Three - Field Evidence
For the study of Late Pleistocene loess like formations and intercalating dark brown bands in the Kashmir valley, several sections were examined at Burzahom, Pampore, Bijbehara, Thajiwara, Sallar, Pahalgam, Anantnag, Mattan, Duru and Tangmarg (Fig. 9.11).

The sections were studied in the road cuttings, river cliffs and nala cuttings. Fresh digging and scrapping was carried out wherever the lithounits were not clear.

The deposits underlying yellowish brown silt and dark brown bands were of different lithological characters in most of the sections inspected. They varied from the fluvio-lacustral Upper Karewa as examined at Burzahom, Bijbehara, Thajiwara and Anantnag. At Duru, the yellowish brown silt directly caps fluvial deposits. It overlies fan deposits as observed at Tangmarg. At Rembiara, silt caps the fluvio-lacustral Lower Karewa.

In field, the yellowish brown silt displays characters which resemble loess i.e it maintains vertical cliffs and is

* Nala is the Hindi word for a small watercourse or a streamlet.
KASHMIR VALLEY
LOCATION OF THE SITES

Fig. 9.11
structureless. Texturally, it seems to be consisting predominantly of silt sized particles. Dark brown bands associated with loess like silt in all the formations preserved, display marked similarities irrespective of the deposit underlying them.

The writer found that in the field, the morphological expression in dark bands was rather weakly displayed and diffused. Unequivocal identification of soil features like colour, horizonation, iron or calcium carbonate accumulation, crumb structure etc in them was difficult to establish on the basis of field evidence alone. Therefore, sampling was carried out at the above mentioned sites for various investigations to differentiate between various pedological features from the non-pedological ones.

Samples were mainly collected to study chemical, mineralogical, textural, pedological and palynological features of dark bands and buff silt. Sampling was conducted on surface exposures where the lithounits were clear.

At Burzahom, sampling was carried out at close interval of 5 cm, whereas at other places sampling was undertaken at an interval of 20 - 30 cm.

Description of the type section Burzahom and other sites is as follows.
BURZAHOM

It is about 17 km north-east of Srinagar and 5 km from the famous Shalimar garden of Jahangir—the Mughal king. Situated at the foothills of Mahadev, it commands a panoramic view of the valley.

Burzahom has proved to be a place of great archaeological importance. The excavations at Burzahom have revealed settlements of earlier settlers— the Neolithic people of Kashmir, after the lake had dried and the valley was fit for habitation.

Certain features regarding origins and affinities of the Kashmir Neolithic are foreign to the Indian tradition. Among them are, the forms of bone tools, the rectangular perforated stone knife and pit dwellings and placing of domestic dogs in the grave with their masters. These features are found in the Neolithic cultures of north China and Ang-Ang-Hsi culture of Manchuria. The story goes as far back as about 2,500 B.C. These people lived in pits cut deep into the ground which were generally circular in plan, narrow at the top and wide at the base.

Burzahom has also revealed construction of a massive Megalithic circle or part circle. It has yielded a new pottery of coarse & red ware replacing that with grey or black burnish of Neolithic.
For the writer's work on Late Pleistocene formations which occur below the Neolithic debris, section facing west along the main road to Chattrahama was chosen (Fig. 10.12).

The section was scrapped thoroughly before making observations and collection of samples for various analyses. Fig. 11.13 gives a section through the formation at Burzahom. Observations made on the formation are as follows.

From the top surface of deposit '0' m to a depth of 1 m downwards, calcareous yellowish brown silt continues. Between 1 m and 1.30 m, the yellowish brown silt grades into dark brown clayey silt. The clayey silt continues up to 1.55 m and it shows moderate development of prismatic blocks.

From 1.55 m downwards to a depth of 1.65 m, the dark brown layer grades into yellowish brown clay loam. It contains caught up patches of dark brown clay loam. Below 1.65 m the same layer grades into dark brown clay loam with very well developed prismatic blocks. The average size of the blocks is about 4 x 6 cm. It has pseudolamination and there is conspicuous development of powdery carbonate along the joints and fissures. Further down, this layer continues up to 2.20 m, below that it
Fig. 10.12 General view of the Neolithic mound and the underlying Late Pleistocene silt and dark brown bands at Burzahom.
BURZAHOM
LITHOSTRATIGRAPHY

Neolithic
habitational
debris

0 m

1.30 m
dbcs (I)
ybs

1.55 m
dbcs (II)
ybs

1.65 m
dbcs (III)
ybs

2.20 m
dbcs (III)
ybs

2.55 m
gal

2.85 m
mal

3.80 m

4.0 m

4.50 m

UK

ybs — yellowish brown silt
dbcs — dark brown clayey silt
gal — greyish ashy loam
mal — mottled ashy loam
UK — Upper Karewa

Fig. 11.13
becomes slightly yellowish brown in colour. It still maintains blocky prismatic characters. The carbonate accumulation continues not only in this layer but also a layer below this to a depth of 2.90 m from top. Between 2.55 m and 2.85 m, the layer is dark brown clay loam which is very similar to the one described above. It displays more or less the same characters as those of overlying layer. Development of blocky pedds is more conspicuous in the lower layers than in the overlying layers. There is more or less a sharp contact between the dark brown layer and the lower yellowish brown clayey loam which is comparatively poor in calcium carbonate.

At a depth of about 3.80 m from top, the layer grades into greyish mottled loam with specks of decayed organic material. The layer further down, grades into mottled ashy loam at a depth of 4.0 m (Fig. 12.14). From this up to the base (4.50 m), the layer retains more or less the same characters as those of the above layers. However, the lower part of the layer (clayey loam/silt) between 4.0 m to 4.50 m shows well developed laminations. There is no trace of any coarse sand in this layer.

Between the yellowish brown loamy silt and the clayey dark brown bands, no distinct break is seen. The yellowish brown or buff silt overlying the band I from the top is
Caption.

Fig. 12.14 Gradational contact between the terminal Upper Karewa and the basal silt, at Burzahom.
more silty and less clayey as compared to the other silty loamy layers of the same section. Band I from the top surface of deposit is not as thick as the other two bands. It does not have well developed fissures and cracks. Though salt ramifications and encrustations are present in this band as they are in others.

Pedogenic kunkars, either powdery, pelley or nodular are not clearly observed at the base or little below in any of the dark bands observed at Burzahom. The only nodular kunkars seen are found in the laminated marly layers of Upper Karewa (Fig. 13,15).

The dark bands are lenticular and do not show continuity for more than few hundred metres. Such as at Garhi, which is a well preserved habitational mound on the east side of Burzahom, one can observe only one dark band in between the Upper Karewa and the habitational debris of probably early Historic period.

Burzahom and Garhi mounds are likely to be a single surface developed during Neolithic and early Historic times. At present, these two mounds are dissected by a drainage system originating in the nearby lesser Himalayan hills.

In between the two mounds of Burzahom and Garhi, one observes non-paired meandering terraces about 5 to 7 m high.
Caption.

Fig 13.15 Close view of marl, overlain by yellowish brown silt, at Burzahom.
They essentially consist of dark brown clay silt which probably is of Late Historical period. Good number of weathered pot sherds have also been found.

At Burzahom, all the dark bands associated with silt do not show any profile development. The bands do not display soil features like colour horizonation, clay illuviation at their base. Their physical characters remain essentially the same throughout their thickness.

More or less similar observations with little variation were made at Pampore, Bijbehara, Thajiwara, Sallar, Mattan, Anantnag, Duru, Banihal (Lower Munda), Shopian and Tangmarg.

PAMPORE

It is a small town about 13 km south-east of Srinagar. It is situated on the right bank of Jhelum river. Its plateaux, the Karewa above and beyond Pampore have saffron beds. It is a renowned place of Kashmir where saffron is cultivated.

At Pampore, the observations were made on formation at Kadalbal near petrol pump, 1.5 km away from the main town. The formation studied occurs on the left bank of river Jhelum along the main highway (Fig. 14,16).

The deposit is about 20 m thick, consisting of Upper
Captions.

Fig. 14.16  Upper Karewa capped by dark brown band and brownish silt (Pampore).

Fig. 14.17  Close view of dark brown showing development of prismatic blocks (Pampore).
Caption.

Fig. 15.18 Close view of blocky character of silt overlying dark brown layer (Pampore).
Karewa which are overlain by yellowish brown silt. The silt is intercalated with dark brown bands (Fig. 16.19).

The greenish laminated sands of Upper Karewa are overlain by laminated greyish loamy/silty clays. They gradually become blocky in the upper parts (Fig. 14.17). In these clays, iron oxides have developed along the cleavages. The blocky greyish clay grades into a band of brownish clayey silt in its upper parts. It is less clayey but still retains blocky character. The intensity of brownish hue increases in the upper part to a height of about 2 m from the basal laminated sands. These clays are sharply overlain by calcareous yellowish brown silt with soft kunkar pellets in it.

The silt is about 5 m thick. It is followed by another dark band of about 70 - 75 cm thickness. It is further followed by yellowish brown silt (Fig 15.18).

Other features like colour horizonation, profile development, pedal characters, kunkar concretions etc are the same as observed at Burzahom.

BIJBEHARA

It is an ancient town of considerable importance, built on both banks of the river Jhelum. It is about 50 km south of Srinagar and about 9 km from Anantnag.
**LITHOSTRATIGRAPHY**

**PAMPORE**

- ybs—yellowish brown silt
- dbcs—dark brown clayey silt
- gal—greyish ashy loam
- mal—mottled ashy loam
- UK—Upper Karewa

**BIJBEHARA**

- ybs—yellowish brown silt
- dbcs—dark brown clayey silt
- gal—greyish ashy loam
- mal—mottled ashy loam
- UK—Upper Karewa

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Fig. 16.19  
Fig. 16.20
It is a sacred and religious centre of Hindus and is also known as Kashi of Kashmir.

The deposit observed here, occurs on the left bank of river Jhelum, along the main highway.

Total height of formation investigated is about 25 m. Yellowish brown silt about 2 m thick rests directly on the Upper Karewa (Fig. 16.20). Carbonate is present in the diffused powdery form. Few molluscan shells are found in the silt. From the top surface of the deposit, about 80 cm below, one dark brown band about 50 cm thick within silt can be seen. The dark band displays striking resemblance in the characters like colour, compactness, crumb structure etc with those of Burzahom and Pampore. In the entire vertical depth of dark band, neither the profile development nor any formation of pedogenic kunkars can be observed.

THAJIWARA

It is a small town about 53 km south-east of Srinagar and 3 km east of Bijbehara. It is situated on the main road to Pahalgam from Bijbehara. It is a sacred and religious place of Hindus because of Lord Shiva's temple here.

The deposit studied here, occurs on the right bank of
Liddar in a nala cutting. Observations made here are as follows:

Total thickness of the deposit is about 10.50 to 12.0 m. The Upper Karewa are overlain by yellowish brown silty deposit. The dark brown layer which intercalates with yellowish brown silt in this deposit is very conspicuous. It occurs at a depth of 3.90 m below the top surface of terrace. The dark band continues for about a hundred metres along the formation in this area. The depth of dark brown layer is about 1 m. Colour, compactness and texture of the sediment remain the same throughout the vertical depth of dark band.

Dark band is clay rich and is fissured. Digging the band yields dark brown clay rich blocks. The average size of blocks is 5 x 6 cm. Sandy or gravelly layers are not observed in this formation.

SALLAR

About 19.5 km west of Pahalgam, it is a small village situated on the main road connecting Pahalgam with Bijbehara.

The formation selected for the studies, occurs near Arkol nala on the left bank of river Liddar. Thickness of the deposit is about 12 m. Deposit underlying silt and dark brown bands is not visible here.
SALLAR
LITHOSTRATIGRAPHY

ybs — yellowish brown silt
gl — gravel lens
dbcS — dark brown clayey silt

Fig. 17.21
Fig. 17, 21 gives a section through the deposit at Sallar.
Observations made on the deposit are as follows.

Pebbly sandy, moderately cemented gravel lense is found in association with buff silt. Lenticular disposition of the gravel lense suggests that it was laid down by an ancient tributary or a streamlet which flowed in the loess like silty landscape.

Loess like silt grades into dark brown clayey silt/loam. The formation continues for about 200 m with thickness of dark band varying from 10 cm to 70 cm. Distinct pedal characters are not displayed in the intervening dark band. There is no distinct horizonation displayed in the band. Kunkary nodules are observed in silt. Average size of nodules is 5 X 8 cm.

In the buff loess like silt, carbonate is found in the diffused form. Thickness of the dark band where sampling was carried out is about 75 cm. The dark band occurs at about 7 m depth from the top surface.

ASWARA

It is a small village which is situated about 2 km south of Thajiwara.

The deposit selected for investigations lies on the right bank of a streamlet of the braided Liddar.
From the nala bed level, the deposit is about 40 m high. The formation comprises buff silt and a dark brown layer associated with it. The underlying deposit is not exposed here. Depth of dark band is about 2 m. Buff or yellowish brown silt is very compact due to high clay content (Fig. 18.22). It also shows mottling. Dark band does not display calcium carbonate concretions at the base. It also does not have salt encrustations or ramifications. No crumb structure or pedality is seen. It appears noncalcareous and gives out compact, hard, angular blocks of 6 X 6 cm size.

PAHALGAM

It is a small, charming tourist resort which is ideally situated at the north end of Liddar valley, at the junction of the Liddar and the Sheshnag streams (Fig. 18.23).

Pahalgam is placed in the bosom of thick pine and fir covered mountains, having an elevation of about 2100 m from the sea level. It is about 96 km south-east of Srinagar. It occupies a central position in relation to the side valleys crowned by high mountains.

The formation examined here lies at the confluence of east and west Liddar near the Golf Ground.
Captions.

Fig 18.22 Yellowish brown silt (Aswara).

Fig 18.23 Cone terrace on the left bank of Liddar at Pahalgam.
20 m deposit examined seems to have been dominated by local scree (which at times is stratified), poorly sorted boulder fans which interfinger with clays. Calcareous greenish/greyish clay seems to have been deposited along with heterogenous bouldery/cobbly, gravelly material. Huge blocks of locally derived metamorphic rocks (quartzite) are deposited along with sub-rounded boulders and pebbles of long transported rocks by the Liddar.

Observations made at Pahalgam are summed up as below:

1. In the fresh exposure of glacio-fluvial morain at Pahalgam, laminated clay lenses and sand pockets are observed, suggesting fluvial action.

2. Matrix base, rubble dominated by the sub-angular fragments of black limestone suggest mud flow; whereas the angular and jagged edged glacial action along with mud flow and fluvial action.

3. The overall similarity of the deposit is with modern torrential gravels in the same area.

These observations suggest that the deposit at issue, is of glacio-fluvial origin. The predominance of clay, well sorted pebbles and rocks, indicate mud flow conditions. It seems to be more dominated by fluvial agency than by
Fig 19.24 Fluvio-glacial gravel deposit on the right bank of Liddar (Pahalgam).
The heterogenous bouldery deposit as observed at Pahalgam, was not observed at other places in the main part of the valley.

As mentioned earlier, the section is located at the confluence of the east and west Liddar. It is the site (Fig. 19, 24) from where Sankalia (1971) reported artefacts. This discovery distinctly raised a possibility of early man's existence in the Kashmir valley. It rightly revived prehistorian's interest in the prehistoric studies of Kashmir.

There are two distinct terraces at Pahalgam. The formation studied by the writer is about 60 m high from the modern level of Liddar. It consists of bouldery gravel with clay and sand which is capped by dark brown loamy silt. It differs from other formations i.e at Burzahom, Pampore, Thajiwara etc, as the silt observed here is several shades darker (4/3 10 Y R Dark brown), while the colour of silt at other places is 5/4 10 Y R Yellowish brown.

MATTAN

It is a small town situated on way to Pahalgam. It is about 61 km south-east of Srinagar and 7 km north-east of Anantnag. It is famous for its clear springs and
Martand temple dedicated to sun.

The formation investigated here is located in a cut made by an ephemeral nala. It lies at the foothill of limestone hillock overlooking the main road connecting Pahalgam with Anantnag.

Height of the fluvial terrace scrutinized from the main road is 20 m (Fig. 20.25). The terrace consists of gravelly layers which alternate with silty (yellowish brown) bands. About six gravel layers alternating with silt are observed (Fig. 20.26). Each gravel layer is about 30 cm thick, whereas the silty deposits in between the gravelly layers measure about 30 - 35 cm thick. The six gravel and silt bands are overlain by a thick deposit of silt about 2 m thick. It is again followed by four gravel and four thick silty deposits. Each gravel deposit is about 1 m thick and silt is 2 m thick. It is finally overlain by silt about 3 - 4 m thick (Fig. 21.27).

Yellowish brown silt alternating with gravel, shows the same loess like characters as are observed elsewhere at other localities described earlier. The silt maintains vertical bluffs. Its colour is yellowish brown and consists primarily of silt sized particles. Calcium carbonate is present in the diffused form and it does not contain shells.
Captions.

Fig. 20.25 Fluvial gravels interlayering with yellowish brown silt (Mattan).

Fig. 20.26 Yellowish brown silt associated with fluvial gravel exposed at Mattan.
MAT TAN
LITHOSTRATIGRAPHY

dbcs — dark brown clayey silt
ybs — yellowish brown silt
g — gravel

Fig. 21.27
Just below the top surface of the terrace, a thick dark layer is observed. It is about 1 - 1.5 m thick. The layer being very high from the road level is unapproachable, thus, its textural characters and other features could not be studied.

Silty samples were collected from the layers within reach, whereas samples from dark bands could not be collected due to their inaccessibility.

ANANTNAG

It is one of the largest towns of the Kashmir valley. It is situated 55 km south-east of Srinagar. The town is famous for its religious shrines and sulphus springs.

The Quaternary formations studied, occur in a very well exposed road cutting and a deep gorge on the road towards Pahalgam. The exposed formations are about 3 km away from the main Anantnag town (Fig. 22.28).

The formations at Anantnag form one of the most striking and unique sections for its conspicuous exposure of sediments. The sediments exposed are the Upper Karewa, boulder conglomerate which underlies Upper Karewa. The Upper Karewa are further capped by the yellowish brown silt which has intercalating dark brown layers.

The Upper Karewa are exposed throughout the road cutting. Their sedimentary characters such as lamination,
Caption.

Fig. 22.28 General view of Quaternary deposits (Upper Karewa to yellowish brown silt and dark brown bands) at Anantnag.
intercalation of clays with sands, clays and lenticular nature of various lithological units, show that these deposits were laid down in fluvio-lacustral environment. The closing phase of the Upper Karewa sedimentation is represented by calcareous clay or marl. The marl is further capped by pebbly, sandy gravel.

Anantnag hill-road cut section confirms observations made earlier at other places that Upper Karewa sands and clays (with predominance of greenish-greyish colour) laterally grade into brownish fissured clay with differential degree of dessication cracks. These cracks vary from broadly jointed to closely jointed. It displays good development of polygonal cracks and manganese staining over the cleavage planes.

Description of the formation studied is as follows. Height of the marl bed in the deposit is about 60 m above the main road. Observations are made from marl onwards, therefore, marl forms the base of section of the Quaternary formation for writer's investigations.

From marl upwards, four dark bands are observed within a depth of 20 m in the deposit (Fig. 23,29). The lowermost dark brown bands are more prominent with darker colour shade (4/3 10 Y R Dark brown). Of the two lower dark bands, the upper one is more conspicuous.
ANANTNAG LITHOSTRATIGRAPHY

- **ybs**—yellowish brown silt
- **dbcs**—dark brown clayey silt
- **fc**—fissured clay
- **bsc**—brownish silty clay
- **mb**—marly bed
- **UK**—Upper Karewa

Fig. 23.29
Thickness of dark brown layers ranges from 35 - 40 cm, whereas the buff loess like silt in between the dark bands is 2 - 3 m thick. Dark brown layers do not display any crumb structure. On digging, they yield blocks of clayey silt. The blocks are hard and can not be broken without hammer blows. They are compact and show Fe, Mn segregation.

At the top of hillock where the formation studied occurs, an undisturbed habitational site overlooking Jhelum river is found. Height of the mound is about 250 m above the main road. It is difficult to understand the nature of settlement without anticipating higher floodplain of the Jhelum during Early Historic period. There might have been a pond on the surface of Upper Karewa terrace which is exposed in the vicinity of habitational site. However, this hypothesis needs to be proved after careful excavations.

DURU

A small village which lies snugly under the south side of a bluish-grey limestone mountain on the right bank of the Sandran river. It is about 65 km south-east of Srinagar and 7 km north of Verinag - the legendary source of Vitasta - the river Jhelum.
The formation (Fig. 24.30) examined by the writer is located about 1.5 km away from the main market of village. It is exposed in a fluvial terrace on the left bank of river Sandran. The source of river is in the catchment areas of Verinag and it forms a tributary of the river Jhelum joining it on the left bank.

The fluvial terrace continues for about a hundred metres along the river (Fig. 24.31). Deposit selected for investigations and sampling is well exposed.

Height of the alluvial fill deposit studied is about 60 - 65 m from the river bed. Starting from the base of exposed section, the fill consists of yellowish brown clay of 1.5 m thickness. It is capped by about 6 m of cobbly-pebbly gravel cemented by ferruginous material. Main litho-constituents are black metamorphics.

Poorly sorted boulders as large as 1/2 m across are also present. Pebble imbrication is common. It is an ancient braid-bar deposit. The gravel is overlain by silty loam and it continues upwards till 14 m from the bed level.

Dark brown layer I makes its appearance here. Thickness of this dark band is little less than 1 m. It is further capped by yellowish brown clayey silt of 1 m thickness. At about 16 m from the bed level, dark brown layer II is seen. It is very prominent and its thickness
Captions.

Fig 24.30 Channel gravel overlain by silt and intervening dark band on the left bank of river Sandran, at Duru.

Fig 24.31 Fluvial gravel overlain by yellowish brown silt and dark bands, at Duru.
DURU

LITHOSTRATIGRAPHY

\[ \begin{align*}
\text{ybs} & \quad \text{yellowish brown silt} \\
\text{dbcs (I)} & \\
\text{ybs} & \\
\text{dbcs (II)} & \\
\text{ybs} & \\
\text{dbcs (III)} & \\
\text{ybs} & \\
\text{ybs} & \\
\text{cg} & \quad \text{cobbly gravel} \\
\text{ybc} & \quad \text{yellowish brown clay} \\
\end{align*} \]

Fig. 25.32
is about 2 m (Fig. 25.32). This layer is overlain by yellowish brown layer of silt which is more than a metre thick. It is further capped by another dark brown layer of more than a metre thickness. This dark layer is again followed by yellowish brown silt.

Yellowish brown silt in between the dark bands is unstratified and is very compact due to high percentage of clay content in it. It also displays mottled appearance. Both dark bands as well as silt yield angular lumps on digging. The lumps from the dark bands are hard, clayey and their size (6 X 6 cm) is bigger than observed at Burzahom and Anantnag. (Fig. 26.33).

Salt encrustations along the cracks and joints are not found in the deposit at Duru. All the dark bands present in this alluvial fill deposit do not display kunkar formation at their base. The dark bands parallel to each other continue horizontally for few hundred metres but they pinch and merge at places. All the bands apparently appear to be non-calcareous clays.

KULGAM

It is a town which is very picturesquely situated on the southern side of a table-land overlooking the left bank of the river Vishav, whose bed is spread out and
Captions.

Fig. 26.33 Close view of dark band showing development of prismatic blocks at Duru.

Fig. 26.34 General view of deposit showing disconformable relationship between fan gravel and overlying silt, (Kulgam)
divided into several channels. Th. 6847.

The town lies about 61 km south-west of Srinagar and 22 km west of Anantnag. The Jhelum floodplain abuts against 9 m to 12 m high floodplain terrace (fill terrace of river Vishav near Kulgam). The fill abuts against older fill (boulder gravel at the base and brown clay loam at the top (Fig. 26.34). The fill is post-Upper Karewa in age as it caps Upper Karewa formation with unconformable contact. The loam phase is thus older than sub-recent fill phase and younger than Upper Karewa phase. It is therefore, of Late Pleistocene age only, and contemporary with Duru, Pahalgam, Mattan loam phase. Thus, Late Pleistocene stratigraphy is as follows (older to younger),

A. Upper Karewa loam member

Disconformity - downcutting

B. Cone - fills formation with considerable facies change. Torrent (morain like) boulder gravels, braid bar gravels, channel gravels, scree, sands (in the lower part) and brownish clay loam with several dark bands and similar to upper part of Upper Karewa loam.

Disconformity - downcutting Th. 6847.

C. Alluvial fill - predominantly loamy with gravel beds at the base.
Field relationship between A, B, C are complex. Correlations based on altitude alone are not sufficient. Description of the section observed is as follows:

Height of bench - 680 m
Height of profile - 690 m from road level
Top - 0 cm
0 cm - 40 cm - Layer I, grades into
40 cm - 70 cm - Layer II,
70 cm - 1.20 m - Layer III, it further grades into
Layer IV which is 1.20 m below.

LAYER I
Yellowish brown clayey silt has little diffused calcium carbonate and is rich in muscovite. It has slightly blocky structure and coating of Mn and FeO (Iron Oxide) along the joint planes.

LAYER II
It consists of brownish silty clay with good development of blocky structure. Proportion of dark manganiferous and ferruginous coating increases by about 25% in comparison with overlying layer. It is harder than Layer I.

LAYER III
It is dark brown in colour and consists of silty clay with conspicuous development of prismatic blocks. Dark
colour of manganiferous coating increases by about 50%.

**LAYER IV**

It is similar to Layer II. It continues to about a depth of 5 cm. Development of illuvial calcium carbonate is not observed anywhere in this section.

**DILPUR**

The village Dilpur in Nagaum town lies about 20 km south-west of Srinagar on way to famous religious shrine Tschrari-sharif.

The formation observed is located near Nilnag facing west, and is 65 m above nala bed level. Up to 65 m, the deposit displays boundary gravel in the lower part which is overlain by yellowish clay and greenish sand. It is interlayered with lenticular thin 2 - 4 cm pebbles. Karewa sands and clays show depositional dip and slump structure. They also show pseudofold due to gravitational settling. The lenticular pebbly thin layer is further capped by brownish clay. It is again overlain by so called Older Loess- the term coined by Bhatt (1982).

The basal part of loess like silt has fluvial sand, yellowish brown finely laminated clay. It gradually grades into blocky clay with a thickness of 1.5 m.

The uppermost part of brown clay shows Mn segregation
and coating on pedal surface. The upper part also shows finely assimilated powdery carbonate and has granular appearance. The clayey sediments show good columnar structure while silty calcareous sediments have granular structure.

The deposit is capped by silty loam which is finely laminated. Distinct illuvial calcium carbonate horizon is not observed within a depth of about 2 m. The kunkar concretions have developed along the polygonal joints in the loamy silt. The kunks observed in the deposit are of sheet type.

The deposit at Dilpur differs from other deposits observed as at Burzahom, Anantnag or Duru because the dark brown layer at Dilpur is not as clayey as at other sites. There is also some colour variation due to clay and other constituents. In general, the observations on this formation do not significantly differ from that of north-eastern part of the valley.

BANIHAL (LOWER MUNDA)

The name of the pass by which the main road from Jammu to Srinagar crosses the Pir Panjal Range, lies 70 km south of Srinagar and about 9.5 km south-west of Verinag in the Shahabad valley.
Captions.

Fig. 27.35 General view of silty deposit on the flanks of Pir Panjal, at Banihal.

Fig. 27.36 Gradational contact between ashy grey clay and overlying brownish silt of Late Pleistocene period, (Banihal)
Formation selected for the examination at Banihal lies perched at the foothills of the Pir Panjal Range. It is located 7 km before crossing the Jawahir Tunnel from Srinagar. (Fig. 27.35).

Gradation from greenish grey clayey silt to mottled ashy loam which further grades into yellowish brown silt is very well observed in this deposit (Fig. 27.36).

At least three dark brown bands are observed along the Jammu-Kashmir National Highway. Depth of dark bands varies from 1 - 1.5 m. Physical characters like colour, compactness, cracks in the band, clayey nature are similar to those observed at other localities mentioned earlier in this chapter.

HIRPUR (SHOPIAN)

A small and scattered village which lies about 16 km south-west of Shopian on the road towards the Pir Panjal pass and 48 km south-west of Srinagar. It is beautifully situated on the right bank of the river Rembiara.

The Hirpur formations are one of the most unique and striking of all the formations in the entire Kashmir vale because they display sediments covering an age span from Miocene-Pliocene (Roy, 1975) to Holocene. The typical Lower Karewa or the famous Hirpur Formations are exposed at
Hirpur village. The well exposed lithounits occur on the left bank of river Rembiara.

The formations have been worked on by De Terra and Paterson (1939), Wadia (1941, 1951), Bhatt (1975, 1982), Roy (1975), Agrawal et al (1978, 1979, 1982), Burbank (1983), as cited elsewhere.

Bronger's magnetic stratigraphy and fission track dates on Hirpur Formations (one of the four worked on by him) date the sediments back to 4 m.y.

The Lower Karewa (Hirpur Formation) abut against the steep slopes of Pir Panjal in the piedmont zones. It is about 1,200 m thick, showing best development in the Rembiara valley near Hirpur village. The formation is characterised by cemented basal torrent gravels which can be seen interlensing with grey to bluish-grey clay, light grey sandy clay, lignite and lignitic clay, coarse to medium grained sand and conglomerates. They gently dip and fold (in Dubjan near Hirpur).

A good exposure of moderately sorted channel bar gravel is observed in the upper part of gravel in the form of a lense in otherwise shaley clays, sands etc.

Post-Upper Karewa terraces are fairly high. They are dominated by boulder fans and brown loams (as seen around
Captions.

Fig. 28.37 General view of alluvial terrace developed on Lower Karewa, at Hirpur.

Fig. 28.38 General view of Ferozpur valley, Tangmarg.
Pahalgam). These terraces are essentially cones and truncate against sub-recent floodplain of Jhelum (Fig. 28.37).

About 2 km downstream of Rembiara river on the right bank, two dark bands are observed in the brown silt. Thickness of each band is about a metre. Characters like colour, clayey nature, compactness, mottled appearance are like other dark bands seen at Duru, Burzahom and Aswara.

TANGMARG

40 km north-west of Srinagar in Ferozpur valley is situated Tangmarg. It is one of the most famous and beautiful tourist resorts of the Kashmir valley. At the foothills of Pir Panjal, it is surrounded by thick pine forests.(Fig. 28.38).

The formation examined at Tangmarg is exposed in a terrace on the main road (connecting Tangmarg with Srinagar) about 3 km away from the main market of Tangmarg. The terrace lies about 45 - 55 m above the river level. Fig. 29.39 gives a section through the formation at Tangmarg. The gravel present in the deposit at Tangmarg has been described as Karewa gravel by De Terra (1939). The gravel overlies Lower Karewa. It is further capped by yellowish brown silts and intervening dark bands.
TANGMARG
LITHOSTRATIGRAPHY

ybs — yellowish brown silt
dbcs — dark brown clayey silt
g — gravel

Fig. 29.39
De Terra (1939) has referred to the silts as Upper Karewa silts and not as a separate lithounit. Further, he has described the dark bands rich in conifer pollen and on this basis ascribed an aeolian origin to the dark bands at Tangmarg (De Terra, 1939, p. 168).

Writer's observations which are mainly confined to yellowish brown silt and associated dark brown layers, observed three brown bands in silt at Tangmarg. The formation continues for few kilometres along the main road towards Srinagar (Fig. 30.40).

The dark brown layers however, do not show lateral continuity for long distance. They pinch and merge with under and overlying deposits.

For detailed inspection and sampling, middle band in the formation has been chosen. It is the thickest of all the three dark bands in that deposit. Thickness of the selected band is about 1.5 m (Fig. 30.41) whereas the other two bands are 1 m thick. The silt in between two successive dark bands measures about 1 - 1.5 m.

As observed at Duru, the dark bands consist of compact, hard, angular blocks of various sizes. Average size is 6 x 8 cm. No salt encrustation or ramifications are observed. All the dark bands are devoid of kunkar formations at their base. Mottling of grey and reddish
Captions.

Fig. 30.40 General view of Late Pleistocene formations at Tangmarg.

Fig. 30.41 Close view of dark brown band showing development of prismatic blocks at Tangmarg.
brown colour can be seen in dark bands. Throughout the vertical depth of dark band no pedogenic variation is seen. The yellowish brown silt separating the two dark bands shows mottling very clearly. Dark bands yield angular blocks on digging, they are hard and compact. No colour horizonation is seen in dark bands.

Apparently, the characters are the same throughout the vertical depth of dark band and no variation in sediments is noticed. The dark bands as observed at Duru, appear noncalcareous. There is no distinct break or sharp contact between the dark bands and intervening silt. Contact between the two seems more gradual than abrupt.

RANGI

It is a small village which is located about 15 km north-west of Srinagar.

The formation scrutinized, occurs along the Srinagar Sopore road. The deposit is about 10 m thick. It comprises yellowish brown silt which rests on the Upper Karewa. The silt has one dark brown layer in it. The transition between the Upper Karewa and overlying silt is not very clear due to lack of good exposures. However, the basal part of silt can be described as dark brown and clayey.
Fig. 31.42 Fissures and mottling in the dark brown band at Rangi.

Fig. 31.43 Yellowish brown silt and dark brown bands in the north-western part of Kashmir.
It is similar to the one observed at Dilpur in Kagaum.

Dark band examined in this formation, distinctly displays reddish brown and purplish mottling (Fig. 31.42). Blocky nature of dark band is also very clear in the deposit. They are angular and appear clayey. They are hard, compact and heavy with average size of 5 x 5 cm. Pedal characters are not distinct in the band. Features like colour, compactness remain unchanged throughout its vertical depth of about 1 m.

Powdery carbonate or salt ramifications are not present in the dark band nor is there any kunkar formation at the base of dark layer.

Apart from observations made at the sites described above, Sopore, Baramulla and Bandipur in the north and north-western part of Kashmir valley were also visited by the writer. At these localities, samples were collected from the Late Pleistocene formations.

Observations made at Sopore and Bandipur, on the buff silt and associated dark bands (Fig. 31.43, & 32.44) are strikingly similar to the ones made in the south-eastern part of Kashmir. No significant variation is found between the silts on Pir Panjal side (so called Older Loess) and the silts on Himalayan side (Younger Loess).

From the above mentioned sites, samples were collected
Caption.

Fig. 32.44 Yellowish brown silt associated with fluvial gravel in the north-western part (Sopore) of Kashmir.
for various investigations. They were properly labelled and sealed in plastic bags untill required for analyses.

All the field observations made in Kashmir, are summed up as below.

1. The contact between Upper Karewa laminated sand, clay member and the overlying yellowish brown silt is gradational. It gradually grades into greyish ashy loam which further grades into greyish mottled loam. It finally merges into yellowish brown silt.

2. The yellowish brown silt alternates with at least two to three dark bands. But more than three intercalating dark bands also have been observed such as at Anantnag.

3. Buff or yellowish brown loess like silt is unstratified and shows mottling.

4. Silt along with dark bands, caps not only the Upper Karewa but also fluvial sediments such as at Duru, and Mattan and fan deposits as seen at Tangmarg.

5. Thickness of dark brown layers in the buff silt varies greatly at different places. It ranges from 15 cm (Anantnag) to more than 1.5 to 2 m (Duru and Tangmarg).

6. Dark bands do not show lateral continuity. They pinch
and merge with under and overlying deposits.

7. Physical characters like colour, compactness, crumb structure remain alike throughout the vertical depth of a dark layer.

8. Dark brown layers have well developed prismatic blocks of various sizes. Average size being 6 X 6 cm. Blocky development is more conspicuous in the lower layers than in the upper ones.

9. Dark bands display reddish brown and purplish mottling as observed at Rangi.

10. Dark brown colour of the angular blocks from dark bands is not uniform. The blocks reveal much lighter colour inside than on outer surface on breaking.

11. During various field trips, no fossil bones, wood, charcoal or similar material suitable for dating was found.

12. In the course of numerous field trips, the writer did not find palaeoshorelines of ancient Karewa lake on the Pir Panjal Range in Kashmir valley. The hypothesis was put forward by Bhatt (1976) on the basis of hypothetical shifting of Karewa lake from south-east to north-west.

Writer also carried out explorations for the Palaeo-
lithic tools in the valley. It was extensively conducted in the Liddar valley in Pahalgam from where the Early Palaeolithic tools were reported by Sankalia (1971) from the fluvio-glacial deposit at Pahalgam (Fig. 19.24). However, despite extensive explorations, no tool was found either in the Liddar valley or at other sites where explorations and studies were carried out. Pseudomorphs (pseudotools) are found in abundance which can be easily mistaken for tools, for they flake and chipp off easily.

Samples collected during various field trips have been studied in the laboratory at Deccan College in Pune. Samples were subjected to various chemical, textural, pedological and palynological investigations.

FIELD EVIDENCE (GUJARAT)

Apart from the Kashmir valley where writer carried out major part of field work, it was also conducted in the Mahi river valley in Gujarat (Fig. 33.45) in western India.

The formations examined in the Mahi valley comprise yellowish brown silts and associated buried soil band in it. The silts in the Sabarmati and Mahi valleys were initially described as loess of aeolian origin by Zeuner (1950). The hypothesis was propounded on the basis of physical
GUJARAT
LOCATION OF THE SITE

- Site studied

Fig. 33.45
characters like colour, impalpability, capacity to maintain vertical cliffs and predominance of silt sized particles. However, these silts were later proved to be of fluvial origin (Lele, 1972).

Main purpose of extending investigations to the Mahi valley, was to make comparative studies between the silt and associated buried soil layer at Mahi valley with the buff silt and dark brown bands in Kashmir.

For detailed examination of the deposit and sampling, Dabka village was chosen. It is situated at a distance of about 24 km south of Baroda and 1 km westwards where the river meanders.

A cliff on the right bank of Mahi river was chosen. The formation is exposed over a vast stretch of distance in the area along the river (Fig. 34.46).

The stratigraphy of Mahi at Dabka is as given below.

1. Hard clay - 2 m
2. There is no gravel and it is directly overlain by a silty deposit which is about 8 m thick.
3. Buried soil which has a thickness of more than 1 m.
4. Buried soil is again overlain by silt. It has a thickness of about 7 m.
5. Modern black soil which has a depth of about 2 m.
Fig. 34.46 View of yellowish brown silt at Dabka in Mahi valley in Gujarat.
Total height of the cliff is in the range of 21 to 23 m. At many places it is still higher whereas at many places it has been eroded away.

Observations made on the soil layer during sampling are as follows:

1. 0 cm - 40 cm - Silty sand. Yellowish brown, it has occasional calcium carbonate pellets.
2. 40 cm - 58 cm - Brown compact sandy clayey silt.
3. 58 cm - 1.25 m - Reddish brown sandy silt, rich in calcium carbonate pellets and concretions. Average size of the pellets is 1/2 cm to as big as 1.5 cm.
4. 1.25 m - 1.75 m - Brownish silty sand with occasional calcium carbonate concretions. This grades into medium to fine sand up to a depth of 2 m.

Reddish horizon represents illuvial zone whereas the top is suspected elluvial horizon. Pedality is poor. No crumb structure is seen. Some platy structure is seen only in the upper part.

Samples collected at Dabka were analysed for chemical, textural, pedological and palynological investigations. All the results are summarised in the following chapter.