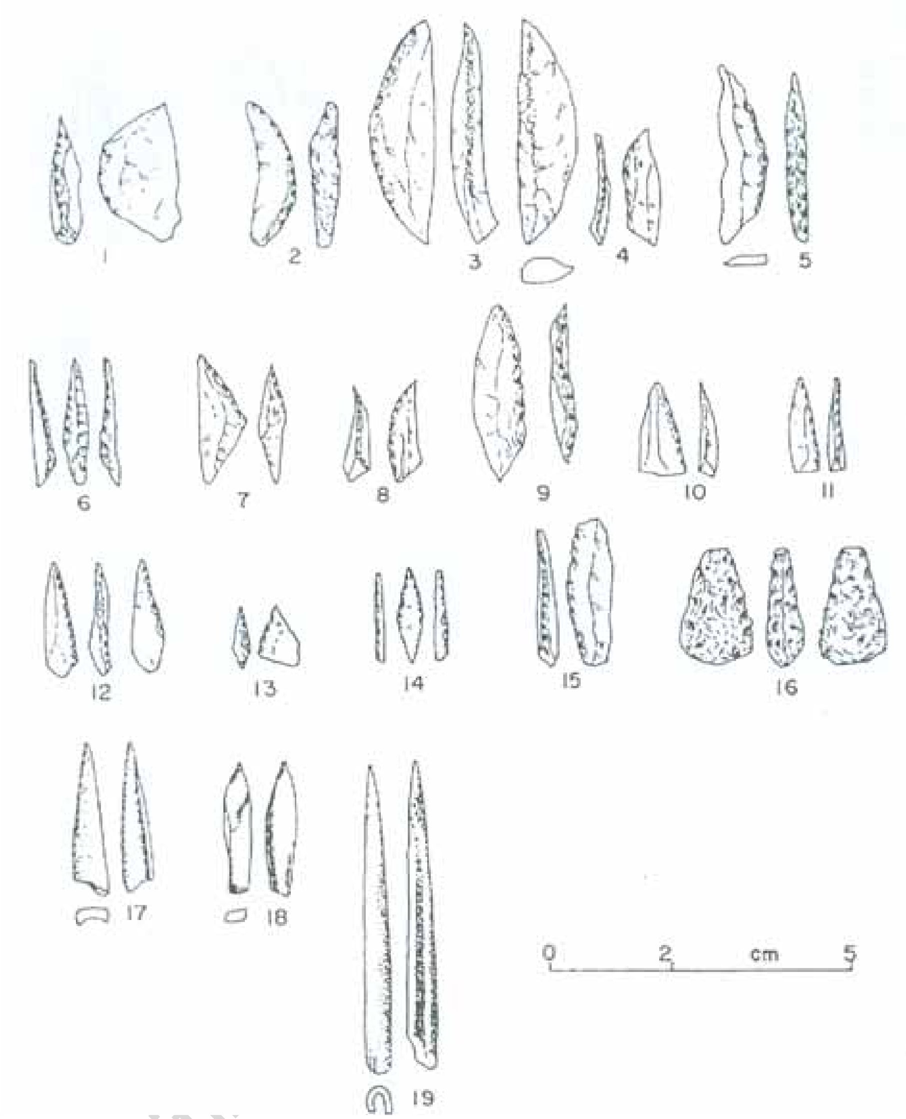


Fig. 12. Batadomba-lena Stratum 7 b, ca. 28,000-23,500 cal BP: *(1-5)* microlithic lunates; *(8)* microlithic semi-lunate; *(15)* backed bladelet; *(16)* Balangoda Point; *(17-19)* bone points.

One of the casualties resulting from the non-preservation of plant materials in Sri Lanka's prehistoric contexts is the bow and arrow. Did prehistoric man in Sri Lanka possess this artefact system? Considering that the Australians are not acquainted with their use (Campbell and Edwards 1966:208; Mulvaney 1969:127), despite their lithic industries including a prominent small tool component, one wonders whether the Mesolithic people of Sri Lanka must necessarily have been acquainted with use of the bow and arrow. The absence of this technological trait among the Kadar and Malapantaram in South India could lead to

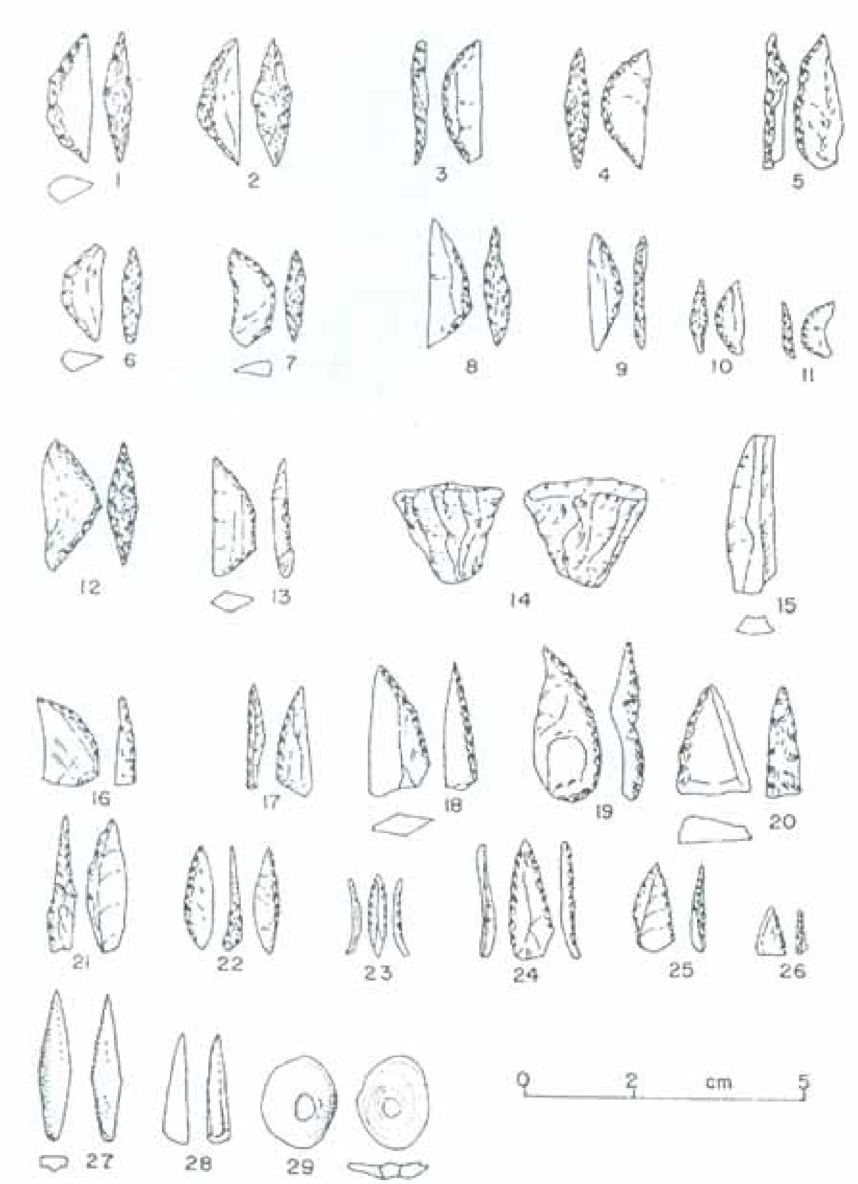


Fig. 13. Batadomba-lena Stratum 7c, ca. 36,000 cal BP: *(1-11)* microlithic lunates; (*12)* microlithic triangle; *(13)* microlithic trapezoidal: *(14)* bladelet-nucleus; *(15)* bladelet: *(16-18)* microlithic semi-lunates; *(27-28)* bone points; *(29)* marine shell bead.

speculation that its occurrence among the Vädda and the Chenchus, for instance, could be a function of acculturation derived from post-Mesolithic sources as a relatively recent technological innovation. On the other hand, the absence of the bow and arrow among the Kadar and Malapantaram could represent the result of cultural devolution, as indeed it might be with the Australians. Another point of interest comprises the arrow-poisons that constitute so important an element in the hunting technology of Southeast Asia, but which have been totally non-utilised by the hunter-gatherers of peninsular India (with the notable exception of the

Kurumbas of Kerala and Karnataka) and Sri Lanka, despite the occurrence of the plant *Antiaris toxicaria* in the latter region (cf. Semang poison). Similarly, it is noteworthy that traps and snares were unknown among the Väddas and Chenchus, contrary to their importance in Southeast Asia (cf. Semang). It could be hypothesised, on the basis of the ethnographic evidence from South Asia as a region, that arrow-poisons, traps and snares were alien to the prehistoric technology of Sri Lanka.

With regard to prehistoric structures in Sri Lanka, Beli-lena Kitulgala has produced evidence of what is possibly an apsidal (partially excavated) rubble footing, which might have stabilised a screening of wattle and thatch or hides constituting an enclosure. There is nothing in the Vädda ethnography to indicate that rubble footings were ever used by them, although this might be an omission of the ethnographers. The function of the structure at Beli-lena is as yet indeterminate; it has been dated to ca. 15,000 BP. Batadomba-lena has yielded clear traces of a terrace wall of rubble at the rear of one of the subsidiary shelters. This probably served to retain a levelled occupation floor from sliding into the deep recess at the back of the shelter. The wall has yet to be dated (? > 20,000 BP). Concerning open-air settlements in Sri Lanka, their floor plans and structural features remain to be investigated. It is possible to hypothesise that the settlements conformed to the arrangement of wattle and thatch structures facing a central public space that typifies South and Southeast Asian hunter-gatherer settlements (Deraniyagala 1992:chap.6.10.5-6), at least in the later prehistory of Sri Lanka. The individual houses for each nuclear family could have been rectilinear in plan (cf. Vadda), and in the Dry Zone the bark of *Antiaris toxicaria* could have been used to clad the wattle structure (ibid.). There is some likelihood that situations with a high ecologic density of humans, as might have prevailed in coastal ecozones F, A and perhaps B, and seasonally in the I Fm's wet dolines, could have been characterised by communal houses such as those of the Andamanese or the Semang (v. ibid.:chap.6.8.3). However, the Indian ethnographic evidence does not support such a hypothesis, and communal dwellings could constitute a settlement trait that never prevailed in South Asia.

Finally, there is the technology of fire-making. While the Andamanese apparently did not know how to start a fire, their's being a matter of keeping an existing fire of unknown derivation (?lightning) burning in perpetuity, it may be assumed that the evidence of the use of fire in Sri Lanka from at least as early as 38,000 BP at Fa Hien-lena represents the result of a knowledge of how to make fire. The present writer has postulated that the pitted hammer-stones found from 36,000 BP, if not earlier, in Sri Lanka were instrumental in supporting the vertical component of a fire-drill assemblage. It is noteworthy that among the Väddas et al. from South and Southeast Asia (ibid.:chap.6) it was only the Väddas who employed a fire-drill for lighting fires, the others having employed the less sophisticated and basic fire saw. In this connection it could be of significance that pitted hammer-stones are very rarely encountered in prehistoric contexts in India, thus adding substance to the hypothesis concerning the association between pitted hammer-stones and fire-drill technology. There is some suspicion that the human frontal bone found in a prehistoric context at Rāvanäla, with its conically drilled pits, had in fact been used to steady a fire-drill, much as the Väddas are known to have used animal crania, and that the pitting in the former is a result of the rotary action of the vertical stick against the bone.

Once the technology of fire-making had been acquired, it may be postulated that prehistoric man in Sri Lanka resorted to using fire as a major element in his hunting technology; namely, in the clearing of forests to encourage the coalescing of gregarious ungulates such as spotted deer (cf. Väddas) and to facilitate game drives and plant management in clearings. This could have occurred from at least as early as 38,000 BP. Fire would also have played a significant role in the preservation of meat by drying into biltong (cf. Väddas), which would have been of great utility in the Wet Zone where sun-drying is frequently not feasible due to the continuous wet weather that characterises this zone through much of the year (ibid.:app.I.4.2.7-8). With the advent of fire-making, the ability to prepare food by roasting or boiling could have had major demographic implications. It is hypothesised that the destruction by heating of harmful parasites in the meat of carrier animals (eg, tapeworm in pigs, and other forms in tropical marine fish) would have markedly reduced parasitic diseases among the prehistoric populations of Sri Lanka, leading to a corresponding shift in their demographic structure.

Ornament, Art, Ritual and Mortuary

Sri Lanka's prehistoric cultural assemblages are conspicuously devoid of artefacts that could unequivocally be categorised as ornaments, with the notable exception of beads (ibid.:chap.5.3.11). With regard to the latter, the discovery of a bead on shell in Batadomba - lena 7c dated to ca. 36,000 BP establishes a considerable antiquity for the emergence of the concept of personal adornment in Sri Lanka, which is perhaps quite as early as (or earlier than) the ostrich shell beads from Patne in India (ibid.:chap.5.3.14). At ca. 18,500 BP in Batadomba-lena there are the distinctive disc-beads on shell, with radial incisions (Fig.10), and Beli-lena Kitulgala has yielded barrel-beads on segmented long-bones from disturbed contexts. As to whether the serrated, and at times grooved, spatulate objects on bone from the latter site constitute ornaments is debatable. Shells of the tree-snail *Acavus*, with perforations through the body-whorl, are likely to have been used as ornaments (cf. former use of shell necklaces by Vädda women (ibid.:chap.6.3.4).

Nothing has survived in Sri Lanka which may be referred to as indubitable prehistoric art (ibid.:chap.5.3.11). The cave drawings encountered in the lowland Dry Zone are ascribable to the Väddas in historical times, as indeed has been attested by the Seligmanns (1911) who watched Vädda women execute these semi-symbolic compositions simply to while away their leisure. The one possible exception comprises the symbols and representations of animals pecked into the walls of Doravak-lena shelter (with over 3m of prehistoric deposit in it; W.H. Wijayapala in Deraniyagala 2000*a*). These could be prehistoric or of the Protohistoric Iron Age. Although the radiocarbon dates for the sealing strata indicate an Early Historic age, it would be a *terminus ante quem* for the engravings. None of the subterranean caverns occurring in the limestone terrain of the island bears any trace of art or ritualistic use. An item of possible ritualistic import to have been discovered in a prehistoric context in Sri Lanka is the human frontal bone from Rāvanälla cave (Deraniyagala 1992:chap.5.3.6), with pits drilled in it, the rough sutural edges and a zygomatic prominence chamfered off and one aspect of the bone smeared with red ochre (cf. above for suggestion that this object was used in a fire-drill assemblage). Other instances comprise human remains at Batadomba-lena (yellow ochre-coated vertebra, ca. 36,000 BP) and at Fa Hien-lena (ochre-coated teeth, ca. 7,700 BP, red ochre-coated bones, ca. 5,500 BP) (Kennedy 2000:183,222). Traces of red ochre are frequently encountered on Mesolithic grindstones and as abraded pieces of haematite; but these are the only instances where its function has been demonstrated. It is significant that none of the other rather numerous specimens of human skeletal remains from Batadomba-lena, Beli-lena and Bellan-bäňdi Palässa (36,000-12,000 BP) has been observed to be associated in any way with red ochre. This is in contrast to Indian Mesolithic burials with red ochre at Lekhahia and Bhimbetka. The Väddas are thought to have decorated their bodies with ochre in former times, and the Andamanese smeared red ochre and a white clay in a highly elaborate manner on their bodies, corpses and disinterred bones (Deraniyagala 1992:chaps.5.3.14; 6.3.4; 6.8.4-5). Noteworthy among the other pigments utilised by Mesolithic man in Sri Lanka are graphite, white chalk and perhaps mica, which have been found as smears on grindstones or as abraded or fragmented lumps.

As regards mortuary practices in prehistoric Sri Lanka (ibid.:chap.5.3.12), data are available primarily from Bellan-bäňdi Palässa (ca. 12,000 BP) where about 30 individuals are represented, the excavations at Beli-lena Kitulgala (over 12 individuals, ca. 15.000 BP), Batadomba-lena (over 24 individuals, ca. 36,000, 18,500 BP) and Fa Hien-lena (over 9 individuals, ca. 38,000, 37,000, 29,000, 8,000, 7,700, 5,500 BP) (Kennedy et al. 1986; 1987; Kennedy 2000:181-4,237-9). In all these instances the human bones have been excavated from within undifferentiated habitation deposits comprising, notably, ash, charcoal and faunal remains. No obvious burial pits have been observed by the excavators (although the coarse textures of the matrices would have made their differentiation difficult). The skeletal remains belong to both sexes, frequently of the 23-25 year age group, although infants and juveniles do occur, there being no selection for any one category. In the cases of Beli-lena and Batadomba-lena, the interments appear to have been within shallow graves dug into the habitation surfaces and heaped over with kitchen debris (cf. hollows made by raking hearths in Bushman camps (Yellen and Harpending 1972)). Considering that they would have had to be dug with wooden digging sticks or bone/antler picks, it is not surprising that deep interments were not the general practice, although the Semang did make graves about 1m deep with their digging sticks (Deraniyagala 1992:chap.6.9.4)(cf. Andamanese digging of graves with digging stick or shell adze and wooden shovel (ibid.:chap.6.8.5)). It appears as if the majority of the burials are secondary and fractional, as clearly indicated by the ochre smeared remains from Rāvanälla, Batadomba-lena and Fa Hien-lena. With the exception of two extended burials at Bellan-bäňdi

Palässa (Kennedy 2000:237), the more complete assemblages have invariably been found in tightly flexed postures (cf. flexed burials among Andamanese, Semang and also Bushmen (Allchin 1966:18) vs. extended burial among the Chenchu) with an east-west orientation in the case of Bellan-baidi Palässa (cf. Semang (Deraniyagala 1992:chap.6.9.4)).

Skulls, calvaria and mandibles have often been found in isolation or in association with individuals to which they do not belong. The frequency with which fragmented human remains, at times with cut-marks and burnt, have been found among kitchen debris such as ash, charcoal and faunal remains, is suggestive of anthropophagy (cf. Mesolithic Denmark (Petersen 1973:99) and the Vädda trait of chewing on dried human liver (Seligmann and Seligmann 1911:207)), or else it could represent a mortuary practice involving the chopping up of humans and incorporating them in middens (cf. Andamanese (Deraniyagala 1992:chap.6.8.5)). Human teeth are of frequent occurrence in the Mesolithic deposits of Sri Lanka, probably because they survived weathering and the depredations of scavengers better than the rest of the skeletal parts which are softer. In this context, the Vädda custom of retaining some of their teeth to be used for ratifying the transfer of territories (Seligmann and Seligmann 1911:113-4) could be a significant analogue. It is noteworthy that none of the prehistoric teeth from Sri Lanka display signs of ritualistic alteration such as filing, as opposed to Protohistoric Iron Age specimens from Pomparippu (Lukacs and Kennedy in Begley et al. 1981) and the practice among the Kadar and Mala-Vetan of South India (Deraniyagala 1992:chap.6.54).

The mortuary practices of Mesolithic man in Sri Lanka have differed considerably from those of the Väddas who have tended to minimise formality in this regard. The latter resorted to a scant interment at some distance from their open-air settlements or, in the case of caves, the corpse was left exposed at the site of death which was promptly abandoned. Caves were re-occupied only after the lapse of a lengthy period when the bones were cursorily swept out without more ado. On the other hand, the Malapantaram are known to have buried their dead close to their habitations, and interments beneath hut-floors have prevailed among the tribal populations of Khandesh and Bihar (Kennedy and Malhotra 1966:124). Hence, the concept of burying the dead within a continuing habitation appears to have survived into recent times in peninsular India. But the example *par excellence* of this practice is among the Andamanese (Deraniyagala 1992:chap.6.8.5): the Onge group interred their dead, including adults, beneath the sleeping place of the deceased; and among the rest of the Andamanese, infants were buried, in a flexed position, underneath the family hearth which continued to function as such.

The similarities between Mesolithic Sri Lankan and Andamanese mortuary practices extend beyond the loci of interment. The Andamanese are known to have bundled their corpses, in a flexed position, inside sleeping-mats – and at least one of the flexed burials at Bellan-bäňdi Palässa has been interpreted as having been similarly positioned. Then there were the complex ritual and associated beliefs pertaining to secondary interments and fractional storage of human remains (ibid.:chap.:6.8.5). The isolated occurrences of numerous skeletal parts of humans in Sri Lanka's Mesolithic contexts find a ready explanation in the Andamanese analogue: compare, for instance, the passing of human relics such as skulls, calvaria and mandibles from hand to hand, resulting in the presence of several skulls and jaws in any given camp (whereas long-bones and other skeletal parts tended to be misplaced frequently), the wearing of skulls, mandibles and broken bits of human bones on the persons of the relatives of the deceased; and the method of reburial of exhumed bones in the habitation deposits. However, while it is tempting to make a tight correlation between the practices of Balangoda Man and the Andamanese as regards mortuary traits, it would be somewhat foolhardy to do so, considering the considerable geographical distance between Sri Lanka and the Andaman Islands and the lack of close genetic or cultural affinities between the two populations, although the sea need not have been a barrier in late prehistoric times.

With regard to the non-core (socio-technic) traits of art, ornament, ritual and mortuary practice in prehistoric Sri Lanka from ca. 38,000 BP onwards, it is very apparent that the degree of specialisation achieved has been unspectacular. Prehistoric art is practically non-existent; ornament has been rudimentary, although with a very early inception for the wearing of beads; and it may be assumed that ritual was similarly unsophisticated (while being aware that material evidence of this category of behaviour can be very elusive under the best of circumstances, even in the case of relatively complex societies; cf. Andamanese ornaments of shell and fibre netting). Ethnographic parallels for the simplicity of art, ornament and ritual are extant in the data on the Väddas, Kadar, Chenchu and Semang. It is in the mortuary traits that Sri Lanka's prehistoric record shows potential complexity which could match that of the Andamanese. While, as with the Andamanese, regular cemeteries and grave goods are not in evidence, there are hints that mortuary procedures, in terms of secondary and fractional interments, keeping of skeletal relics and perhaps anthropophagy, reflect a society at a higher level of complexity than with the Väddas. This could signify that the subsistence base of Sri Lanka's Mesolithic was richer and more stable than with the Väddas or Kadar for instance, the latter appearing to have undergone cultural devolution as relict groups in historical times. While noting that the Andamanese mortuary complexity does indeed correlate positively with the richness of their resource base as reflected in high population densities, the interpretation of the mortuary record of Sri Lanka's Mesolithic may perhaps not be delivered in quite such simple and direct terms without risking being naive to the processual complexities associated with socio-technic traits.

Physical Anthropology

A treatment of the biological anthropology of Sri Lanka's prehistoric populations falls outside the scope of the present work, and what is being set out (ibid.:chaps.3.2.4; 5.3.13; Kennedy 2000; Hawkey 1998; 2002) is an abstract of the relevant literature. Commencing with *Homopithecus* and *Homo sinhaleyus* (Deraniyagala 1992:chap.3.2.4), the age of the fossils is unknown and the taxonomic status of the incisor has tentatively been described as hominoid, while that of the molar has been considered hominid. Recent investigations on these two specimens suggest that they are not hominoid, while a semi-mineralised, dolichocranic human calotte from 2.74m below the surface in a gem mine at Ellāvala (Ratnapura Beds) could be prehistoric (Kennedy 2000:187).

Sri Lanka's Mesolithic human, popularly termed 'Balangoda Man', is best known from the remains of over 30 individuals from Bellan-bäňdi Palässa, over 12 from Beli-lena Kitulgala, over 24 from Batadomba-lena, and over 9 from Fa Hien-lena (ibid.:18.1-4,237-9). Remnants from a total of at least 75 individuals have been retrieved from these sites. The age of this material ranges from ca. 38,000 to 5,500 BP (v. *Chronology* above; Deraniyagala 1992:add.I). The physical traits of Balangoda Man, as per the analyses of P.E.PDeraniyagala and Kennedy (v. ibid.:5.3.13; Kennedy 1965; 2000; Kennedy et al. 1986, 1987), may be summarised as follows. The estimated stature is ca. 174cm for males and ca. 166cm for females, which is tall in the modern southern Indian/Sri Lankan context. The vertebrae, however, are thought to be disproportionately short for the stature, the axis vertebra in the neck in particular. The skull has a variable cranial capacity (eg, male 1600cc, female 920cc), and its bones tend to be thick. It is dolichocephalic with a low vault, and a markedly receding forehead in males which is vertical or bulbous in females. The occipital curvature at the rear is pronounced with a heavy nuchal crest. The cheekbones are thick and wide. The brow-ridges are heavy in males, and the postorbital constriction is marked. The nose in both sexes is very broad with nasal bones that are concave dorsally and depressed at the root. In some adult males the distance from the lower margin of the nasal aperture to the base of the upper incisors is conspicuously great. The canine fossa is ill-defined and alveolar prognathism is evident in most males. The palate is large. The lower jaw is very robust at times and tends to possess a pointed chin. The teeth are exceptionally large[34] especialy the molars, even in infants. The summed molar crown areas of 713-700 mm^2 are the largest from anatomically modern prehistoric South Asians. The pelvis is small in both males and females, the scapula large and the limb bones robust[35]. Sexual dimorphism is pronounced except with regard to stature.

It is significant that the humans from Fa Hien-lena (38,000-5,500 BP), Batadomba-lena (18,500 BP), Beli-lena Kitulgala (15,000 BP) and Bellan-bäňdi Palässa (12,000 BP) are said to display traits that are very similar to each other despite the considerable range in antiquity (Kennedy 2000:184,186). As far as the humans from Bellan-bäňdi Palässa are concerned, Kennedy's analyses (1965) employing metrical indices and discrete morphological traits have revealed that the physical traits of Balangoda Man survive in varying degrees among the present-day populations of Sri Lanka, as they have among the Protohistoric Iron Age people of Pomparippu (Lukacs and Kennedy in Begley et al. 1981). However, they are said to be most pronounced among the Väddas, and Kennedy affirms (1974; 2000:186,238) that they undoubtedly represent a biological continuum, the Vaddas being the phylogenetic descendants of Balangoda Man, stemming from >18,000 BP, with Fa Hien-lena yielding the earliest evidence (at ca. 38,000 BP) of modern *Homo sapiens sapiens* in South Asia (id. 2000:180,182). The links between Balangoda Man and certain tribal populations of India are also said to be strong, although not nearly as pronounced as with the Väddas. It is worthwhile noting that Sri Lanka's ancient chronicles mention the Väddas as being the descendants of the aborigines who were on the island at the time of the Indo-European intrusion which is said to have occurred at ca. 500 BC.

> Few palaeo-anthropologists are now typologists; most realise that fossils individuals that were once part of genetically variable populations that were themselves part of a network of groups linked by gene flow across wide areas. At all time levels, local populations would have expanded or contracted, replacing others or being replaced, generally by a process of fusions, absorption, and hybridization. The populations involved might have been genetically very similar; less frequently, populations would have been genetically and morphologically different, having shared only a remote ancestry. In some cases, the differences between populations might have been so great as to preclude inter-breeding, or keep it at a phylogenetically insignificant level. When fossils are providing the information about populations, such distinctions are of course difficult to make [Pilbeam 1975:835].

Keeping the above constraints in mind, it appears nonetheless to be true that some of the specimens of Balangoda Man, as instanced from Bellan-bäňdi Palässa, Beli-lena Kitulgala and Batadomba-lena, display remarkably archaic characteristics. A mandible from the last site is said to approach the dimensions of *Homo sapiens* from Heidelberg and Ternifine (Kennedy 2000:185). This does suggest, as mentioned above, admixture of distinct phenotypic groups in relatively recent times, so as to give rise to such heterogeneity. In this connection it would be opportune to cite the evidence from Australia's Kow Swamp:

> The oldest Australian human remains, from Lake Mungo in New South Wales... date from almost 30,000 years...and appear fully modern. Other Australian remains, however, are considerably more archaic-looking ... for example, the large sample from Kow Swamp in Victoria dated at around 10,000 years.... Crania from this site have thick vaults, low frontals with prominent tori, massive faces, and robust mandibles. It is possible that these hominids are a continuation of the archaic forms represented earlier in Java [*Homo erectus* and Solo Man]. It is a further possibility that Australian Aborigines represent a mixing of this lineage with more modern types that first appeared in southeast Asia around 40,000 years ago. ... What happened in Australia during the past 30,000 or 40,000 years may well resemble what occurred in most parts of the Old World between perhaps 100,000 and 30,000 years ago, and could therefore be used as a 'model' for such events [ibid.:832].

The result appears to be "a good case for the variable persistence of *H. erectus* traits" (Mulvaney 1975:204) among post-Pleistocene South and Southeast Asian populations; and Balangoda Man has been no exception. It is perhaps noteworthy that P.E.P. Deraniyagala has maintained this stance consistently with regard to the latter population (cf. his reconstruction of Balangoda Man on display at the British Museum; Oakley 1980:268, fig.1)[36].

A recent investigation of much significance is that of Hawkey (1998; 2002) who assessed population distance on the basis of dental morphological traits. She states that these characteristics "are genetically inherited, exhibit little environmental influence, are evolutionarily conservative, and lack sexual dimorphism"; and that they can be used to suggest potential micro-evolutionary processes at work within a region (id. 1998:iii). Further, the "dental phenotype does appear to reflect the genotype" (id. 2002:62), and "dental traits are currently the preferred source of evidence for population affinity assessment due to their strong genetic component" (ibid.:30).

Hawkey compared the morphology of the teeth of Sri Lanka's Mesolithic humans, 'Balangoda Man' (Fa Hien-lena, Batadomba-lena, Beli-lena Kitulgala, Bellan-bäňdi Palässa; ca. 38,000-5,500 BP), with those of Indian Mesolithic humans and correlative prehistoric populations in South, Southeast and West Asia and Europe; and also with the dental traits of recent tribal (non-caste) and other caste- groups in India, as well as with the Andamanese. The conclusions based on dental data, may be summarised as follows:

a) At least by the commencement of the Holocene, the dental traits of South Asians are more similar to each other than to any other group outside South Asia. This South Asian dental pattern is termed 'Indodont' (ibid.:119,123,183).
b) Balangoda Man probably represents the earliest evidence of the ancestral dental pattern of anatomically modern humans (AMHS) in South Asia. This Indodont pattern, suggests common ancestry, probably of great time depth encompassing Southeast Europe and parts of Southeast Asia as well (ibid.:82,110,119,183).
c) It is probable that there was a South/Southeast Asian origin for anatomically modern humans. This stands opposed to the 'Out of Africa' theory which can now be contested with Sri Lanka's early material of Balangoda Man constituting the empirical basis. Hawkey (ibid.:183-91) states that

> the early Sundadont populations (Southeast Asia, Malaysia, Japan-Jomon, Taiwan) and the early South Asians, are the least divergent of all other… [Old] World populations.... The minimum divergence of the Early IndoSundadont...pattern from the rest of the ... [Old] World lends support to an 'Out of Asia' model for the origin of modern humans. As Turner (1992*b*) has suggested, migration of small, isolated 'founder' populations out of Asia would best explain the minimal dental divergence from the parental population. In addition, he proposed that this migration would also provide the mechanism for genetic diversity to occur in World populations (ie, through colonization-linked genetic drift...).
>
> Available biological data for South Asians indicate a complex, but basically homogeneous genetic pattern (Bowles 1977; Cavalli-Sforza et al. 1994). Past studies have suggested that the high genetic diversity seen in modern African populations equates with great antiquity (Watson and Penny 1997). But new research has proposed several thought-provoking hypotheses. Hammer and associates (1997; 1998) used Y-chromosome DNA data to suggest that an Asian migration back into Africa may account for the African genetic diversity.... The African genetic diversity may be an artifact of remnant population size, rather than

antiquity of AMHS origin.

During the late Pleistocene, Early Sundadont populations may have separated into two divisions. One branch (Sundadont)... The second branch (Indodont) migrated to the west and northwest into the Near-Mid East, Eurasia, and eventually North Europe. This hub-and-spoke scenario may well explain why mtDNA results for modern Sri Lankan Vedda suggest they cluster between European and North Asians (Harihara et al. 1988; Saitou and Harihara 1989). Although current molecular genetic data are patchy, populations in India also appear situated between Europe-North Asia groups (Majumdar 1997).

The close affinity of [Balangoda Man] with recent Melanesians, and to a lesser degree with modern Australian Aborigines, suggests that the Indodont (or Early Sundadont) pattern may be ancestral to the populations of the Sahul region. A recent study using *Alu* insertion polymorphism data indicates that the inhabitants of Sahul are as genetically similar as African groups to an unknown AMHS ancestral population (Stoneking et al. 1997)…. Craniometric data... suggest a strong link between Australasians and South Asians (Kennedy 1975).

d) Balangoda Man had certain archaic dental traits, notably the protostylid M1. Its incidence is very high (84.6%) as against 11.1% for Indian Mesolithic populations (ibid.:192).

e) Balangoda Man's dentition is dissimilar to that of all other South Asian groups. But it is more similar to that of the Vaddas than to the Sinhalese or Tamils (ibid.: 69,92). Conversely, more than any other South Asian group, Vädda dentition is the closest to that of Balangoda Man, indicating a genetic continuum (ibid.:92). The Vadda molars and premolars are smaller than in Balangoda Man, possibly due to a shift in subsistence strategy (ibid.:88).
f) Despite what is stated above, Balangoda Man does not exhibit close phenetic similarity with Väddas, Sinhalese or Tamils, who are more similar to each other than to the former (ibid.:89).
g) The Väddas are heavily mixed with Sinhalese and Tamils (ibid.:92). All three groups bear the closest similarities in South Asia to tribal populations of South India.

The Palk Strait separating Sri Lanka and India is only ca. 11m at its deepest. Hence a slight eustatic drop in sea level would create a land-bridge between the two countries, and this is likely to have occurred on numerous occasions during the Quaternary, the last being estimated at ca. 7,000 BP (Deraniyagala 1992:174). The crossing of the straits by sea-craft over the last 50,000 years is also a possibility, by analogy with the settling of Australia over a wider expanse of sea. It is thus clear that prehistoric human traffic to and fro between India and Sri Lanka would have been commonplace, leading to complex patterns of miscegenation between groups. Moreover, it is also necessary to bear in mind that the southern tip of India would have constituted a *cul-de-sac* for groups moving down the peninsula under pressures from the northwest and northeast. The present diversity in physical traits among the tribal people of India bears ample testimony to these trends in population movements. It can therefore be concluded that while southern India and Sri Lanka could have constituted a regular melting pot of Stone Age groups, both in terms of their biological attributes as well as their cultural concomitants, the relative homogeneity of morphological traits since at least 18,500 BP up to ≤5,500 BP in Sri Lanka could have been maintained only if this region was a backwater in the scene of genetic flow on the sub-continent.

The subject of the apparent homogeneity of the Väddas deserves scrutiny. The Kadar of Kerala (von Ehrenfels 1952:4-5,152-3) have been classified as protoAustraloids: short (males ca. 158cm; females ca. 150cm) and stocky, very dark, with frizzly hair and a conspicuous sparsity of body-hair. It appears as if the Malapantarams were similar (von Fürer-Haimendorf 1965:13). But the typical Vädda of Sri Lanka and the Chenchu have had what seems to have been a different phenotype which was much more gracile and with lighter pigmentation. Any layman with a discerning eye can probably spot the occasional occurrence of the former (ie, Kadar) type within the present range of phenotypic variability among the Sinhalese. It is now a matter of some urgency that physical anthropologists address this subject, extending the pioneering investigations of Kennedy (2000) and Hawkey (1998; 2002) so as to bring resolution into the question of the degree of homogeneity that can be postulated for the genetic make-up of Sri Lanka's late prehistoric humans. In this regard mitochondrial DNA studies have been conducted on prehistoric skeletal material from Sri Lanka (Kennedy 2001:pers. comm.)[46]. Perhaps the group referred to as the *Nittavo* in Sinhalese legend (Nevill 1887), which was supposed to have been exterminated by the Väddas in relatively recent times, was not a figment of the popular imagination after all: the possibility of their having been a hunter gatherer group that was genetically, at least partially, distinct from the Väddas (cf. Kow Swamp vs. Lake Mungo) cannot be discounted.

A major intrusion into the (apparently) homogeneous gene pool of the island (?and Southern India) appears to have occurred with the dawn of the Protohistoric Iron Age at ca. 1.000-500 BC (v. Lukacs and Kennedy in Begley et al. 1981; Deraniyagala 1986, Hawkey 2002). It would seem that it was this intrusion (and its successors) that led to the present-day configuration of Sri Lanka's populations, which induced Stoudt forty years ago (1961:157) to affirm that the Väddas, Sinhalese and Tamils are anthropometrically and morphologically distinct from each other.

Neolithic/Chalcolithic

The periodisation of Sri Lanka's main technological episodes comprises the Middle Palaeolithic, Mesolithic, Protohistoric Iron Age, Early Historic, Middle Historic, Late Historic and the Modern periods. What concerns the present account is the interface between the Mesolithic and Protohistoric Iron Age episodes.

The termination of the Mesolithic and the inception of the Protohistoric Iron Age in Sri Lanka has yet to be delineated with any clarity, due primarily to the lack of a single context with evidence of the transition between the two periods: none of the sites excavated so far has been able to present a chronological continuum from pre- to protohistory. In the case of caves the proto-and Early Historic strata have invariably been disturbed by guano diggers, whereas with open-air sites the selection of loci for settlement does not appear to have coincided (owing to different subsistence strategies) during the prehistoric and subsequent periods repectively.

What has been designated the 'Upper Mesolithic' (v. *Chronology*, *Settlement* and *Subsistence* above) is characterised by the evidence from the Horton Plains for herding (? *Bos indicus*) and the incipient management of barley and oats by >15,000 BC, and by herding and the farming of barley and oats by 8,000 BC (v. Premathilaka 2003). Then there is Doravak-lena shelter which is said to have yielded a geometric microlithic industry in association with what is claimed to be a cereal and a crude red pottery by 5,300 BC and Black and Red Ware by 3,100 BC (Wijayapala 1997; in Deraniyagala 2000a:34). There is also Māntai where a geometric microlithic horizon dated to ca. 1,800 BC was found associated with a few pieces of slag, which could indicate hę knowledge of copper-working as manifested in Southern India by ca. 2,000 BC[37].

At all three sites, the indications are that settlements suggestive of herding/ farming dominating the subsistence strategy are not in evidence. Assuming that the term 'protohistoric' applies only when over half the nutrient intake is derived from food production (ie, herding/farming) these data have been assigned to the prehistoric period and discussed accordingly. But they do represent the transition from prehistory to protohistory in Sri Lanka. It was of considerable duration, ca. 13,000 years, and constitutes a field of research into what is still uncharted terrain. It is probable that from at least as early as 15,000 BC up to ca. 1,000 BC, different subsistence strategies were being employed contemporaneously, according to the ecological niche being exploited. These strategies could have ranged from one based 100 per cent on hunting and gathering to those with a certain degree of herding/ farming with hunting and gathering being still predominant.

The new evidence from the Horton Plains is of the greatest significance (Premathilaka 2003). Ghar-i-Mar and Aq Kupruk in Afghanistan and Mehrgarh in Pakistan are known to have had a Neolithic subsistence strategy by 7,000-6,000 BC. There is tentative evidence of herding in northern Rajasthan by 7,000 BC, of rice and pottery at Koldihwa, U.P. in India by 5,000 BC, and perhaps cereal management/farming in the Nilgiri Hills of South India by 8,000 BC (Gupta and Prasad 1985 cited in Premathilake 2003).

It was proposed, but not established, that Sri Lanka could have constituted yet another 'hearth' for the domestication of plants (Deraniyagala 1980:185; 1988:701,1011-2; 1992:322,448). And so indeed it has proved to be, comparable to the incipient plant domestication of the Natufian in Syria, Lebanon and Israel (ca. 10,000-8,000 BC) and incipient herding at Zawi Chemi Shanidar and Shanidar in the Zagros and Kurdish hills of Iraq (ca. 9,000 BC)[38].

Protohistoric Iron Age

The protohistoric period in Sri Lanka is defined (at present) by the existence of a subsistence strategy mainly based on herding/farming, but which is antecedent to the appearance of writing (v. de Laet 1957:18). It is represented by the Protohistoric Iron Age (syn. Early Iron Age), which in South India appears to have established itself by at least as early as 1,200 BC (Possehl 1990; Deraniyagala 1992:734).

The earliest manifestation of this in Sri Lanka is radiocarbon dated to ca. 1,000-900 BC at Anurādhapura and Aligala shelter in Sigiriya (Deraniyagala 1992:709-29; Karunaratne and Adikari 1994:58; Mogren 1994:39; the Anurādhapura dating is now corroborated by Coningham 1996; Coningham and Batt 1999). It is very likely that further investigations will push back the Sri Lankan lower boundary to match that of South India.

The Protohistoric Iron Age in Sri Lanka is distinguished by the appearance of iron technology, rice cultivation, the domestic horse and neat cattle, and pottery. Iron technology appears to have rapidly superseded the preceding stone technology to such a degree that not a single stone artefact was found in the Protohistoric Iron Age horizons of the Citadel at Anurādhapura. The ready availability of iron ores in much of Sri Lanka would have made the continued use of stone tools unnecessary. Most significantly iron tools would have been essential for constructing reservoirs and earthworks for water management, a *sine qua non* for permanent settlements in the Dry Zone which is characterised by seasonal water deficit (C.R.Panabokke 2003:pers. comm.). Besides, the clearing of the heavy forests of the lowland Dry Zone and the preparation of the clayey loams of the Reddish Brown Earths for cultivation would have been effected very much more efficiently with iron tools than with those of stone. These factors would have led to the abandoning of the latter technology in those areas coming under the new protohistoric agricultural economy.

The opening up of the Reddish Brown Earth regions of Sri Lanka's Dry Zone for intensive wet-rice cultivation supplemented by swiddening would have resulted in a rapid increase in the carrying capacity of these areas with a concomitant increase in socio-economic complexity. It is proposed that this phenomenon would have occurred throughout India, in the north and the south, commencing at ca. 1,200 BC, giving rise to a pan-Indian (inclusive of Sri Lanka) Protohistoric Iron Age. It was distinguished by a ceramic sphere (v. Dunnell 1971:3) comprising a synthetic unit consisting of contemporaneous and related but yet dissimilar ceramic complexes sharing a few traits which are diagnostic. The Black and Red Ware (BRW) ceramic tradition is one such diagnostic trait, which from a localised inception in Chalcolithic contexts in the Banas basin of western India at ca. 3,000 BC spread thence north into the doab and further east, into central India and further east, and into the southern extreme of the peninsula reaching into Sri Lanka. It was a hallmark of the Protohistoric Iron Age of India. It is proposed that the BRW tradition on the sub-continent was a diffused trait, as per the chronological gradients of its spread from western India; but it is premature to connect it with the occurrence of BRW in Pre-Dynastic Egypt and Nubia (Banerjee 1965:67; Allchin and Allchin 1968:291)[39].

The settlement at Anurādhapura exceeded 10ha in extent by ca. 900 BC, and it was at least 50ha by ca. 700-600 BC and thus already a 'town' (Deraniyagala 1992: addendum I; cf. Allchin 1989:3). So far no other settlements of the Protohistoric Iron Age have been securely identified in Sri Lanka (with the possible exception of the very small-scale deposit within the rock-shelter at Aligala and another in Tissamaharama (Saňdagiri). Potential sites are Kandarōdai and Māntai; but the evidence has yet to surface (Deraniyagala 1992:730-2,735).

The 'Megalithic' Protohistoric Iron Age mortuary complex of Sri Lanka (Seneviratne 1984) is akin to that of peninsular India. It falls initially within the protohistoric period, as indicated by its radiocarbon age of 500-400 BC at Ibbankatuva (v. Bandaranayake and Kilian in Deraniyagala 1992:734) and continued well into the Mid-Early Historic period as evidenced by the radiocarbon dates for the cemeteries at Galsohon Kanatta (ca. 112 BC) and Kalotuwawa (ca. 130 BC) (id. 2001; 2005). The place of this mortuary trait within the overall Protohistoric Iron Age culture in Sri Lanka is as yet indeterminate. It is noteworthy that these cemeteries do not have protohistoric settlements associated with them; for instance at Ibbankatuva the settlement postdates the cemetery by several centuries (Karunaratne 1994). In India too this situation prevails at most localities (Deo 1985 cited in Kennedy 2000:356). Conversely, the Protohistoric Iron Age Settlement at Anurādhapura does not have a Megalithic cemetery to which it can even remotely be linked. The Megalithic mortuary complex could thus possibly have been associated with just a special group of people, such as pastoralists, on the periphery of those who occupied Anurādhapura (cf. Leshnik 1974). What this signifies is that the Megalithic mortuary trait is but a discrete facet of the Protohistoric Iron Age and Early Historic culture complexes of India which had its distribution from the Gangetic valley down to Sri Lanka with regional variations. Hence it is misleading to refer to a Megalithic culture, as several scholars are apt to, since this mortuary trait is not necessarily a concomitant of the Protohistoric Iron Age of peninsular India or Sri Lanka. Similarly, the BRW tradition, which characterises much of the subcontinent's Protohistoric Iron Age (except in the northwest) is not confined to the Megalithic mortuary facies in peninsular India, a point that is frequently overlooked. There is a tendency to equate the BRW with the Megalithic complex on a one-to-one basis, thereby distorting the basis of interpretations from the outset. It is important, therefore, that the nature of this interrelationship between (a) the total Protohistoric Iron Age complex of the sub-continent, (b) its BRW ceramic complex and (c) the Megalithic cemetery complex in southern India and Sri Lanka be kept clearly in mind, so as to avoid confusion in interpreting the archaeological record (Deraniyagala 1992:734). The Sri Lankan data need to be interpreted against the backdrop of the total sub-continental Protohistoric Iron Age, since medium- to long-range cultural diffusion appears to have been prevalent.

It is probable that stimulus-diffusion was not the only mechanism that was active in the advent of the Protohistoric Iron Age in Sri Lanka. It has been postulated that the Nāga ethnic group mentioned in the ancient chronicles were the authors of this Protohistoric Iron Age (ibid.:chap.5.4.3) and the pattern of their purported distribution, particularly in the maritime regions, as of the north, suggests a physical intrusion on the Yakka hunter-gatherers (ie, Balangoda Man). Considering that the radiocarbon chronology for the Lower Early Historic period in the Citadel of Anurādhapura corroborates the historical chronology of the chronicles (ibid.:addendum II),. it would be rash to reject the statements of the latter concerning the Nāgas as mere legend. It could be concluded, hypothetically, that the catalyst that precipitated the movement of Protohistoric Iron Age populations into Sri Lanka at ca. ?1,000 BC would have been the radically increased carrying capacity of the latter resulting from the advent of iron technology.

The evidence from the limited excavations in the Citadel suggests that by ca. 900 BC there was a nucleated settlement of the Protohistoric Iron Age at the site. This in turn suggests a relatively high degree of socio-economic complexity compared with that of the hunter-gatherers. However, the historical accounts mentioning the high social status accorded to the Yakka/Väddas from at least as early as the 5th century BC onwards by the Sinhalese is indicative of a not so conspicuous a socio-economic gap between the Sinhalese and the Yakka/ Väddas in this period.

The biological anthropology of Protohistoric Iron Age humans in Sri Lanka was first assayed systematically in the nineteen seventies. The dental and osteological evidence from 14 burials excavated from the Megalithic (urn burial) site of Pomparippu (undated) indicated the survival of certain traits of Balangoda Man and the Väddas – but together with others indicative of a major new genetic input (Kennedy 2000:352). Since then, Hawkey's (2002:81-3,160) comparative investigation into the dental morphology of the Pomparippu Protohistoric Iron Age humans have confirmed these findings, indicating migration from India. In addition she affirms that they were dissimilar to Indian Protohistoric Iron Age populations, but more like the peninsular Indian ones than the Indo-Gangetic or northwest Indian communities. The closest affinities of the Pomparippu humans were to the Sinhalese population of the island and not to the Väddas or Tamils, suggesting that they were ancestral to the modern Sinhalese (ibid.:182,195). These conclusions, although based on a sample from just one Megalithic cemetery in Sri Lanka, do not support the theory that all Megalith builders were Dravidian speakers. Some of Hawkey's assertions (based on dental morphology) that are relevant are as follows:

a) Balangoda Man and the Indian Mesolithic humans form two distinct groups by the early Holocene. But certain similarities suggest a common ancestry, probably of great antiquity (ibid.:10). The same holds true for Balangoda Man *vis à vis* peninsular Indian Chalcolithic groups (ibid.:84). The latter, however, have affinities to the Indian Mesolithic, the Indus Civilisation, and the tribal groups of peninsular India (ibid.:92). The Indus/Chalcolithic similarities are few, but both have strong links to the Indian Mesolithic (ibid.: 133), suggesting that the latter were ancestral (ibid.:155)[40].

b) The Indus dentition is closer to that of the Sinhalese than to South Indian tribal groups or the Sri Lankan Tamils. The peninsular Indian Chalcolithic is also closer to the Sinhalese than to the Tamils (ibid.:136).

c) Only eastern Indian Austro-Asiatic speaking tribal groups and the Sinhalese bear close similarities to both Indus and peninsular Indian Chalcolithic populations. The Sinhalese and Austro-Asiatic speaking groups of eastern India could be decendants of these, having migrated to the south and east (ibid.:239). They may have been "displaced to the south and east by the later arrival of Indo-European speaking groups... [or these] affinities may reflect a phylogenetic link ... either by gene flow or shared origin" (ibid.:155). "Coedes... maintained that migration of both Dravidian and Indo-European language speakers from the northwest pushed Austro-Asiatic populations into East and South India. The dental evidence lends some support to his argument" (ibid.:193). Sri Lanka would be the southernmost extreme, as manifested in the Sinhalese.

d) "The dental data do not support an Indus or [peninsular Indian Chalcolithic]... linguistic link with modern-day speakers of Dravidian languages" (ibid.:144). The Indus Civilisation "may have been composed of a multi-linguistic, and possibly ethnically diverse population, consistent with people commonly found in large cosmopolitan areas" (ibid.:155).

e) The Pomparippu humans are more similar to the Sinhalese and to Indian Mesolithic populations than to Sri Lankan Tamils (or to Balangoda Man) (ibid.:182).

f) Close similarities exist between the peninsular Indian Chalcolithic and its Protohistoric Iron Age groups (ibid.). Dental data support the hypothesis of an indigenous origin for South Asian Protohistoric Iron Age populations. "The people of the South Asian [Protohistoric] Iron [Age]... appear to be the biological descendents of indigenous hunter-gatherer populations of India and Sri Lanka, although there is a temporal trend towards increased population heterogeneity" (ibid.:182). "Kennedy ... notes that the Iron Age biological variability continues the trend towards heterogeneity observed in the [Indian Mesolithic and Chalcolithic] communities" (ibid.:158). This is based on craniometric data and supported by dental evidence which indicates that the Protohistoric Iron Age populations were phenotypically heterogeneous groups (ibid.: 160). Cluster analysis results "suggest a different biohistory for [the Sri Lankan Protohistoric Iron Age] than for… [Indian Protohistoric Iron Age] groups" (ibid.:168).

g) All the Protohistoric Iron Age groups of India consistently share strong affinities with modern populations from eastern and north-eastern India, regions of present-day Megalith builders (ibid.:166). In Sri Lanka, the Megalithic group at Pomparippu shows its closest links to the modern Sinhalese (ibid.:182). None shares a dental pattern with modern Dravidian speakers of South India (ibid.:166). It is perhaps significant that the earliest remains of domesticated horse (its trappings are a hallmark of the Megalithic) to have been found in India come from the peninsular Indian Chalcolithic at Inamgaon (ibid.:22).

h) "Gene drift rather than gene flow appears to have been the main micro-evolutionary process operative within [prehistoric and protohistoric] India and Sri Lanka" (ibid.: 183).

Hawkey's hypotheses are counter-intuitive in that one expects the Dravidian language to have imposed itself on pre-existing populations in Southern India rather than a massive migration of Dravidian speakers into the region. But the dental evidence, which methodologically is apparently sound, does support her stance, although the exclusion of the protostylid dental trait, a procedure that does not appear to be justified, alters the picture somewhat. A larger sample needs to be investigated and these hypotheses tested rigorously before concluding on these issues. Until then, they deserve to be used as working hypotheses on the cutting edge of biohistorical research in South Asia.

Transition to the Historical Period

The Protohistoric Iron Age of Sri Lanka, at ca. 1,000-500 BC, is referred to as protohistoric since there is no evidence of writing in this period. At ca. 600-500 BC, the first appearance of writing (in Brāhmi almost identical to the Asokan script some 200 years later) heralds the commencement of the Early Historic period (Deraniyagala 1992:739-50; Coningham 1999: Deraniyagala and Abeyratne 2000). This writing, radiocarbon dated on charcoal from three locations in the Citadel of Anurādhapura and checked by thermoluminescence dating, is inscribed on potsherds apparently signifying ownership (Figs.14,15). Among the names was *Anuradh*... which, coincidentally or otherwise, is stated in the ancient chronicles to have been the name of a minister of Prince Vijaya, the purported founder leader of the Sinhalese, at ca. 500 BC.

The new chronology for the beginnings of writing has thus revolutionised our concept of the lower boundary of the historical period of South Asia (for revised periodisation v. Deraniyagala 1992:714). It has pushed it back by at least two centuries, into the times of the Buddha. Coeval with the first appearance of writing at Anurādhapura is the rise of new pottery forms (such as Early Historic BRW) and wares (eg, a medium-fine grey ware, possibly a North Indian import), red glass beads (for North India 600-400 BC v. Basa 1992:97) and what appear to be writing styli made of bone[41] (Deraniyagala 1992:714). One suspects a pan-India wave of cultural impulses that manifested itself in these material transformations. It is possible that some long-distance migrations, as evinced in the legend of Prince Vijaya's arrival in Sri Lanka from North India, were concomitant to this phenomenon.

The earliest (600-500 BC) inscriptions on pottery at Anurādhapura, whenever adequately complete to be linguistically diagnostic, are in Indo-European Prakrit. This situation is repeated in the earliest inscription found in Megalithic Kodumanal, and possibly in the lowermost levels of Arikamedu as well, in South India (ibid.:745-6; Casal 1949; Rajan 1990). (The Kodumanal inscription has not been dated (Rajan 2000:pers comm.) So far, none of them are in Dravidian. It appears to corroborate the view that Indo-European was predominant from at least as early as 500 BC in Sri Lanka, as affirmed in the chronicles concerning an Aryan impulse associated with Vijaya. The views of Parpola (1984; 1988; v. Deraniyagala 1992:749-8) are relevant in this regard. They are bold and provocative, and they merit serious consideration. He postulates long-distance southward migrations of ruling Indo-European elites at ca. 500 BC and argues his case well.

The prime mover for these impulses is difficult to isolate. The urban centres of the Ganges plains could well have constituted the nodes from which they went out, centrifugally, to be developed in the periphery and returned centripetally to those original nodes as a feedback phenomenon, thus creating a relatively closed interactive system. On the other hand, one cannot discount the possibility of inputs at the same time from West Asia, the Mediterranean and China. It is probable that this latter aspect has been greatly underestimated. The idea of devising the Brahmi script might have arisen through contact with Semitic trading scripts from West Asia (Deraniyagala 1992:744; note that long-distance trade (in spices?) could have occurred during the Protohistoric Iron Age extending into Southeast Asia and West Asia). Whatever the mechanism for the onset of urbanism in Sri Lanka, by 500 BC it was ready to accelerate into the Early Historic period.

By the time of Emperor Asoka in the third century BC, the city of Anurādhapura was nearly 100ha in extent (ibid.:712-3), making it (on present estimates) the tenth largest city in India/Sri Lanka at that time and the largest South of Ujjain in northern India (Allchin 1989:3,12). Buddhism had by then taken root as the formal belief system of the island, coinage introduced and the concept of irrigated agriculture, probably heralded during the Protohistoric Iron Age, developed into sophisticated and large-scale systems which served as the economic foundation of the correspondingly complex settlement configurations of the Early Historic period.

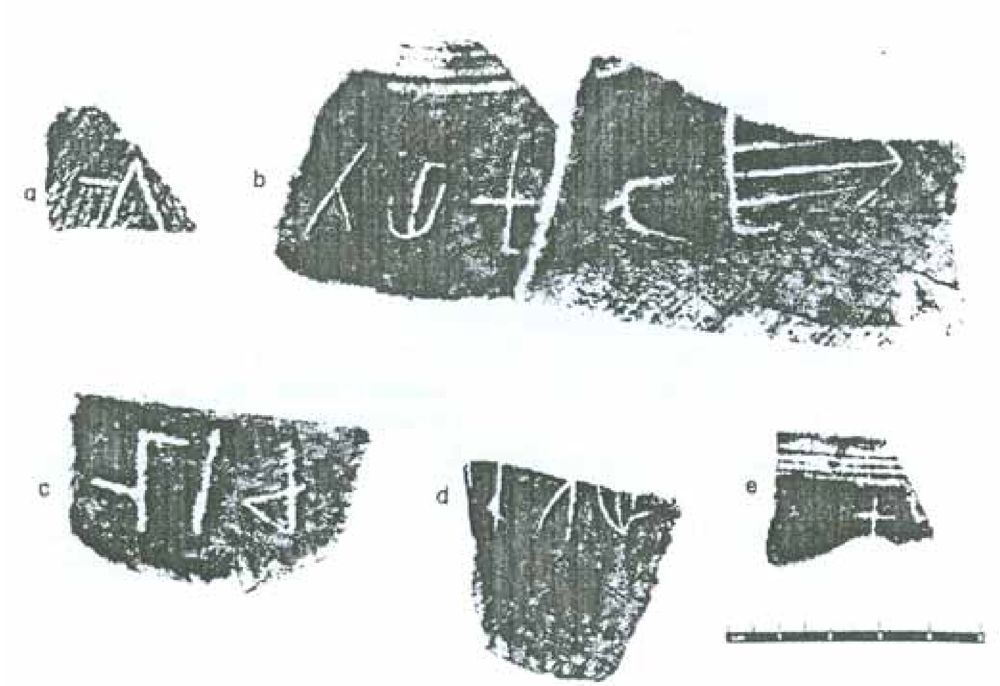


Fig. 14. Early Brahmi inscriptions on potsherds from Anuradhapura CitadelAMP-88(75); ca. 600-500 BC.

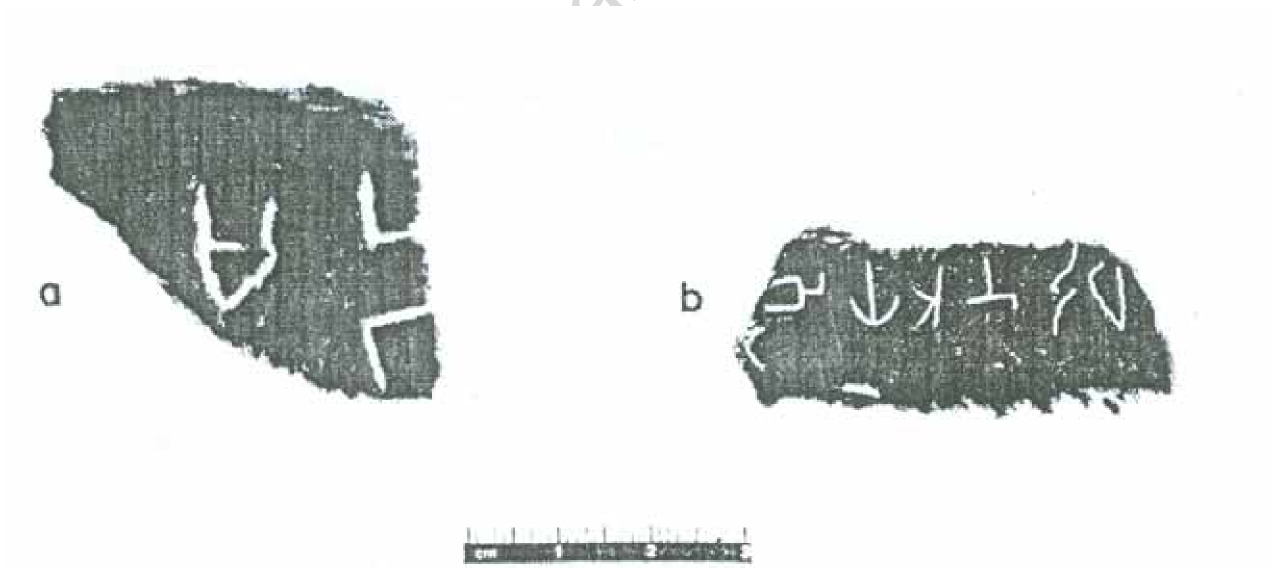


Fig. 15. Early Brahmi inscriptions on potsherds from Anuradhapura Citadel ASW-88(88): ca. 600-500 BC.

It is noteworthy that ceramics of Hellenistic origin and their local derivatives (perhaps the fabric of Rouletted Ware) appeared in Sri Lanka at this time, as they undoubtedly would have in India as well, the contacts between India and the Hellenistic culture sphere being historically an established fact. Somewhat later on, Roman influences became apparent, particularly during the latter phase of the Roman Empire, as amply attested by numerous finds of Roman coins in various locations. The upper chronological boundary of the Early Historic period in Sri Lanka may be defined at ca. 300 AD, which historically saw the end of the Mahavamsa dynastic line which in turn appears to have coincided with the demise of the BRW ceramic tradition. Meanwhile, Sri Lanka's socio-economic organisation, based primarily on both the intensification and extensification of wet-rice cultivation in the Dry Zone, had acquired a full-fledged urban status by the first few centuries AD, perhaps much earlier (?250-0 BC), with a concomitant increase in social stratification (cf. Hole 1974:276). The optimisation of the sub-system of Sinhalese culture would have conflicted with that of the hunter-gatherer Yakkas (Väddas) (cf. Henderson 1973:30) forcing the latter into a relict status. This has been maintained in partial symbiosis with the Sinhalese (Deraniyagala 1992:chap.6.3.6; cf. Barth 1956:1088). It appears probable that culturally the Vädda resistance to adopting an economy geared to food production was at least in part due to the ability of their effective environment to maintain a relatively high crude density of population (ca. 0.4 individuals per km; cf. Butzer 1971:583), whereas this same environment was not conducive towards the wet-rice cultivation that provided the basis of Sinhalese settlement (v. Sherratt 1972.512). It is significant that the Väddas were not in the least interested in adopting the simple domestication procedures used by the Sinhalese in noosing and taming wild buffaloes with their high potential for maintaining a pastoral economy. The effects of acculturation of the Väddas as a result of Sinhalese, and to a lesser degree Tamil, influences appear to have been primarily confined to the technological supersession of stone with iron. However, the degree of cultural and genetic identity that they have contrived to retain through the ages is quite remarkable (cf. Kadar), probably as a function of the acceptance of the group as part of a larger community – but not of the individual with any degree of intimacy – running very deep in Indian and Sri Lankan society (v. Leshnik 1973:68; Allchin and Allchin 1974:48).

Conclusions

Sri Lanka's prehistory has primarily been delineated from three sets of sediments: the fluviatile Ratnapura Beds of the lowland Wet Zone, the coastal alluvial gravels and overlying dune sands of the Iranamadu Formation in the semi-arid Dry Zone, and the cave sediments (supplemented by open-air occupation deposits) primarily of the lowland Wet Zone. The Ratnapura Beds have yet to be dated radiometrically, but faunistically they do yield Middle or early Upper Pleistocene elements which could correlate with the rather non-descript stone tools that are occasionally found in the Ratnapura Beds.

The coastal dune sands of the I Fm have been dated by TL and OSL to 80,000-64,000 and ca. 28,000 BP at Patirajavela, and to ca. 28,000 BP at Bundala. The associated basal gravels have been assigned OSL dates of ca. 125,000 and 80,000 BP for Patirajavela (15m

+msl) and Bundala (8m +ms1) respectively. It is possible to estimate the relative age of a wide array of occurrences of the I Fm via eustatic altimetry as modified by tectonic uplift; and it has been hypothesised that some of the deposits, possibly implementiferous, are assignable to > 400,000 BP.

As for the cave sediments, these have been reliably dated (^{14}C, charcoal) from ca. 38,000 BP onwards (Deraniyagala 1992:addendum I).

Geomorphic investigations pertaining to the basal gravels of the I Fm and RBE Fm have indicated that these deposits are coeval with certain altithermals which witnessed a climate of greater seasonal extremes of aridity and rainfall than is prevalent in the Dry Zone today. This evidence has been interpreted as being a function of increased atmospheric circulation during such altithermals (eg, at ca. 125,000, 80,000, 5,900 BP) which led to the katabatic *Foehn* winds of the Southwest Monsoon desiccating the Dry Zone to a more marked degree than they do today. It has thus been proposed that, since altithermals witnessed an increase in atmospheric circulation, glacial episodes would have experienced the converse, with the Dry versus Wet dichotomy of the island's main ecozones being less pronounced than during the present altithermal. This is borne out by the palynological evidence of a dry episode in the Horton Plains during the Würm upper pleniglacial at ca. 17,000 BP (Premathilaka 2003). It is clear that there would have been a gradation of environments, ranging from highly differentiated zonal configurations during certain altithermals to others with less differentiation (as at present) and on to pronounced glacial episodes in the higher latitudes which would probably have witnessed minimal zonal climatic and hence biotic differentiation in Sri Lanka.

The gradation of the island's zonal differentiation would have been reflected in the carrying capacities, relative to prehistoric human population, of the respective ecozones. It appears unlikely that the lowland and upland Wet Zone witnessed significant shifts in carrying capacity throughout the middle and late Quaternary (as per the malacological evidence from Batadomba-lena for the Würm upper pleniglacial which would have experienced a period of relative dryness). On the basis of ethnographic analogy, it is hypothesised that the population density through much of the late Quaternary in the Wet Zone, from at least as early as ca. 36,000 BP, was around 0.1 individuals per square kilometre. The Dry Zone, on the other hand, would have experienced much more pronounced oscillations in effective environment and it is hypothesised that the population densities varied between ca. 0.8 and < 0.25 individuals per square kilometre, with exceptionally high densities of up to ca. 1.5 in the coastal tracts.

The settlement data suggest that Sri Lank's prehistoric communities were based primarily on the nuclear family as the effective subsistence unit. Vadda and Semang ethnographies provide valuable insights as to how these would have functioned. Faunal evidence indicates the exploitation of a very wide spectrum, with no obvious shifts in strategy from ca. 36,000 BP onwards. It appears as if this has not been quite the case with food plants. The incidence of incipient herding (?*Bos indicus*) and farming (barley and oats) at ca. 17,000 BP, with their full-fledged occurrence at ca. 10,000-7,500 BP. on the Horton Plains (ibid.) does indicate a shift in strategy from the Würm upper pleniglacial onwards, although the data on settlement extents do not reflect a significant charge in carrying capacities.

The technology that was employed to apply the subsistence strategy indicated above, comprised the use of quartz, occasionally chert, tools. Most of these were made on flakes, bladelets being very rare. Typologically it is of considerable significance that geometric microliths have been found from securely dated contexts from ca. 36,000 BP onwards, a situation that is paralleled in Southern Africa and Zaire and perhaps also elsewhere in the lower latitudes of the Old World (v. Mellars 2006). A flake-tool industry, predominantly of small artefacts, is known to have been prevalent at ca. 125,000 BP (Patirajavela). There are indications that non-geometric microliths were being made at this early date, but it requires further sampling to corroborate this evidence. Bone tools, characteristically represented by small single and rhomboidal points, and shell beads have been found from ca. 36,000 BP onwards (Batadomba-lena). It is possible that pottery (Doravaklena, Beli-lena Kitulgala) and copper-working technology (Māntai) occur in the Upper Mesolithic. But this has yet to be established unequivocally.

There is scarcely anything of ritualistic import Sri Lanka's prehistoric record, and the cave drawings that are extant may be attributed to the Väddas of recent times (except perhaps in the case of two groups of rock engravings which could be Protohistoric Iron Age). Mortuary practices (ca. 38,000–5,500 BP) suggest secondary, fractional interment (very occasionally smeared with ochre, eg, Fa Hien-lena) as the basic mode, with more complete (?secondary) flexed (very rarely extended) burials occurring at times. There is some hint of anthropophagy as evidenced by fragments of cut human bones among food remains at Batadomba-lena, Beli-lena Kitulgala and Bellan-bäňdi Palässa (ca. 18,500-12,000 BP). The cave floors were common burial places, not restricted to members of one sex or to separate age groups (Kennedy 2000:184).

The earliest anatomically modern human to have been discovered in South Asia (ca. 38,000 BP) is from Sri Lanka (Fa Hien-lena)[42]. Genetically, the island's prehistoric populations display remarkable homogeneity from 18,500 BP (Batadomba-lena) to 16,500 BP (Kitulgala) to 12.000 BP (Bellan-bäňdi Palässa). These features have survived markedly in the recent Vädda relict group of the island. Eustatic altimetric estimates suggest a land connection between India and Sri Lanka from ca. 110,000 BP up to ca. 7,000 BP, and the genetic make-up of prehistoric Sri Lanka must necessarily be viewed in the context of demographic dynamics as they manifested themselves in Southern India. Hawkey (2002: 170-1) postulates, as per Southeast Asian ethnographic evidence, that

> migration would have been a continual process, involving small numbers of kin-based groups, moving short distances of probably less than 500 kilometres… Given this scenario, the primary cause of intra-population homogeneity within South Asian populations [as dentally established for Balangoda Man] may be due to a kin-based fission-[and subsequent] fusion pattern....People tend to migrate and separate from parental populations along family lineages.... If this pattern holds true for... prehistoric

> South Asians, the genetic patterns found among modern populations of India and Sri Lanka may be the result of fission of kinbased groups [eg, Mesolithic] and eventual fusion with other migrant family groups [eg, Indus/Chalcolithic, Indo-European, Dravidian].

In this regard the Indian Mesolithic populations appear to have been less isolated than Balangoda Man, but more so than the Neolithic humans of the northwest (ibid.:92).

A major intrusion to the gene pool of Sri Lanka occurred with the dawn of the Protohistoric Iron Age at ca. 1,000-900 BC or earlier, possibly as a result of southward pressure on the sub-continent from Indo-European speakers. It is proposed that this new influx into Sri Lanka had genetic affinities with the Indus and Chalcolithic populations of India, with the Megalithic peoples of Pomparippu being directly ancentral to the Sinhalese. Kennedy (2000:354) affirms that

> The Megalith builders of India and Sri Lanka…were never members of a simple homogenous biological group of humankind but instead were parts of genetically heterogenous enclaves exhibiting regional differences. ...
>
> Skeletons do not reveal the languages spoken by their living representatives; hence indentification of any archaeological population with Indo-European, Dravidian or Austro-Asiatic tongues is entirely speculative. Beyond the dates of Brahmi inscriptions, the ultimate origins of Dravidian languages remain unknown, although the survival of [Protohistoric] Iron Age culture into the Early Historic period allows a reasonable hypothesis that Dravidian dialects were already well established in peninsular India while the Megalith builders of peninsular India and Sri Lanka)... were never members Indo-European [eg, Sinhalese] and AustroAsiatic languages were known to other Megalith builders.

Kennedy (ibid.:356) continues that “social and biological relationships of Early Asiatic urban dwellers and rural Megalith building populations are unclear, and these may be the components of the same culture in some regions. It is probable that most Megalith-building communities survived in the shadow of early cities until around 100 AD when their burial complexes cease to be built save in tribal areas of relative isolation [eg, present-day eastern India]”.

From ca. 1,000 BC onwards, iron technology has enabled the intensive exploitation of the Dry Zone of Sri Lanka through water storage for permanent settlements supported by swidden and irrigated rice cultivation. Thereafter the island’s prehistory was to survive as a relict among the Vaddas representing “the historic endpoint of ancient generational successions sharing a distinctive phenotypic pattern” (ibid.:238).

Review

Stage IV of the present research design (v, Deraniyagala 1992:chap.2) for the elucidation of Sri Lanka’s prehistory has comprised the pulling together of diverse strands of information on

Quaternary chronology, environment and culture, to be synthetically interpreted against data on present environment and hunter-gatherer ethnography. This objective has been assayed and propositions, hypotheses and models formulated to be tested in future programmes. In concluding, it is opportune to review the impact of Stage IV as a prelude to the setting up of Stage V of the research design.

The theoretical framework for Stage IV has been explicitly stated (ibid.:chap.1.4). Cultural palaeo-ecology has been adopted as the paradigm providing the broadest framework on which archaeological data may be stretched, particularly with regard to hunter-gatherer societies. In review, there is no need to revise this theoretical stance with regard to Stage V.

The chronology of Sri Lanka's prehistoric period was very scanty and insecure at the commencement of Stage IV (ibid.:chap.1.2). That there was a technological Mesolithic was known, which, as per the European analogues, was assumed to be of Holocene age. A Palaeolithic period, while suspected, had not been identified. Stage IV has established the existence of a (Middle) Palaeolithic industry on the island at ca. 125,000 BP as demonstrated at Site 50a II of the I Fm and perhaps the basal levels of Fa Hien-lena, Batadomba-lena, Sites 49b III and 50a III of the I Fm, and Beli-lena Kitulgala have yielded evidence of the occurrence of a geometric microlithic (Mesolithic) techno-tradition in Sri Lanka from at least as early as ca. 36,000 BP, thereby initiating a drastically revised concept of the emergence of Mesolithic stone technology in South Asia as a whole, with theoretical implications for large extents of the Old World, from Africa to Europe and Asia to Australia.

Despite the very real progress that has been achieved with regard to Sri Lanka's prehistoric chronology in Stage IV, the degree of resolution that is extant is scarcely satisfactory. Many more dates are required from secure contexts. With regard to the Ratnapura Beds, their stratigraphy is so complex that its resolution can only be achieved with considerable effort and input of sophisticated techniques. Since the prehistoric cultural contents of these beds are isolated, and probably frequently in secondary contexts, intensive research on the Ratnapura Beds may not be considered a priority at the present juncture.

The postulated Middle and early Upper Pleistocene horizons in the coastal dunes of the I Fm can usefully be assayed by TL and OSL dating, as in the regions around Mānkulam and Iranamadu in the north. From ca. 40,000 BP onwards, there are probably several caves which would yield an adequate radiocarbon chronology, as initiated at Batadomba-lena and Fa Hien-lena, and this may be supplemented by a TL and OSL chronology for the I Fm deposits of this period as has already been effected at Sites 49 III and 50 III[43].

A considerable lacuna exists as regards the transition from pre- to protohistory in Sri Lanka. Evidence of a Neolithic subsistence strategy has been documented from the Horton Plains (17,000-7,500 BP) and perhaps Doravak-lena shelter, while Māntai might have a Chalcolithic deposit of ca. 1,800 BC. Pending further data, these horizons are currently being assigned to an 'Upper Mesolithic'. The Citadel in Anurādhapura constitutes the earliest

Protohistoric Iron Age horizon to have been dated in Sri Lanka at ca. 900 BC; but nothing is known with regard to the transitional episode between the Stone Age and Iron Age. It is difficult to suggest a strategy for breaking this impasse. None of the sites investigated so far display any potential of harbouring evidence of such a transitional episode. It would seem that surveys and probes require to be conducted in the northern, north-western and perhaps south-eastern Dry Zone, where, due to environmental factors, most of the traces of the Protohistoric Iron Age could be concentrated. Habitation sites will have to be identified and sampled with the hope of finding a chronological continuum with the preceding Stone Age. It is probable that some of the large caves occurring in the northern Dry Zone will yield the requisite data, but the present writer's experience of testing several large and habitable caves in the eastern sector – which consistently provided negative data – does not bode well for positive results in the northern sector, as already intimated by probes in Ochchappuva cave near Pomparippu in Vilpattu and Vavul-lena cave at Kok-ébé, both of which adjoin 'Megalithic' cemeteries.

The state of knowledge prior to the present research programme concerning Sri Lanka's Quaternary environments has been summarised (id. 1971). It was rudimentary at best. However, the geomorphological and sedimentological investigations in the I Fm, supplemented by those relating to the RBE Fm, have enabled the formulation of the model that at least some of the more intense altithermals witnessed an increase in atmospheric circulation accompanied by desiccation of the island's Dry Zone. The corollary to this postulate, as per the processes dominating Sri Lanka's climatic configuration today, is that the Wet Zone would have been conversely affected, with increased rainfall, during such altithermals. It is further postulated that cold (glacial) episodes witnessed a muting of the extremes of humid and arid in the Wet and Dry Zones respectively; for instance, the Horton Plains witnessed a dry episode during the Würm upper pleniglacial. This is a model which can have far-reaching consequences on the Quaternary climatology of the Monsoonal tropics. These interpretations, based as they are on substantive geomorphic and radiometric data from the I Fm, may not be dismissed lightly.

The climatological interpretations of the I Fm and RBE Fm, calibrated against a chronological framework (TL, OSL) from a hypothetical Middle Pleistocene period onwards, can add vastly to our meagre store of knowledge on this subject. It has been possible to secure a few significant results, which would serve to orientate future research strategy relating to palaeo-climatology as reflected in the I Fm and RBE Fm. An integrated assay comprisingTL and OSL dating, geomorphology, sedimentology and climatology is a necessary prerequisite for further progress and the results are likely to be of great significance.

While the interpretation of the sediments in the I Fm has been based primarily on sedimentology and geomorphology against a backdrop of present-day climatic processes, more substantive data on Quaternary environments have been forthcoming from the faunal and floristic evidence from the caves of Fa Hien-lena, Batadomba-lena and Beli-lena Kitulgala. These three sites span a time range of ca. 38,000-5,500 BP. This is indeed a major addition to our knowledge of the late Quaternary environment of Sri Lanka's Wet Zone and it is of direct applicability to the windward aspect of the tropical Monsoonal terrain in South and Southeast Asia. Sedimentological studies on cave deposits are likely to yield complementary data: there is, for instance, an anomalous homogeneous deposit constituting Batadomba-lena Stratum 4 (ca. 15,000-13,000 BP) which requires to be interpreted in terms of its depositional facies. It is probable that there are many more cave sites in the Wet Zone which could yield comparable and supplementary information on the late Quaternary.

Palynological work on the ombrogenic swamps in the highlands, calibrated against a radiocarbon chronology on peat, would serve to elucidate the environmental succession in ecozone D3, particularly as regards temperature and rainfall shifts. The investigations in the Horton Plains have already produced very important information (Premathilaka 2003). Two swamps were sampled and the palynological and sedimentological evidence when calibrated against a radiocarbon chronology (on peat) indicates a relatively arid episode in the Würm upper pleniglacial. The subsequent Holocene climatic shifts have also been delineated, although further investigations would be required to compare with other sequences worked out elsewhere, for instance in India, and to distinguish between anthropogenic and climate-induced features.

Although the Horton Plains should rightly be the focus of further research into this uncharted field, the swamps of ecozones D2, D1 and E could yield complementary data of considerable importance. Deposits situated at ecotones between the Wet and Dry Zones would be exceptionally sensitive to climatic fluctuations and it is suggested that the caves in the Knuckles Range at the boundary between lowlands and uplands (ca. 1,000m +msl) be systematically sampled in this regard.

The postglacial climatic fluctuations postulated for India (v. Deraniyagala 1992:chap.4.5.1, 4.6.4) may usefully be transposed to Sri Lanka – with a corresponding reduction in the amplitude of the fluctuations – to be tested in Stage V of the research design.

While the investigations of the Sarasins and P.E.P. Deraniyagala had provided clear pointers regarding Mesolithic subsistence practices in Sri Lanka (ibid.:chap.1.2), it has been the data from Fa Hien-lena, Batadomba-lena, Beli-lena Kitulgala and the Horton Plains, primarily, that set these practices against a firm chronological scale ranging from ca. 38,000 to 3,000 BP. As such, for the first time it has been possible to assess the presence or absence of evolutionary trends in subsistence practices in the Wet Zone during the late Quaternary (while being aware that evidence of plant-derived food is rarely preserved in prehistoric deposits, thus introducing a major bias). With regard to the I Fm, no data have been forthcoming concerning subsistence strategy; but ethnographic analogy has been employed in conjunction with our knowledge of present-day effective environments in Sri Lanka's various ecozones to hypothesise about prehistoric subsistence practices in the coastal Dry Zone.

The environmental fluctuations postulated for the island's middle and late Quaternary have been transposed in terms of carrying capacities for the respective ecozones. These fluctuations and ecozonal distinctions in carrying capacity have been further transposed into human population densities based on ethnographic analogy. While such a series of constructs is indeed somewhat speculative, it has been sequentially deduced from inferences based on empirical material and hence is methodologically viable.

The data on prehistoric settlement in Sri Lanka have been secured primarily from the spot surveys of Stage I of the research design and the surveys of the I Fm and RBE Fm in Stage II. The quality of the data retrieved leaves much to be desired, as the surveys were undertaken with the main goal of plotting the occurrences of sites for assessing their age and suitability for vertical sampling (ibid.:chap.2), as against a settlement survey with attention to such traits as site extents or location relative to exploitable resources. However, sufficient data have been forthcoming so as to provide a basis for hypothesising concerning the modal extents of these settlements, and thence the number of individuals and nuclear families in a resident group as exemplified in ethnographic analogues. In this regard, the vertical probes in the caves have not produced any significant body of information, although open-plan excavations in selected caves could conceivably yield relevant data. Ethnographic analogy has been employed to postulate the nature of intra-settlement organisation and the discrete features within settlements. To test these propositions, open-plan excavations could be conducted in the open-air sites of the I Fm and RBE Fm. Attempts at regional surveys are invariably vitiated by the sampling bias introduced by non-discovery of sites due to colluvial blankets overlain in turn by Sri Lanka's dense vegetation, notable exceptions being the dry dolines of the I Fm (which could have bias inherent in several habitation episodes occurring in palimpsest) and, of course, the cave habitations.

Eustatic altimetry has, for the first time, been employed to work out a chronology for land connections between India and Sri Lanka during the late Quaternary. While not gainsaying that sea travel could well have been within the technological means of South Asian hunter-gatherers from ca. 50,000 BP onwards, the postulated land links provide instances when there undoubtedly would have been traffic between the sub-continent and Sri Lanka. As for the settling of Malays on the island *en route* to Madagascar and eastern Africa in the first millennium BC (v. Deraniyagala 1957), surveys conducted to test this hypothesis by Solheim and the present writer (1972) failed to yield positive results. Further enquiry, with probes into the Malay settlement localities attributable to the historical period (as along the south coast) could be more productive.

The existence of a Palaeolithic technological phase has for the first time been established for Sri Lanka: Sites 50a II and 49b II at 125,000 and 80,000 BP, and probably Fa Hien-lena at 38,000 BP. The artefacts, while not assignable to any formal types with specialised stylistic traits, may be referred to as Middle Palaeolithic with a predominance of small tools. It is evident that a much larger sample of artefacts is required before it is possible to define this industry adequately. The occurrence of form-trimmed, step-flaked implements as surface finds in the dry dolines of the I Fm is suggestive of a Middle Palaeolithic complex akin to that of

India, with certain high-level terraces possibly containing Lower Palaeolithic assemblages from possibly as early as 400,000 BP. It is necessary to sample the artefacts from securely dated contexts before assaying their taxonomy.

The problem of the absence of the Acheulean techno-complex in Sri Lanka persists. While the present writer has hypothetically explained this phenomenon on the basis of the distribution of raw materials for biface manufacture and the nature of the exploitable fauna, these hypotheses require testing in the light of the pattern of distribution of the Acheulean assemblages in South India. Any conclusions that might arise thereby could be considered applicable to Sri Lanka as well. Similarly, the apparent lack of a Neolithic technological tradition in Sri Lanka, as represented by polished stone celts and pottery[44], requires to be viewed as an extension of the Indian pattern in the extreme south and should hence be studied within the framework of the broader Indian context.

The revelation that geometric microliths are at least as early as 36,000 BP in Sri Lanka is likely to have a major impact on how one approaches the question of the origins of geometric microlithic (ie, Mesolithic) technology in a world-wide context. In the case of Europe, it may no longer be considered in isolation from the African and Sri Lankan data – unless, of course, rigid anti-diffusionist posture is struck. With regard to the spread of geometric microlithic technology in Asia, Africa, Europe and Australia, the present writer's stance is explicitly diffusionist, as the stylistic element in the selection for geometric forms could be considered stronger than the functional one. Stimulus-diffusion may be favoured as the predominant mechanism of dispersal, although no doubt direct diffusion could certainly have occurred in restricted spatial contexts as within India itself or western Europe. Considering the spatial lacuna existing between the early dates for the Mesolithic in Africa and Sri Lanka, it is desirable that the density of information in West Asia and India be increased to a comparable degree.

The system of lithic classification that has been formulated (Deraniyagala 1992:chap.5.2.2) has been based on a divisive process of isolating key attribute-states, succeeded by an agglomerative strategy of creating types and classes, followed by a further divisive process of formulating sub-types and variants. This system has met all the requirements of lithic analyses in Stages I-IV of the present research design. In review, apart from a few minor modifications, there is no necessity to revise the systematics of this scheme for Stage V. There is a great deal of flexibility and expandability inherent in the system, and it has been structured in such manner as to make data storage conducive to rapid execution. Further, more detailed analyses may be undertaken (eg, modal analysis) on the basis of the data that have already been stored. It is projected that tool-specific analyses of certain specialised types such as Balangoda Points may usefully be undertaken to advance techno-chronological resolution; and the new evidence of cereal harvesting from the Horton Plains necessitates a focus on the possible occurrence of silica gloss on stone tools.

Among the various taxa considered in the stone artefact classification, form-trimmed types have emerged as possessing the most analytical utility. However, the exceedingly low proportion of such types in any given assemblage (ca. 0.2%) necessitates the sampling of very large numbers of artefacts before a typologically representative sample of tools can be considered to have been retrieved. It is estimated that over two million more artefacts require to be sorted through before this can be effected and these should necessarily be from secure contexts.

The prehistoric bone, antler and shell industry of Sri Lanka has not been adequately classified, due to the meagreness of the extant sample. However, classes, types, sub-types and variants are being formulated for the material from Batadomba-lena and Beli-lena Kitulgala, following the same basic taxonomic procedure as for the lithics (Wijayapala 1997). The discovery of bone and antler tools from as early as ca. 36,000 BP at Batadomba -lena has broken new ground as regards the antiquity of such tools in South Asia. India has yet to produce comparable material.

The classification of Sri Lanka's Protohistoric Iron Age and Early Historic ceramics has been conducted in some detail for the Citadel at Anurādhapura (Deraniyagala 1972). The systematics have subsequently been revised (id. 1984) so as to employ the concept of ware analysis followed by form analysis[45]. It can now be affirmed that the taxonomic groundwork has now been completed for the servicing of the ceramic classification of material being excavated from the Protohistoric Iron Age and Early Historic levels of the Citadel of Anurādhapura . It is proposed that the analysis of the beads and utilitarian glass objects be effected on a similar basis.

Ethnographic analogues with potential application for the interpretation of Sri Lanka's prehistoric data have been culled from a few selected sources in the South and Southeast Asian literature (id. 1992:chap.6). These hunter-gatherer groups, namely the Väddas, Kadar, Chenchu, Andamanese and Semang have indeed provided valuable insights into hypothetical prehistoric behaviour, with particular reference to subsistence and settlement strategies, population density and, in the case of the Andamanese, mortuary practices. However, none of these groups are recorded as having an exploitative technology based on stone tools; their's instead have been 'bamboo' or 'shell' technologies, or else, as in the case of the Väddas, acculturation has led to the adoption of iron tools. Hence their relevance for interpreting the prehistoric lithic record is very limited. On the other hand, they do highlight the significance of readily perishable artefactual materials such as bamboo in prehistoric technology, as for instance on the Horton Plains, which would rarely have left a trace of their erstwhile existence in a given cultural assemblage, thus creating a major bias in the retrievable technological sample.

The five hunter-gatherer groups (Vaddas et al.) that been have focused upon have been the basic source of ethnographic analogues in relation to Sri Lanka's prehistory – due primarily to their having interacted with effective environments akin to those postulated for the

Quaternary on the island with a subsistence strategy approximating to (if not entirely based on) hunting and gathering.

Prehistoric research requires a multi-disciplinary approach, the major components being archaeological, environmental, linguistic (whenever feasible) and biological anthropological. The last is assuming increasing significance. In addition to the traditional morphometric analysis of the total human skeleton, recent research has been able to isolate certain elements that are "genetically inherited, exhibit little environmental influence, are evolutionarily conservative and lack sexual dimorphism" (Hawkey 1998:iii). Dental morphological traits are considered to be a preferred source of evidence, due to their strong genetic component, for population affinity assessment. Other techniques that can usefully be applied comprise Gm and HLA blood systems, mt DNA and Y-chromosome DNA (id. 2002:196)[46].

Hawkey's (1998) investigation into the dental traits of prehistoric, protohistoric, Early Historic and present-day populations of South Asia with a focus on Sri Lanka and with comparisons being made with samples from outside the Indian sub-continent, constitutes a landmark in the physical anthropology of this region. New hypotheses have been presented: such as, the "Out of Asia" concept for anatomically modern humans; the occurrence of dental traits of the Indus population in the Sinhalese and Austro-Asiatics of eastern India; and the evidence that dental similarities between the Indus populations and Egyptians at 1,990 BC - 200 AD and Nubia at 1,575-1,380 BC indicate gene flow from the sub-continent into northeastern Africa (ibid.:155,194-5)[47]. However, as with most pioneering projects, the sample size needs to be expanded so as to stand the test of rigorous scientific appraisal.

Research Stage V: Formulation

The above review of Stages I-III, and particularly of IV, of the present research design (Deraniyagala 1992:chap.2) has provided orientation for the formulation of Stage V. The highest priority is accordable to improving the prehistoric chronological framework of Sri Lanka. For the Palaeolithic industries, it should be possible to secure further resolution by TL and OSL dating of the implementiferous raised beaches in the I Fm. Some of the deeper cave deposits could yield datable Palaeolithic assemblages, which indeed has been the case with Fa Hien-lena. As for the Mesolithic, several caves have been located which could provide an increase in the density of radiocarbon dates. Fa Hien-lena, Beli-lena and Batadomba-lena have been excavated, and the preliminary results have been used in the present work due to their great significance. It is possible that some of the habitation sites in the RBE Fm, will yield datable charcoal, which would enhance the prehistoric chronology of the island (ibid.:addendum I)

With regard to technology, its evolutionary aspects may be assessed on the basis of typological analyses on the artefact samples secured in the course of the chronological investigations. At present, functional analyses, whether on the artefacts themselves or in terms of spatial configurations, are somewhat premature, apart from the investigation of silica gloss which would shed light on cereal harvesting in the Upper Mesolithic.

Quaternary environmental studies may be furthered by sedimentological and geomorphological analyses on the I Fm . These could complement the chronological and technological investigations to be conducted on these deposits; but palaeoenvironmental surveys would necessarily have to be more extensive than those geared primarily to prehistoric culture. Animal and plant remains secured from cave deposits during the chronological investigations may be used for evaluating configurations of environment and of subsistence practices during (at least) the last 38,000 years. Studies of micro-snails and phytoliths can be of considerable importance as they would reflect prevalent environmental conditions with sensitivity. The totality of the environmental data to be retrieved may be viewed against the hypotheses that have been formulated for the fluctuations in environment in Sri Lanka from the early Middle Pleistocene onwards, supplemented by what has been postulated for India, in the context of rapid advances in global Quaternary climatology. Palynological studies in the swamps of the Horton Plains have already revolutionised concepts of the domestication of plants and animals, not just in Sri Lanka and South Asia but in a worldwide context.

As mentioned earlier, settlement surveys are beset with the problem of the lack of visibility of prehistoric sites, due to colluvial blankets and the dense vegetation. However, settlement size assessments may be attempted in the dry dolines (*vembus*) of the I Fm, and on the eroded hill-tops of Uva in ecozone E. These could add information to the very sketchy outline that has been presented of prehistoric settlement configurations in Sri Lanka (ibid.:chap.5.3); but sample bias and the chronological imprecision of the artefact exposures defining the settlements will adversely affect the degree of confidence that one may reasonably place on the results of such investigations.

Finally, although the subject of Sri Lanka's resource potential (with reference to hunter-gatherer subsistence) and present-day environment has been treated in some detail (ibid.:app.I,IV), there is an extensive body of literature which may usefully be tapped for amplifying on the outline that has been presented. The same applies to the question of ethnographic data: much await culling from South and Southeast Asian sources in the literature.

Stage V of the research design has already been embarked upon. The excavations in the caves of Fa Hien-lena, Beli-lena Kitulgala and Batadomba-lena have been initiated under this stage, and they have served to yield data of the utmost significance for Sri Lanka's prehistoric studies. The work of Premathilaka on the Neolithic/Upper Mesolithic subsistence practices and of Hawkey on the biological anthropology of Sri Lanka constitute path-breaking programmes from which much can be expected in the future. Meanwhile, further investigations should be launched with regard to the I Fm, as per the strategy outlined above. The prime requirement at the present juncture is expertise to implement these programmes. It is projected that within less than two decades from now there would be an adequate body of new data so as to justify the assaying of yet another synthesis such as the present work – which would constitute a prelude to the formulation of a further mega-stage of prehistoric research in Sri Lanka.

NOTES

1. Remains of *R. sinhaleyus*, akin to *R. sondaicus* of Java, have been discovered in channel deposits of an alluvium near Lunugala in ecozone E (Manamendra-Arachchi et al. 2005:431-2). These sediments have been thermoluminescence (TL) dated to 80,000±20,000 BP, placing them in the Upper Pleistocene (M.Abeyratine 1999:pers. comm.).

2. These identifications have been questioned by Kennedy (2000:187) who considers them to be non-hominoid.

3. The nomenclature of Günz-Cromerian-Mindel-Holstein-Riss-Eem-Würm had previously been explicitly employed by the present writer (1988; 1992) for clarity of expression, as have Butzer and Cooke for instance (v. Butzer 1971:43-4; Cooke 1972:7). The postulated interglacial high sea levels of Tyrrhenian (Holstein), Main Monasterian (main Eem) and late Monasterian (final Eem) (Deraniyagala 1992: 686), were similarly designated, and Zeuner's (1959:205,207) model of eustatism (*vis à vis* eustasy), was adopted as a heuristic device.

   Recent research indicates that apart from a 5-10m high sea level for the Eem interglacial there is no evidence of higher global sea levels having prevailed during earlier altithermals in the Pleistocene (Shackleton 1987; IGBP2001). It is however, valid to assume that the various raised beaches of the Iranamadu Formation do represent a sequence of past altithermal episodes, some of which could precede the Eem interglacial by several hundred-thousand years, with tectonics as the main factor to be considered in assessing their relative and absolute chronology (v. Gunatilaka 2000:31). Investigations by the Lamont-Doherty Observatory indicate the splitting of the Indo-Australian plate at about 300km south of Sri Lanka (C.B. Dissanayake 2004:comm.) and the LaccadiveChagos line, ca. 300km to the west, has also been found to be splitting (C.Synolakis 2004: comm., v. Deraniyagala 1992:103,606,608).

4. Calibrated dates are as per the most recent ones given by Perera (2007). (v. Deraniyagala 1992:addendum I; 2000 for radiocarbon dates.)

5. While Mesolithic sites have been documented on the Horton Plains, in the highland Wet Zone, these have not been dated. However, two series of cores taken from the ombrogenic swamps of these plains have provided several radiocarbon dates on peat from ca. 21,500 cal BP testifying to human activity from ca. 17,000 to 3,000 cal BP and to herding and cultivation of barley and oats by ca. 10,000 cal BP (Premathilaka 2003). This would assign post-10,000 BP geometric microlithic sites of the Horton Plains a Neolithic status, namely Neolithic subsistence strategy with a Mesolithic stone tool technology.

Given the evidence on the Horton Plains from ca. 10,000 BP onwards, it would be valid to assume that many of the so-called Mesolithic sites in Sri Lanka that post-date ca. 10,000 BP could in fact be referred to as 'Neolithic'. However, until this status can be established for specific sites, the term 'Mesolithic' must perforce be applied.

Doravak-lena shelter in the Kegalle District of the lowland Wet Zone has, according to the excavator (Wijayapala 1997: in Deraniyagala 2000*a*:34), produced evidence of a geometric microlithic industry in association with crude red ware at ca 7,300 BP. By 5,100 BP, Black and Red Ware is said to occur in this sequence. Seeds of what could be a domesticated cereal (possibly finger-millet) are stated to occur in association with both the above-mentioned horizons. If the occurrence of pottery and/or domesticated plants can indeed be securely established for this site, it could be referred to as Neolithic. The Black and Red Ware horizon could turn out to be Chalcolithic, considering that this ceramic technology has been reported from Dolavira (Indus Civilisation; A.S. Bisht 1994: pers. comm.), Rajasthan (Ahar Culture sites; V.Shinde 2002: pers. comm.) and Khairadih, Uttar Pradesh, in India (Bellwood et al. 1992 cited in Kennedy 2000:248) at ca. 5,000-4,500 BP.

It is premature to decide whether the Neolithic as evinced on the Horton Plains and perhaps Doravak-lena and the possible Chalcolithic at Māntai should be assigned a prehistoric or protohistoric status. The latter subsumes a settled mode of living, which is not evident yet at these sites. Hence, pending the accumulation of further data, they will be referred to as prehistoric.

6. Radiocarbon dates have been secured for three shell middens along the southern coast (Katupotha 1988; 1988*a*; Deraniyagala 1992:702): *Kalannetiya Lagoon*, Hungama, 6,660 cal BP (HR-124): *Uda Malala*, Hambantota, 4,460-5,330 cal BP (HR122.268); *Karagan Lewaya*, 3,140-3,375 cal BP (HR-123). No artefacts have been reported in association with these sites.

7. Comparison with Fairbridge's (1976:fig.4, 536-40, table 1) interpretations of Holocene climatic fluctuations for Rajasthan, Monsoon Africa and the tropics in general produces a relatively poor fit, except for the Würm upper pleniglacial arid interpluvial which is universal in the tropics. This may be due to Fairbridge's interpretations being no longer fully valid or that this lack of fit is due to the anthropogenic factor influencing the pollen spectra on the Horton Plains. Comparisons with recent data on deep-sea core and ice-core-derived climatic inferences should test the first proposition.

8. Wet Zone (ecozones D1,C)-habitat *Acavus* arboreal snails and *Canarium zeylanicum* nuts occur in Aligala shelter at Sigiriya (ecozone B) in context 24 at 5,500-4,000 cal BP (Adikari 1998:49-51).

9. The Southeast Asian evidence however denotes a depression by ca. 1,000m, which has been interpreted as due to an increase in the lapse-rate during glacial episodes, caused by amplification with altitude of any changes in surface temperature of sea water (Verstappen 1975:9).

10. The discovery of Neolithic subsistence traits comprising (a) herding and incipient cultivation of barley and oats from as early as 17,000 cal BP and (b) herding and the cultivation of domesticated barley and oats by ca. 10,000 cal BP (Premathilaka 2003) adds a new dimension

to the assessment of' 'Mesolithic' subsistence and settlement patterns in the final Pleistocene and Holocene of Sri Lanka. The extents of the sites encountered so far, notably on the Horton Plains, do not indicate population densities that were different from those of the pre-herding/ farming hunter-gatherers. Hence, the Neolithic as manifested in the Horton Plains is subsumed in the present discussion.

11. While Sri Lanka's *Axis axis ceylonensis* is essentially a dry lowland form, it is probable that at times the animal present in the Ratnapura Beds is at times *A. porcinus* misidentified.

12. Note that grass cover is very resistant to erosion and hence a savanna biome is unlikely as an alternative to this hypothesis.

13. The Mesolithic sites in southern Rajasthan are said to range between 25 and 100m^2 (Deraniyagala 1992:chap.5.3.14), which – perhaps coincidentally, as the ecozones do not correlate – agree with the extents of most of the Sri Lankan sites.

14. Vädda ethnographies mention 2-3 families as forming resident local groups at times, presumably in seasons of plenty. Such a group could have a floor area requirement of ca. 150m^2. But it should be borne in mind that their basic economic unit was the nuclear family.

15. For definitions of site-, annual and extended territories v. Deraniyagala (1992:277,371).

16. For instance, the sites on *venbus* and grassy hill-tops of the I Fm and ecozone E respectively have far more visibility than those blanketed by colluvia in the Wet Zone; and sites dominated by quartz artefacts will stand out markedly, in contrast to those which once held bamboo artefacts which have since been weathered out (eg, in ecozone D3). On the present evidence, it is scarcely possible to make any comparisons between the various ecozones as regards prehistoric settlements, due to insufficient data. The only obvious feature is that the caves in the lowland Dry Zone bear only vestiges of prehistoric occupation (Deraniyagala 1992:chap.5.3.3-5), whereas those in the Wet Zone are very rich in this respect.

17. It is this annual territory that would appear to expand and contract with shifts in carrying capacity initiated by environmental change.

18. Note the Malapantaram, who were almost continuously on the move with hardly any base-camps and the fragmenting of even the nuclear family during lean seasons.

19. Remains of several humans have been found in this midden. The teeth appear to be smaller than in typical Balangoda Man. Systematic excavation, so far foiled by the frequently high water table, could prove this site to be Neolithic.

20. The Upper Acheulean hearths at Kalambo Falls had similar dimensions (Clark et al. 1969).

21. For over-exploitation due to a lack of integrated subsistence strategy among hunter bands (v. Henderson 1973:152).

22. At the University of Stockholm with its specialist input.

23. The bovine remains found in the Ratnapura Beds and in the prehistoric deposits at Kitulgala and Batadomba-lena have been assigned to a form smaller than either water bufalo or gaur (P.B.Karunaratne 1983:pers. comm.). It could be a form ancestral to modern *Bos indicus*, which was found in a relict form (referred to as Sinhala cattle) in remote Sinhalese settlements in the Sinharaja rain-forest until the nineteen forties (v. Deraniyagala 1992:359).The grazing evinced on the Horton Plains from ca. 17,000 to 3,000 BP might be attributed to this animal, which was probably progressively domesticated from > 17,000 BP onwards; or was it the gaur?

24. These settlement areas have been assessed by the scatter of stone artefacts. A variety of small bamboo is abundant on the Horton Plains and artefacts which might have been made of this material have not left a trace at the sites, thereby somewhat distorting the interpretation of artefact scatter.

25. The sago from a single log of *C. urens* could maintain a Reddi family for a week or more.

26. The occurrence of *Acavus* in the Mesolithic deposits at Aligala shelter, Sigiriya, could however signify an extension of the present ecozone C into this region in the past, perhaps during an interpluvial episode. This appears to be corroborated by the presence of *Canarium zeylanicum* nutshells in these contexts (Adikari 1998).

27. Much of the Pacific Ocean had been traversed at >3.500 BP.

28. As for the chronological upper boundary of the 'Mesolithic' geometric microlithic industry in Sri Lanka, it occurs in a lag deposit on Church Hill at Bandārawela and has been radiocarbon dated to 6,000-3,000 cal BP. The latter is the most recent date there is for the geometric microlithic industry in Sri Lanka, although its depositional facies is not ideal for dating the site. The next most recent date is from the 'Mesolithic' (perhaps Chalcolithic) at Māntai which occurs directly above a horizon dated to ca. 3,800 BP.

29. Examination of stone tools for silica gloss indicative of cereal harvesting has now become a mandatory analytical procedure, as a result of the discovery of cereal harvesting on the Horton Plains at ≤17,000 BP.

30. Nut-stones have been found in association with *C. zeylanicum* nut remains at Aligala shelter in Sigiriya (Adikari 1998) and Bellan-bäňdi Palässa, both in ecozone B. These nuts could have been harvested in ecozone C, which is not a great distance away, and brought to the base-camps; or else the trees grew in the vicinity, indicating a more humid climate than at present.

31. An excellent specimen on chert has been discovered in the Samanala-wewa explorations around Kinchigune (ecozone C. G. Juleff 1990: pers. comm.).

32. Despite the evidence for barley and oats cultivation on the Horton Plains at 10,000- 7,500 BP, it is noteworthy that stone celts have not been found.

33. Apparently the rate of discarding of such untrimmed tools in a single operation, such as the shaving of heads, was so high among the Andamanese that macroscopic use marks would almost certainly not occur on their quartz tools.

34. The anterior teeth are large as well. They probably served to hold, tear and abrade tough materials while the large molars would have met severe masticatory stress (Kennedy 2000:186-7), as corroborated by the powerful jaw musculature and nuchal crests.

35. The presence of a prominent supinator crest in a right ulna from Batadomba-lena suggests a strong throwing action as of stones or spears (Kennedy 2000:186).

36. In this regard the reader is referred to the archaic cranium BP3/15a from Bellan-bäňdi Palässa and the mandible BDL-16-H-30-6 from Batadomba-lena (Deraniyagala 1963: pl.6; Kennedy 2000:185).

37. The slag at Māntai, however, could have intruded into the sample from this otherwise carefully excavated context, perhaps through incorrect labelling. No pottery was found in association. Further sampling is required to clarity these points. It is now known that the only major source of copper ore south of Madhya Pradesh in central India is located at Seruvila (the ancient Tambapitta) in eastern Sri Lanka (Seneviratne 1984; 1994). It is likely that this was known to the Chalcolithic peoples of India and that Sri Lanka exploited this resource. Māntai could well have been a port for shipping copper to India.

    Despite the occurrence of copper ores in Sri Lanka, it appears as if copper-alloy technology as found in the Chalcolithic of peninsular India (ca. 1,800-1,200 BC) was not adopted significantly in Sri Lanka due to the relative inefficiency of this technology as applied to the island's agricultural milieu.

38. These radiocarbon dates are assumed to be uncalibrated.

39. BRW was being manufactured by the Cherokian and Pawnee Indians of America in the 19th and 20th centuries, who employed this firing technique to reduce the permeability of the fabric (Binford 1972:53-4), which certainly represents a case of convergent evolution, *vis à vis* India.

40. Dentally, populations of the Indus Civilisation show genetic homogeneity (Hawkey 2002: 155).

41. Similar bone 'styli' have been found in the Painted Grey Ware levels of Hastinapura and the pre-NBPW levels of Ujjain and Nagda (Banerjee 1965:204-8), thus indirectly corroborating the dating of the writing in Anuradhapura.

42. The earliest AMHS for Asia is said to be from Niah Cave in Borneo at ca. 43,000 BP (G. Barker 2002:pers. comm.).

43. Chronological markers of volcanic ash could also occur, as in India. For instance, the largest volcanic eruption since 450 million years ago is thought to have occurred on Mt Toba in Sumatra at ca. 70,000-60.000 BP (Hawkey 2002:190). Sediments from this incident could well serve as a marker horizon in Sri Lanka.

44. With the possible exception of the occurrences at Doravak-lena and in the disturbed upper contexts of Batadomba-lena and Beli-lena Kitulgala.

45. For its application v. Juleff (1998).

46. The first attempt at mt DNA analysis of prehistoric skeletal material from Beli-lena Kitulgala and Batadomba-lena was conducted at the Department of Genetics, Cornell University (Reed et al. 2003). The initial results have been disappointing. Reed (2001:pers. comm.) affirms that "we had hoped that the ... dry cave preservation of the Sri Lankan human remains might allow many of the obstacles of ancient human DNA preservation in warm wet climates to be overcome (Kumar et al. 2000: Discouraging prospects for ancient DNA from India; in *American Journal of Physical Anthropology* 113:129-33). But apparently there is little or no chance of obtaining authentic DNA and any results would be highly suspect of modern contamination".

47. There are said to be resemblances between Protohistoric Iron Age populations of peninsular India/Sri Lanka, Egypt and Nubia, probably reflecting early episodes of gene transfer (Hawkey 2002:172).

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