CHAPTER - 2

LITHOFACIES : FIELD RELATIONSHIP AND CORRELATION

2.1 LITHOTYPES

The entire area was geologically surveyed and the various lithotypes representing different formations/members were studied. The base map published by Biswas and Deshpande, (1970) was taken as a reference for the work. Detailed stratigraphic measurements and sampling was carried out along four traverses, along the rivers near the villages Ratipal, Bermoti, Bernani and Waior from west to east respectively, (Figure 1.3).

The main rock types encountered in the area are yellowish / white, and pinkish/white, compact, highly fossiliferous muddy limestone and olive green to greyish green, well laminated, as well as, lumpy, shale and clay. The fossils are various species of foraminifera, corals, algae, bryozoa, bivalves, echinoids and ichnofossils. Both the carbonate bands and shales comprise abundant fossils occurring along several horizons. However, unfossiliferous/poorly fossiliferous bands are also not uncommon. Silty shales and siltstones are also common, particularly towards the base and top of the Oligocene sequence. The siltstones are yellowish white and characteristically light greenish coloured, moderately lithified and glauconitic in nature.

The entire strata shows very low south-westerly dips, usually ranging between 2° to 3°. . The stratigraphic measurements and sampling are therefore possible along the vertical sections exposed along deeply incised nala/river cuttings (Plate I.A). The overall topography is characterised by gentle undulations and low mounds (Plate I.B) . The Oligocene sequence, in field occurring between Fulra limestones of middle Eocene age and Khari nadi Formation siltstones of lower Miocene age, represents Maniyara Fort Formation. It mainly consists of limestone, clay and siltstone (Biswas and Raju, 1971). The Maniyara Fort Formation is equivalent to Bermoti series consisting of two stages namely Ramania and Waior.

The lower Oligocene Ramania stage overlies Babia stage limestones of middle Eocene age with an unconformity. However, in field the unconformity is not distinct and hard to be ascertained on the basis of field criteria. The yellowish-white foraminiferal limestones of Babia stage grade into silty, argillaceous and glauconitic limestones of overlying Ramania stage. The glauconite in limestone and siltstone is characteristic of Ramania stage and is distinct from underlying Babia stage carbonates. Coralline, echinodermal, algal and foraminiferal limestones along with olive and greenish grey shale as well as lumpy clays are common rock types of Ramania stage, (Plate I.C).

The overlying Waior stage usually includes greyish yellow, fine grained, fossiliferous muddy limestones, glauconitic siltstones and yellowish-white shales. The common fossils are foraminifera,

pelecypods, echinoids etc. The Waior stage indicates a diastem at it's base, ie. along it's contact with Ramania. Besides, three distinct, highly bioturbated limestone bands occur at an interval of 10 to 15 feet particularly in the upper part, indicating periodic shallowing of the depositional environment (Plate II.A). The band also shows load cast structure (Plate II.B). The top of the Waior stage is marked by a distinct unconformity represented by ferruginous and unfossiliferous nodular siltstone (Plate II.C), overlying highly fossiliferous sandy limestone band. This fossiliferous band is characterised by echinoderms, pecten and foraminifera, particularly - Spiroclypeus. The excellent section of the fossiliferous band and overlying unfossiliferous sequence is exposed in the river just north of Waior village (Plate III.A).

2.2 FIELD DESCRIPTION OF TRAVERSES

A brief field description along the traverses taken is as follows:

2.2.1 Ratipal Traverse

Figure 2.1 represents detailed thicknesses along with the precise sample positions along Ratipal traverse.

The base of the Ramania stage is marked by greenish grey, glauconitic siltstones and shales with thin shaly partings and abundant larger foraminifera (Figure 2.2). The glauconitic nature is distinguished from underlying Fulra limestones which is devoid of it.

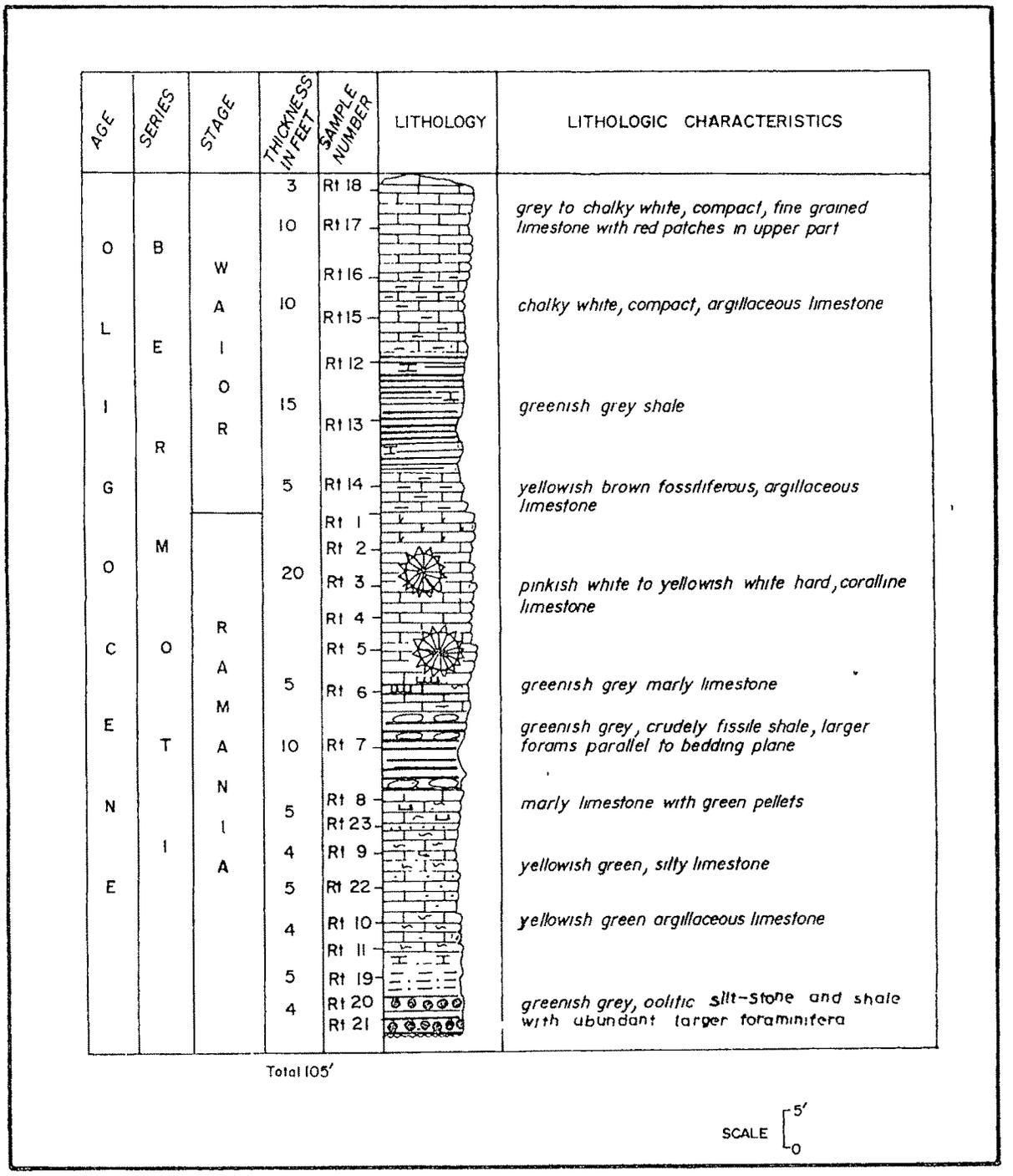

FIG. 2·1 ; STRATIGRAPHIC SECTION ALONG RATIPAL TRAVERSE.

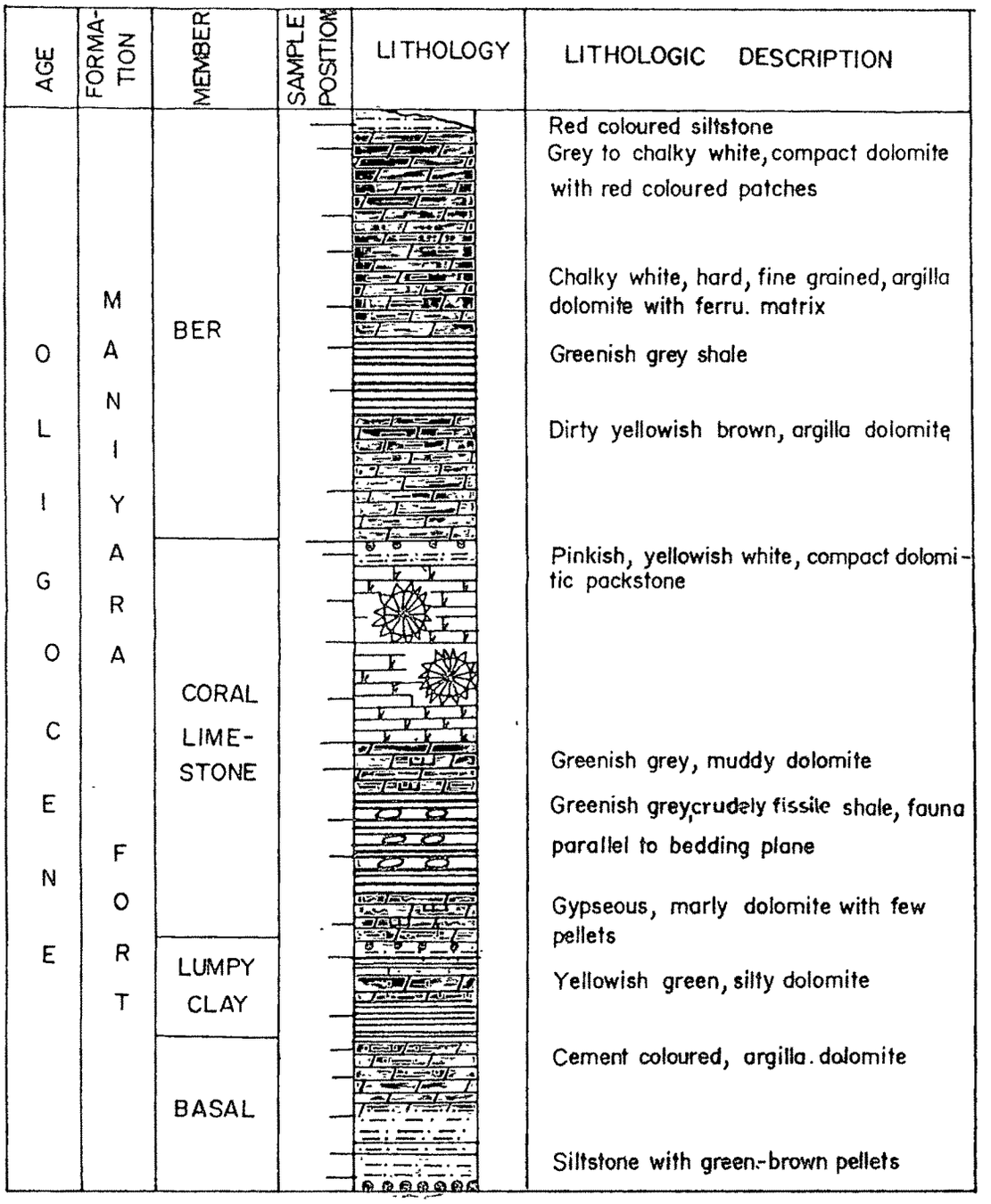

FIG. 2·2 LITHOSECTION OF RATIPAL TRAVERSE .

It is overlain by greenish grey and muddy foraminiferal limestones. Greenish grey, laminated, as well as bedded, shale/clay overlies foraminiferal limestones. The fossils within the shale are roughly oriented along the bedding plane. The shale grades upwards into argillaceous limestones which, in turn, passes upwards in a thick, hard, compact, pinkish-white to yellowish-white coralline limestone. The corals are usually of colonial type and at places form good bioherms measuring few feet to 25 to 30 feet in diameter (Plate III.B) A ferruginous and gypseous clay band is exposed at many places over the top of coralline limestone indicating a diastem.

The overlying Waior stage sequence consists of yellowish brown, fossiliferous, argillaceous limestone and greenish shale alternations. Chalky white, fine grained, well bedded, limestone occurs towards the top of the sequence. Ferruginous red colouration in patches is observed in the upper part of the sequence. The unfossiliferous and lateritic sequence of Aida stage overlies this limestone , and it is an obvious unconformity.

The thickness of the Maniyara Fort Formation is measured to be 105 feet. Figure 2.2 represents a generalised litho section showing formations and members representing the strata exposed along this traverse.

2.2.2 Bermoti Traverse

Detailed thicknesses along the sample positions of Bermoti traverse is shown in Figure 2.3.

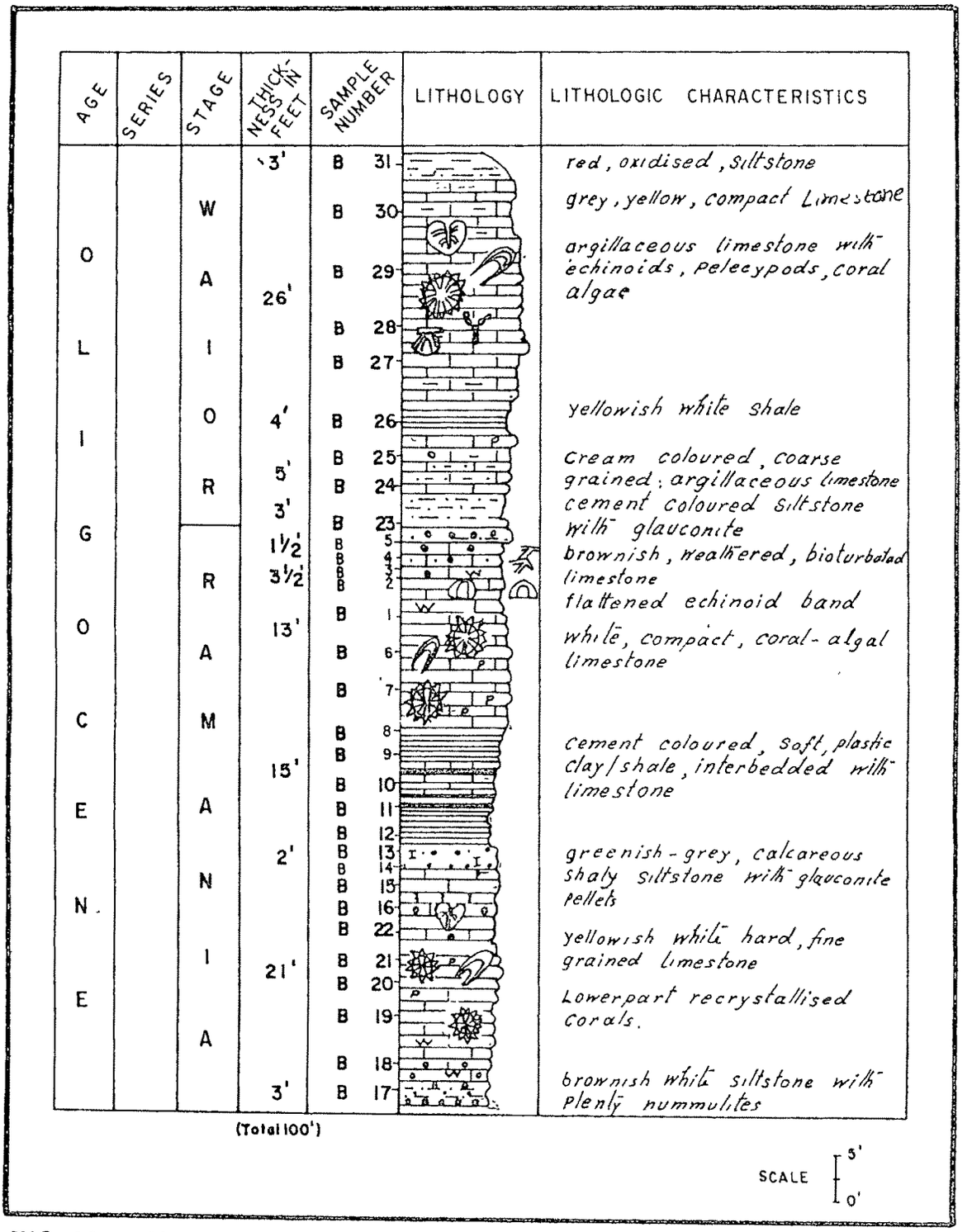

FIG. 23; STRATIGRAPHIC SECTION ALONG BER-MOTI TRAVERSE

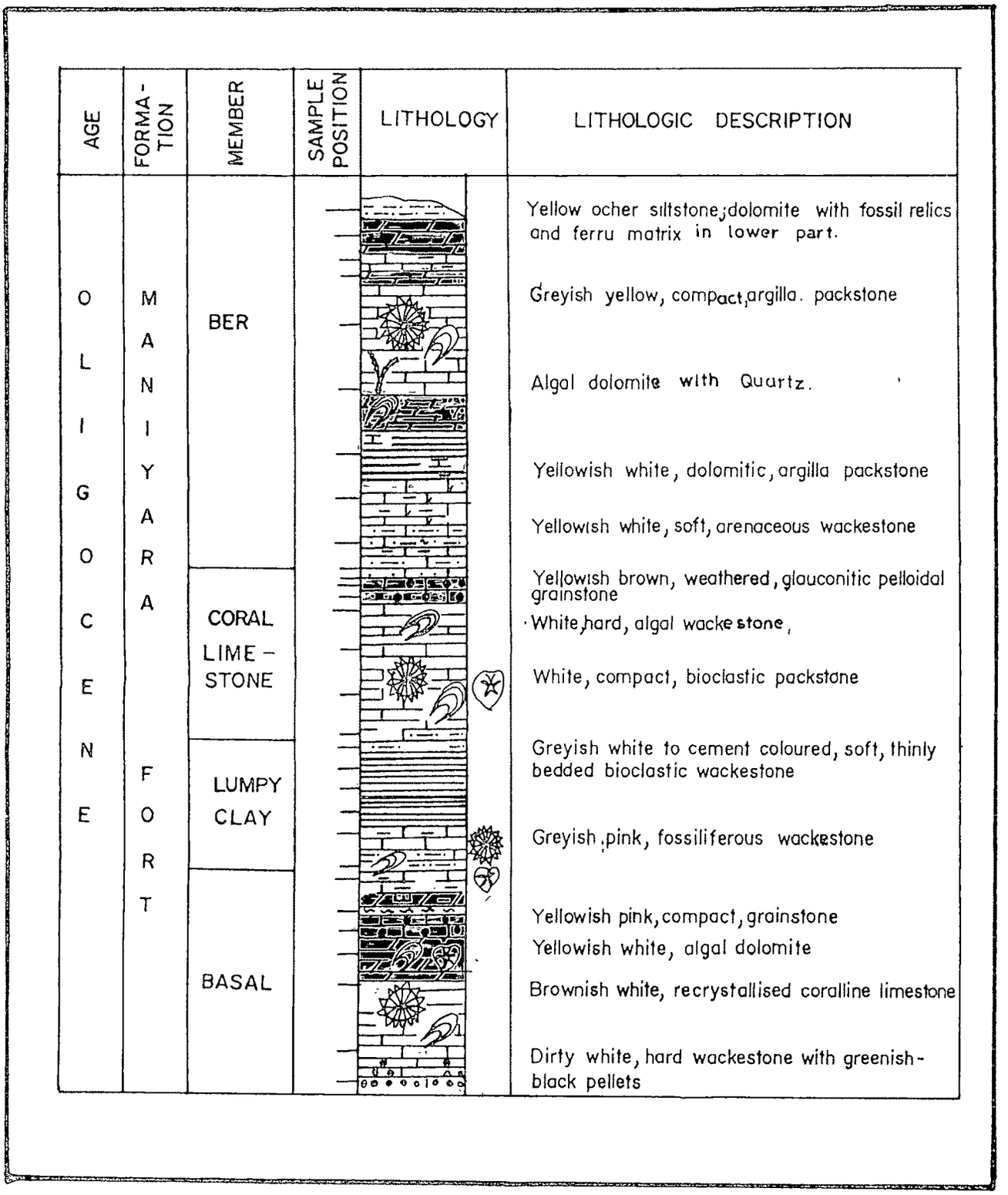

FIG. 2·4 ; LITHOSECTION OF BER-MOTI TRAVERSE.

The base of the Ramania stage in this section is marked by brownish white and glauconitic siltstones full of Nummulites, (Figure 2.4). This siltstone grades upwards into hard and compact, fine grained, muddy, as well as, commonly recrystallised limestone with profuse coralline growths, usually of colonial type. Several patchy reef developments are observed in this part (Plate III.C). This reefal limestone is overlain by greenish grey, calcareous glauconitic and peloidal siltstone, greenish grey, soft, thinly bedded shales and plastic clays with occasional limestone bands occurring above glauconitic siltstone. The top of Ramania stage is marked by brownish white, weathered, highly bioturbated and muddy limestone overlying a foraminiferal and echinodermal, hard recrystallised limestone band.

The Waior stage comprises of alternating bands of glauconitic siltstone, cream and yellowish green, coarse grained and fossiliferous limestones with yellowish, grey to white shaly bands. The top is marked by red oxidised, silty limestone, overlying hard, highly fossiliferous limestones with echinoids, pelecypods and larger foraminifera. The red oxidised, ferruginous, silty limestone is considered to be as Oligo-Miocene unconformity.

Figure 2.4 represents a lithosection indicating rock types of formation and members exposed along Bermoti traverse.

The total thickness of Maniyara Fort Formation calculated along this traverse is about 100 feet.

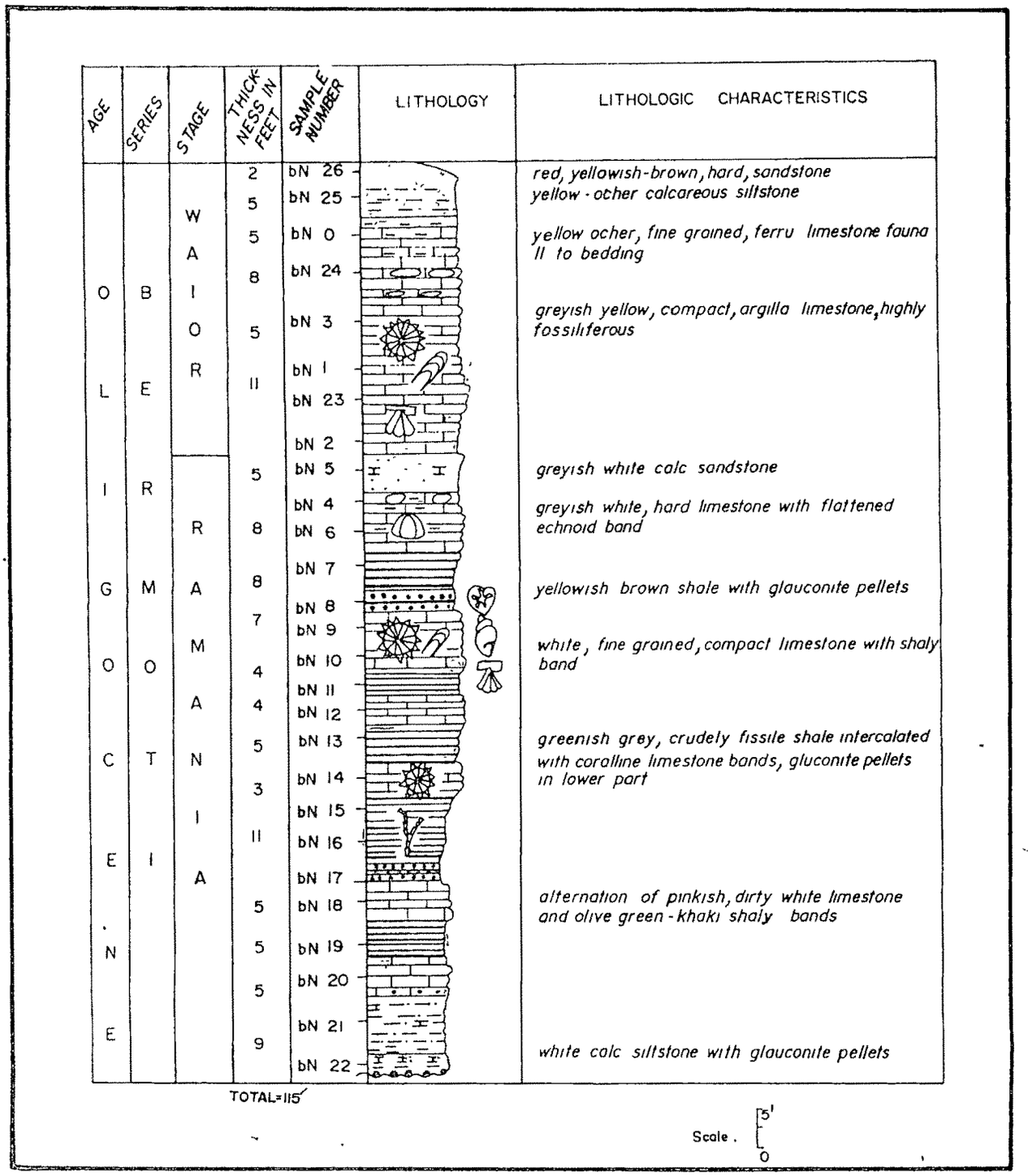

FIG. 2·5 STRATIGRAPHIC SECTION ALONG BER-NANI TRAVERSE.

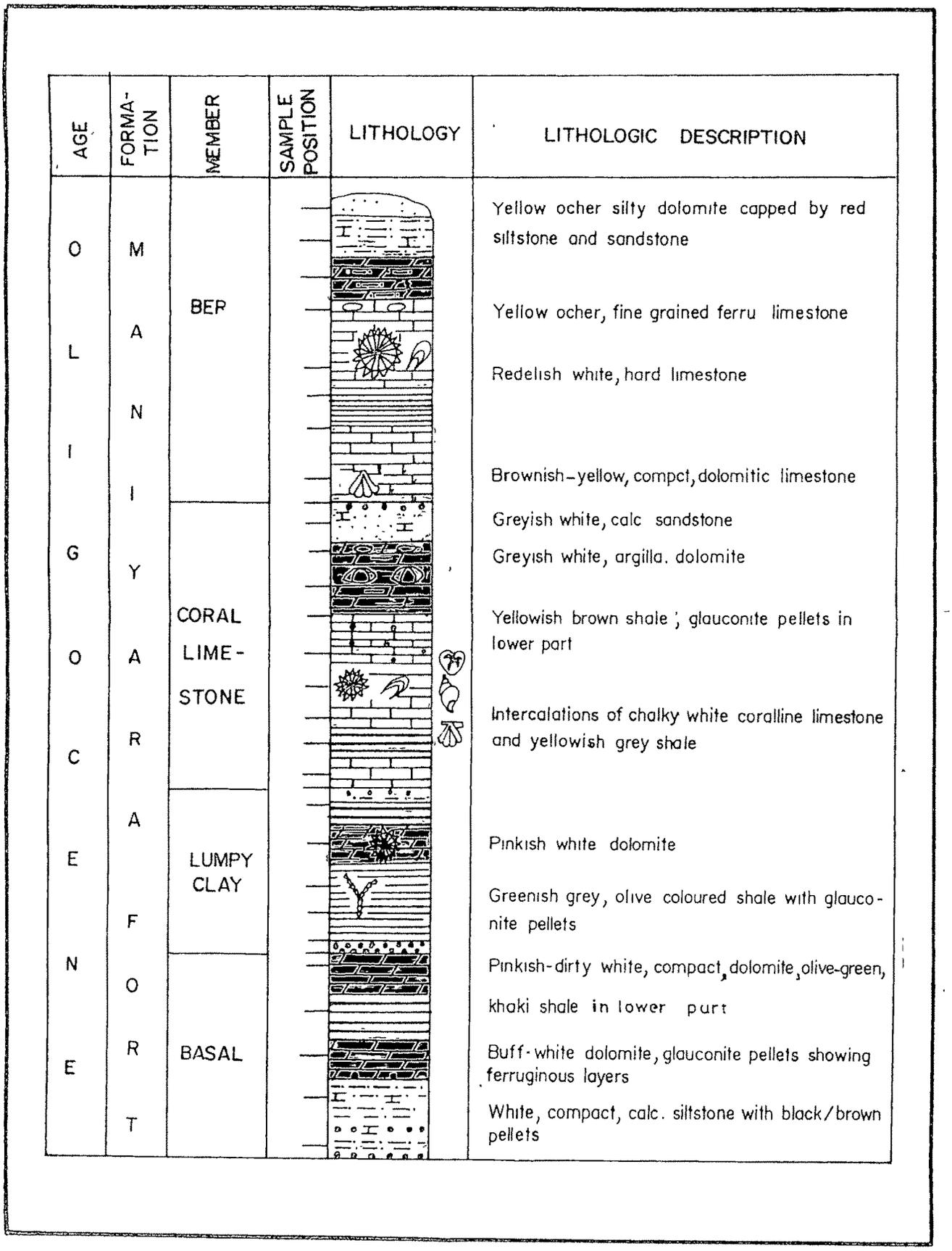

FIG. 2·6, LITHOSECTION OF BER-NANI TRAVERSE.

2.2.3 Bernani Traverse

Figure 2.5 shows the sample position and related thicknesses of the sequences of the Bernani traverse.

The base of the Ramania stage characteristically consists of grey and cream coloured, glauconitic siltstone, overlain by coarse grained recrystallised, hard, limestone (Figure 2.6). The lower half of the Ramania sequence mainly comprises of greyish white and greenish grey, bedded shale, as well as lumpy plastic clay with minor development of pinkish white fossiliferous limestone. However, patchy coralline reefs are also developed in the central part. The upper half consists, mainly, of several limestone bands with yellow ochreous and cream, fine grained muddy and compact limestone with minor intercalations of shale. Occurrence of glauconite is common. The top of the sequence is marked by highly fossiliferous limestone with echinoids, bivalves and larger foraminifera, overlain by ferruginous, calcareous, glauconitic siltstones. The Waior stage is characterised by argillaceous, fossiliferous limestone and silty shale alternations capped by white, hard, silty and sandy fossiliferous limestones, in turn overlain by ochreous yellow-brown, hard sandstone band, obviously indicating a depositional break.

The lithostratigraphic subdivisions are shown in Figure 2.6. The thickness of Maniyara Fort Formation in this traverse measures 115 feet.

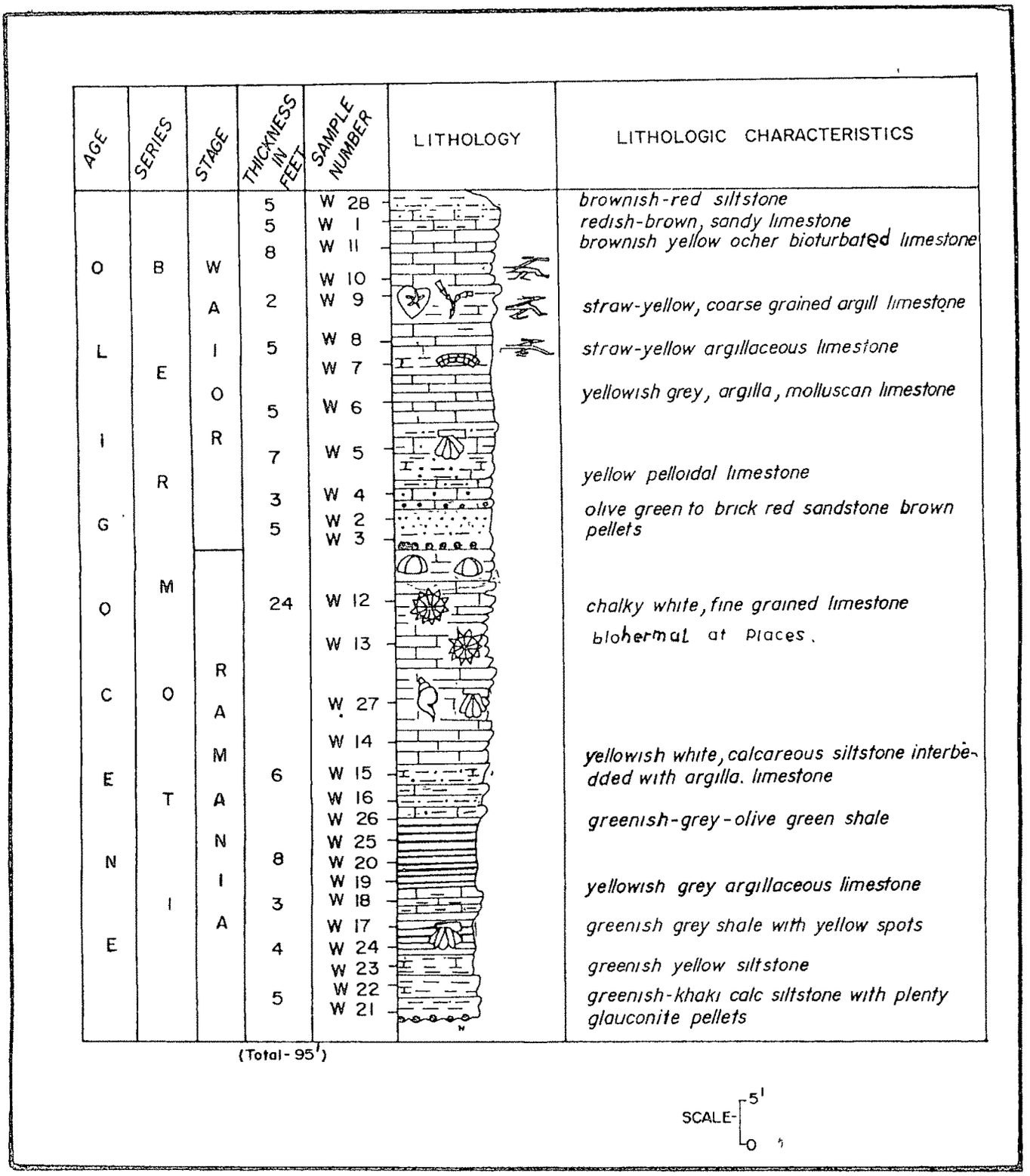

FIG. 2·7 STRATIGRAPHIC SECTION ALONG WAIOR TRAVERSE.

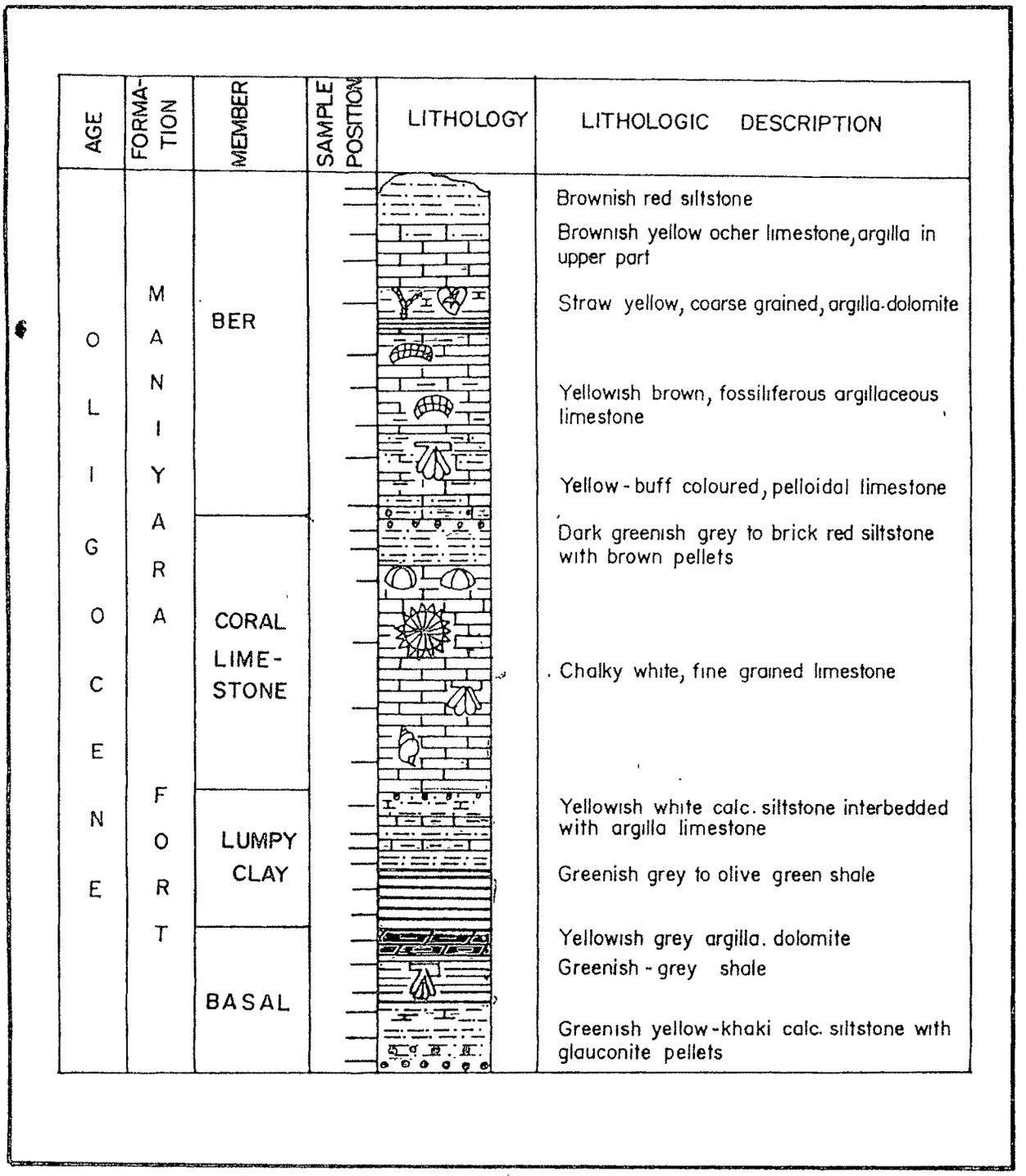

FIG. 2·8; LITHOSECTION OF WAIOR TRAVERSE.

2.2.4 Waior Traverse.

Figure 2.7 depicts sample positions and the measured thicknesses of sequences along Waior traverse.

The base of the Ramania stage consists of peloidal, ferruginous, silty clay-stones indicating a break in sedimentation with respect to the underlying middle Eocene sequence. It is overlain by calcareous and glauconitic siltstone bands (Figure 2.8). Yellow ochreous, calcareous, marly shales occur above this. The upper -most part consists of chalky white, fine grained, biohermal and fossiliferous limestone consisting of coral, gastropod, pecten, etc. The coralline limestone is capped by reddish brown, gypseous shale and marl indicating a diastem.

The Waior stage is made up of alternations of yellowish brown and cream coloured glauconitic and calcareous siltstone and straw to brownish yellow, hard, compact, well bedded, fossiliferous limestone alternations.

The upper part of the sequence typically consists of three highly bioturbated limestone bands (Plate IV.A), indicating shallowing of the sea. Reddish, hard, fossiliferous limestone occurs at the top of the sequence. This, in turn, is overlain by ferruginous, unfossiliferous and concretionary siltstone of Aida stage indicating an unconformity.

The total thickness of the Maniyara Fort Formation along this traverse measures about 95 feet.

The lithostraigraphic subdivisions and their characteristics are shown in Figure 2.8.

2.3 FACIES VARIATION AND CORRELATION

The unconformity at the base of Oligocene i.e. at the base of Ramania stage can be inferred in field only on the basis of sudden change in the lithological characteristics. For example occurrence of glauconite characteristically within Oligocene strata, is in contrast to Eocene Fulra limestone. The greenish grey calcareous glauconitic siltstone and argillaceous limestone within the lower Ramania sequence is present throughout the area (Figure 2.9). A thick coralline limestone is developed over this in the Bermoti section towards west, whereas similar coralline limestone alongwith shale and silty limestone are developed in the Bernani and eastern Waior sections. Western-most part, however, indicates occurrence of silty and argillaceous limestone, rarely with corals. A thin shale sequence is developed almost throughout the area over this. The overlying strata of the Ramania stage is represented by coralline/reefal limestone in the western Bermoti and Ratipal sections, whereas in the central region around Bernani it is represented by argillaceous limestone with relatively less abundant biohermal development. At the base of the coralline/argillaceous limestone sequence, a thin ferruginous peloidal band, is observed indicating a feeble diastem. Silty, argillaceous and highly bioturbated carbonate bands are common in the eastern Waior section.

A diastem at the base of Waior stage marked by ferruginous and gypseous marl band is observed in all the four

sections. A thin shale and argillaceous limestone sequence is present at the basal part of Waior stage in Ratipal and Bernani sections. The central and upper parts of Waior sequence are represented by alternations of shales and limestones in the west and grade into argillaceous and silty limestones in central and eastern parts. The top is marked by a highly fossiliferous silty limestone band, locally ferruginous with patchy red colours. This band is traceable in most of the area and is overlain by ferruginous, concretionary and unfossiliferous siltstone of Aida stage of Aquitanian age.

The thickness of the strata is maximum in the Bernani area in the central part and measures 115 feet, whereas it is 95 feet in the eastern part around Waior. It is 100 feet and 105 feet in western Bermoti and Ratipal sections respectively (Figure 2.9). It is expected that the strata would considerably thicken in the south-western, coastal and neighbouring offshore part. The detailed facies variations and possible correlation is shown in Figure 2.10.

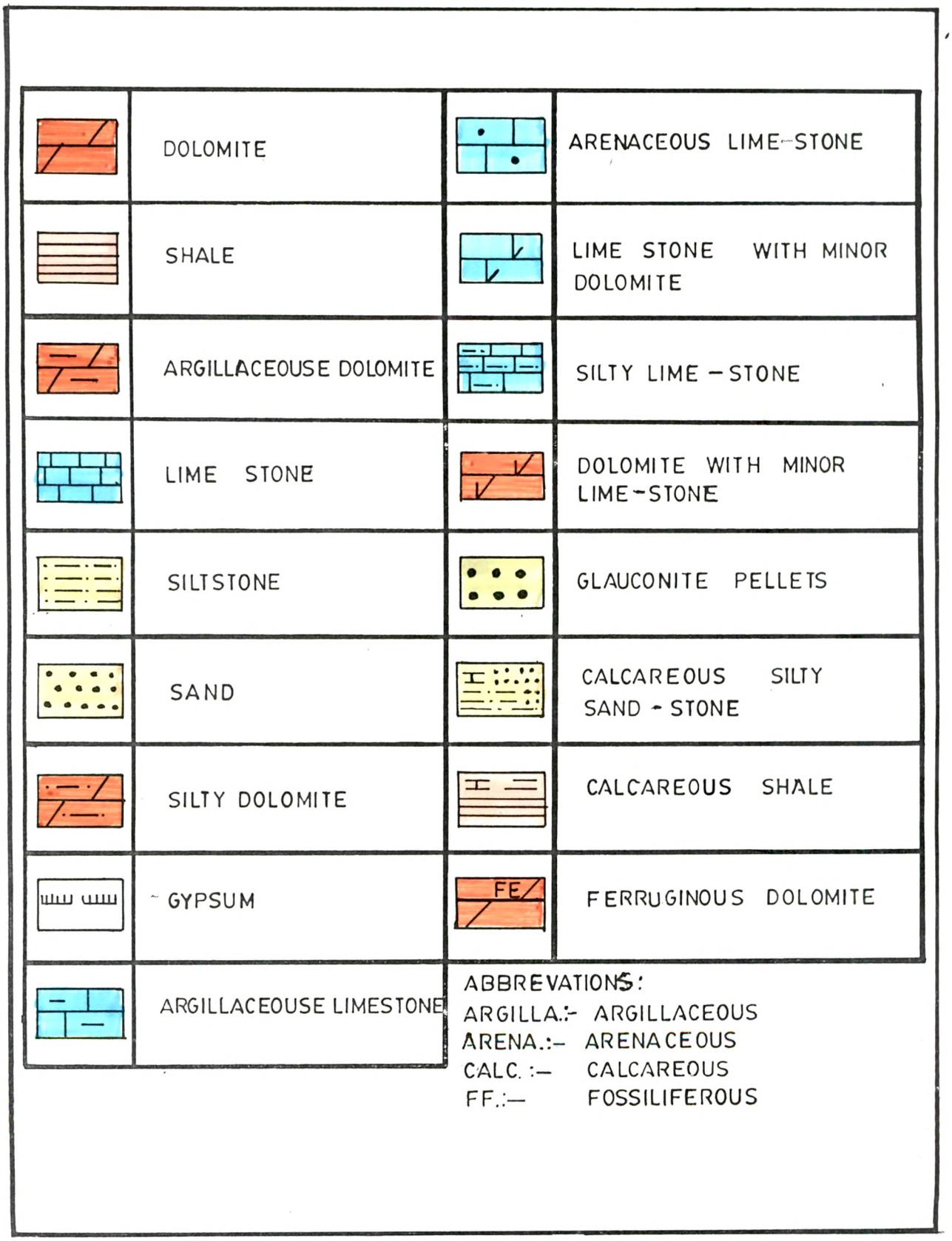

FIG. 2.11, LITHO STRATIGRAPHIC LEGEND