PALYNOSTRATIGRAPHY OF THE SEDIMENTARY FORMATIONS OF ASSAM: 3. BIOSTRATIGRAPHIC ZONATION OF THE CHERRA FORMATION OF SOUTH SHILLONG PLATEAU*

S. C. D. SAH & S. K. DUTTA†

Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

In the South Shillong Plateau, sediments of the Cherra Formation rest on the eroded surface of the Langpar Formation (Danian) and are in turn conformably overlain by the Lakadong Limestone (Lower Eocene) member of the Sylhet Limestone Formation. Based on the disposition of the Cherra Sandstone in three altitudinal belts, each characterized by a coal-seam, and on the distribution of commonly occurring palynological species, three biostratigraphic zones have been recognized in the Cherra Sequence.

The lower zone can be distinguished by the high frequencies of *Nympheoipollis crassimurus*, *Retialetes emendatus* and *Polypodiisporites mawkmaensis*, together with a few other forms restricted only to this zone. The middle zone can be recognized by the common occurrence of *Corrugatisporites formosus*, *Sestrosporites dettmanii*, *Foraminisporis medius*, *Couperipollis rarispinosus*, *Couperipollis wodehousei*, etc., and low frequencies or ± absence of *Nymphaeoipollis crassimurus* and *Polypodiisporites mawkmaensis*. The upper zone is distinct in the absence of palynomorphs characteristic of the lower and middle zones together with increased frequencies of *Foveosporites pachyexinous*, *Polycolpites speciosus*, *Engelhardtioidites parvus*, etc.

A distinct palynological change across the Cherra/Lakadong boundary is apparent, which can be fruitfully used for demarcating this boundary.

INTRODUCTION

THE coal bearing Cherra Sandstone and its directly associated sediments, conglomerate shale, carbonaceous shale and clay, form a sedimentary sequence, best developed near Cherrapunji and hence named as the Cherra Formation. During the course of geological mapping it was felt that the Cherra Formation was clearly divisible into three subdivisions. This feature became apparent by the development of this lithostratigraphic unit in three different altitudinal belts. The idea of subdividing this formation was further strengthened by the occurrence of three coal-seams within this sandstone group. It was noted that the Top-seam characterized the upper belt, the Middle-seam distinguished the middle belt, while the Bottom-seam marked the basal belt. Moreover, these seams are laterally traceable to a considerable distance, sometimes up to as much as 16 km., and the same sequence is observable throughout this lateral distance. However, in the absence of key beds, the three distinct zones remain lithologically indistinguishable. Consequently, qualitative and quantitative analyses of the palynological assemblage was undertaken to find a more reliable basis for demarcating the different stratigraphic levels within the Cherra Formation.

The pollen analytical data from the Cherra Formation were obtained by counting 200 specimens per sample. More than 200 samples from twenty-one escarp and gorge sections were analysed and studied. The complete thickness of the Cherra Formation has not been observed in any single section. Hence, a composite section has been compiled from three ± complete and 18 smaller sections. Similarly, a composite assemblage has been obtained by calculating the mean value of the palynological data from samples representing the same stratigraphic levels within the Cherra Formation. The resulting diagram (distribution chart) gives an idea of the frequencies of the significant spore/pollen species. The diagram at a glance clearly shows:

1. That the Cherra Formation is divisible into three palynological zones.
2. That the Cherra Formation, from base to the top, does not show any major miofloral change. A major floral change

*The paper was originally presented to the Eastern Himalayan Geology Symposium, held at Shillong, Assam, in November 1967. The long delay and uncertainty in the publication of the proceedings of the above Symposium necessitated the revision of the paper in the light of recent palynological studies on the area and its publication elsewhere.

†Applied Geology Department, Dibrugarh University (Assam).

was not expected because the formation represents a comparatively short time interval to bring about any major evolutionary development.

3. A small but distinct miofloral change of stratigraphic significance is apparent between the assemblages of the Cherra Formation and the overlying Lakadong Sandstone.
4. Another important feature clearly observable is the gradual decline of those species which attained their maximum development at the lower horizons. On the other hand, species with low frequency, in the lower horizons, show progressive development towards the upper horizons until they reach the boundary with the overlying Lakadong Sandstone.
5. Palynological zonation of the Cherra composite section and the lateral persistence of the three cenozones provides corroborative evidence for the subdivision of this formation on lithological and structural grounds. Palynological markers provide a more reliable basis for the identification and correlation of different stratigraphic levels within the formation.

PALYNOSTRATIGRAPHY

The Cherra palynological assemblage is rich in pteridophytic spores and angiosperm pollen. Gymnospermous elements are absent. A total of 103 form species have been identified. Of these, some have a wide range of distribution while others are restricted to a small stratigraphic interval. Similarly, their numerical representation varies from very rare (1), rare (2-6), common (6-15), abundant (16-30), to predominant (above 30). The distribution of the palynological taxa in both time and space and their frequency differences have helped in the selection of certain key species which are of particular biostratigraphic significance in zoning and correlating the Cherra Formation. The following three palynological cenozones have been recognized in the composite section of the Cherra Formation:

NYMPHAEOIPOLLIS CRASSIMURUS CENOZONE

Places of Occurrence — Cherrapunji, Mawmluh, Mawsmai, Pynursla, Laitryngew, Umsawmat, Sohrarim, Mawrap and Lyngkyrdem.

Lithology — Fine to medium-grained sandstones, often white, friable in nature, are the dominant rock types of this cenozone. Beside these, shale, carbonaceous shale and coal are the other associated rock types. The average thickness of the sediments varies from 160-200 ft.

Lower Contact — The Cherra Formation is separated from the underlying Langpar Formation by a prominent band of conglomerate. An erosional unconformity between the two has been observed at fall section 1023″.

Upper Contact — The sandstone below the carbonaceous shale band forming the floor of the middle coal-seam constitutes the roof of this cenozone.

Principal Miofloral Constituents — *Nymphaeoipollis crassimurus, Polypodiisporites mawkmaensis, Nymphaeacidites clarus, Polycolpites ornatus, P. cooksonii, Lakiapollis matanmadhensis, Triorites inferius, T. communis, Talisiipites wodehousei, Liliacidites microreticulatus, Corrugatisporites formosus, Sestrosporites dettmanii, Foraminisporis medius, Tricolpites reticulatus, Trifossapollenites constatus, Dandotiaspora* spp., *Couperipollis brevispinosus, C. rarispinosus, Palmaepollenites communis, P. eocenicus, Palaeosantalaceaepites dinoflagellatus, Lycopodiumsporites palaeocenicus, Retialites emendatus* and *Cyathidites minor*.

Zonal Markers — *Nymphaeoipollis crassimurus, Retialetes emendatus, Polypodiisporites mawkmaensis, Nymphaeacidites clarus, Polycolpites ornatus, Lakiapollis matanomadhensis, Triorites inferius, Talisiipites wodehousei* and *Liliacidites microreticulatus*.

Remarks — The conglomerate bed at the base of the Cherra Sequence together with two closely placed coal partings provide a lithological basis for delineating the *Nymphaeoipollis crassimurus* Cenozone from the underlying Langpar Formation. This zone can also be readily distinguished from the Langpar by high frequencies of *Nymphaeoipollis crassimurus* and *Retialetes emendatus*. However, there are also other species which occur in low frequencies in the Langpar Formation but have become common in the *Nymphaeoipollis crassimurus* Cenozone. Two species, *Lycopodiumsporites palaeocenicus* and *Dandotiaspora dilata* have higher frequency value in Langpar Formation as compared to Cherra Formation.

ARALIACEOIPOLLENITES RETICULATUS CENOZONE

Places of Occurrence — Cherrapunji, Umswamat, Sohrarim, Mawmluh, Mawsmai, Pynursla and Bapung.

Lithology — Sandstones, shale, carbonaceous shale and coal are the principal rock types of *Araliaceoipollenites reticulatus* Cenozone. The average thickness of strata constituting this stratigraphic interval is in the order of 150-200 ft.

Lower Contact — Carbonaceous shale forming the floor of the middle coal-seam is the basal boundary of this cenozone. It is conformably underlain by a sandstone member which forms the top of the underlying *Nymphaeoipollis crassimurus* Cenozone.

Upper Contact — A sandstone bed which overlies the middle coal-seam forms the topmost member of *Araliaceoipollenites* cenozone.

Principal Miofloral Constituents — *Corrugatisporites formosus, Sestrosporites dettmanii, Foraminisporis medius, Araliaceoipollenites reticulatus, A. psilatus, Droseridites parvus, Polycolpites speciosus, Engelhardtoidites parvus, Couperipollis brevispinosus, Lycopodiumsporites palaeocenicus, Retialetes emendatus, Palmaepollenites eocenicus, Polycolpites cooksonii* and *Triorites communis.*

Zonal Markers — *Araliaceoipollenites reticulatus, A. psilatus, Droseridites parvus, Corrugatisporites formosus, Couperipollis brevispinosus, Triorites communis* and *Retialetes emendatus.*

Remarks — A thick massive sandstone overlying the middle coal-seam is the major lithological marker of this cenozone. White friable sandstone layers which constitute a common feature of the underlying *Nymphaeoipollis crassimurus* and the overlying *Tricolpites reticulatus* Cenozones are not met with in this stratigraphic interval.

TRICOLPITES RETICULATUS CENOZONE

Place of Occurrence — Cherrapunji, Laitryngew, Sohrarium, Mawmluh, Lyngkyrdem, Kyndiar, Gumaghat, Langrin and Mawsynram.

Lithology — The principal lithofacies of this interval comprise white friable sandstones underlain by ferruginous sandstone, coal and carbonaceous shale. The thickness of this cenozone varies from place to place but 200 ft. has been estimated as the average thickness.

Lower Contact — The carbonaceous shale forming the floor of the upper coal-seam marks the lower boundary of *Tricolpites reticulatus* Cenozone. It rests conformably over a massive sandstone stratum which constitutes the topmost horizon of the *Araliaceoipollenites reticulatus* Cenozone.

Upper Contact — The white friable sandstone that occurs at the top of the *Tricolpoites reticulatus* Cenozone is conformably overlain by a marine limestone band which is named as the Lakadong Limestone.

Principal Miofloral Constituents — *Corrugatisporites formosus, Tricolpites reticulatus, Trifossapollenites constatus, Polycolpites speciosus, P. cooksonii, Engelhardtoidites parvus, Couperipollis brevispinosus, C. rarispinosus, Palmaepollenites communis, P. eocenicus, Retialetes emendatus, Triporopollenites vimalii, Triorites communis* and *Cyathidites minor.*

Zonal Markers — *Tricolpites reticulatus, Trifossapollenites constatus, Triporopollenites vimalii* and *Cyathidites minor.*

Remarks — The upper zone of the Cherra Formation is very poor in palynological fossils. A distinct floral decline is discernible at this level which might be related to the advent of arid climate during the closing of the depositional phase of the Cherra Formation. Adverse environmental conditions are not only reflected by the poverty in the plant community but is also indicated by the development of a fairly thick ferruginous sandstone.

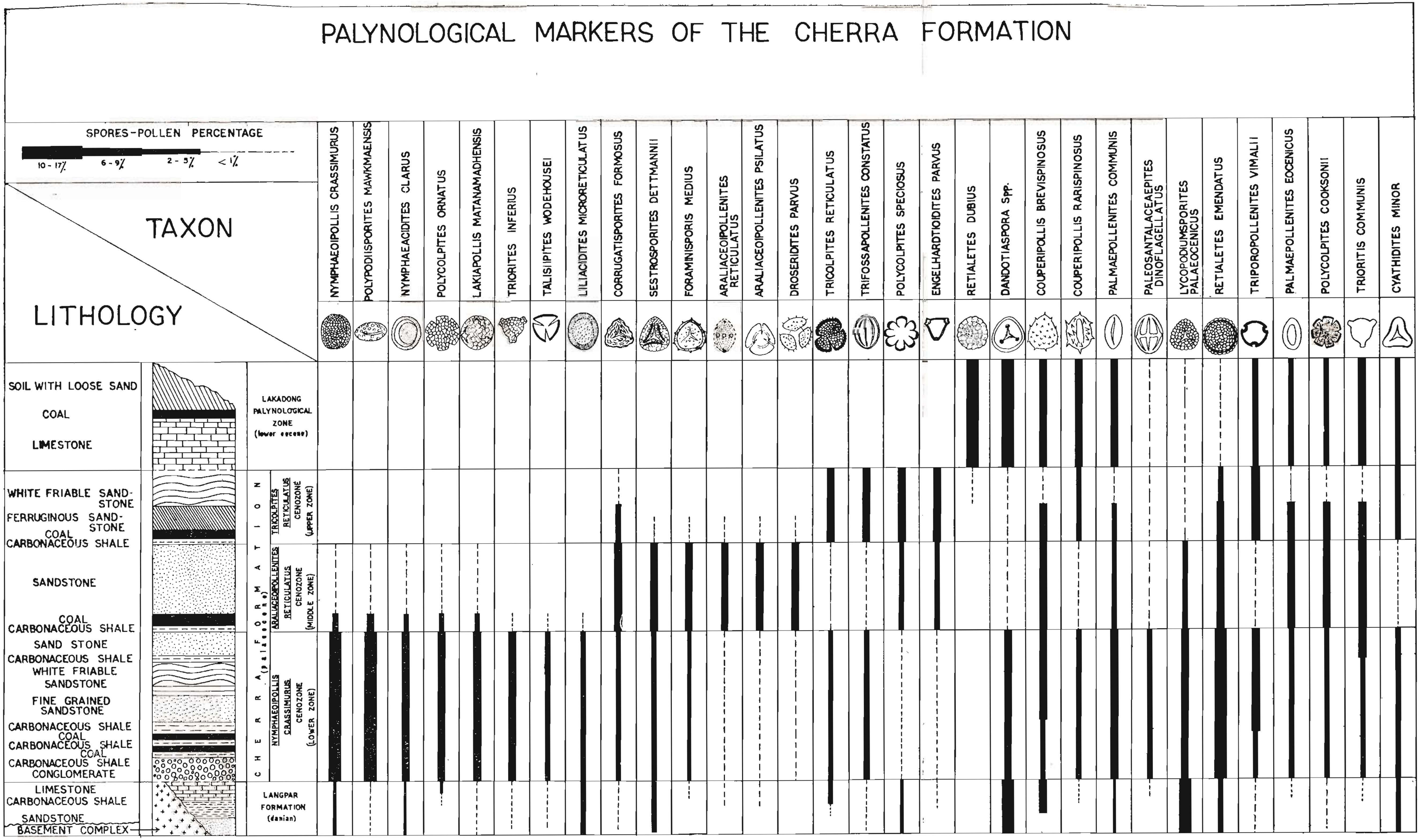
LAKADONG PALYNOLOGICAL ZONE

Places of Occurrence — Cherrapunji, Shella, Laitryngew, Lumshnong, Therriaghat, Mawmluh, Thanjinag and Pynursla.

Lithology — The strata of this cenozone comprise limestone, coal, carbonaceous shale and sandstone. They range from 500 to 600 ft. in thickness and constitute the lower part of the Sylhet Limestone Formation.

Lower Contact— Lakadong Limestone forms the lower boundary of the Lakadong palynological zone. It is underlain by a white friable sandstone which forms the topmost bed of the Cherra Formation.

Upper Contact — Lakadong Sandstone is conformably overlain by the Umlatodoh Limestone, which has yielded typical Laki fossils like *Nummulites, Alveolina, Discocyclina, Miliolidae,* etc., and on this evidence dated as Lower-Middle Eocene in age.


PALYNOLOGICAL MARKERS OF THE CHERRA FORMATION
SPORES-POLLEN PERCENTAGE
10 - 17%
6 - 9%
2 - 5%
< 1%
TAXON
LITHOLOGY
NYMPHAEOIPOLLIS CRASSIMURUS
POLYPODIISPORITES MAWKMAENSIS
NYMPHAEACIDITES CLARUS
POLYCOLPITES ORNATUS
LAKIAPOLLIS MATANAMADHENSIS
TRIORITES INFERIUS
TALISIIPITES WODEHOUSEI
LILIACIDITES MICRORETICULATUS
CORRUGATISPORITES FORMOSUS
SESTROSPORITES DETTMANNII
FORAMINISPORIS MEDIUS
ARALIACEOIPOLLENITES RETICULATUS
ARALIACEOIPOLLENITES PSILATUS
DROSERIDITES PARVUS
TRICOLPITES RETICULATUS
TRIFOSSAPOLLENITES CONSTATUS
POLYCOLPITES SPECIOSUS
ENGELHARDTIOIDITES PARVUS
RETIALETES DUBIUS
DANDOTIASPORA Spp.
COUPERIPOLLIS BREVISPINOSUS
COUPERIPOLLIS RARISPINOSUS
PALMAEPOLLENITES COMMUNIS
PALEOSANTALACEAEPITES DINOFLAGELLATUS
LYCOPODIUMSPORITES PALAEOCENICUS
RETIALETES EMENDATUS
TRIPOROPOLLENITES VIMALII
PALMAEPOLLENITES EOCENICUS
POLYCOLPITES COOKSONII
TRIORITIS COMMUNIS
CYATHIDITES MINOR
SOIL WITH LOOSE SAND
COAL
LIMESTONE
WHITE FRIABLE SAND-STONE
FERRUGINOUS SAND-STONE
COAL
CARBONACEOUS SHALE
SANDSTONE
COAL
CARBONACEOUS SHALE
SAND STONE
CARBONACEOUS SHALE
WHITE FRIABLE SANDSTONE
FINE GRAINED SANDSTONE
CARBONACEOUS SHALE
COAL
CARBONACEOUS SHALE
COAL
CARBONACEOUS SHALE
CONGLOMERATE
LIMESTONE
CARBONACEOUS SHALE
SANDSTONE
BASEMENT COMPLEX
LAKADONG PALYNOLOGICAL ZONE (lower eocene)
CHERRA FORMATION (palaeocene)
TRICOLPITES RETICULATUS CENOZONE (UPPER ZONE)
ARALIACEOIPOLLENITES RETICULATUS CENOZONE (MIDDLE ZONE)
NYMPHAEOIPOLLIS CRASSIMURUS CENOZONE (LOWER ZONE)
LANGPAR FORMATION (danian)

Text-fig 1

Principal Miofloral Constituents — *Retialetes dubius, Dandotiaspora* spp., *Couperipollis brevispinosus, C. rarispinosus, Palmaepollenites communis, P. eocenicus, Polycolpites cooksonii, Triorites communis* and *Cyathidites minor* and some microplanktons.

Zonal Markers — The dominance of *Dandotiaspora* complex and *Retialetes dubius* together with high frequencies of *Palmaepollenites communis* and *Cyathidites minor* distinguishes this zone from the underlying *Tricolpites reticulatus* Cenozone of the Cherra Formation.

Remarks — The passage between the Cherra Formation and the overlying Lakadong Limestone is readily observable by a distinct change in facies from arenaceous to calcareous. This evidence has been used to define the boundary between the two formations as this change seems to be related to the negative movements of the basin of deposition during the Lakadong times. The change in the composition of the palynological assemblages across this boundary conforms to the changes in the depositional basin and hence considered to be stratigraphically significant.

CONCLUSION

The range and relative frequency of the significant taxa shown in the range chart reveal that no sharp miofloral change occurs at the Langpar/Cherra boundary while a significant change is discernible at the Cherra/Lakadong boundary. Although most of the spore-pollen species pass through the Langpar/Cherra boundary without any change in their assemblage composition, there are some species which exhibit distinct change in their relative abundance. These changes seem to be of stratigraphic significance. Palynological data from the Langpar Formation is at present meagre. Hence examination of some more stratigraphic sections from the Langpar Formation is desirable before these changes can be used as reliable indices for delineating the Langpar/Cherra boundary.

The change in assemblage composition across Cherra/Lakadong boundary is of sufficient stratigraphic significance and can be used for delineating this boundary. This change is significant and may be related to the sinking of the basin which resulted in the advent of the transgressive phase at the close of the Cherra depositional cycle.

Study of a large number of stratigraphic sections, representing almost the entire outcrop area of the Cherra Formation, clearly demonstrates the correlative value of the three Cenozones established within the Cherra Composite Section. The position of the three cenozone boundaries in relation to the three coal-seams is essentially the same throughout the sections studied. This indicates close correspondence between lithologic and biostratigraphic boundaries.

Field indications supported by lithological succession indicate that the Cherra Formation of Shillong Plateau is equivalent to the Tura Formation of Garo Hills. Cenozone correlation of the Cherra Formation with the Tura Formation (Sah & Singh, 1974) shows close parallelism between the two. The three Cherra Cenozones closely correspond to the three lower cenozones of the Tura Formation, i.e. *Nymphaeoipollis crassimurus* Cenozone corresponding to *Retialetes emendatus*, *Araliaceoipollenites reticulatus* Cenozone correlating with *Dandotiaspora telonata* and *Tricolpites reticulatus* Cenozone comparing with *Palmidites plicatus* Cenozone of Tura Formation. The relationship between lithological and biostratigraphical boundaries is essentially the same at both these places which clearly establishes the correlative value of these zonal assemblages. Thus, palynology provides conclusive evidence that the Tura Formation of Garo Hills is the westerly extension of the Cherra Formation of Shillong Plateau.

The lateral persistence of these diagnostic biota throughout the Garo, Khasi and Jaintia Hills, the close correspondence in the lithological succession and the outcrop area being restricted to the southern slopes indicate that all these basins were once part of a long foredeep in front of the Assam autochthon and as such they may be parts of the same sedimentary basin. The heavy mineral assemblage is also more or less the same at both these basins indicating that these areas received sediments from the Pre-Cambrian crystalline mass of the autochthon.

REFERENCES

SAH, S. C. D. & SINGH, R. Y. (1974). Palynological biostratigraphy of the Tura Formation in the Type Area. *Spl. Publ. B. Sahni Inst. Palaeobotan.* **3**.