The Patu industry in its environment in the Siwaliks in Eastern Nepal

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1. Introduction

The stone age site of Patu was discovered in 1985 during a geological survey of the Siwaliks in the Rato Khola area in Eastern Nepal.

A number of river terraces had developed here along the Rato and Bawshi Khola* and on examining and measuring them a number of sites, all connected with the upper terraces of the rivers, were discovered.

One site in particular was rich and seemed to be a factory site, which was called Patu 2 and 2a, and here a comprehensive study was undertaken in the first two seasons of 1986 and 1987 (Corvinus 1987). The third season was devoted to surveying the entire environment and to studying the distribution and the pattern of distribution of the industry and the variety of the tool kit in the environment. Because it was found that around the centre of activity, which was the already described site of Patu 2 and 2a, the whole area seemed to belong to the activity circulation of the people who manufactured the artefacts of Patu 2 and 2a.

A second aim was to continue to search for possibilities of dating the industry and understanding the environment 1) by studying the river terraces, their deposits and their red surfaces; 2) by sampling the site for TL (thermoluminescence) dating of the sediments.

No fauna was found at the sites, and the collected charcoal poses a problem, as no hearths or fireplaces are encountered, and the charcoal could belong to any of the yearly forest fires and may have been buried by burrowing animals or termite activities.

For obtaining the TL samples a few new small trenches were put down into the red silt at Patu 2 and 2a. But otherwise this main site was left untouched after the initial survey in 86 and 87.

3 TL-samples each were taken from just above and just below the artefact horizon and from within the artefact horizon. The samples have been given to Dr. Singhvi at the Physical Research Laboratory at Ahmedabad, India.

2. The main site of Patu (Pa. 2 and 2a)

The main site of Pa. 2 and 2a (Patu 2 and 2a, named after the near village of Patu) has already been described in QUARTÄR 37/38, 1987 and only the relevant points will be repeated here.

It is a factory site and seems to have been the center of activity and manufacture and the central focus of all other activities around.

* Khola = stream, river

The site is situated in the forest, on the level of a 70 to 75 m terrace above the Rato Khola. The height of the terrace is difficult to measure without a theodolite as it is rather removed from the river. The once thick forest is cut down recently by the villagers and the bare red silt is exposed and gets eroded away slope downwards.

On the uneroded, plain forest level no artefacts were found at all. But on the slope where recent erosion rapidly cuts away the red silt, the surface is simply covered by thousands of artefacts (tools, debris, flakes and chips, split and broken cobbles and whole cobbles). All are artefacts and manuports, lying on the bare red eroded silt as a residue.

Small scale trench cutting has shown, that the artefacts have been eroded out from a definite artefact horizon within the red clayey silt, and that the horizon is not an actual occupation floor. Artefacts are scattered in a horizon within the red silt from about 0.30 to 0.70 m below the flat level of the forest floor.

All the trenches opened to solve the question of stratigraphic position show the same picture. The profiles of the red silt in the trenches do not show any stratification, nor any floor-demarcation; there are no postholes, no hearths, etc. The only decoloration is from root marks and burrowing holes of small animals.

It is, however, without any doubt that the entire artefact scatter outside on the slope is a residual cluster from within the red silt after erosion.

The site consists of two parts, Pa. 2 and Pa. 2a. They must have originally constituted one uninterrupted site. A gully of 10 m depth with its starting point (as a nickpoint) between Pa. 2 and Pa. 2a seperates the two parts now, which was certainly not present at the time of occupation.

To the east the site discontinues and disappears under the forest cover. To the north it slopes down in a long, bare red slope of 40 m descent towards the here forested 30 m red terrace of the Bawshi Khola. The Patu 2 site is actually the water divide between the two streams, but as a terrace it belongs to the Rato Khola terrace system (Fig. 27 b). To the west and south the site is bordered by deep erosional gullies which expose the fluvial cobble gravel underneath the red silt.

It is from these cobble gravels that Patu man brought up his raw material for the manufacture of his tool kit.

The site extended originally probably further west, but it is now heavily eroded away and many artefacts are found in the cobble covered western gullies and the red slopes in the north. For the description of the artefact types and their technique of manufacture the reader is referred to the article in QUARTÄR 37/38, 1987.

Last season a few new trenches were opened, mainly to obtain samples for thermoluminescence dating and to search further for an explanation of the age and the origin of the site and the cause of its emplacement in the silt.

Trench VII (Fig. 1) at Pa. 2a (4 m^2 in E-W direction) was opened on the sterile forest floor, 10 m SSE of Tr. V around grid point F 7. The two eastern squares had no surface artefacts, being entirely on the forest floor; the two western squares extend already into the area where erosion has started (compare Fig. 12 and Fig. 7.2, Corvinus 1987) and a few artefacts (4 in each square) are already exposed on the surface. The rest of the artefacts (72) came from a level between 0.25 to 0.55 m below 1-point near the forest level.

Again the artefacts do not derive from a defined floor, but from an enriched horizon of 30 cm:
31 % come from 0.25 to 0.30 m below 1-point
35 % come from 0.30 to 0.39 m
28 % come from 0.40 to 0.49 m
5 % come from 0.50 to 0.59 m.

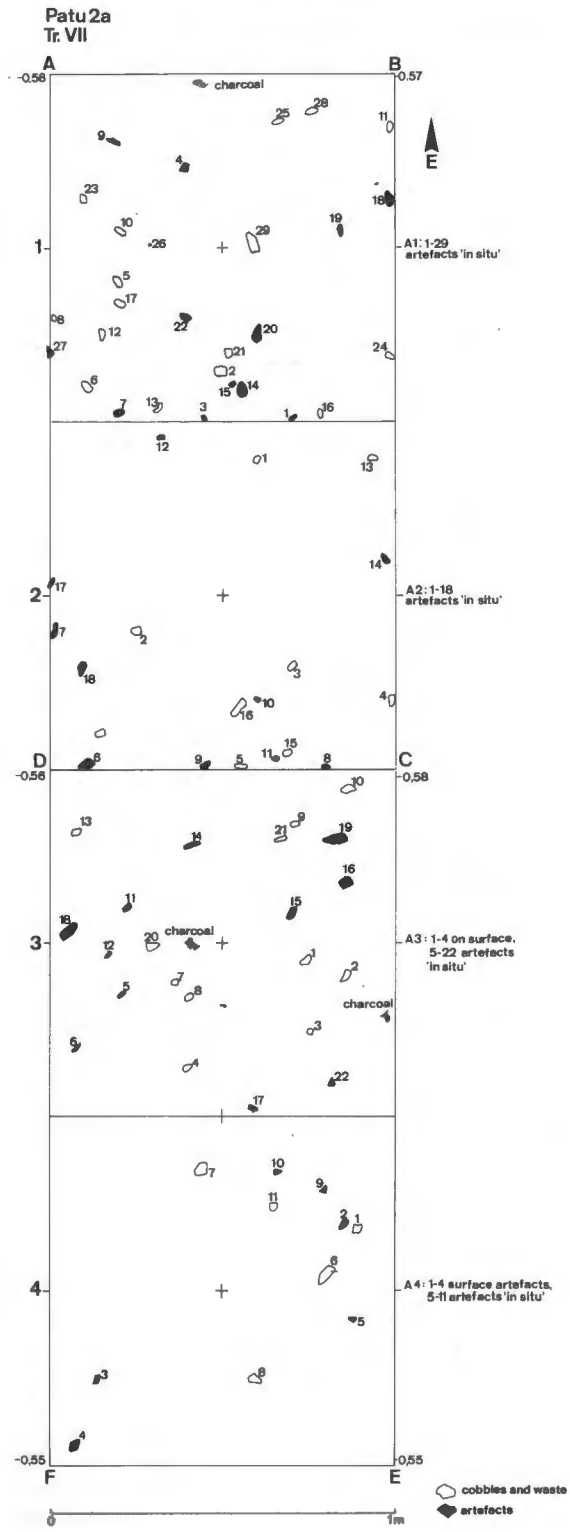

Fig. 1. Plotting of finds of Tr. VII at Patu 2a.

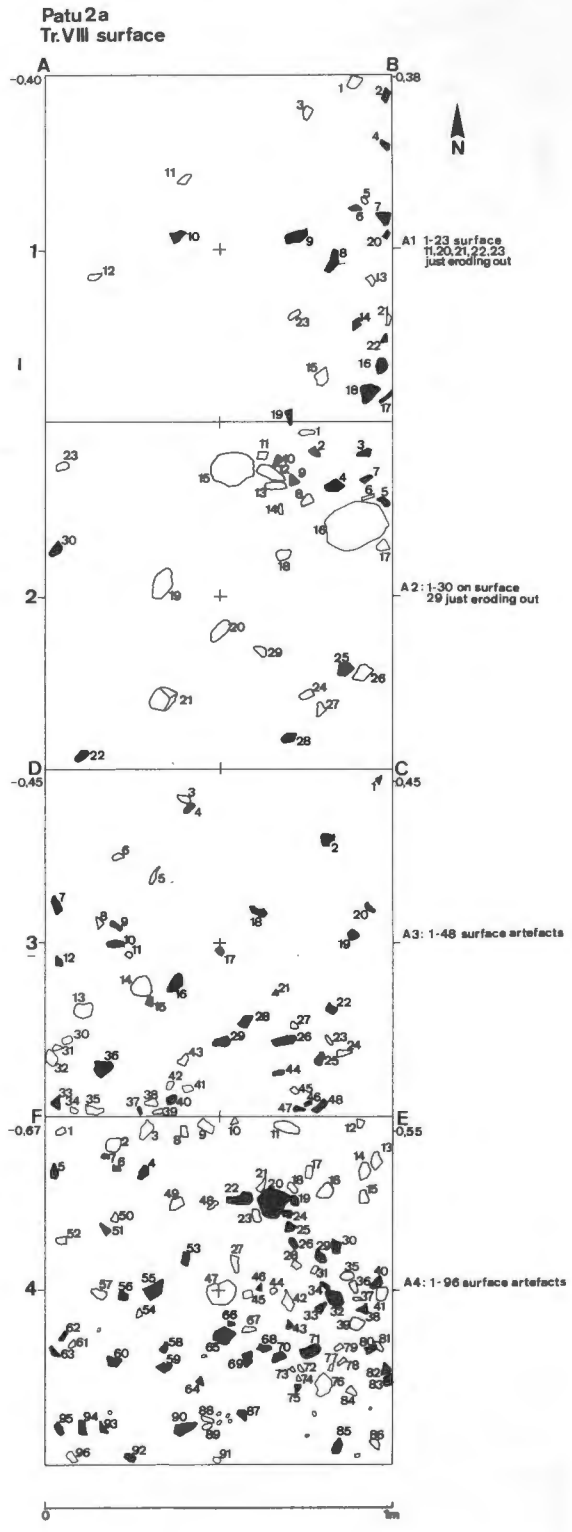

Fig. 2. Plotting of surface finds of Tr. VIII at Patu 2.

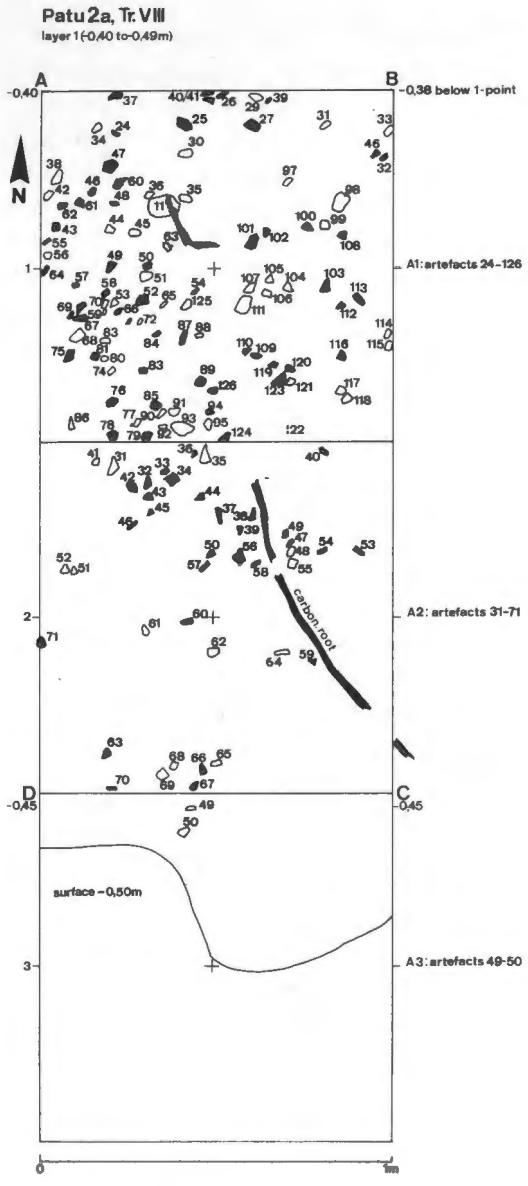

Fig. 3a. Plotting of finds of Tr. VIII, layer 1, at Patu 2a.

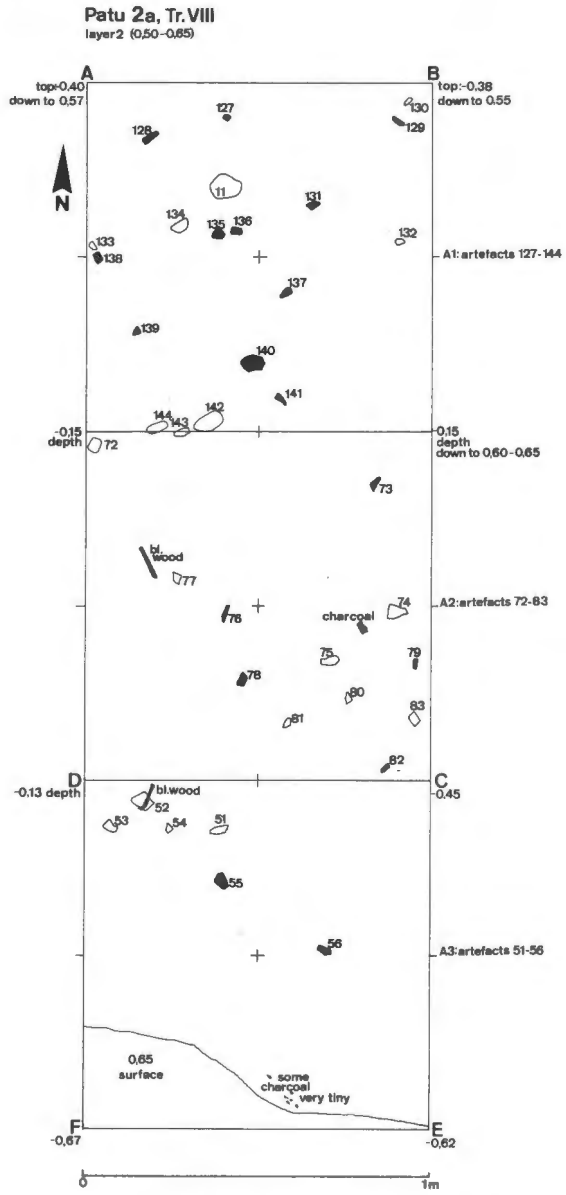

Fig. 3b. Plotting of finds of Tr. VIII, layer 2, at Patu 2a.

Some charcoal from square A3 was collected. A conspicuous observation was that a few artefacts were lying on edge or in an oblique position in the silt. The same observation was made in the other trenches.

Trench VIII (Fig. 2) in Pa. 2a was opened 5 m east from Tr. II, 1 m north of grid point E 7 in N-S direction in an area where surface erosion has already started the exposure of artefacts. Fig. 2 shows the surface concentration from the more elevated and therefore only slightly exposed northern squares to the very exposed southern square, where all artefacts are already eroded out from the artefact horizon and lie on the surface.

Fig. 3a shows the excavated artefact level of layer 1 at a depth of 0.40 to 0.49 m below 1-point. Most artefacts come from this level and are found in square A1.

Fig. 3b shows the artefact level of layer 2 at a depth of 0.50 to 0.65 m below 1-point, and it is evident that here the artefact concentration is much less. It decreases downwards; in fact, of the 41 artefacts from this layer 40 come from level −0.50 to −0.59, and only one comes from −0.65 m.

Of the total of 378 artefacts from the 4 squares, 196 are from the surface and 182 from *in situ* in squares A1, A2 and A3. The *in situ* artefacts from A1–A3 show that in layer 1, between 0.40 to 0.49 below 1-point there are 77.5 % artefacts, in layer 2, between 0.50 to 0.59 there are 22 % artefacts, and below that, between 0.60 to 0.65 there are only 0.5 % artefacts.

This is, however, a distorted percentage, because the 48 surface artefacts from square A3 belong to the greater part already to the layer 1 level, as they lie at a level of 0.45 to 0.55 m. Altogether one can deduct that here the artefact horizon ranged from about 0.30 to 0.60 m below 1-point.

Looking at the surface artefacts and the *in situ* concentration together one observes that the actual artefact concentration is more or less equal in all squares and that even the exposed surface artefacts in square A4 are probably not too far removed from their original emplacement in the silt, and that the erosion and exposure is a very recent one.

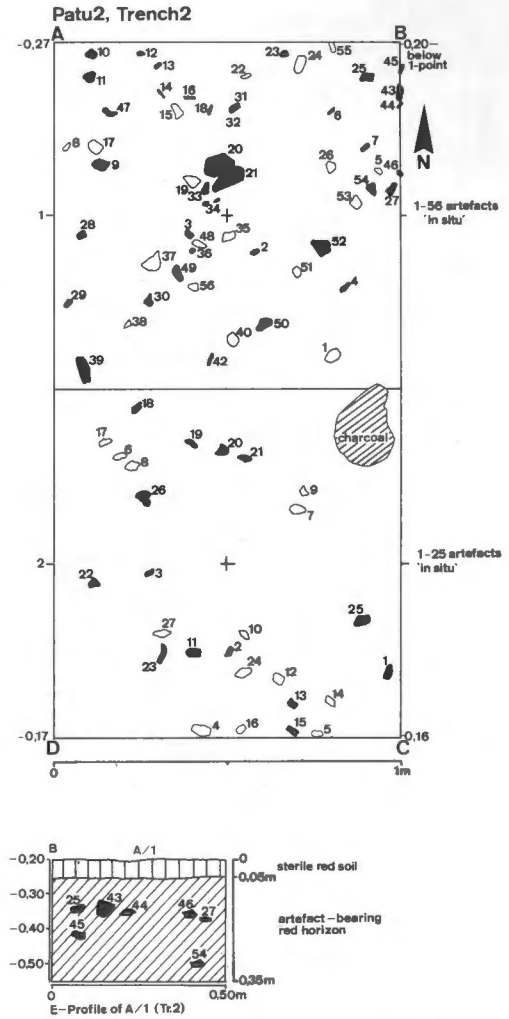

Fig. 4. Plotting of finds and profile of Tr. 2 at Patu 2.

One also observes that the overall concentration of artefacts is higher here than in Tr. VII and considerably higher than in Tr. V (Fig. 22, Corvinus 1987). It indicates that the original area of artefact concentration is thinning out to the E and NE and that the main occupational area was originally really there where it is found today exposed by erosion.

In Pa. 2 a second trench of 2 m² (Pa. 2, Tr. 2) was opened 3 m south of grid point F 14 (Fig. 13, Corvinus 1987), where no surface artefacts were exposed by erosion. An artefact level was encountered between 0.25 to 0,55 m below 1-point (Fig. 4). Only 83 artefacts came from this level, of which

16 % come from 0.22 to 0.29 m below 1-point,
29 % come from 0.30 to 0.39 m
42 % come from 0.40 to 0.49 m and
13 % come from 0.50 to 0.55 m.

A third trench of 2 m² at Pa. 2 (Tr. 3) was then opened a little further east of Tr. 2 in the same 10 m grid. No artefacts were found on the surface.

The distribution of the 135 artefacts within the silt in this trench is interesting (Figs. 5–9). A first artefact level is encountered between 0.20 to 0.34 m below 1-point with 43 artefacts from the two squares

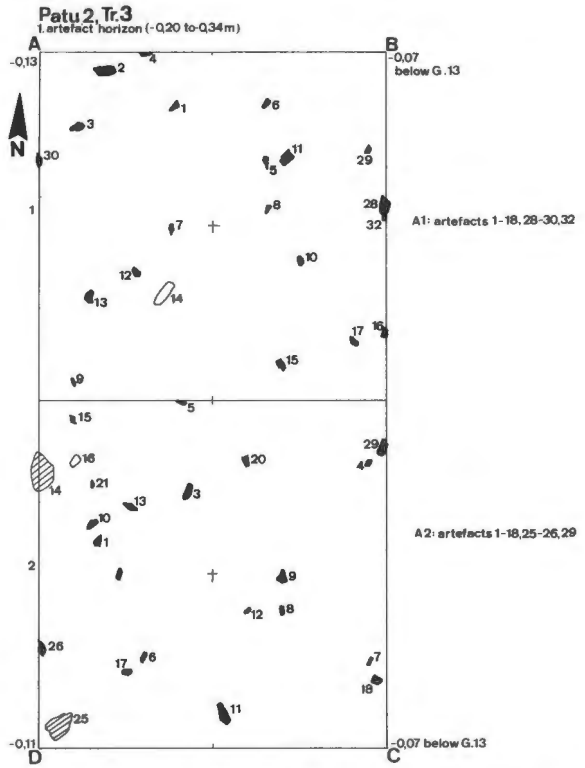

Fig. 5a. Plotting of finds of Tr. 3, 1.Artefact horizon, at Patu 2.

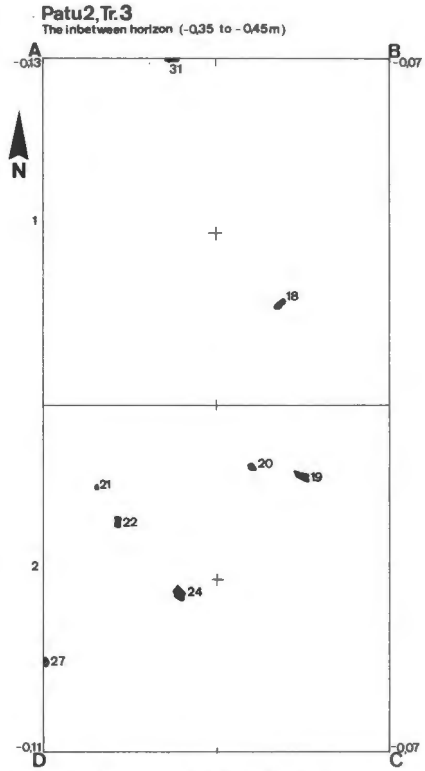

Fig. 5b. Plotting of finds of Tr. 3, The inbetween horizon, at Patu 2.

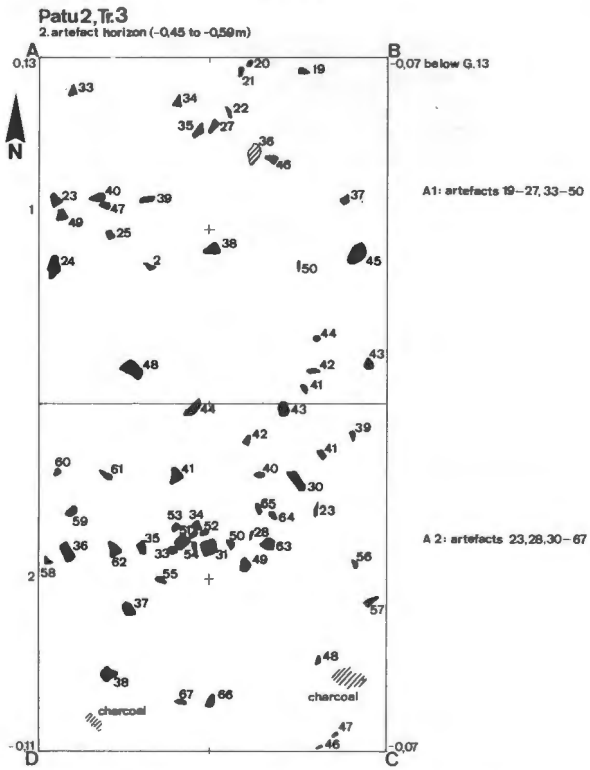

Fig. 6a. Plotting of finds of Tr. 3, 2.Artefact horizon, at Patu 2.

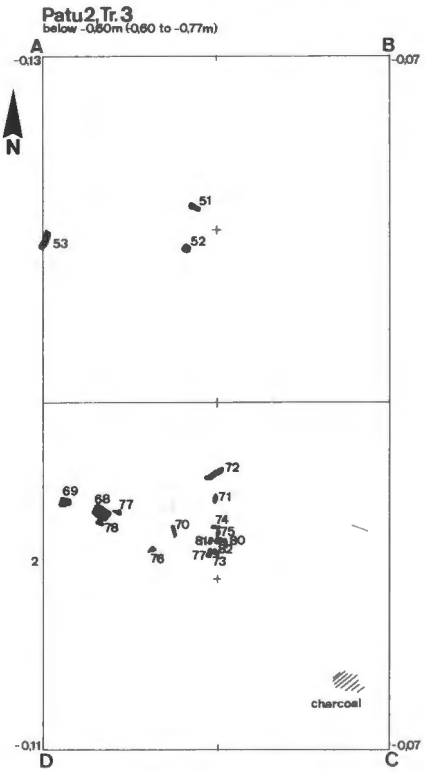

Fig. 6b. Plotting of finds of Tr. 3, below −0,60 m, at Patu 2.

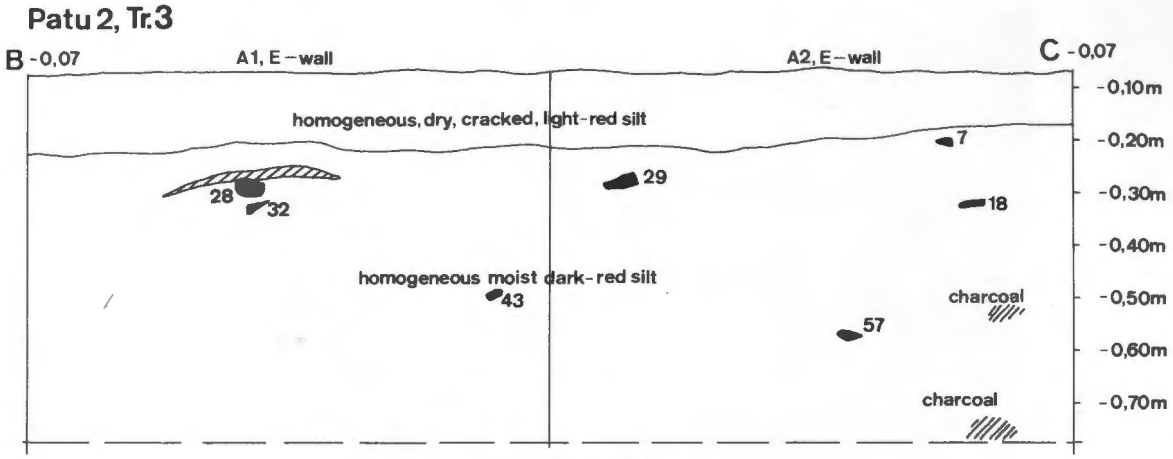

Fig. 7. Profile of Tr. 3 at Patu 2.

(Fig. 5a). The level between 0.35 to 0.45 m is almost sterile except for 8 artefacts (Fig. 5b), while the level of 0.45 to 0.59 m is the richest with altogether 72 artefacts (Fig. 6a). Especially evident is a cluster of artefacts in the middle of square A2. This cluster continues in the next lower level in A2, extending down to 0.77 m below 1-point (Fig. 6b, 8, 9). From this cluster it becomes quite evident that it is caused by burrowing animals, either by a larger animal, or, what is more likely, after having observed their activities at the site itself, by termite construction, which can reach down to 2 m into the ground, and which has large cavities which collaps after the death of the termite hill. This trench seems to point quite clearly to such disturbance and confirms the suggestion put earlier, that bioturbation has played a role in the disturbance of the original floor.

The distribution of artefacts is as follows:
21.5 % between 0.20 to 0.29 m below 1-point,
12 % between 0.30 to 0.39 m
12 % between 0.40 to 0.49 m
41 % between 0.50 to 0.59 m
7.5 % between 0.60 to 0.69 m
6 % between 0.70 to 0.77 m.

The data from the new trenches shows clearly that 1) no clearly defined occupation floor in the strict sense is encountered at Patu but instead an enriched artefact horizon of about 30 cm thickness, 2) that the artefact horizon in the red silt is, wherever it is exposed under the sterile forest surface, always at a level not deeper than 0.70 m below the forest floor, 3) that wherever erosion has set in after deforestation the artefact horizon gets eroded out from its original emplacement in the upper part of the red silt and the artefacts get exposed as a residue on the surface.

3. Other sites of the Patu industry in the neighbourhood of Patu 2 and 2a

After the detailed study of the main site at Pa. 2 and 2a it was felt necessary to investigate the neighbourhood for the location of other sites and for a study of the environment.

The whole area of about 18 km^2 around the main site was surveyed this year in order to define the extent of the site complex and the pattern of occupation, if possible (Fig. 10).

Fig. 8. Pa. 2, Tr. 3; W-wall at square A2, the lowest level with the cluster at −0.75 m depth.

Fig. 9. Pa. 2, Tr. 3; looking N; the lowest artefact level at −0.75 m, with the artefact cluster at A2.

Fig. 10. Map of the Bawshi-Rato Khola area with sites indicated. Contourlines are in feet, but are converted into meter in the cross-section of Figure 27. The lines a, b, c indicate the three cross-sections from north to south.

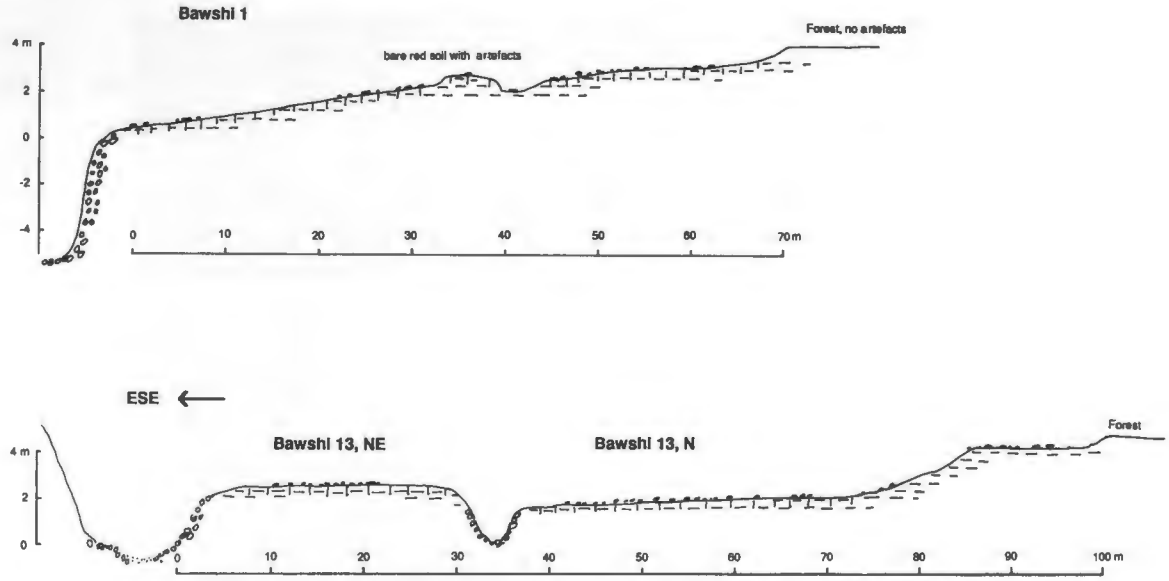

Fig. 11. Profiles across sites Bawshi 1 and Bawshi 13 on eroded edge of the red 30 m terrace of the Bawshi Khola.

Fig. 12. Site Bawshi 1, with uneroded forest surface in the background (extreme right) and the eroded red, bare surface with artefacts in the foreground.

Site Pa. 2 and 2a lies on the highest hilly elevation between the Rato and the Bawshi Kholas, where the remnants of the highest terraces are situated.

Surrounding this center, in all directions between longitudes 85°53–55′ and latitudes 27°00–03′, a number of sites of the same Patu industry could be located, either in the form of small localities with only

some debris and a few tools, or little activity spots with only some tools of choppers and adzes or only with a few adzes, or sites with a considerable artefact scatter of tools and debris.

It was found that the entire area around Pa. 2 between the two rivers of Rato and Bawshi was occupied by the Patu people and that the two rivers seemed to have been the boundary of the "territory" of the Patu people. It was found too, that only the surfaces of the red terraces had been occupied (and practically every red surface was occupied or used) and that all the non-red surfaces are devoid of occupational remains.

In what way the people of the Patu industry used this territory could only be found out by a more detailed survey of the sites and localities.

Fig. 10 shows the extent of the located sites.

Apart from Pa. 2, which was a factory site, most of the other localities seem to have been either working places, or only small activity spots, or probable camp places.

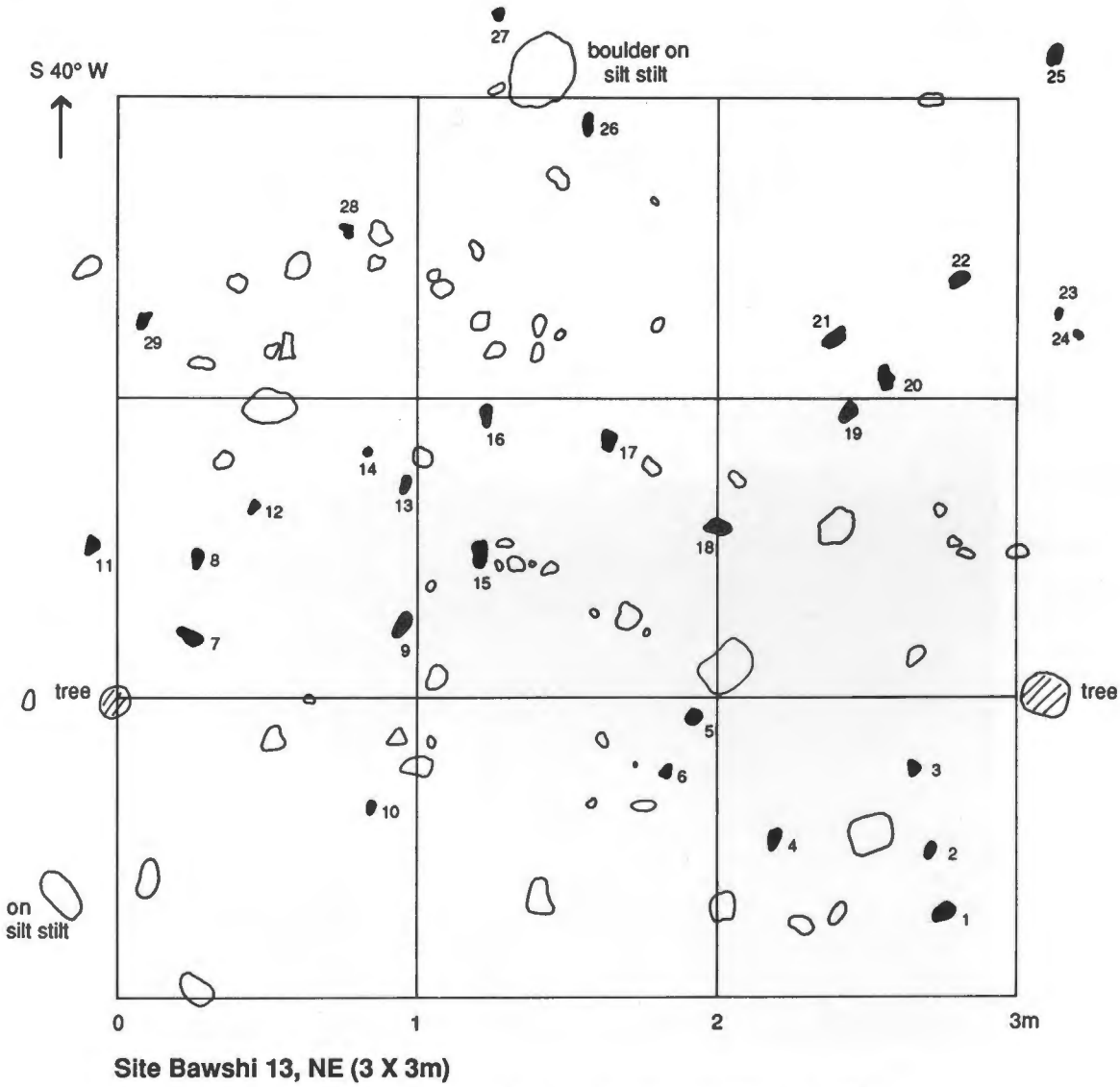

Fig. 13. Plotting of the 3 × 3 m area at site Bawshi 13, NE.

Fig. 14. The heavily eroded badlands of the alluvial silt at locality E-Bawshi 8; artefacts are found on the terrace remnants (extreme left and background) and also washed down into the badlands.

Fig. 15. Steep erosion at locality E-Bawshi 9 in the head area of the Bawshi Khola, where only alluvial silts are exposed.

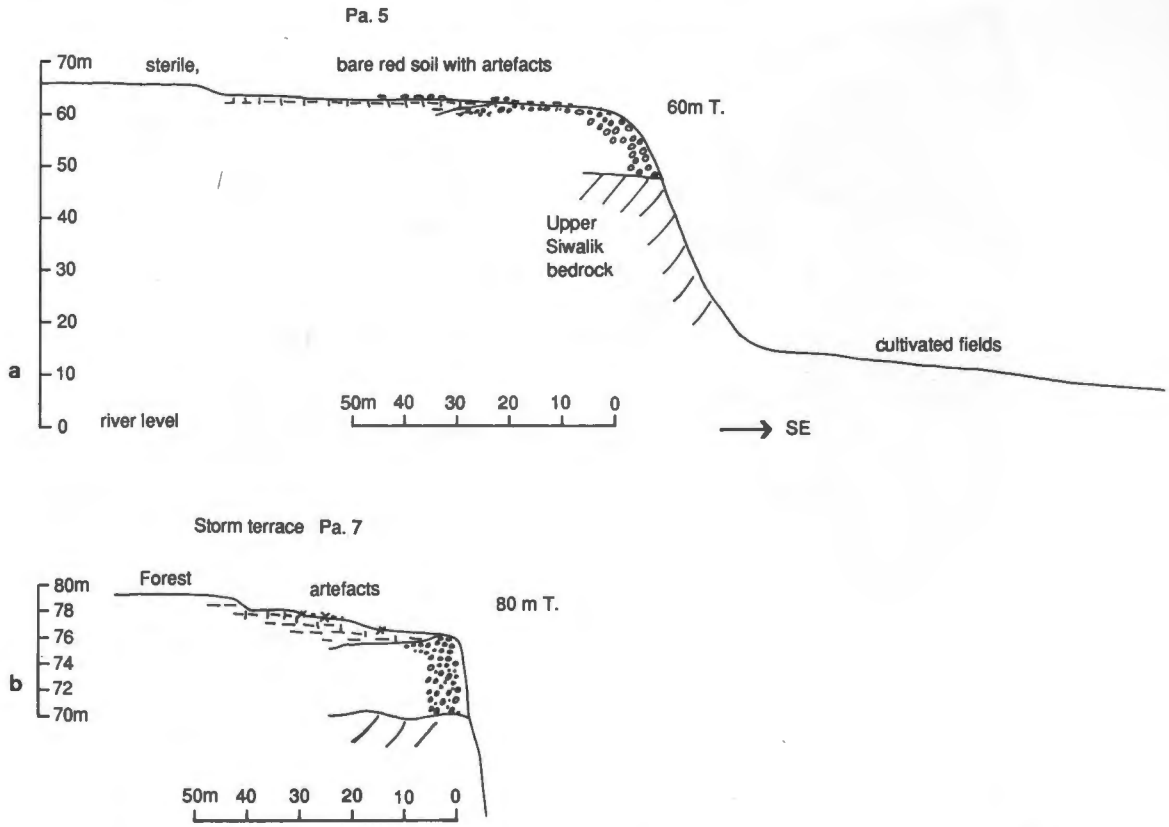

Fig. 16a, b. Profiles of the artefact-bearing 60 and 80 m red terraces at Pa. 5 and Pa. 7 in the Rato Khola valley.

Of these the richest are Bawshi 1 (1 km W of Pa. 2) and Bawshi 13 (only 1/2 km W of Pa. 2), situated on the 30 m red terrace of the Bawshi Khola, but quite removed from the Bawshi (Fig. 11).

At Bawshi 1 (Fig. 12) mainly tools were found: all the varieties of corescrapers and choppers for heavy work and a surprising amount of adzes for lighter work (Fig. 17 and 21.2). The adzes often have a gloss of strong wear (Fig. 21.2). The artefacts lie exposed on a bare, red deforested surface, which stretches for about 700 m in E-W to SW direction between a thin forest and a gully bed, where cobble gravel is exposed unter the red silt (Fig. 11). In the forest no artefacts are found. The artefacts on the red surface are exposed by erosion from the uppermost part of the red silt below the forest.

Even closer to Pa. 2, but hidden in the forest, is site Bawshi 13, which was discovered only in December 88. Situation and position of artefacts is quite the same as at Bawshi 1, and the artefacts are getting eroded out on a bare red silt surface just below the forest surface (Fig. 11). This site proved to be most interesting, as at no other place so many adzes were found together. One small area of 3 × 3 m which was plotted on Christmas Day 1988 (Fig. 13) and from which the tools were lifted, had in 9 m^2 17 adzes, of which 9 have an intensive gloss at the edge. Apart from the tools there are only a few stones and pebbles. It is quite certainly a place where a specific work with the adzes, producing such gloss, has been carried out.

Following the 30 m terrace of the Bawshi upstream along the eastern tributaries of the headstream area, one encounters at the edge of the terraces, where erosion has cut 15–20 m deep, box-like gorges into the alluvial silt, a number of localities with just a few tools, or some debris (E-Bawshi 1–7) (Fig. 20.2 and 23.1).

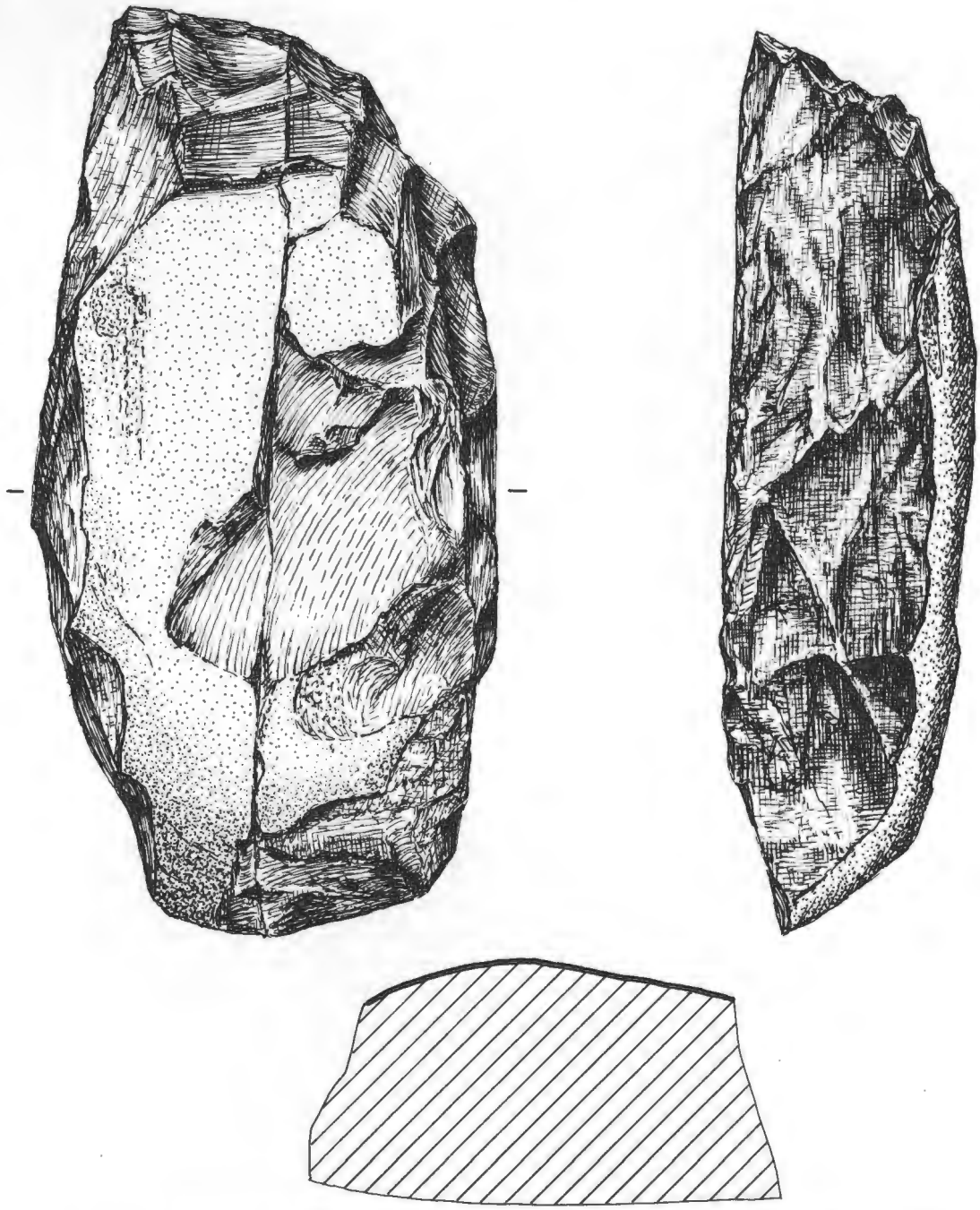

Fig. 17. A high-backed, unifacial sumatralith-type tool, on a split cobble, a rare tool, from Bawshi 1, SW.

One of the most delicate adzes was found here at Bawshi 6 (Fig. 22) which shows usemarks on the distal edge in the form of small chippings and gloss at the proximal narrow edge.

Localities E-Bawshi 8 and 9 (Fig. 14, 15) are interesting, as here a typical badland topography has developed, caused by the strong incision by the numerous steep gullies which generally start with sudden 5–10 m deep nickpoints. Headward erosion in extremely strong and fast here.

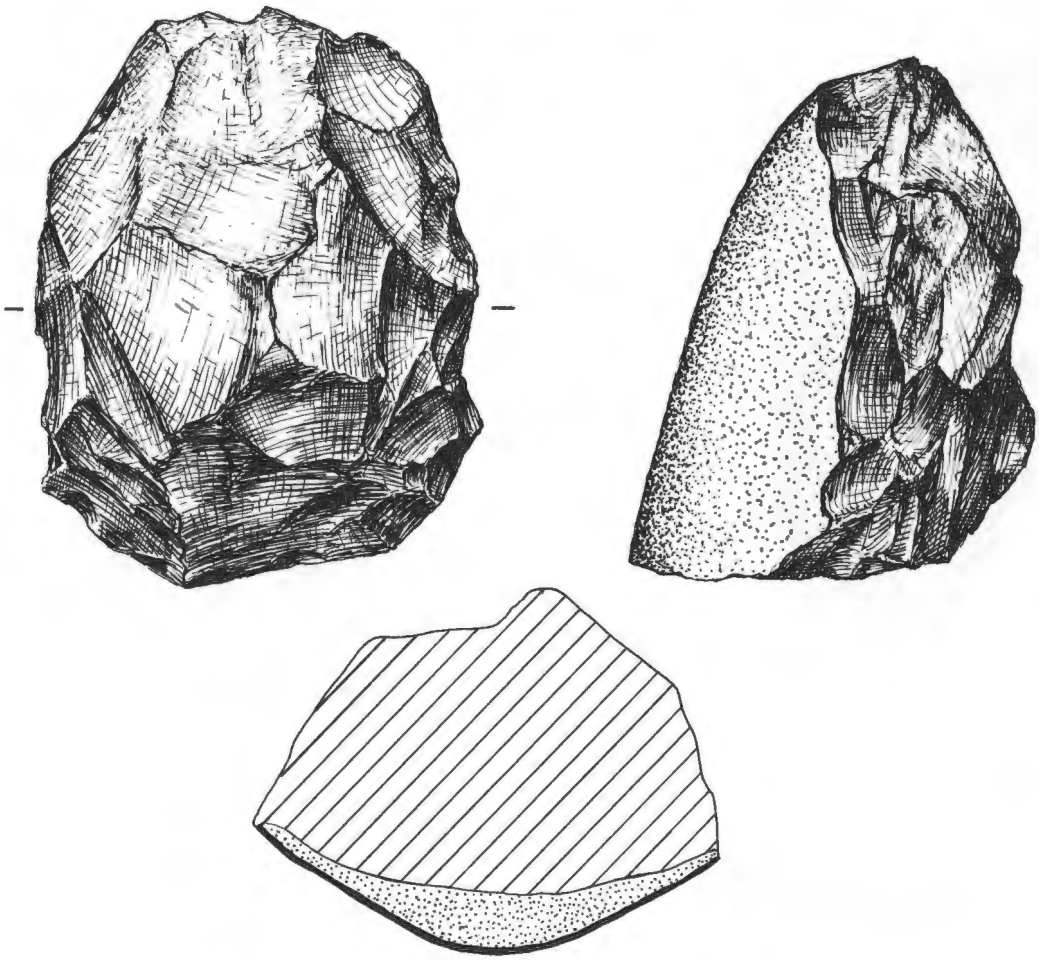

Fig. 18. A round, steep-edged corescraper (Gidhniya type), from Pa. 3b.

At E-Bawshi 8 artefacts (Fig. 24 and 25.2) are found not only in the deeply eroded badlands, but also on the few remnants of the original terrace top, indicating clearly that the people lived on these terraces before they were destroyed by erosion.

It is at these places, that it becomes clear, that the badland formation, the steep gully erosion with nickpoints and the overall strong erosion, postdates the time of occupation of the Patu people and that the Patu people had lived here on the terrace surfaces when these were still continuous and uninterrupted by erosion.

The question is, when did this extreme erosion start and what caused it? Is it only the cause of man's destruction of the vegetation cover? Or are there other causes involved, too?

The localities of the Bawshi area are all connected with the low-level red 30 m terrace of the Bawshi valley.

To the south, north and east of Pa. 2 the discovered localities are all associated with the high-level red terraces of the Rato valley. The localities are numbered Pa. 1 through to Pa. 11 and Pa. SW and are indicated on the map (Fig. 10). Of these Pa. 5 (Fig. 16a) and Pa. 7 (Fig. 16 b) and Pa. SW are richer and have yielded some interesting material. The artefacts occur at the edge of the 60 to 80 m terrace, bordering the Rato Khola and cut off by the young incision of the river. They derive, as usual, from the

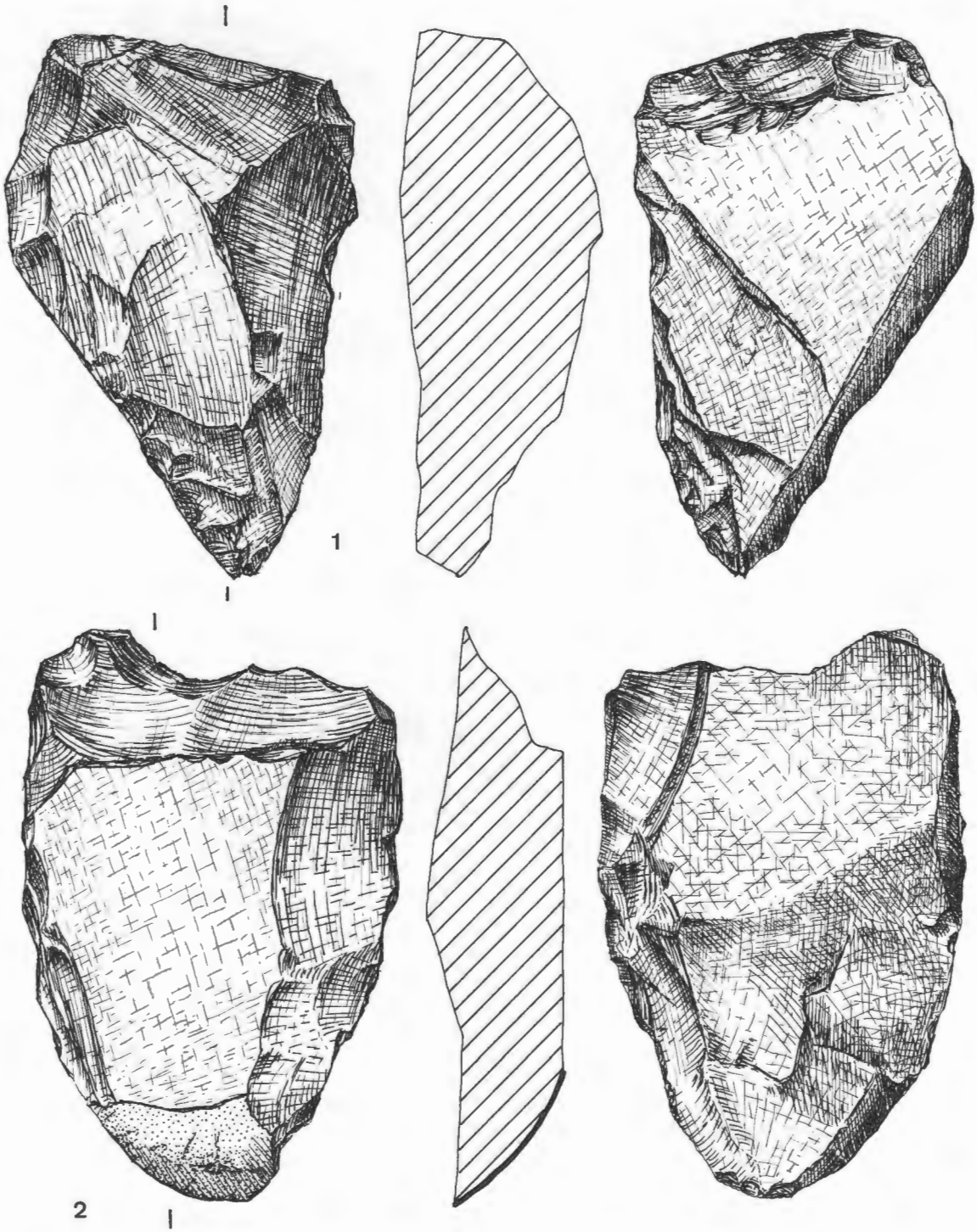

Fig. 19. Two thick adzes with heavy battering marks at the edge, from Pa. 6, S and Pa. 3, b.

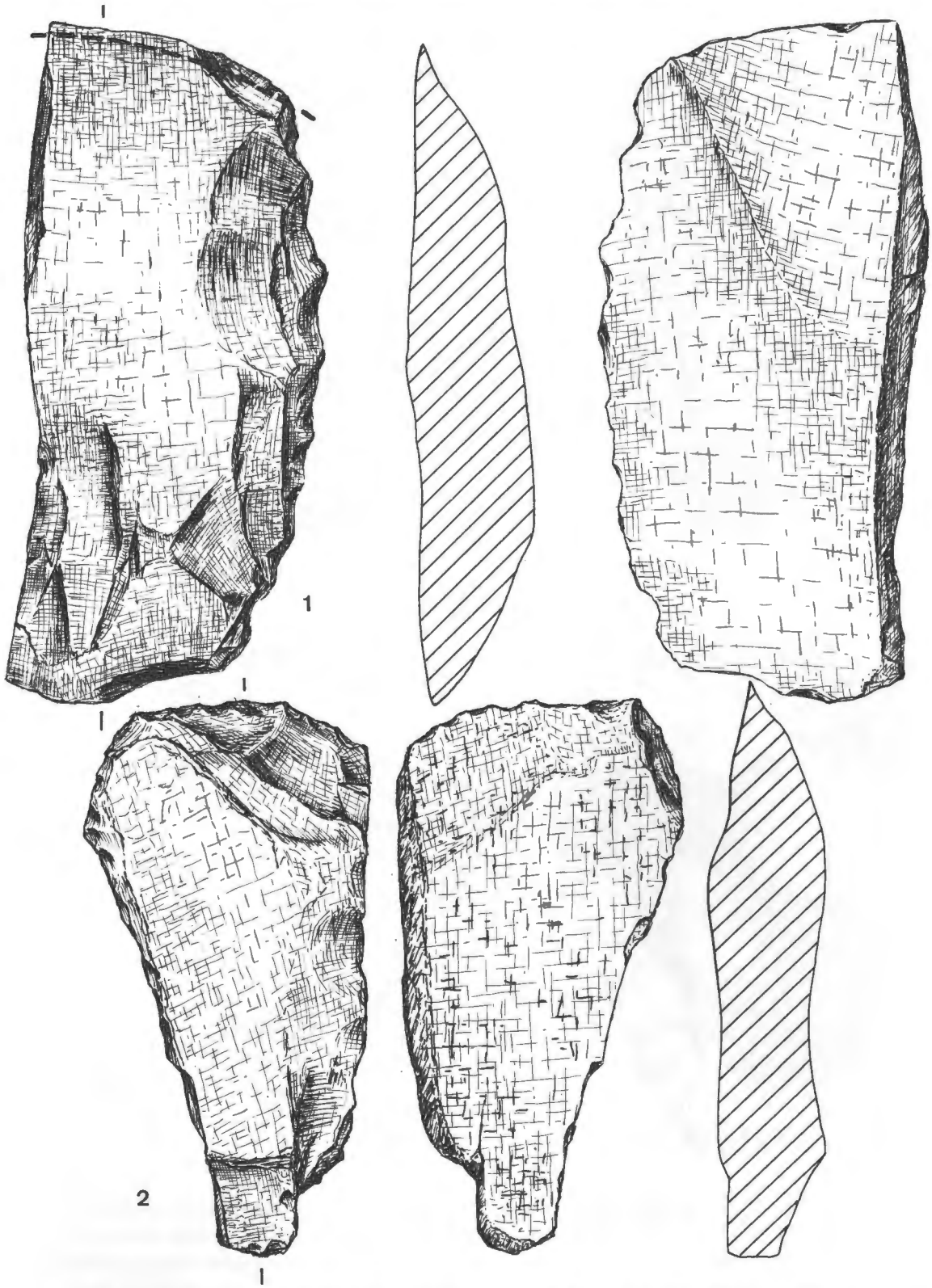

Fig. 20. Two longitudinally split or broken adzes, made on slices, one with gloss at the very edge, from Pa. 7, E and E-Bawshi 3.

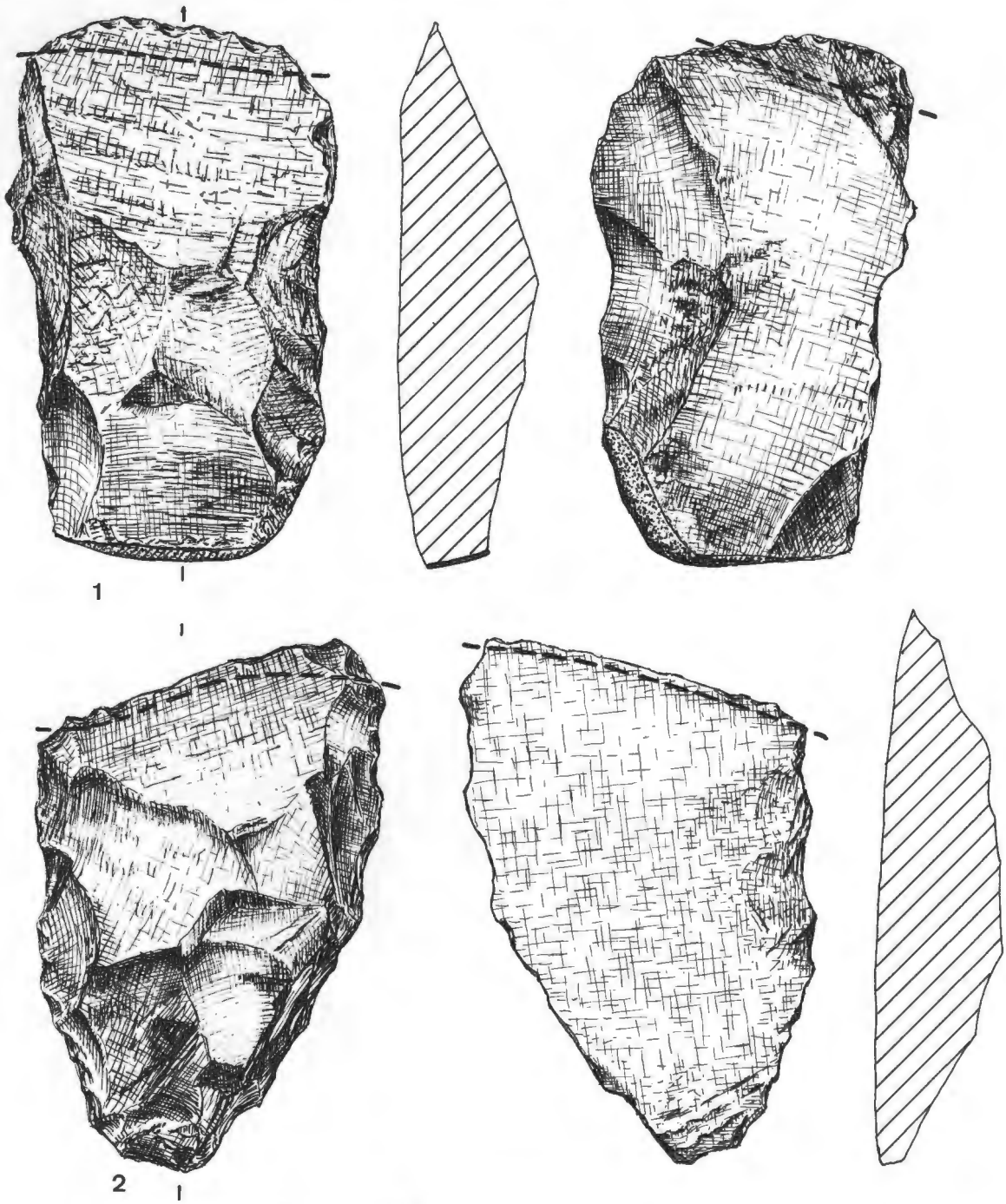

Fig. 21. A straight edged adze from Bawshi 1, SW, and an oblique edged adze from Pa. 6, S, both with gloss at the edges; 1. made on a flake; 2. made on a slice.

upper part of the red silt, like for example the fine, longitudinally split adze from Pa. 7 (Fig. 20.1) and the adzes from Pa. 6, S (Fig. 21.2 and 19.1), or the 'hache courte' from Pa. 5c (Fig. 23.2).

The selection of drawn tools shall give an idea of the variety of tool types from the neighbouring sites and shall show that they all belong to the Patu industry.

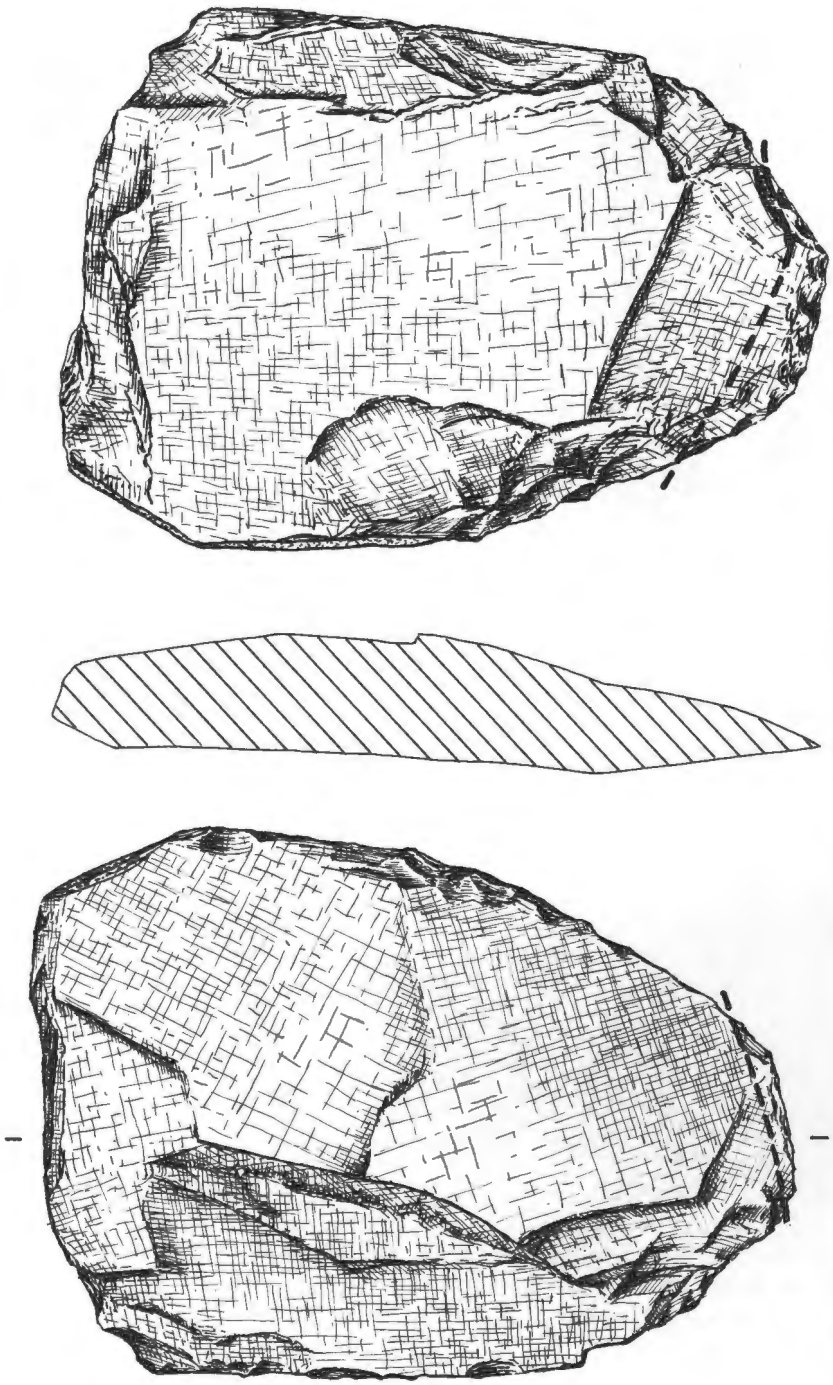

Fig. 22. A fine, very flat adze from E-Bawshi 6, with slight battering marks on the distal edge and gloss on the proximal edge.

Apart from corescrapers, choppers, rare scrapers and flakes and the types of adzes as they have been described previously, there are some new elements.

A fine, steep-edged 'sumatralith' with cortex on the upper face (Fig. 17) is from the Bawshi 1 site, which is rich in tools. The distal edge and the left lateral edge which together form a point, are extremely well retouched and used. The lower face is a completely flat split cobble surface. Such tools are rare.

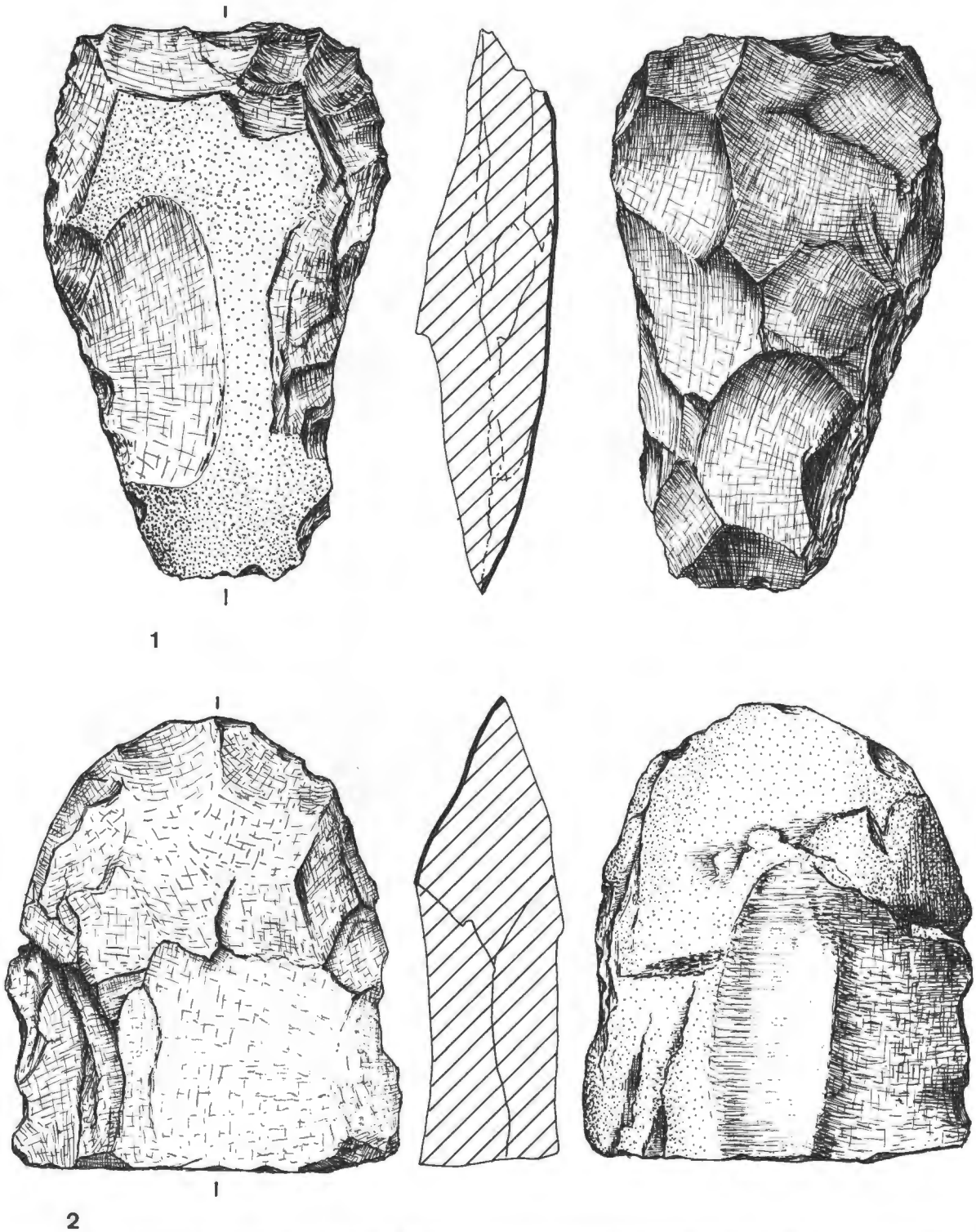

Fig. 23. 1. Adze from a flat cobble with cortex on the upper face and with retouched and used lateral edges from E-Bawshi 4, top; 2. ‚Hache courte', (like Colanis haches courtes from Vietnam); unifacial with cortex on the lower face and a round unifacial distal edge, from Pa. 5c.

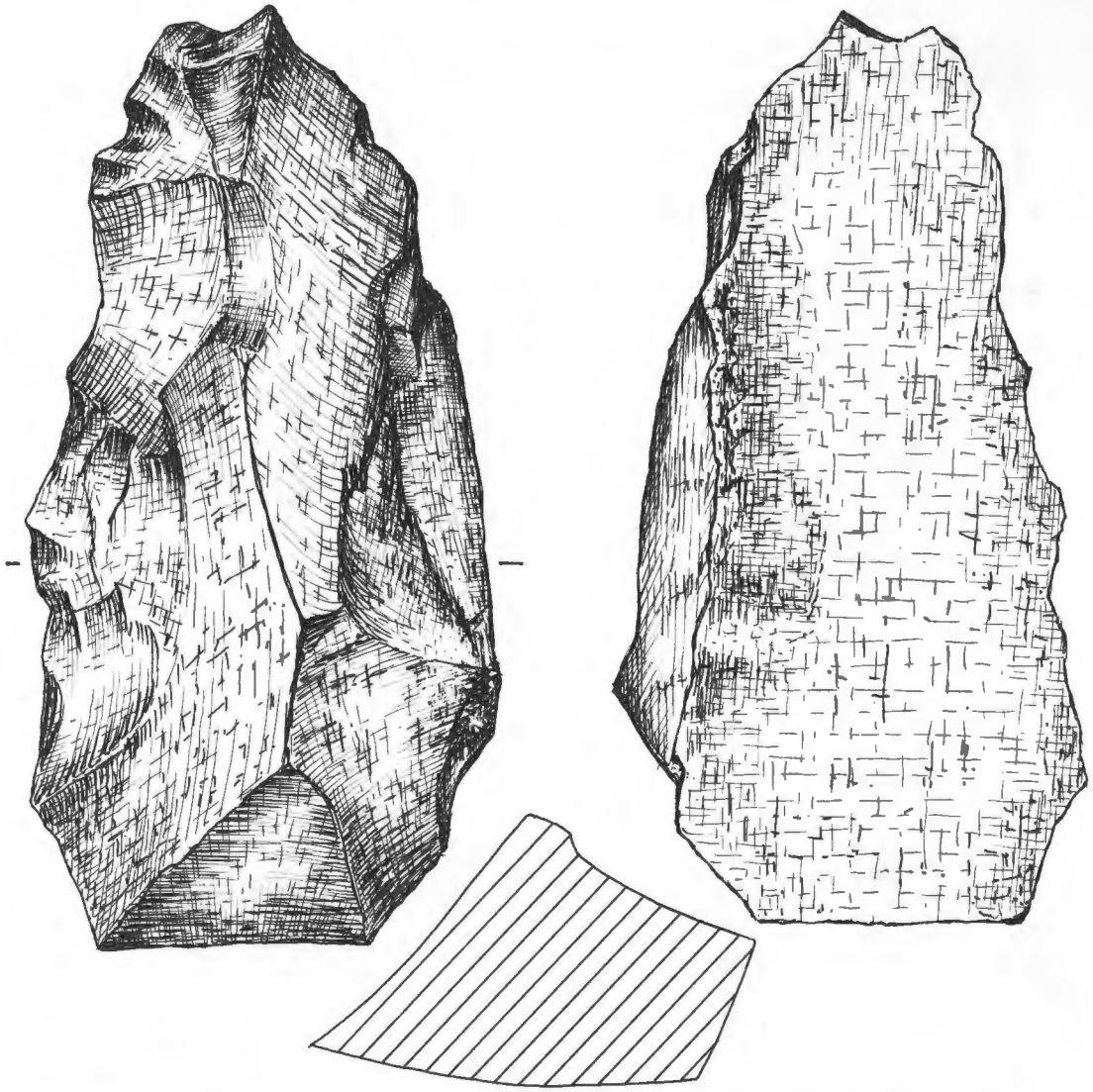

Fig. 24. Elongate uniface from a side flake with large primary flaking on the upper face, from E-Bawshi 8.

The round, small corescraper from Pa. 3b (Fig. 18) is also not a common tool. Corescrapers are usually heavy tools and either display a long lateral edge or an edge at the end which is sometimes pointed.

Adzes are as varied as at Patu 2. Thick adzes with heavily used and battered distal edges like the two specimens in Fig. 19 from the Patu terraces are functionally quite different from the fine, thin adzes with gloss. They must have been used for heavier cutting work (probably of wood). They never show any gloss.

The fine, sharp adzes (Fig. 21.1 and 2; Fig. 22; Fig. 20.1) were certainly used for a very different, lighter work than the thick adzes. They often show a distinct gloss at their edges, like the depicted specimens, and seem to have been used for work with bamboo and/or reed. A particularly fine piece is from E-Bawshi 6/6 (Fig. 22), which unexpectedly does not have the gloss at the broad distal edge but at the narrow and very delicate proximal edge. It must have been delicate work on such a delicate edge, that

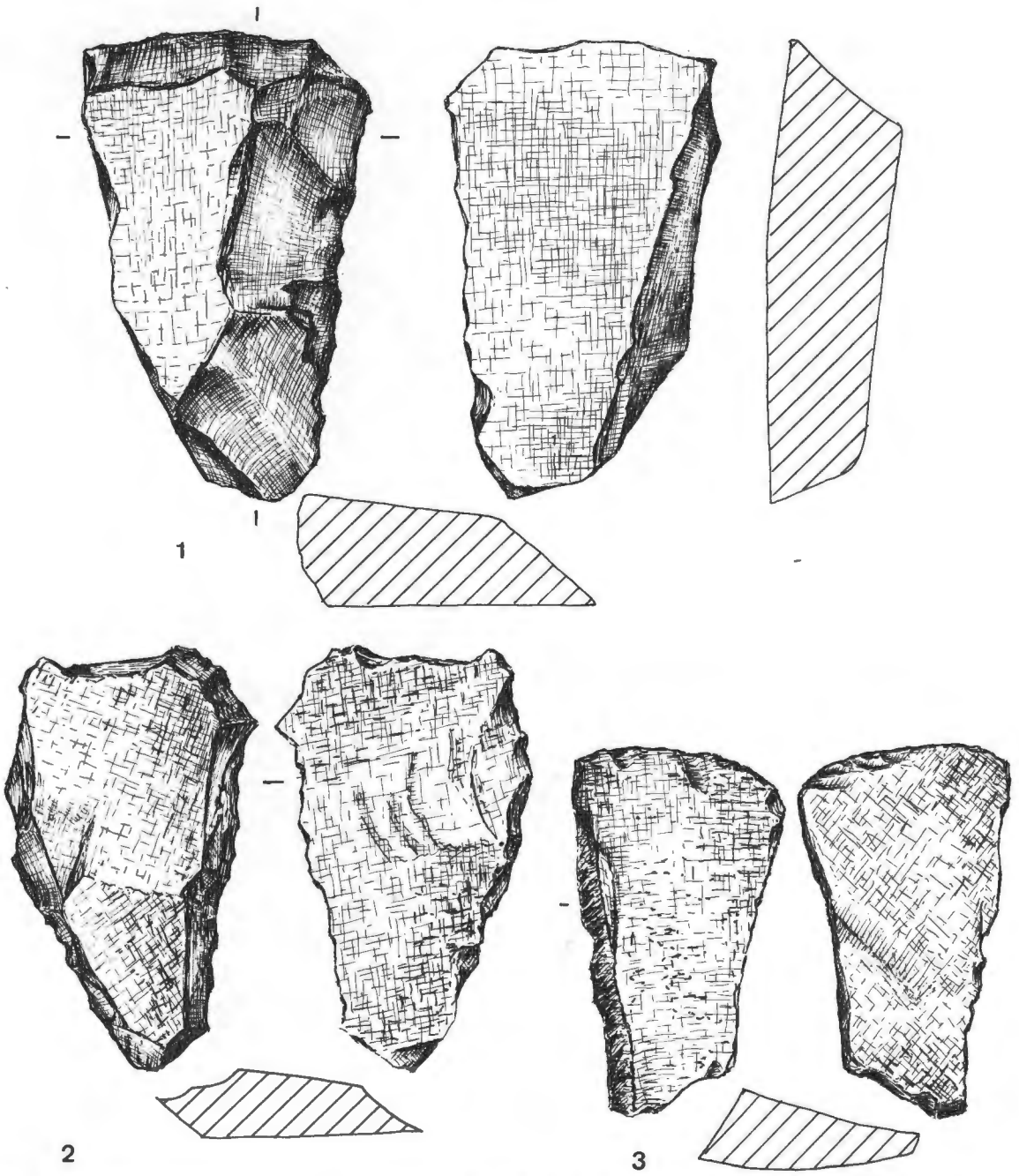

Fig. 25. 1. Miniature adze or end-scraper on thin slice, from Pa. 5c; 2. Small adze on side flake, with steep retouch at right edge from E-Bawshi 8; 3. Small chisel on thin slice, with retouch or usemarks at distal edge, from Pa. 2a.

the edge did not break. The work was long and time-consuming to produce a gloss, and yet the edge did not break.

An interesting adze is also E-Bawshi 4/6 (Fig. 23.1) which was made on a flat cobble (most of the upper face consists of cortex), though usually adzes were made on flakes (Fig. 21.1) or split cobble slices (Fig. 21.2).

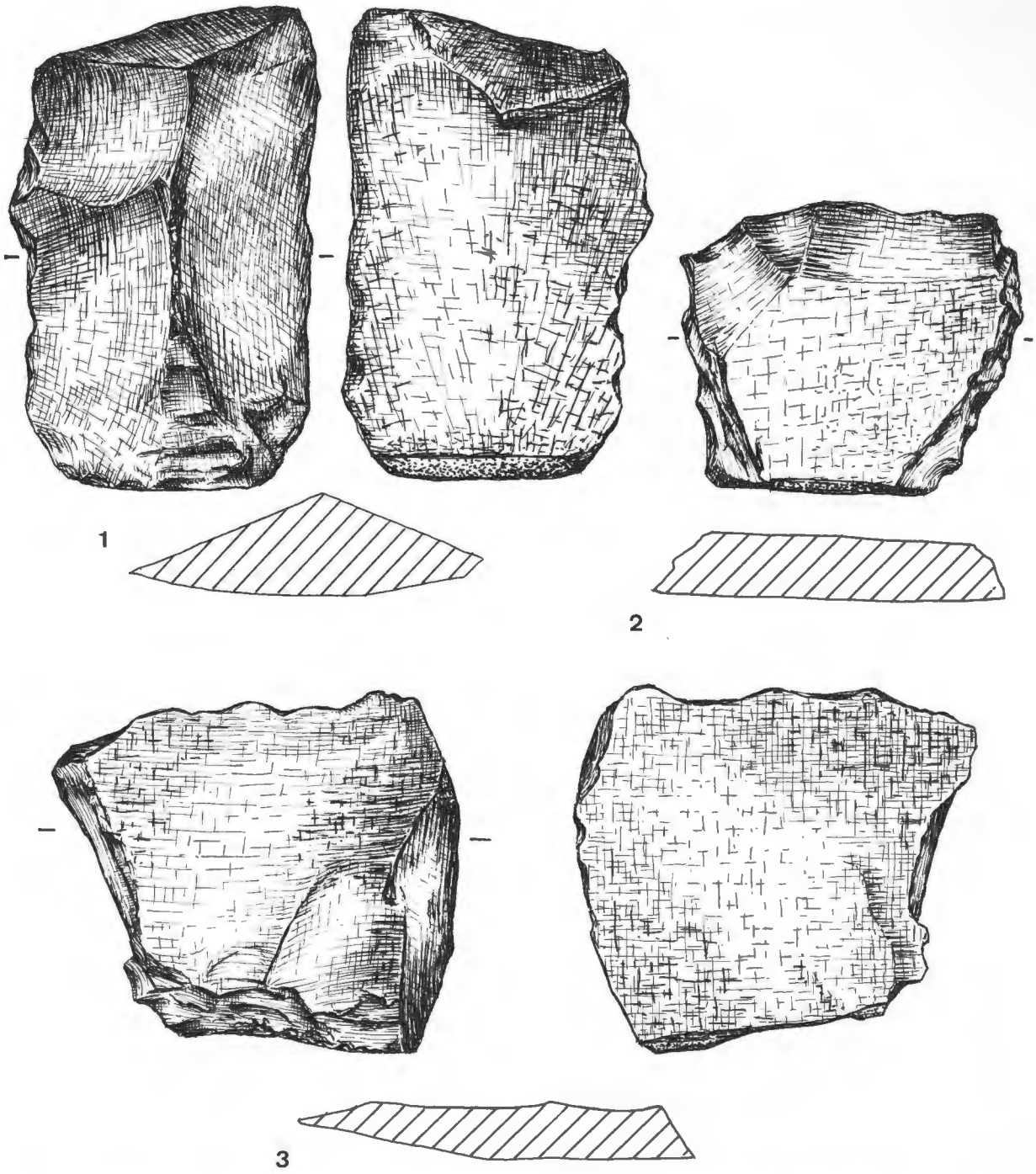

Fig. 26. Retouched flakes: 1. with cortex at the platform and some retouch and usemarks at the lateral edges, from Pa. 5c; 3. used, square flake with retouch at the platform edge, from Pa. 5b.
Retouched slice: 2. thin slice, with step-retouch at left and right edge, from Pa. 2a.

A rare and interesting tool is the broken, round-edged adze from Pa. 5c/12 (Fig. 23.2) which is called here 'hache courte', as it resembles these tools from Vietnam, called so by Colani from Hoa Binh.

The uniface E-Bawshi 8/5 (Fig. 24), too, is not a common tool in its elongate-pointed, handaxe-like shape with a middle ridge on the upper face, made on a side-flake and trimmed only by primary scars.

Some mention should also be made of a number of 'miniature adzes' (Fig. 25) which must have been used as small chisels or scrapers, but are made rather unusually from thin slices, rarely from flakes, and have used, broad edges at the distal end. Retouched flakes, too, are very rare (Fig. 26.1 and 3, Nr. 2 being a retouched piece on a thin slice). Most of the flakes are rejuvenation flakes of choppers and corescrapers.

4. Fluvial geology, environment and river terrace formation

The area of the Patu sites formerly was a dense forest environment of mainly saal *(shorea robusta)* and bamboo. Nowadays the forests are rapidly cut away by the villagers for fire wood and cattle fodder and the remaining thin forest has no chance of recovery but soon will be completely destroyed.

At the time, when the 1:50 000 topomaps were produced some 30 years ago, the forests were still intact and, where now everything is cut down, the map indicates 'dense forest of saal and bamboo'.

The farmers who live in this area now, have come down from the hills some 25 years ago. They have adopted and cultivated the land, after the malaria mosquito was eradicated and since then the forests are disappearing.

The forest soils in the still intact forests are thin, grey, slightly humic soils above the red weathered alluvial silt of the upper terraces. Wherever the forests are thinning and the undergrowth is cut away the forest soils are washed away, leaving the bare red silt surface.

The Rato Khola is the major river which emerges in this area from the Siwaliks into the Terai plains. Its source area does not extend beyond the Siwaliks, but the entire drainage lies within the Siwaliks. It is a comparatively small, but perennial river. The upper reaches run parallel to the strike of the Siwaliks, but at Patu it cuts through the Siwalik sandstone barrier of the Pinjor/Tatrot sandstones to emerge into the plains. At the entry into the plains the river has developed an impressive set of terraces, cut into and overlying uppermost Upper Siwalik conglomerates unconformably. A thrust zone separates these uppermost Siwalik deposits from the Tatrot/Pinjor sandstone facies exactly at the foot of the higher hills, where the Rato River began its terrace formation. The older Pinjors are here thrust over the younger Boulder Conglomerates.

At exactly this place terrace formation has set in.

Along the Rato Khola the higher terraces (with the red surfaces) range from 55 to 105 m and the lower, recent terraces (with no red surfaces) range from 10 to 40 m (Fig. 27) above river level.

The younger set of terraces (of 10 m, 20 m and 40 m) are well preserved, flat and uninterrupted. They have a dark grey, humic soil developed over their fluvial deposits. No artefacts of any kind were found in or on them.

The higher set of terraces are only partly well preserved, but generally quite dissected by erosion. The 60 m terrace is the best preserved terrace above the river south of Patu (Fig. 16a). Beyond it and higher up there are terrace remnants of 75 to 80 m and of 90 to 105 m. All the higher terraces have a red surface developed over their fluvial gravel-silt deposits, which in turn overlie Upper Siwalik conglomerates unconformably.

Almost all the terraces of the higher set carry prehistoric sites in the uppermost red part of the red silt.

The terrace deposits quite generally consist of basal cobble gravel, very well rounded and sorted, which are all derived from the reworking of the Siwalik Boulder conglomerates, set in a coarse sandy matrix.

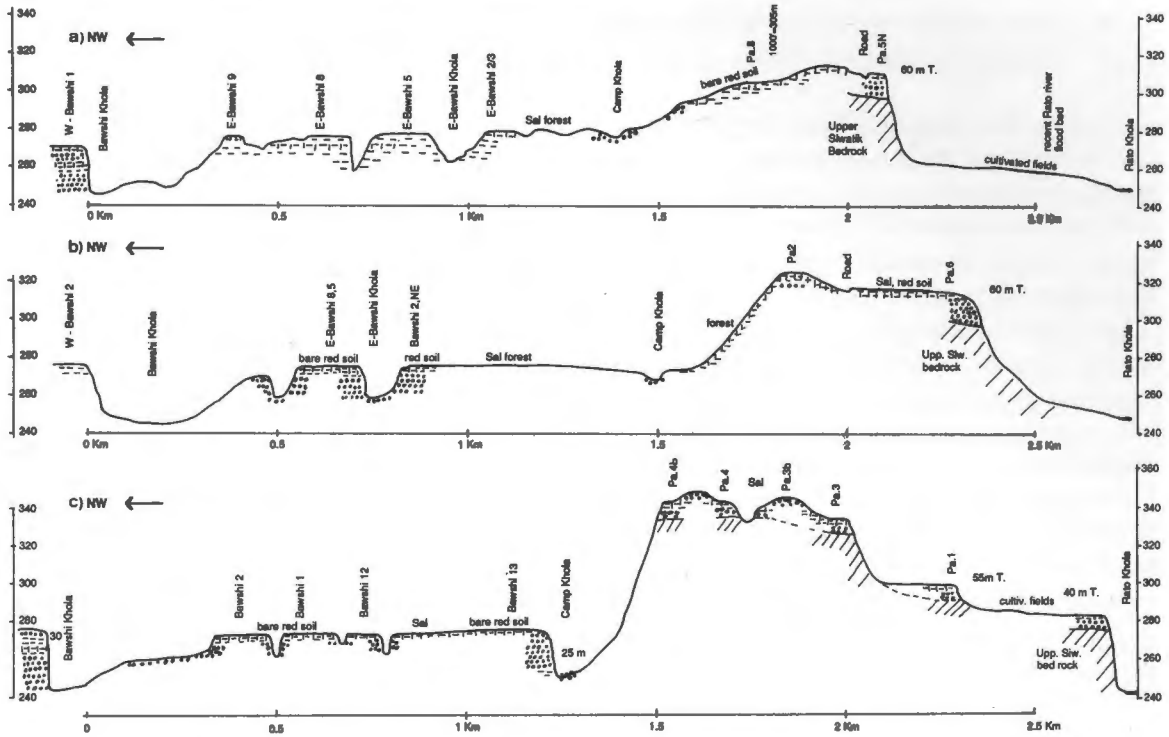

Fig. 27. Terrace profiles across the Bawshi and Rato rivers (with sites indicated).

Cobbles are predominantly of quartzite, mainly of banded, very micacious quartzite, which splits easily, and less commonly of compact quartzites, which breaks conchoidally. Of lesser quantity are gneisses and metamorphics.

Overlying these cobble gravels, are silt deposits and mottled clays of beige, yellow to reddish yellow colours. They, too, derive from the Siwaliks, from the erosion of the many intermittent claystone and siltstone beds. They have been deposited as overbank deposits of the streams, and form almost everywhere the upper part of the terrace deposits.

In some cases, younger pebble gravels overlie the silts or intercalate within the silts. The silts and clayey silts are compact, often mottled greenish, with many burrowing channels of animals and roots, and show little stratification.

The uppermost part of the upper terraces are strongly coloured red, often to a deep red, which diminishes downwards. The lower part of the silt/clay is usually beige-yellow. The red colouring usually does not exceed 1 1/2 m, except at site Pa. 2 and 2a, where it is at least 2,50 m. If a gravel directly underlies a thin red silt, the matrix of the gravel, too, is usually red. Lower down, however, in the succession, the gravel matrix has a normal, unweathered light colour.

It all points to a development of a red weathered horizon on the alluvial terraces.

Usually, also the gentle slopes from one terrace to the next lower one is red.

The question was put here, whether we deal here in all cases with an *in situ* developed red soil or weathered horizon, or with soil sediments, derived from elsewhere. This question is not yet satisfactorily understood and is currently under study.

The fluvial terrace deposits of the ancient Rato Khola never exceed more than 10 m, usually less. The recent Rato Khola has cut its modern bed everywhere through its own deposits, but also through the underlying Siwalik bedrock, much in contrast to the neighbouring Bawshi Khola.

The terraces of the smaller Bawshi Khola are less high in overall elevation than those of the Rato Khola, though the thickness of the terrace deposits in all cases exceed those of the Rato Khola deposits.

Whereas along the Rato Khola everywhere the underlying Siwaliks are exposed, nowhere along the Baswhi Khola the underlying bedrock is encountered underneath the fluvial deposits (Fig. 27). Being a smaller, not perennial stream with low current and low energy, the Bawshi now has little erosional power and thus cuts its recent bed only to a moderate degree and does not reach the underlying bedrock under its thick fluvial deposits. Whereas the recent, perennial Rato Khola, which has a higher energy, cuts its recent channel to a much deeper level, exposing bedrock underneath its thin fluvial deposits.

Thicknesses of more than 10 m and up to 30 m of fluvial gravel, overlain by more than 5 m of clay and silts are the rule at Bawshi. Such thick gravels are exposed mainly in the terraces slightly below the emergence from the hills (Fig. 27b, c), while the head area of the Bawshi at the very emergence from the hills exposes only silts and clays (Fig. 27a), which is not what one would have expected at this place. Maybe basal gravels are present underneath the silts but are not exposed.

The terraces along the eastern side of the small Bawshi Khola are well developed with wide extensions of more than 1 km in width (Fig. 27, Fig. 10). Overall elevations of the terraces do not exceed 30 m in height above recent Bawshi level. They all show a red surface cover above the silt, and they all carry prehistoric material of the Patu industrial complex in the red silt.

The low elevation of the red terraces at Bawshi stands in great contrast to the high elevation of the red terraces of the Rato Khola.

The western banks of the Bawshi Khola only have few remnants of a red terrace in the uppermost reaches. Very little artefact scatter of the same cultural facies is encountered here, too.

Lower downstream, a well-preserved and wide 20–30 m terrace is developed, which carries a yellow-brown soil with no forest but with cultivations of crops of millet and maize. Only at one place at the margin of the terrace at Bawshi 2 some heavy artefacts of corescrapers and choppers could be found in the fields and at the uncultivated margin of the terrace, where a thin red soil had developed.

But on the whole the west side of the Bawshi Khola has very little cultural remains.

Opposite the little hamlet of Biankute (just west of Bawshi 2) the west bank of the Bawshi exposes an interesting, vertical cliff of 30 m. It exposes above a cobble gravel in a yellow sand matrix a buried red soil (or soil sediment) overlain by beige coarse silts, sands and gravels (Fig. 27c, extreme left and Fig. 5.2 in Corvinus 1987). This buried red horizon seems to be rather a reworked soil sediment, derived from an older red soil, deposited here at a later stage.

It is a curious phenomenon that the Rato Khola red terraces are all more than 55 m above the recent Rato bed, and are rather broken up and not very extensive, while the red terraces east of the much smaller Bawshi Khola, immediately adjoining the high Rato Khola terraces, are at a much lower level and are of such contrasting width. And they all, just like the Rato red terraces, are associated with artefacts of the Patu industry.

It is also quite evident that the bedrock level underneath the terraces of the Rato is much higher than underneath the Bawshi terraces, more than 80 m difference in the cross profile at Fig. 27c.

In summing up: we have on one hand, in the east, the high level red terraces over high level bedrock at the Rato river, and on the other hand, in the west, we have the low level red terraces over low level bedrock at the Bawshi Khola. The Bawshi red terraces are more extensively pronounced than the Rato river red terraces. The fluvial deposits of the Bawshi Khola are thicker for at least 20 m or more than the Rato Khola deposits. The Bawshi Khola has a buried and deeper ancient channel than the Rato Khola, and the Siwalik bedrock is not exposed below the fluvial deposits at Bawshi, whereas the Rato Khola cuts through its own shallower deposits deep down into bedrock. In short: the recent small and short Bawshi Khola is quite an underfit stream for its wide valley and thickly in-filled alluvium.

The ancient Bawshi Khola channel was cut down to a considerably deeper level than the ancient Rato Khola and had a stronger current and stronger load than the recent Bawshi and than the ancient Rato Khola, while now the situation is reverse.

Was the Bawshi area the former valley of the ancient Rato stream and later was captured, at the loop at Patu, by a small stream, which had then occupied the recent Rato bed area?

The high level terraces at Rato may then have belonged to the ancient, higher situated small capturing stream.

Or, more probable, the high level terraces of Rato may have been the older set of terraces of the ancient Rato, of which only remnants remain (having been cut off by the modern Rato), after which the Rato began shifting its bed westwards, from a point near the village Patu, cutting a deep, now buried valley in the Bawshi area, forming the 30 m red terraces there as a younger set of terraces. And then it was captured at the loop at Patu to cut its modern bed where it runs now, forming the youngest, non-red terraces at levels of 40 m (on the western side) and 25 m and 10 m (at the eastern side of the river).

5. Distribution and position of the Patu sites

Artefacts of the Patu industry are found in association with almost all the red terraces and only with the red terraces. The terraces are certainly not all of the same age, but the artefacts of the Patu industry are of the same age and period. This discrepancy has to be understood, but has not yet been fully explained.

The artefacts are not just simply lying on the surfaces of the terraces, which, if they had, would have made the issue simple. The artefacts are everywhere always in the process of being eroded out from the uppermost part of the red silt. Wherever they are found it is the same situation, whether it is on the 90 m or the 60 m terraces of the Rato Khola at Pa. 1, Pa. 2, Pa. 3 etc., or whether it is at the 30 m red terraces of the Bawshi Khola at Bawshi 1, 2, 13 or at E-Bawshi 3, 4, 5, 8 etc.

Sites Pa. 2 and 2a have already been surveyed and described in detail. Exactly the same position is found for example at Pa. 5 (Fig. 16a), at Pa. 7 (Fig. 16b) or at Pa. 1 (Corvinus 1987, Fig 4.3) where a recently dug test-trench has located the horizon. The same situation again is found at the Bawshi sites, for example at Bawshi 1 (Fig. 11) and at Bawshi 13 (Fig. 11), which was discovered only in December 1988 and proved to be one of the richest and most interesting sites of the whole area.

Everywhere they are eroding out from the uppermost level of the red stilt.

It is most certain that the various terrace levels at the Rato and Bawshi streams are formed at different times, most probably during the later part of the Pleistocene and maybe up to the beginning of the Holocene. The Patu industry most probably belongs to a mesolithic cultural complex in the earlier Holocene.

Therefore the occurrence of the Patu artefacts not only in the probably youngest 30 m terraces of the Bawshi, but also at the high level terraces of the Rato river has to be explained.

In the previous article (Corvinus 1987, p. 150–153, 155) it was already pointed out that no well-defined occupation floor was present in the red silt at Pa. 2 and Pa. 2a, but invariably at all the dug trenches (and also at Pa. 1 and at Pa. 3, where small test-trenches had been put down) a 20–30 cm thick artefact horizon, some 0.30 to 0.70 m below the sterile forest floor, was encountered with no demarcations and no stratification.

At the moment no other explanation can be offered as already indicated previously. The occupation postdates the terrace formations, and is either contemporaneous with the red weathering processes or postdates even this process.

Yet, the question remains, why are the artefacts then, everywhere where they are found, embedded within the red silt? It is conspicuous, however, that they are only embedded in the uppermost 0.70 meter of the red silt and never deeper down. It seems to be obvious then, that the original occupation floors became reworked somehow (by termite activity (?) and other bio-turbation (?)) from the original floor on the terrace surface into the upper level of the red silt of the same terrace surface, from which they now – after having been protected from any surface weathering during the time of their being embedded – become exposed by the heavy, man-induced erosion due to the cutting of the once thick forest cover.

It is evident by the thick residual scatter of artefacts on the eroded red silts, that the original floors have been disturbed but not destroyed nor transported horizontally to any greater degree. That what we now find on the sites are – if one may call it like that – the *in situ* reworked remains of the occupation floors.

There may also have been climatical causes responsible for the embedding of the occupation floors. Maybe the climate at the time of occupation was somewhat drier than in later Holocene times and the red surfaces were more accessible and open for human occupation. In that case the thick, rather impenetrable forestcover of recent historical times may have been much thinner and may have developed only later during the Holocene, thereby forming a thin, sterile forest soil above the red silts. This alone, however, does not explain the reworking of the occupation floors into the upper strata of the red silt, and would only explain the thin, sterile covering of the red silts.

It is therefore of the utmost importance to investigate the red surfaces and understand the development, the causes of development and the age of the red silts and red weathering horizons. We know nothing about the red surfaces in Nepal so far, though they are present not only along the fringe of the mountains, but also within the Himalayan mountains. The study of this aspect of the research is been taken up recently in collaboration with A. Bronger, Kiel.

Summary

A few additional trenches have been cut at the main site of Pa. 2 to clarify extent and position of the artefact horizon and to take samples for TL dating.

The surrounding neighbourhood of Pa. 2, of ca. 18 km², between the two rivers Rato and Bawshi was surveyed to define the extent of the occupation of the Patu industry. It was found that all the red terraces, and only the red terraces, in the entire area between the two rivers, where the occupational territory of the people responsible for the Patu industry.

The artefact assemblages of the surrounding localities, of which a few are particularly rich in adzes, all belong in their tool composition to the Patu industrial complex. Tools consist mainly of heavy-working implements of corescrapers and choppers and rare sumatraliths, and of light-working implements of adzes with gloss and adzes as cutting tools, and of a few scrapers and chisels. Everywhere the artefacts occur eroding out from within the uppermost part of the red alluvial silt of the terrace deposits.

Special attention was given to the study of the geomorphology of the river terraces of the Bawshi and Rato rivers, in order to find an answer to the question of the elusive age of the industry, and to find an explanation for the puzzling occurrence of the industry in the covering red silts of all terraces.

Distinction was made between high-level red terraces above high bedrock along the Rato Khola and low-level red terraces with thick alluvial deposits above low bedrock in the Bawshi valley. The modern small Bawshi river was found to be an underfit stream with a buried channel in its wide, infilled valley, while the perennial Rato Khola, too, shows abnormalities in the proportions between its cut and fill structures.

Artefacts of the Patu industry occur at many places at all the terrace levels of the Rato and the Bawshi streams. They are always associated with the red surfaces, and wherever they are found they occur only in the uppermost part of the red silt.

The industry postdates the terrace formation and probably also the red weathering process of the terrace surfaces. The causes of why the industry everywhere and at all terrace levels was embedded in the red silt are still imperfectly understood. Explanations are sought in the possibility that the original scatter of the sites on the various terrace levels became embedded into the silt by bioturbation (termite activity, burrowing animals, etc.). Possibilities of causes by changes of climate and vegetation cover are also suggested.

Acknowledgements

I am happy to thank at this place Professor Dr. Gisela Freund, Institut für Ur- und Frühgeschichte, University Erlangen, for encouraging and promoting this project in Nepal, and to thank the Deutsche Forschungsgemeinschaft, Bonn, for financing the research, and the Research Division of Tribuhuvan University, Kathmandu, for the permission for carrying out the research. Thanks also go to Mr. J. L. Sharma, former Acting Director of HMG Department of Archaeology, Kathmandu, and Mr. R. J. Thapa, First Secretary of the Ministry of Education, Kathmandu, for facilitating and encouraging the study. Mr. Taubald at the Institute in Erlangen is thanked for drawing the figures.

Reference:

Corvinus, G. 1987: Patu, a new stone age site of a jungle habitat in Nepal. Quartär 37/38, 1987; 135–187.

Addendum

The results of a few C^{14} dates from Patu have just reached us from Dr. Geyh from the 14C Laboratory of the „Niedersächsisches Landesamt für Bodenforschung" in Hannover and are included here.

They are from Patu 2, trench 3 from charcoal found at square A2:

15913, from a depth of −0.52 m has an age of 6695 ± 155 BP
15914, from a depth of −0.71 m has an age of 6865 ± 110 BP
15915, from a depth of −0.86 m has an age of 7045 ± 110 BP

The dates are minimum ages and it is not yet clear whether they are contemporaneous with the occupation or later, in which case they may have been brought down by burrowing animals from burnt wood of a jungle fire some 7 000 years ago. The occupation of the Patu people then must have occurred before 7 000 B.P.