CHAPTER 3
LOWER TERTIARY BIOSTRATIGRAPHY

The various subdivisions of the Lower Tertiary beds of Rajasthan have already been indicated in Chapter 1. In the present Chapter, the detailed biostratigraphic successions at different localities have been dealt with. Five different stratigraphic successions were studied during the course of the present investigation. A total of 138 bed-by-bed samples were collected from these localities. The details of the localities are given below:

(A) District Bikaner

Locality I - Mudh (27° 51' 30" N: 72° 56' E), thirty-two miles WSW of Bikaner town and two miles WNW of Srikolayatji (samples M/1 to M/64).

Locality II - Palana (27° 50' N: 73° 15' E), fourteen miles south of Bikaner.

IIA, half-a-mile west of colliery office, Palana (samples P/A1 to P/A11).

IIB, three miles west of Palana town (samples P/B1 to P/B38).
(B) District Jaisalmer

Locality III - Bandah (27°11'N: 70°22'E), forty-five miles WNW of Jaisalmer town (samples B/1 to B/17).

(C) District Barmer

Locality IV - Bhadka (26°3'30" N: 71°25'30"E)
twenty-six miles NNW of Barmer town. (samples BH/1 to BH/6).

The stratigraphic successions exposed in these localities are given below.

**GEOLOGY AND STRATIGRAPHIC SUCCESSION AT LOCALITY I**

The Lower Tertiary beds at Mudh occur in an area of nearly five square miles. Since there is no important landmark in this particular stretch the following account of the geology of the area is given with reference to two milestones numbered 32 and 33 on the main Bikaner-Bap road which passes through this area (Text Figure III). The foot path leading from the Mudh village meets this road near the 32-milestone.

The Lower Tertiary beds in the area occur in a 'S'-shaped outcrop and are unconformably overlain by the ?post-Eocene beds of the Jogira Formation. These are in turn capped by
TEXT FIGURE III - MAP SHOWING THE LOCATION OF SECTIONS STUDIED AT LOCALITIES I-MUDH, II A AND II B-PALANA.
the recent alluvium and aeolian sand. The beds of the Jogira Formation occur as prominent plateau and it is mainly as a sequel to the erosion of these beds that the Lower Tertiary succession is exposed. The stratigraphic succession worked out by the author is described below (Text Figure IV).

PALANA FORMATION

The oldest beds in the area i.e. those belonging to the Palana Formation occur in an outcrop east of the 32-milestone. The beds of this formation are composed of predominantly white clays with interbedded friable and ferruginous sandstone. Towards the top of the Palanas, and at the base of the Khuialas, there is a well marked laterite bed which indicates a distinct unconformity in the succession. The white clays are extensively quarried at Mudh and at Kotri for pottery and allied works.

It is not possible to estimate the total thickness of the Palana Formation as the base is nowhere exposed in this area. However, according to Ghosh (1952) a thin band of lignite (similar to the one which is being mined at Palana) occurs in this area at a depth of 208 feet below the surface. Since this lignite belongs to the Palanas (see description of the successions at Palana, p.30) and the dips in general are 5° to 10° towards the north-west, the total thickness of the formation would be more than 200 feet.

KHUIALA FORMATION

The Khuialas rest unconformably on the Palanas and
cover the major part of the Lower Tertiary outcrop. They attain a thickness of about 300 feet. They are of varying lithology and consist of calcareous shales, limestones, Fuller's earth, red shales and sandstones. The calcareous shales and limestones are richly fossiliferous and contain a prolific micro- and mega-fauna. On the basis of larger foraminifers and pelecypods it is possible to subdivide the Khullialas into six distinct assemblage zones. These zones, in ascending order, are described in the sequel.

Zone I - Assilina granulosa zone

This lowermost zone, which is approximately 40 feet thick, is named as Assilina granulosa zone and rests directly on the laterites of the Palana Formation. Lithologically, the beds of this zone comprise whitish-yellow Fuller's earth (20 feet) at the base followed by earthy yellow calcareous marlstones. These calcareous marlstones contain abundant oysters in the lower horizons and Assilina granulosa (d'Archiac) in the upper. The other predominant fossils in this zone are as follows:

Foraminifers: Nummulites sp., Operculina sp., Rotalia subgranulosa Jacob and Sastri, Cibicides aknerianus (d'Orbigny).

Ostracodes: Cuneocythere (Monsmirabilia) sp., Anticythereis mamorans mudhensis new subspecies, Cytherella protuberantis Lubimova and Guha, Cushmanidea tewarii new species.
Zone 2 - Assilina daviesi zone

This zone is about 123 feet thick and consists mainly of calcareous shales (107 feet) at the base and earthy yellow limestone (16 feet) towards the top. A well-marked whitish limestone, 3-feet thick, occurs in the calcareous shale about 56 feet from the base of this zone. This limestone contains abundant Nautilus sp. and other invertebrate fossils. Both the calcareous shales and the yellow limestone contain abundant specimens of Assilina daviesi de Cizancourt on account of which the zone is named as such. The other predominant fossils of this zone are as follows:

Foraminifers: Nummulites atacicus Leymerie, Operculina sp., Rotalia subgranulosa Jacob and Sastri, Cibicides akkenerianus (d'Orbigny), Discorbis sp., Clavulina sp., Pyrgo sp. cf. P. elongata (d'Orbigny), Bulimina sp.

Ostracodes: Krithe indica Tewari and Tandon, Quadracythere lagaghiroboensis (Apostolescu), Xestoleberis subglobosa (Bosquet).

Zone 3 - Assilina lacunata Zone

This zone is about 32 feet thick and consists of fine grained, hard, massive white limestone in the lower part and argillaceous limestone in the upper, containing abundant specimens of Assilina lacunata de Cizancourt. The zone is
accordingly named after the above species. The beds of this zone are rich in molluscs and echinoids and the same species persist here as in the underlying zone. *Nautilus* sp. occurs commonly only in the massive white limestone. The other predominant fossils present in this zone are listed below:

**Foraminifers:** *Nummulites atacicus* Leymerie, *Cibicides akne-rianus* (d'Orbigny), *Quinqueloculina* sp., *Pyrgo* sp., *Clavulina* sp.

**Ostracodes:** *Krithe indica* Tewari and Tandon, *Xestoleberis subglobosa* (Bosquet), *Bairdia poddari* (Lubimova and Mohan), *Paracytheridea eocenica* new species.

**Zone 4 - Venericardia mutabilis zone**

This zone is approximately 50 feet thick. It is predominantly argillaceous and comprises Fuller's earth at the base, successively overlain by red clays and shelly limestone. Larger foraminifers are very poorly present and only some small-sized *Nummulites* sp. are met in the lower horizons. The zone however, is rich in megafossils. The Fuller's earth and red clays in the lower horizons contain abundant *Venericardia mutabilis* (d' Archiac and Haime) and *Ostrea* sp. These fossils occur mostly in pockets. The limestone in the upper horizons is full of oysters. Except for a few specimens which have been identified as *Ostrea multicostata* Deshayes, most of the oysters are indeterminate. The zone is named after *Venericardia mutabilis*, the dominant pelecypod. The microfossils
which occur in this zone are listed below:

Foraminifers: *Cibicides aknerianus* (d'Orbigny), *Discorbis* sp., *Nonion scapha* var. *indica* Jacob and Sastri, *Rotalia subgranulosa* Jacob and Sastri.


**Zone 5 - Assilina sp. Zone**

This zone is only 8 feet thick and consists of earthy brown limestone with abundant tests of *Assilina* sp. and the zone is named after this species. The species was recognised as *Assilina exponens* (Sowerby) by Singh (1953C). However, this species of *Assilina* from the zone under study differs considerably from *A. exponens* in shape, surface ornamentation and size. The other predominant species which occur in this zone are as follows:

Foraminifers: *Cibicides aknerianus* (d'Orbigny)

Zone 6 - Barren zone

The Assilina sp. zone is overlain by about 50 feet thick beds comprising clays, friable sandstones and ferruginous sandstones. These are devoid of any fossil remains and are accordingly grouped as Barren zone.

BANDAH FORMATION

The youngest beds in the Lower Tertiary succession of the area are those of the Bandah Formation. The beds crop out in a small area about 200 yards NNW of the 33-milestone and 3 1/2 miles WNW of Mudh village. (Singh 1953C inadvertently referred to this locality as 3 1/2 miles WSW of Mudh village.) The outcrop of the Bandahs trends almost N-S and is somewhat sickle-shaped. These beds occur in a gently plunging syncline, the plunge being towards ESE. The dips in either limb do not exceed 15°. There is a minor fault which effects the beds. This fault strikes NE-SW with downthrow towards NW. The formation is divisible into the following two assemblage zones:

Zone 7 - Discocyclina sella zone

This zone is about 18 feet thick and comprises whitish-yellow limestone with abundant Discocyclina sella (d'Archiac). The zone is named after this species. The other predominant microfossils of the zone are listed below:
Foraminifers: Discocyclina sowerbyi Nuttall, Nummulites stamineus Nuttall, Operculina sp., Cibicides vortex Dorreen, Rotalia calcar (d'Orbigny), Glandulina sp., Rotalia subgranulosa Jacob and Sastri, Fursenkoina dubia var. robusta (Haque), Nonion scapha var. indica Jacob and Sastri, Textularia agglutinans var. nalinnesensis Kaasschieter, Textularia punjabensis Haque, Pyrgo sp. cf. P. elongata (d'Orbigny), Cibicides sp. cf. C. dutemplei (d'Orbigny), Discorbis perplexa Le Calvez, Asterigerina mudhensis Bhatia and Khosla, Asterigerina pandei Bhatia and Khosla, Sphaerogypsina globulus (Reuss).


Zone 8- Nummulites maculatus zone

Like the underlying zone, this zone is also about 18 feet thick and comprises whitish-yellow limestone with Nummulites maculatus Nuttall as the dominant species. The other predominant microfossils are as follows:

Foraminifers: Nummulites stamineus Nuttall, Dictyoconoides cooki (Carter), Alveolina elliptica var. flosculina Silvestri, Discocyclina dispansa (Sowerby), Operculina sp., Asterigerina mudhensis Bhatia and Khosla, Asterigerina pandei Bhatia and


**JOGIRA FORMATION**

The Bandahs are overlain by the Jogiras of ?post-Eocene age. These are approximately 40 feet thick and comprise greyish-white grits and fireable sandstones in the lower horizons and lime-kankars and ferruginous nodules in the upper. The beds are unfossiliferous.
# STRATIGRAPHY SUCCESSION IN WESTERN RAJASTHAN

(Compiled from data obtained from several sources including Geological Survey of India publications; Singh, 1969; Swaminath et al., in Roy, 1962A; Siddique and Bahl, 1965; Narayanan et al., MS, fide Srivastava, 1966; and author's personal observations.)

<table>
<thead>
<tr>
<th>Age</th>
<th>District Bikaner</th>
<th>District Jaisalmer</th>
<th>District Barmer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent</td>
<td>Aeolian Sand</td>
<td>Aeolian Sand</td>
<td>Aeolian Sand</td>
</tr>
<tr>
<td>Sub-Recent</td>
<td>Alluvium and Lime-Kankars</td>
<td>Amir Shingle beds</td>
<td>Conglomerates</td>
</tr>
<tr>
<td>Upper</td>
<td>Jogira Formation-Grits and sandstones</td>
<td>Jogira Formation-Grits and sandstones</td>
<td>Jogira Formation-Grits and sandstones</td>
</tr>
<tr>
<td>Tertiary</td>
<td>Bandah Formation- Whitish yellow limestone with abundant foraminifers</td>
<td>Bandah Formation - Whitish yellow limestone with abundant foraminifers</td>
<td>Bandah Formation - Whitish yellow limestone with abundant foraminifers</td>
</tr>
<tr>
<td></td>
<td>Khujiala Formation - Calcareous shales, limestone, Fuller's earth, red shales, and sandstones, with abundant foraminifers</td>
<td>Khujiala Formation - Calcareous shales, limestone, Fuller's earth, sandstones, with abundant foraminifers</td>
<td>Khujiala Formation - Fuller's earth</td>
</tr>
<tr>
<td>Palaeocene</td>
<td>Palana Formation - Grits, sandstones, clays associated with lignite</td>
<td>?</td>
<td>Palana Formation - Clays and lignite</td>
</tr>
</tbody>
</table>
COMPARISON OF THE SUCCESSION WITH THAT OF SINGH'S SUCCESSION

The stratigraphic succession discussed above differs in some detail from the succession recorded by Singh (1953C). The main differences relate to the subdivisions of the Khualas into assemblage zones and the stratigraphical position of the Fuller's earth beds. According to Singh the Fuller's earth beds are interbedded with limestone rich in Assilina granulosa and these lie at the base of the Khualas. However, a detailed study of the area reveals that Fuller's earth occurs at two distinct stratigraphic levels, one near the base, above the laterite beds, and the other 23 feet below the top of the Khualas. A comparison of the succession at Mudh as worked out by the author and that by Singh is given in Table 4.

STRATIGRAPHIC SUCCESSION AT LOCALITY II

The Lower Tertiaries at Palana, situated about 20 miles west of Mudh and 14 miles south of Bikaner occur as subsurface beds. These are concealed beneath the beds of the Jogira Formation and the aeolian sand. The area is well known for lignite mining for over half a century. Unlike Mudh, the Palana Formation here is represented by a thick seam of lignite underlain by grits and sandstones and the Khualas by two assemblage zones viz. Assilina granulosa zone and Assilina daviesi zone. The latter zone is directly overlain
<table>
<thead>
<tr>
<th>Singh (1953c)</th>
<th>Present author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stratigraphic division</td>
<td>Thickness</td>
</tr>
<tr>
<td>Post Kirthar grits</td>
<td>40'</td>
</tr>
<tr>
<td>Equivalent of Lower part of middle Kirthar, Bed No.1, white Nummulites band yellow Nummulites band</td>
<td>18'</td>
</tr>
<tr>
<td>Lower Kirthar Bed No.2 yellow Discocyclina band white Discocyclina band</td>
<td>18'</td>
</tr>
<tr>
<td>Ferruginous band</td>
<td>8'</td>
</tr>
<tr>
<td>Upper Laki, Assilina exponens band Shelly band</td>
<td>8'</td>
</tr>
<tr>
<td>Lower part of upper Laki, Nummulites atacticus and Assilina davlesi band</td>
<td>20'</td>
</tr>
<tr>
<td>Middle Laki</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>?Eocene Palana Lignite</td>
<td></td>
</tr>
</tbody>
</table>
by Jogira Formation. At Palana, two underground sections were studied from localities IIA and IIB (Text Figure III).

**Locality IIA**

The Lower Tertiary beds at the locality under study occur at a depth of 70 feet below the surface. The succession has been worked out from the core samples and other data made available by the Department of Mines and Geology, Rajasthan. A brief description is given below (Text Figure V).

**PALANA FORMATION**

The beds of this formation comprise grits, sandstones and clays in the lower horizons and a 4-feet thick lignite seam in the upper. Except for the lignite, the beds are unfossiliferous and the precise thickness is not known, as the base was not touched in this drilling.

**KHUIALA FORMATION**

The Palanas are overlain by the Khuialas and these are approximately 176 feet thick. The formation is divisible into two assemblage zones—Assilina granulosa zone and Assilina daviesi zone—equivalent to similar zones at Mudh. A brief discussion of each of these zones is given below in ascending order.
Zone 1 - Assilina granulosa zone

This zone is 162 feet thick. Lithologically, the zone is divisible into two horizons. The lower horizon consists of grey shales (72 feet) with two bands each 10 feet thick, rich in larger foraminifers; one 31 feet above the base and the other 61 feet. The upper horizon consists of whitish-yellow Fuller's earth (90 feet) with a thin band (8 feet) rich in larger foraminifers occurring 18 feet above the base of the Fuller's earth. The predominant microfossils in this zone are as follows:

Foraminifers: Assilina granulosa (d'Archiac), Nummulites sp., Cibicides aknerianus (d'Orbigny) Asterigerina indica Jacob and Sastri, Nonionella sp., Rotalia crookshankiana Jacob and Sastri.


Zone 2 - Assilina daviesi zone

This zone is only 10 feet thick and consists of
calcareous shales with abundant species of Assilina daviesi de Cizancourt and Nummulites atacicus Leymerie.

JOGIRA FORMATION

The Khuiala Formation is overlain by the Jogira Formation. This is 66-feet thick and consists of grits, clays associated with lime-kankars, similar to the beds at Mudh.

Locality IIB

The Lower Teritary beds at Locality IIB occur at a depth of 120 feet below the surface. The stratigraphic succession was studied in the Lignite Mine. The succession is given below (Text Figure VI).

PALANA FORMATION

The beds of this formation consist of clays, sandstones and grits at the base, overlain by a 20-feet thick seam of lignite at the top. The lignite seam at places has been washed away and replaced by clay pockets. The total thickness of the formation is not known.

KHUIALA FORMATION

The Khuialas overlie the Palanas with an unconformity and are 70-feet thick. As at locality IIA, the beds at this locality are divisible into two assemblage zones viz. Assilina
granulosa zone and Assilina daviesi zone. The description of the each zone in ascending order is given below:

Zone 1 - Assilina granulosa zone

The zone is 60 feet thick and comprises grey pyritous shales (12 feet) in the lower horizons, and Fuller's earth (48 feet) in the upper. The latter bed, towards the top, is rich in Assilina granulosa (d'Archiac). The other pre­dominant microfossils are as follows:

Foraminifers: Nummulites sp., Cibicides aknerianus (d'Orbigny), Glandulina laevigata (d'Orbigny), Asterigerina indica Jacob and Sastrri.

Ostracodes: Krithe bartonensis (Jones), Cytherella protuberan­tis Lubimova and Guha, Echinocythereis jaini new species, Paracytheridea eocenica new species, Xestoleberis sp. X. muelleriana Lieneklaus, Cytherella palanaensis new species, Ruggieria bhatiai new species, Cytherelloidea guhai new species, Parakrithe pandei new species, Leguminocythereis lunghiensis Guha, Occultocythereis mithali new species, Paijenborchella (Eupaijenborchella) indica new species, Paijenborchella (Eupaijenborchella) sp. indet.

Zone 2 - Assilina daviesi zone

This zone is 10 feet thick and is represented by calcareous shales crowded with tests of Assilina daviesi
de Cizancourt and *Nummulites atacicus* Leymerie.

**JOGIRA FORMATION**

The Khuiialas are overlain by 116-feet thick beds of the Jogira Formation with a stratigraphic break as at locality IIA and I.

**GEOLOGY AND STRATIGRAPHIC SUCCESSION AT LOCALITY III**

The only well-developed Eocene succession which occurs in the Jaisalmer District, is along Jaisalmer-Bandah road between Khuiiala and Bandah (Text Figure VII). Since the area lies close to the international border between India and Pakistan, geological mapping could not be undertaken for security reasons. However, the author worked out the stratigraphic succession and made bed-by-bed collection of the specimens from Bandah with a view to work out the microfauna and correlate the succession with that of Bikaner district.

At locality III, near Bandah, only the upper part of the Khuiiala Formation and the Bandah Formation crop out while the lower part of Khuiiala Formation is exposed near Khuiiala village. The beds in general dip 2° to 3° due west. The stratigraphic succession at locality III is slightly different from that at locality I. However, insofar as the upper part of Khuiiala Formation is concerned, there is not much difference.
TEXT FIGURE VII—MAP SHOWING THE LOCATION OF SECTION STUDIED AT LOCALITY III-BANDAH.
between the two localities. These are represented by three assemblage zones viz. Assilina lacunata zone, Venericardia mutabilis zone and Assilina sp. zone similar to that at locality I, except that the individual zones here are comparatively thin. The Venericardia mutabilis zone is represented by 3-feet thick Fuller's earth. The red shales and oyster limestone which occur at locality I are absent here. The barren zone is also absent at locality III. The Bandah Formation also shows slight difference in zonation from that of locality I. The lower Discocyclina sella zone is present at both the localities but the overlying zone at locality III contains abundant specimens of Discocyclina dispansa instead of Nummulites maculatus. However, on grounds of similarity of other microfauna in the Discocyclina dispansa and Nummulites maculatus zones, the two are considered equivalent. The stratigraphic succession at locality III is discussed below (Text Figure VIII).

KHUIALA FORMATION

The beds of this formation are covered with sand dunes and the precise thickness is not known. As already stated, only the upper beds of the formation are exposed at Bandah. These are divisible into three assemblage zones. The zones are given similar numbers as the corresponding zones at locality I. A brief description of the zones is given below, in ascending order.
Zone 3-Assilina lacunata zone

This zone comprises massive white limestone in lower part and argillaceous limestone in the upper. The precise thickness of the zone is not known as the base is not seen. However, the exposed thickness is about 30 feet. The rocks are rich in Assilina lacunata de Cizancourt and Nummulites atacicus Leymerie. Nautilus sp. is abundant in the massive white limestone. No other microfauna was found in the samples collected.

Zone 4- Venericardia mutabilis zone

This zone is poorly developed and consists of only a 3-feet thick bed of Fuller's earth. This is frequently associated with gypsum and is at places full of casts of Venericardia mutabilis (d' Archiac and Haime). No microfossils were found in this zone.

Zone 5 - Assilina sp. zone

This zone is about 3 feet thick and consists of a whitish-yellow limestone, full of Assilina sp. The other predominant microfossils are Nummulites sp. and Cibicides aknerianus (d'Orbigny).

BANDAH FORMATION

The Bandahs directly overlie the Assilina sp. zone
of the Khuialas and are only 18 feet thick. These are divisible into two assemblage zones. The descriptions of these are given below in ascending order.

Zone 7 - Discocyclina sella zone

This zone is 14 feet thick and lithologically consists of reddish brown sandstone (5 feet) at the base and successively overlain by brownish calcareous sandstone (3 feet) containing Ostrea sp. and Nummulites stamineus Nuttall, and brownish to white coloured limestone (6 feet) crowded with Discocyclina sella (d'Archiac). The following microfossils also occur in this zone:

Foraminifers: Discocyclina sowerbyi Nuttall, Nummulites stamineus Nuttall, Textularia agglutinans var. nalinnnesensis Kaasschieter, Textularia punjabensis Haque, Asterigerina mudhensis Bhatia and Khosla, Asterigerina pandel Bhatia and Khosla, Discorbis perplexa Le Calvez, Quinqueloculina sp.

Ostracodes: Bairdia beeraquaensis Singh and Tewari, Occultocythereis subspinelllosa new species.

Zone 8 - Discocyclina dispansa zone

This zone is only 4 feet thick and consists of a whitish-yellow limestone containing abundant specimens of
Discocyclina dispansa (Sowerby). The other important microfossils are listed below:

Foraminifers: Dictyoconoides cooki (Carter), Alveolina elliptica, var. flosculina Silvestri, Textularia agglutinans var. nalinnesensis Kaasschieter, Sphaerogypsina globulus (Reuss) Nonion scapha var. indica Jacob and Sastri, Rotalia subgranulosa Jacob and Sastri, Glandulina sp., Fursenkoina dubia var. robusta (Haque), Asterigerina pandei Bhatia and Khosla, Asterigerina mudhensis Bhatia and Khosla.

Ostracodes: Bairdia qliberti (Keij), Krithe indica Tewari and Tandon, Schizocythere appendiculata Triebel.

JOGIRA FORMATION

The beds of Bandah Formation are overlain by those of the Jogira Formation. These are represented by grits, sandstones and laterite. The total thickness is not known.

STRATIGRAPHIC SUCCESSION AT LOCALITY IV

As stated earlier, the Lower Tertiary beds in the Barmer District occur at shallow subsurface depth. The geological investigations were carried out in a Fuller's earth mine at locality IV-Bhadka. Here, only the beds belonging to the Khualia Formation are present and these occur at a depth of 40 to 60 feet below the surface. The stratigraphic succession
### Stratigraphic Succession at Locality U-Bhadka

#### Lithology

<table>
<thead>
<tr>
<th>Age</th>
<th>Formation</th>
<th>Sample No</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Eocene</td>
<td>Jogira</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post—Eocene</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Eocene</td>
<td>Khulala</td>
<td>BH1-6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Base not exposed</td>
</tr>
</tbody>
</table>

#### Predominant Fossils

- **Legend**
  - AEOLIAN SAND
  - GRIT AND LIME-KANKAR
  - FULLER'S EARTH

- Plant impressions and casts of echinoids

#### Vertical Scale

- 40 FEET
  - 20
  - 16
  - 12
  - 8
  - 4
  - 0

**Text Figure IX**
as worked out in the Fuller's earth quarry is discussed below (Text Figure IX).

KHUIALA FORMATION

The Khuialas are approximately 40 feet thick and overlie Barmer Sandstone (Cretaceous). These are composed of Fuller's earth, frequently associated with gypsum. The beds are rich in plant impressions and casts of echinoids. No microfossils were found. On account of the similar stratigraphic position as at locality II, the Fuller's earth beds of Barmer District are considered equivalent of the Fuller's earth of the Assilina granulosa zone of Bikaner District.

JOGIRA FORMATION

A 60-feet thick succession of grits and sandstones of the Jogiras unconformably overlie the Khuialas.