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No. 338 | 2014 | Page 1-67

CONTENTS

INTRODUCTION

The state of Nagaland is situated in the extreme north-east part of India, bounded by Myanmar in the east, Assam in the west, Arunachal Pradesh and part of Assam in the north, and Manipur in the south. The state lies between the latitude 25°6′ N to 27°4′ N and longitude 93°20′ E to 95°15′ E covering an area of about 16579 sq. km. It is predominantly a hilly terrain with an altitude varying from 194 m. to 3840 m. In past the Tethys Sea continued to receive sediments of conglomerates, shales, sandstones and limestones, eroded from the Archaean rocks, during the Palaeozoic and much of the Mesozoic period. This geological unit underwent an orogenic activity in the late Cretaceous and early Caenozoic period that influenced the geographic and tectonic alignments of the region and established a new pattern of sedimentation. This orogeny was accompanied by extensive igneous activity. The Shan plateau was uplifted in the east and a narrow belt along the west that marked the beginning of a tectonic highland of Arakan-Yoma and Naga Hills. The rock units exposed in Naga Hills may be grouped as follows:

Age	Group	Formation	Lithology
Holocene	Alluvium	-	Clay, sand, silt, gravels, boulders
Pliocene to Pleistocene	Dihing	Dihing	Pebbles, cobbles and boulders of sandstone in ferruginous coarse sandy matrix.
Mio-Pliocene	Dupitila	Namsang	Sandstone coarse, occasionally pebbly and gritty with mottled, clay bands.
Miocene	Tipam	Girujan clay	Clay-mottled, shales of grey, red, brown with thin medium to fine grained sandstone.
		Tipam	Sandstone, massive, medium to coarse grained, large current bedded intraformational conglomerates with lignite.
	Surma	Bokabil	Alternations of shales with siltstone and sandstone shale, grey thinly laminated splintery, fossil sandstone grained.
		Upper Bhuban	Sandstone shale alternation, sandstone with pseudoconglomerates, rippled cross-laminated.
		Middle Bhuban	Silty shale with sand lenticles, sandstone medium grained, soft, with current ripples.

Age	Group	Formation	Lithology
Oligocene to Late Eocene	Barail	Renji	Sandstone medium to thick bedded, finegrained, and well sorted hard with current bedding, current ripples, and occasional carbonaceous shale bands.
		Jenam	Shales with subordinate sandstone occur as lenticular bodies and as thin bands.
		Laison	Sandstone with minor silty shale, sandstone thin to thick bedded. Rare coal streaks and veins, sandstone shows low angle current bedding.
Eocene to Upper Cretaceous	Disang	Upper	Dark grey, solintery shale with noncalcareous siltstone and silty sandstone.
Pre-Cambrian	Metamorphic complex	Upper	Epimetamorphosed sediments or slates, phyllites with lenticular limestone beds.
		Lower	Granite/gneiss

After Mathur and Evans (1964), Ranga Rao (1983) and Baruah *et al.* (1987)

Nagaland is in fact part of Assam-Arakan basin which has come up through the collision of the Indian, European and Burmese plates. The Naga Schuppen Belt and the Kohima-Patkai folded zone are the major geotectonic units of Nagaland (Ranga Rao, 1983; Ganju *et al.*, 1986) the Naga Schuppen Belt is an imbricate thrust zone, consisting predominantly of Oligocene and Younger sediments, whereas the Kohima-Patkai folded zone contains a huge pile of Eocene (Disang Group) and Oligocne (Barail Group) deposits (Mallet, 1876). The Lower Disang Formation consists of dark grey shales interbedded with mudstones and sandstones. The shales are argillaceous, bear ferruginised concretionary nodules, laminated and carbonaceous at places. The Upper Disang Formation chiefly comprises huge thickness of dark grey splintery shales interbedded with sandy shales and siltstones. The shales are arenaceous and finely laminated, bear pyritic nodules of assorted sizes, oval to round in shape and enclosed partially decomposed leaf impressions. The sandy shale bands are soft and fossiliferous. These enclosed tiny forms of gastropod and bivalve mollusks, and occasionally microfossils. The fossiliferous locations are found near Pfutsero and Meluri areas (Sinha & Chatterjee, 1982). The exploration and updating of records of animal fossils from Nagaland were a part of the programme of the preparation of an exhaustive faunal atlas of the state by the ZSI.

PHYSIOGRAPHIC SETTINGS

Topographic characteristics: Nagaland consists of a narrow strip of hilly country running northeast to southeast and facing the Assam plains to its north and north-west. The Barail range starts at the south-west corner of the state and runs in a north-easterly direction almost up to Kohima. The Barail range merges with the mountain ranges which have extended to Manipur and the main range assumes a much more northernly trend. This range is considerably higher than the Barail with peaks like, Saramati (3826.15 m.) and Mataungse Kien (3420 m.) at its east. Between Mao and Kohima, there are several high peaks including Japvo. The main range declines in height northward of Kohima, and as far north as Mokokchung district the Japukong range attains an average height of 750 m. [see Text-Figs. 1-3].

Natural drainage: The Barail and Japvo range form the main watershed of Nagaland state but none of the streams that come down their slopes are considerably large. Almost as far north as Mokokchung, the whole of the drainage of the north-western face of hills ultimately find their way into Dhansiri River. Diphu-pani is an important tributary of Dhansiri. Doiang river originates near Mao and follows a north-northeasternly course and then flowing north-west cutting across the main chain of hills until it joins its largest tributary, the Rongmapani. In North of Doiang the major streams are Disal and Thanzi which ultimately join the Brahmaputra in Assam.

Climatic condition: The state enjoys a typical monsoon climate with variants ranging from tropical to temperate conditions. The rapid changes in topography result in climatic changes within short distance. There are two seasons separated by two short transitions. From November to February is the period of winter. The summer commences in April and continues up to September. The summer season is also the period of rains, with an average rainfall of about 1943 mm. in Kohima. The October is the period of transition between the summer and winter, so is the month of March between the winter and summer. The temperature varies from 0 ° C in winter to about 40 ° C in summer.

STRATIGRAPHY

Acharyya *et al.* (1986) while dealing with the Naga Hills ophiolite belt had put forward the stratigraphic succession in this area. The rocks of Naga Hills ophiolite and tectonically juxtaposed western sedimentary belt have different stratigraphic settings. The following account is drawn mainly from the above work.

NAGA HILLS OPHIOLITE

The sediments associated with the ophiolite are mainly chert and limestone. They occur usually in intimate association and intrbedded with the volcanic suite, though

locally tectonised slices also occur in other members of the ophiolite suite. Among these, mainly the red chert, rarely the grey chert and a few of the less recrystallised limestone bands are fossiliferous. The chert beds contain radiolarian or both radiolarians and calcareous nannofossils in occasions. Some limestone bands interbedded with chert contained calcareous nannofossils, smaller forams and radiolarian assemblage.

The radiolarian assemblage with long ranging forms is not age specific but occurrence of the genera like, *Kassina, Spongocanthus, Acanthocirus*, etc. point out to the Cretaceous time zone. The calcareous nannofossils indicate a Maestrichtian age. In occasions, limestone containing *Rotalipora*-dominated assemblage signifying Cenomanian-Turonian age in association with typical Maestrichtian forms was noticed. The chert bed associated with the ophiolite bed of Nagaland was assigned to Upper Jurassic-Lower Cretaceous age on the basis of radiolarian assemblage by Duara *et al.* (1983).

The Chiphur limestone, associated closely with the volcanic contained moderately rich nannofossil assemblage indicating Maestrichtian age. The available evidences thus suggested that most of the chert-limestone volcanic association to be assigned to Maestrichtian. There were also a few chert bands and limestone of Cretaceous age, but not restricted to Maestrichtian time horizon only.

In the Chin Hills, a very late Jurassic age c. 158 ± 26 Ma was assigned to the ultramafic members of the ophiolite suite on the basis of K- Ar age of the hornblende bearing pegmatite intruding them.

PHOKPHUR FORMATION

The dismembered ophiolites are non-conformably overlain by ophiolite derived from marine to paralic sediments designated as Phokphur Formation after its type locality. The faunal and floral records from this Formation were limited but distinct biozones were recorded from the type sections as well as area between Luthur and Salumi. Some pockets of coaly and carbonaceous matters were present within the closely associated beds. Gastropod-bearing horizons were noticed in beds northeast of Phokphur Village. All the taxa were long ranging and suggestive of shallow marine transgression only. Ranga Rao (1983) suggested Eocene age of the Formation. The plant bearing horizons were noticed at places and the assemblage indicated humid tropical climate.

The plant and mollusc bearing beds, located nearby, were both associated with carbonaceous horizons. The plant bearing beds located close to non-conformable base of the Formation seemed to be older in age but the age is likely to be Eocene.

A conglomerate bed with pebbles of chert, volcanic and phyllites located between Luthur and Salumi contained foraminiferal species with minor fauna of marine habitat. These broadly suggest a Tertiary age.

A limestone bed occurring near Reguri contained assemblage of radiolarians, smaller foraminifers and other minor fauna. The total assemblage was not age specific but of Eocene or younger age of shallow marine habitat. Hence, fossil records from the basal part of Phokphur Formation suggested a shallow marine to fluvial condition, indicating Eocene age.

NAGA METAMORPHICS

The *Naga Metamorphics* name was coined by Brunnschweiler (1966) mainly for mesograde metamorphic rocks occurring in the Burmese side of the Indo-Burman Range. It is represented in the Naga Hills by quartzite, marble, mica, schist/schistose, phyllite/phyllonite, mica schist, gneisses, etc. Base of this Formation is not exposed but these are tectonically juxtaposed against and even overlie the ophiolitic rocks as well as the Phokphur Formation. Brunnschewiler (1966) regarded this of Pre-Mesozoic age. Acharyya *et al.* (1986) considered this may be of Proterozoic age.

NIMI FORMATION

The *Nimi Formation* retains relict sedimentary classic texture that was totally obliterated in the *Naga Metamorphics*. The dominant members of this Formation are phyllite, quartzite and marble, which are also available in the *Naga Metamorphics*. The feldspar in the arenaceous units of the Nimi Formation is indicative of continental provenance whereas those in association with palagioclase and ophiolitic clasts in the Phokphur Formation indicate oceanic provenance. There is no significant structural difference between the limestone/marble of the Nimi Formation and those associated with the volcanic of the ophiolite, but the former one is more recrystallised. The Nimi Formation was assigned a Middle Cretaceous age by Acharyya *et al.* (1986).

AVANGKHU BEDS

Around Avangkhu, near Myanmar border, the Nimi Formation is followed by grey and carbonaceous slate, phyllite and quartzite. These are lithologically and structurally comparable to those of Phokphur Formation or the Disang Formation but their correlation is not well understood.

WESTERN SEDIMENTARY BELT

The Western sedimentary belt is subdivided into two tectono-sedimentary domains:

(i) The Western narrow belt of Schuppen consisting of homoclinal to open folded and thrust repeated Tertiary sediments of the outer Molasse Basin;

(ii) The Eastern or inner belt in Central Naga Hills consisting of folded sequence of a thick pile of Lower Tertiary flyschoid sediments (*viz.,* the Disang Formation and the Barail Group).

DISANG FORMATION

The oldest sedimentaries of the central Naga Hills comprise the Disang Formation which consists of monotonous and thick succession of splintery grey and black shales, slate-siltstone and sandstone rhythmites. The sandstones are relatively coarser, thicker and more evident in the upper part. The surface extent of the Disang Formation is tectonically limited to the west by the Disang thrust. The basal part of the Disang Formation is not exposed but the argillaceous bed with limestone interbands was considered to represent the lower section of the Formation on the basis of fauna of older time.

It has often been considered that the contact between the limestone and the shale unit is tectonic in nature. However, a part of the shale sequence lies in strike continuity of the limestone bed. It is likely that the limestone occurs as exotic blocks within the shale.

On the basis of associated fauna and plant remains the lower and upper age limit of Disang Formation could be taken as Upper Cretaceous and Upper Eocene age respectively.

BARAIL GROUP

The Barail Group occurs in two different tectonic belts with different stratigraphic settings and slightly different facies:

Inter belt Barail : This belt conformably overlie the Disang Formation and there has been fair sedimentological and faunal continuity from the Upper Disang to the Lower Barail. The faunal assemblage contain mollusk like, *Tellina, Nucula, Corbula, Turritella* etc. The basal Barail beds at places contained angiospermic plant impressions which did not signify a specific age (Ranga Rao, 1983).

The Barail sandstone of both inner and outer belt often contained rough and knoby walled 'Ophiomorpha' type of burrow and various trace fossils (Acharyya *et al.,* 1986).

Barail from Belt of Schuppen : This belt is the oldest exposed Formation which at places disconformably underlies the Surma Formation in the belt of Schuppen. The molluscan forms were recorded from various locations but that do not signify a specific age.

The Barail of outer belt was generally regarded as Oligocene in age. However, Barail from foothills of Kohima featuring clayey beds and sandstone with carbonaceous

streaks, neighbouring Disang thrust showed *Nummulites*- bearing zone. These suggested Middle Eocene age (Acharyya *et al.*, 1986). Hence, the lower age limit of the Barail of outer belt extends to Middle Eocene, in at least places. The upper age limit of the Barail group was assigned an Oligocene age by Ranga Rao (1983).

A general tectono-stratigraphic sequence in Naga Hills has been represented in the following Table

Tectonostratigraphic Sequence In Naga Hills (after Acharyya *et al.*, 1986)

Tectonic domain	Formations	Broad age
Parts of overriding Burmese Plate	Nimi Formation	? Triassic
	Naga Metamorphics	? Proterozoic
	- - -Thrust- - -	
	Phokphur Formation	Eocene
Ophiolite belt rocks	Naga Hills Ophiolite	Maestrichtian and older
	- - -Thrust- - -	
	Barail Group	Oligocene - Upper Eocene
Flysch belt Cretaceous (on Indian Continental Plate)	Disang Formation	Upper Eocene to Upper
	(Base not exposed)	
	- - -Disang Thrust- - -	
	Namsang Formation	? Pliocene
Belt of Schuppen outer Molasse basin (on Indian Continental Plate)	Tipam Group	Upper-Middle Miocene
	Surma Formation	Lower Miocene
	Barail Group (Base not exposed)	Oligocene to Middle Eocene

GEOLOGY

Nagaland is located in the northern extension of the Arakan Yoma ranges which are of Tertiary Cretaceous age and belong to a fairly young unstable belt of the earth (GSI, 1974).

Structure: Three major structural units have been recognized in the State of Nagaland viz, (i) the 'Belt of Schuppen' in the north-west bordering the Assam plains, (ii) the patkai synchinorium in the south-east and (iii) the Kohima Synclinorium in the south.

On the western flank of the Naga Hills, the 'Belt of Schuppen' consisting of eight or more overthrusts overriding one above the other forming an imbricate pattern has been found. Along these thrusts the Naga Hills region moved north-westerd relative to the Foreland spur. The North-western margin which for many Kilomiters followed the boundary along the outer fringe of the Naga-Patkai ranges in conventionally called the Naga Thrusts separating the sharply folded sediments of the Belt of Schuppen from the little affected flat to gently dipping beds lying north of this belt.

The highest ground of the Patkai range synclinorium comprises synclines with Barail rocks and the relatively open synclines are separated by faulted and overthrust Disang shale. On the north-western fringe of this synclinorium a number of thrust planes occur and the Disang thrust is taken as the Belt dividing line between the Patkai synclinorium and the 'Belt of Schuppen'.

The Kohima Synclinorium occurs a little far to the southwest of Patkai Synclinorium lies mainly within the Disangs but towards the Surma Valley, higher groups of rocks were noted. It is bounded in the north-west by the Disang Thrust and to the south it merges into the eastrn end of the Surma Valley.

MINERAL RESOURCES

I) Asbestos:

Thin lenses of chrysotile asbestos are reported from the serpentine dyke occurring near Panchimi and Kurani in the Tuzu Valley (25° 40' 00"N : 94° 40' 00"E) between Nayung and Tape River and near Gedu River in the southern part of the country bordering Myanmar.

II) Chromite:

Occurrences of nickeliferous chromite have been located by the State Department of Geology, Government of Nagaland, in the ultrabasic belt of Tuensang district at the following places:

1) One km. south of Pang Village (25° 56' 00"N: 94° 58' 00"E), the chromite veins upto 6 cm. thick are contained in pebbles of pyroxenite.

2) At a place (25° 54' 00"N: 94° 59' 15"E) between Pang and Thonoshinya village (25° 53' 00"N: 94° 58' 30"E), thin veins of nickeliferous chromite upto 3 cm. thick are seen in fine grained serpentinised peridolite.

3) Between Phokphur (25° 52' 30"N: 94° 57' 00"E) and Thonoshinye massive nickeliferous chromite veins are located in serpentinite.

The Chromium oxide (Cr_2O_3) percentage in these occurrences varies from 35 to 40 whereas the nickel content is from 1000 to 3000 ppm.

III) Coal:

The Tertiary sediments of Nagaland *viz.*, the Barails abound in coal. Important coal seams occur in the basal argillaceous member of the Tikak Parbat Formation.

Although excellent as coaking coal, it cannot find use in the Iron and Steel Industry in view of its high content of organic sulphur and indifferent coaking character. It has, so far, not been possible to separate the sulphur economically. Therefore, the future utilization of the Tertiary coals of north-east India will depend on exploring its use in coal-based industries and production of synthetic petroleum, now considered feasible and being tried in several countries.

Nazira Coalfield or otherwise known as Dikhu Valley coalfield till to-day represent the most important coalfield of Nagaland. Coal bearing Barail rocks occur as a strip along the outer flanks of Naga Hill ranges over a strike length of 16 km. though the coal measures of this belt forms a continuos strip across the Dikhu River, the northern section (north of Dikhu River) shows a better promise than that part lying to the south of Dikhu River.

Only the Tikak Parbat Formation which is the topmost member of the Barail Group is coal bearing in this area. The seams, however, are restricted mainly to the lower argillaceous member. They occur in subordinate proportion in the upper member but the middle member is devoid of any coal seam. The major seams of the lower member are exposed mainly in Waktingjan Valley and in other streams south of it.

The coal is generally of low ash (3.0%) and moisture (around 5.4%) but high in sulphur (4.3%). The coal is poorly coaking.

The gross total reserves in the Nazira Coal-field, north of Dikhu River, is estimated to be of the order of 55 m. tones down to a depth of 600 m.

In the Nazira coal belt, south of Dikhu River, along with the progressive decrease in thickness of the coal bearing Tikak Parbat Formation towards south-west, there is a marked reduction in thickness of the coal seams particularly that of the Wakting seam. Only the area around Yamtin *nala*, west of Namsang Chingchung Village (26° 43' 30"N: 94° 49'E) appears to be potential where the seam can be traced continuously and is relatively free from tectonic disturbances.

Other Coal bearing Areas

The Barail in Changkikong-Japukong region of the Mokokchung district are found to contain coal seams. The occurrences of thick coal seams in this region appear to be of significant extent and good quality having considerable economic potentiality. The occurrences have been located in: (a) Changki (26° 25' 15"N: 94° 23' 30"E)-Chonglymsen (26° 25' 43"N: 94° 25' 43"E), (b) Waromung (26° 33' 30"N: 94° 32' 00"E)-Mongchen (26° 30' 03"N: 94° 28' 45"E), (c) Lakuni (26° 31' 30"N: 94° 20' 00"E)- Mirinpoh (26° 25' 30"N: 94° 36' 30"E) areas.

(a) Changki-Chonglymsen Area: A number of workable coal seams are noted between Changki in the south and Chonglymsen in the north. Thick coal seams are also exposed north-west of Changki. The top coal seam of the region which is 1.5 to 2.2 m. thick, seems to be the most important one from the mining point of view. The seam is exposed in a number of *nala* courses as well as on the Hill scarps such as:-

(i) In a *nala* course about 140 m. south-east of the culvert on the prominent loop of the Changki road about 1 km. south-east of Merakyong Village (26° 25' 20"N: 94° 24' 23"E),

(ii) In the central branch of Nongak *nala* about 1.5 km. to the east of Merakyong Village,

(iii) In the southern branch of the Chonglymsen (*nala* about 1 km. to the WNW of Chonglymsen) Village and

(iv) In the scarp face 1.5 km. south of Athuphumi Village (26° 28' 00"N: 94° 25' 20"E).

This seam not only shows a consistency in thickness along its lateral extension of more than 8 km. but also is much less tectonically disturbed being away from the thrust contact.

(b) Waromung- Mongchen Area: East of Waromung a seam of about 3.5 m. crops out about 20 m. below the Khari fault. The seam increases in thickness towards south-west to a thickness of 5 m. including parting of shales. Below this seam there are two more compound seams exposed near Khari Village (26° 28' 00"N: 94° 28' 30"E). Besides the above seams, six Coal seams varying in thickness from 1 to 6 m. are found within 1000 m. of the strata. North-west of waromung Village only three coal seams are exposed, the thickness being 4.4 m. Coal seams of workable thickness also occur in the Ait *nala* north-west of Mongchen Village.

(c) Lakuni-Mirinpoh Area: To the north of Mirinpoh a 3.4 m. thick seam is exposed about 20 m. below the top of the Barail extending strikewise south-west for about 1.5 km. with diminishing thickness. Two coal seams of 4.4 m. and 1 m. thickness are noted to the west of Lakuni.

IV) Iron (Larerite) and Zinc:

Iron laterite cappings occur over Tipam sandstone in Merapani area (26° 18' 00"N: 96° 06' 30"E) of the Wokha district. Zinc in appreciable concentration had been indicated in the laterite by chemical tests.

V) Limestone:

Eight bands of limestone have been discovered by the State Department of Geology and Mining around Nimi (25° 43' 00"N: 94° 54' 45"E) in the Pungro Circle of Tuensang district. The first four bands (from top) have a total average thickness of 100 m. and are quite uniform in their character and extend over a strike length of 10,000 m. The analysed results of these bands show that they are very high in CaO content (52 to 54%) and very low in magnesia and insolubles.The reported limestone occurrence at Chakhabama (25° 37' 00"N: 94° 12' 00"E) near Kohima and Dibuia (26° 31' 30"N: 94° 31' 00"E) in the Chanki range north-west of Mokokchung were found to be of the nature of calc-tufa. The occurrences are too minor to be of any economic use.

VI) Magnetite:

Reconnaissance Survey of the areas around Phokphur Village in the Pungro circle of the Kiphre Sub-Division in the Tuensang district was carried out in connection with an investigation of nickeliferous magnetite-ore.

The magnetite body is sheet-like and bedded massive with slickensided surfaces outcropping as solid cliffs in the razor sharp ridge crests of Mataungse Kein Hill with an average elevation of 1985 m. in the central part of the Hill aligned in a N-S direction. The foot wall of the magnetite band comprises consistently ultramafics consisting of serpentinites, peridotites and pyroxenites with pockets of fine-grained chromite. The hanging wall consists of pyroclastics and pebble conglomerates.

The thickness of the magnetite band as measured in the ridge crest as well as in the Hill is 15 m. in average, with a gradual thinning southward to about 6 m. The total strike length on the ridge crest observed is about 800 m. A few analysed samples have indicated 10% Cr_2O_3, 5400 ppm. Ni and 1700 ppm Co.

VII) Oil:

Several oil seepages close to the thrust contact between the Tipams and the Barails have been found within the Barail sandstone all along the hill slopes at the following places: (a) West of Dibuia Village (26° 31' 30"N: 94° 31' 00"E) at about an altitude of 650 m. at the head water of an unnamed *nala* flowing into Tsurang. Oil seeps through the planes of weakness in the country rock-Barail sandstone, (b) About 4 km. north-west of Lakhuni, crude oil is seen to seep through the conglomerate bed between Barail sandstone and overlying Tipam sandstone and (c) 4 km. north-west of Longsamtang Village a belt of gas seepage is found along the Waromung Fault in the bed of Desai River. The anticlinal structures were cut off at depth by thrust faulting and in the comparatively small thickness of beds above the fault no productive sand

were found. Only more extensive prospecting can finally decide whether oil can be found or not. Lately, Oil and Natural Gas Commission has commenced drilling for oil in Nagaland and the result appears to be encouraging.

VIII) Pyrite:

Fine to coarse grained pyrite disseminations have been observed in Disang shales and phyllites. In one such occurrence in Zunki *nala* (26° 03' 00"N: 94° 55' 15"E), Tuensang district, the pyrite crystals tends to become concentrated in the form of thin veins (up to 8 cm.) and lenticles (10 cm. × 4 cm.) along the bedding planes. Economic concentrations of pyrites have, however, not been found, so far. Similar disseminations have also been observed in the quartzites associated with basic tuffs. Carbonaceous shale effervescing to greenish-yellow sulphur and white sulphate encrustations are reported from the Barail near Sanis in the Mokokchung dostrict.

IX) Road Metals:

The pebble bed occurring near Yachang (26° 41' 00"N: 94° 32' 15"E) resembling older Alluvium of Upper Assam consists of pebbles of fine and coarse graind sandstones, quartzites and fragments of silicified fossil wood which can be used as road metal. A hillock made up of this material extends over an area of 4 sq. km.

X) Salt:

Salt and brine springs are fairly common in Nagaland, generally confined to the Disang Formations. A complete analysis of about 10 brine samples by the State Department of Geology and Mining from different salt springs in Kohima and Tuensang districts indicates that they vary greatly in their degree of saturation (Maximum dissolved salts being about 5.5%). Generally their potassium content is very low. A few of them, however, contain calcium sulphate and chloride of calcium and magnesium making them unsuitable for human consumption.

It was reported that areas occupied by the Girujan clays are favourite hunts for elephants as they are fond of eating these clays obviously for their salt content. On this clue a sample of Girujan clay was analysed at Geological Survey of India laboratory which gave 0.25% Na_2O and 1.75% K_2O. Although normal potash content in the argillaceous sediments and shales varies upto 8% or even more, the low content of potash in the Girujan clays may not be of much significance. But it may be noted that the collected samples were from the surface and highly soluble potash salts might have been removed. In the context of the known saline springs in the Tertiary sediments in Nagaland-Manipur, concealed occurrences of evaporate with high potash content may not be ruled out.

XI) Slate and Phyllite:

Slate and phyllite occurrences have been located at various places along the entire eastern belt of Kohima and Tuensang districts. Of these, the occurrences of compact

phyllites east of Nimi (25° 43' 00"N: 94° 54' 45"E), dark grey slates in between Thonoknyu (25° 58' 00"N: 94° 54' 30"E) and Pang (25° 55' 00"N: 94° 45' 30"E) and Wui (25° 02' 00"N: 95° 61' 00"E) and Pesu (25° 02' 45"N: 94° 58' 15"E) are noteworthy. In addition, good quality slates have also been noticed at various places in the Tizu River, and Zunki and Chikla *nalas.*

PREVIOUS WORKS

Geological investigation in Nagaland and adjacent regions were of the nature of scanty traverses during the pre-independent period of India. The earliest geological information of Nagaland was traced back to Theobald (1873). The Disang Series, as referred in past, comprises a great monotonous thickness of splintery dark grey shales interbedded with siltstones and sandstones towards top. It was first named by Mallet (1876) whose type section in located along Disang River. Later, Oldham (1883) correlated the Disang with axials of Arakan Yoma. Maclaren (1904) and Pascoe (1912) considered that the bulk of Disangs have more in common with the Negaris bed of Arakan Yoma. Hayden (1910) considered that the Disang "may be made up of a great Flysch Formation" and might extend up even into the Tertiary. On the basis of a reported find of ammonite by Hayden the Disang was considered to be ranging from Cretaceous to Middle Eocene by Evans (1932). Evans (*op. cit.)* found *Nummulites* and stated that 'the Disang will eventually be shown to be a more altered and practically infossiliferous equivalent of Laungshe shales of Burma' which are believed to range from Paleocene to Eocene. He further described Disang shales "as very like those of Kopili Formation" and suggested that the Disang include a deeper water facies of the Jaiatia Group and perhaps lower horizons equivalent to Ranikot, Laki and Kirthar and possibly upper most Cretaceous.

Nagappa (1959) recorded the occurrence of some arenaceous foraminifers *viz., Ammobacullites, Ammodiscus, Bathysiphons, Cyclammina, Gaudryina, Haplophragmoides* from the top most bed of the Disang Formation exposed at north of Damchara, suggesting deposition under shallow marine environment.

Sinha & Chatterjee (1982) recorded the occurrence of some marine gastropods and bivalves apart from some larger foraminifera. The available forms were very few and tiny. They considered lower age limit of Disang Group as Paleocene.

Micropalaeontological studies have reported occurrence of *Nummilites* in Disang Formation exposed at Changtogka; *Dicotybconoides* sp. and *Nummulites* spp. from Tuensang and Phek of Upper Disang Formation (Sinha, 1974; Singh & Adiga, 1977; Sinha & Chatterjee, 1982).

Sinha *et al.* (1982) presented a concise account of the Palaeontological studies carried out on the various sedimentaries in Nagaland, and in other States of north-eastern India.

Ranga Rao (1983) recorded *Nummulites chavannesi*, reticulate *Nummulites*, *Operculina* sp. and *Biplanispira* sp. from Laisong Formation near Hening Kunglwa and assigned Eocene age.

Ghosh *et al.* (1984) recorded the presence of rich radiolarian microfauna in parts of eastern Nagaland Ophiolite belt. They considered Upper Cretaceous age of the fauna.

Acharyya *et al.* (1986) worked out the radiolarians and nanofossils of the ophiolite belt and several fossil bearing localities of Nagaland and associated the results with earlier micropalaeontological studies in the region. They reconstructed the stratigraphic succession of the ophiolite belt, stratigraphic relations between the different formations and members of the ophiolite belt were worked out and geochronologically dated.

Baruah *et al.* (1987) recorded rich foraminiferal assemblage from the shale and siltstone sequence exposed near Hening Kunglwa and Lotsa Village. The foraminiferal assemblage included larger benthic foraminifers *viz.*, *Nummulites pengaroensis, N. discorbinus, Discocyclina dispansa, D. eamesi, Pellatispira madaraszi* and *P. inflata.* They also recorded the planktic foraminifers like, *Hantkenima alabamensis, Globorotalia centralis, G. cerroazulensis, G.increbescens, G. insolita, Globigerina pseudoampliapertura, G. yeguaensis, G. tripartite, G. ouchitaensis, Cribrohantkenina inflata,* and *Pseudohastigerina barbadoensis;* smaller benthic foraminifera *viz.*, *Uvigerina* sp., *Marginulina* sp., *Cibicides* sp., *Dentalina* sp., *Operculina* sp., *Lagena* sp., *Bulimina* sp., *Quinqueloculina* sp. and arenaceous foraminifera like, *Trochammina* sp., *Haplophragmoides* sp., *Cyclammina* sp., and *Miliammina* sp. Baruah *et al.* (op. cit.) recognized two assemblage zones *viz.*, (i) *Cribrohantkenina inflata- Hantkenina alabamensis* assemblage zone, and (ii) *Nummulites pengaroensis- Pellatispira madaraszi-Discocyclina dispansa* assembege zone and assigned them to Eocene age.

Samanta *et al.* (1991) recorded the occurrence of fossil vertebrates from conglomerate band within Surma Group in Schuppen belt, south of Borholla-Changpang oil field. The fossil assemblage comprised teeth and bones of mammals [Gomphotheridae], crocodiles, chelonians and fishes. The close association of the aquatic and land vertebrates indicated the existence of lowland aquatic environment during Miocene.

Bhatia and Dave (1996) recorded rich foraminiferal assemblage of Paleogene sequence encountered in five exploratory wells in Chumukedima, Tynyphe, Naojan, Kasomarigaon and Baspathar across the Dhansiri valley. They recognized three biozones *viz.*, *Nummulites acutus-Fasciolites elliptica* assemblage zone, *Nummulites discorbinus- Assilina* sp. assemblage zone, *Nummulites pengaronensis* zone and poorly fossiliferous zone ranging in age from Middle Eocene to Oligocene.

Lokho & Kumar (2008) recorded occurrence of fossil pteropod species (Molluscs) from the Eocene beds of the Upper Disang Formation exposed near Pfutsero and

highlighted their importance from the view point of biostratigraphy and palaeoecology.

SYSTEMATIC PALAEONTOLOGY

LIST OF TAXA

Phylum PROTOZOA

Subphylum SARCODINA

Class RHIZOPODA

Order FORAMINIFERA

Family ROTALIDAE

Genus ***Ammonia*** Brûnich

1. ***Ammonia beccari*** Linnaeus,

Genus ***Dictyoconoides*** Nuttall

2. ***Dictyoconoides*** sp.

Family NODSARIIDAE

Genus ***Nodosaria*** Lamarck

3. ***Nodosaria*** sp.

Family TURRILINIDAE

Genus ***Praebulimina*** Hofker

4. ***Praebulimina*** sp.

Family BOLIVINITIDAE

Genus ***Bolivina*** d' Orbigny

5. ***Bolivina*** sp.

Family NUMMULITIDAE

Genus ***Nummulites*** Lamarck

6. ***Nummulites*** sp.

Family HETEROHELICIDAE

Genus ***Heterohelix*** Ehrenberg

7. ***Heterohelis*** sp.

Family PLANOMALINIDAE

Genus ***Globigerinelloides*** Cushman

8. ***Globigerinelloides*** sp.

Family ROTALIPORIDAE

Genus ***Hedbergella*** Broennimann & Brown

9. ***Hedbergella*** sp.

Genus ***Rotalipora*** Brotzen

10. ***Rotalipora*** sp.

Family GLOBIGERINIDAE

Genus ***Globigerina*** d' Orbigny

11. ***Globigerina*** sp.

Genus ***Globorotaloides*** Bolli

12. ***Globorotaloides*** sp.

Family LOXOSTOMIDAE

Genus ***Loxostomum*** Ehrenberg

13. ***Loxostomum*** sp.

Family NONIONIDAE

Genus ***Nonion*** de Montfort

14. ***Nonion*** sp.

Family TEXTULARIDAE

Genus ***Bolivinopsis*** Yakovlev

15. ***Bolivinopsis*** sp.

Genus ***Pseudobolivina*** Wiesner

16. ***Pseudobolivina*** sp.

Genus ***Textularia*** Defrance

17. ***Textularia*** sp.

Family MILIOLIDAE

Genus ***Quinqueloculina*** d' Orbigny

18. ***Quinqueloculina*** sp.

Family DISCORBIDAE

Genus ***Epistominella*** Husezima & Maruhasi

19. ***Epistominella*** sp.

Class ACTINOPODA

Subclass RADIOLARIA

Order PORULOSIDA

Family BELONASPIDIDAE

Genus ***Cribrosphaera*** Popofsky

20. ***Cribrosphaera*** sp.

Family THALASSICOLIDAE

Genus ***Thalassicola*** Huxley

21. ***Thalassicola*** sp.

Family LIOSPHAERIDAE

Genus ***Liosphaera*** Haeckel

22. ***Liosphaera*** sp.

Genus ***Melitosphaera*** Haeckel

23. ***Melitosphaera*** sp.

Genus ***Ethmosphaera*** Haeckel

24. ***Ethmosphaera*** sp.

Genus ***Cromyosphaera*** Haeckel

25. ***Cromyosphaera*** sp.

Family DORYSPHAERIDAE

Genus ***Dorydictyum*** Hinde

26. ***Dorydictyum*** sp.

Family ASTROSPHAERIDAE

Genus ***Sphaeropyle*** Dreyer

27. ***Sphaeropyle*** sp.

Genus ***Dorypyle*** Squinabol

28. ***Dorypyle*** sp.

Family DACTYLIOSPHAERIDAE

Genus ***Dactyliosphaera*** Squinabol

29. ***Dactyliosphaera*** sp.

Family ELLIPSIDIIDAE

Genus ***Cenellipsis*** Rüst

30. ***Cenellipsis*** sp.

Family SPONGURIDAE

Genus ***Spongoprunum*** Haeckel

31. ***Spongoprunum*** sp.

Family CENODISCIDAE

Genus ***Cenodiscus*** Haeckel

32. ***Cenodiscus*** sp.

Family PHACODISCIDAE

Genus ***Phacodiscus*** Haeckel

33. ***Phacodiscus*** sp.

Family EUCHITONIIDAE

Genus ***Perichlamydium*** Ehrenberg

34. ***Perichlamydium*** sp.

Genus ***Ommatodiscus*** Stöhr

35. ***Ommatodiscus*** sp.

Family SPONGODISCIDAE

Genus ***Spongotrochus*** Haeckel

36. ***Spongotrochus*** sp.

Family LARACARIIDAE

Genus ***Coccolarcus*** Haeckel

37. ***Coccolarcus*** sp.

Order OSCULOSIDA

Family STEPHANIIDAE

Genus ***Acanthocircus*** Squinabol

38. ***Acanthocircus*** sp.

Family ARCHIPHORMIDIDAE

Genus ***Bathropyramis*** Haeckel

39. ***Bathropyramis*** sp.

Family ARCHIOCORYTHIDAE

Genus ***Archicorys*** Haeckel

40. ***Archicorys*** sp.

Genus ***Cornutanna*** Haeckel

41. ***Cornutanna*** sp.

Genus ***Cornutella*** Ehrenberg

42. ***Cornutella*** sp.

Genus ***Archicapsa*** Haeckel

43. ***Archicapsa*** sp.

Genus ***Mitracalpis*** Haeckel

44. ***Mitracalpis*** sp.

Genus ***Sciadiocapsa*** Squinabol

45. ***Sciadiocapsa*** sp.

Family SETHOPILIIDAE

Genus ***Lychnocanium*** Ehrenberg

46. ***Lychnocanium*** sp.

Family LOPHOPHAENIDAE

Genus ***Sethocyrtis*** Haeckel

47. ***Sethocyrtis*** sp.

Genus ***Dictyocephalus*** Ehrenberg

48. ***Dictyocephalus*** sp.

Genus ***Discolocapsa*** Haeckel

49. ***Discolocapsa*** sp.

Family THEOCORYTHIDAE

Genus ***Theocyrtis*** Haeckel

50. ***Theocyrtis*** sp.

Genus ***Tricolocapsa*** Haeckel

51. ***Tricolocapsa*** sp.

Genus ***Distylocapsa*** Squinabol

52. ***Distylocapsa*** sp.

Genus ***Triacartus*** Haeckel

53. ***Triacartus*** sp.

Family ARTOPHORMIDIDAE

Genus ***Cyrtophormis*** Haeckel

54. ***Cyrtophormis*** sp.

Genus ***Kassina*** Chabakov

55. ***Kassina*** sp.

Family STICHOCORYTHIDAE

Genus ***Dictyomitra*** Zittel

56. ***Dictyomitra*** sp.

Genus ***Eucyrtidium*** Ehrenberg

57. ***Eucyrtidium*** sp.

Genus ***Lithocampe*** Ehrenberg

58. ***Lithocampe*** sp.

Genus ***Spirocyrtis*** Haeckel

59. ***Spirocyrtis*** sp.

Genus ***Stichocapsa*** Haeckel

60. ***Stichocapsa*** sp.

Phylum MOLLUSCA

Class GASTROPODA

Order ARCHAEOGASTROPODA

Family TROCHIDAE

Genus ***Solariella*** Wood

61. ***Solariella*** sp.

Genus ***Jujubinus*** Monterosato

62. ***Jujubinus*** sp.

Genus ***Isanda*** Adams & Adams

63. ***Isanda*** sp.

Family NERITIDAE

Genus ***Nerita*** Linnaeus

64. ***Nerita*** sp.

Family MURCHISONIIDAE

Genus ***Murchisonia*** d' Archiac & de Verneuil

Subgenus ***Sinuspira*** Perner

65. *Murchisonia (Sinuspira)* sp.

Genus ***Ectomaria*** Koken

66. ***Ectomaria*** sp.

Family PLETHOSPIRIDAE

Genus ***Wortheniopsis*** J. Böhm

67. ***Wortheniopsis*** sp.

Order MESOGASTROPODA

Family TURRITELLIDAE

Genus ***Turritella*** Lamarck

68. ***Turritella*** sp.

Genus ***Haustator*** Lamarck

69. ***Haustator*** sp.

Family LITTORINIDAE

Genus ***Littorina*** Ferussac

70. ***Littorina*** sp.

Family CERITHIIDAE

Genus ***Cerithium*** Bruguere

71. ***Cerithium*** sp.

Family RANELLIDAE

Genus ***Cymatium*** Roeding

72. ***Cymatium*** sp.

Order CAENOGASTROPODA

Family LOXONEMATIDAE

Genus ***Katoptychia*** Perner

73. ***Katoptychia*** sp.

Genus ***Polygyrina*** Koken

74. ***Polygyrina*** sp.

Family PSEUDOMELANIIDAE

Genus ***Bourgetia*** Terquem & Jourdy

75. ***Bourgetia*** sp.

Family ZYGOPLEURIDAE

Genus ***Allocosmia*** Cossmann

76. ***Allocosmia*** sp.

Superorder ALLOGASTROPODA

Family PYRAMIDELLIDAE

Genus ***Niso*** Risso

77. ***Niso*** sp.

Order OPHISTOBRANCHIA

Family STREPTACIDIDAE

Genus ***Streptacis*** Meek

78. ***Streptacis*** sp.

Order NEOGASTROPODA

Family NASSARIIDAE

Genus ***Nassarius*** Dumeril

79. ***Nassarius*** sp.

Family OLIVIDAE

Genus ***Ancilla*** Lamarck

80. ***Ancilla*** sp.

Family VASIDAE

Genus ***Turbinella*** Lamarck

81. ***Turbinella*** sp.

Family MITRIDAE

Genus ***Mitra*** Lamarck

82. ***Mitra*** sp.

Family TEREBRIDAE

Genus ***Terebra*** Bruguiire

83. ***Terebra*** sp.

Family TURRIDAE

Genus ***Polystira*** Woodring

84. ***Polystria*** sp.

Order BASOMATOPHORA

Family LYMNAEIDAE

Genus ***Lymnaea*** Lamarck

85. ***Lymnaea*** sp.

Class BIVALVIA (PELECYPODA)

Subclass PTERIOMORPHIA

Order PTERIOIDA

Family TERQUEIIDAE

Genus ***Enantiostreon*** Bittner

86. ***Enantiostreon*** sp.

Genus ***Anomia*** Rafinesque

87. ***Anomia*** sp.

Order ARCOIDA

Family ARCIDAE

Genus ***Arca*** Linnaeus

88. ***Arca*** sp.

Genus ***Barbatia*** Gray

89. ***Barbatia*** sp.

Subgenus ***Cucullaearca*** Conrad

90. ***Barbatia* (*Cucullaearca*)** sp.

Family CORBICULIDAE

Genus ***Corbula*** Bruguière

91. ***Corbula*** sp.

Subgenus ***Bicorbula*** Fischer

92. ***Corbula* (*Bicorbula*)** sp.

Subgenus ***Varicorbula*** Grant & Gale

93. ***Corbula* (*Varicorbula*)** sp.

Family GLYCYMERIDAE

Genus ***Glycymeris*** da Costa

94. ***Glycymeris*** sp.

Genus ***Nemocardium*** Meek

Subgenus ***Discors*** Lamarck

95. ***Nemocardium* (*Discors*)** sp.

Genus ***Venericardia*** Lamarck

96. ***Venericardia*** sp.

Subgenus ***Venericor*** Stewart

97. ***Venericardia* (*Venericor*)** sp.

Order MYTILOIDA

Suborder OSTREINA

Family OSTREIDAE

Genus ***Ostrea*** Linnaeus

98. ***Ostrea*** sp.

Family PECTINIDAE

Genus ***Pecten*** Muller

99. ***Pecten*** sp.

Subgenus ***Yabepecten*** Masuda

100. ***Pecten* (*Yabepecten*)** sp.

Genus ***Pholadomya*** Swoerby

101. ***Pholadomya*** sp.

Subclass HETERODONTA

Order VENEROIDA

Family VENERIDAE

Genus ***Pitar*** Römer

102. ***Pitar*** sp.

Genus ***Ventricolaria*** Keen

103. ***Ventricolaria*** sp.

Genus ***Chione*** Megerle von Muehlfeld

104. ***Chione*** sp.

Genus ***Paphia*** Bolten

105. ***Paphia*** sp.

Genus ***Timoclea*** Brown

106. ***Timoclea*** (s. str.) sp.

Family SOLENIDAE

Genus ***Solen*** Linnaeus

107. ***Solen*** sp.

Family TELLINIDAE

Genus ***Tellina*** Linnaeus

108. ***Tellina*** sp.

Subgenus ***Elliptoellina*** Cossmann

109. ***Tellina*** **(*Elliptoellina*)** sp.

Subgenus ***Cadella*** Dall, Bartsch & Rehder

110. ***Tellina*** **(*Cadella*)** sp.

Subgenus ***Gastranopsis*** Cossmann & Pissaro

111. ***Tellina*** **(*Gastranopsis*)** sp.

Genus ***Hercodon*** Conrad

112. ***Hercodon*** sp.

Genus ***Macoma*** Leach

Subgenus ***Macoploma*** Pilsbry & Olsson

113. ***Macoma*** **(*Macoploma*)** sp.

Family DONACIDAE

Genus ***Donax*** Linnaeus

Subgenus ***Capsella*** Gray

114. ***Donax*** **(*Capsella*)** sp.

Family PSAMMOBIIDAE

Genus ***Gari*** Schumacher

Subgenus ***Psammotaena*** Dall

115. ***Gari*** **(*Psammotaena*)** sp.

Subgenus ***Gobraeus*** Brown

116. ***Gari*** **(*Gobraeus*)** sp.

Subgenus ***Psammoica*** Dall

117. ***Gari*** **(*Psammoica*)** sp.

Genus ***Asaphis*** Modeer

118. ***Asaphis*** sp.

Family VESICOMYIDAE

Genus ***Calyptogena*** Dall

119. ***Calyptogena*** sp.

Family CORBICULIDAE

Genus ***Corbicula*** Mergele von Muehlfeld

Subgenus ***Donacopsis*** Sandberger

120. ***Corbicula* (*Donacopsis*)** sp.

Order NUCULOIDA

Family CTENODONTIDAE

Genus ***Tancrediopsis*** Beushausen

121. ***Tancrediopsis*** sp.

Family NUCULIDAE

Genus ***Nuculopsis*** Girty

122. ***Nuculopsis*** sp.

Genus ***Nuculana*** Link

123. ***Nuculana*** sp.

Order NUCULOIDA

Family NUCULANIDAE

Genus ***Yoldia*** Moeller

124. ***Yoldia*** sp.

Order ARCOIDA

Family NOETIDAE

Genus ***Arginopsis*** Mac Neil

125. ***Arginopsis*** sp.

Order PTERIOIDA

Family INOCERAMIDAE

Genus ***Parainoceramus*** Voronetz

126. ***Parainoceramus*** sp.

Family AVICULOPECTINIDAE

Genus ***Euchondria*** Meek

127. ***Euchondria*** sp.

Genus *Decatopecten* **Rüppel**

Subgenus ***Sinectenolium*** Eames & Cox

128. ***Decatopecten* (*Sinectenolium*)** sp.

Family LIMIDAE

Genus ***Limea*** Bronn

129. ***Limea*** sp.

Order UNIONOIDA
Family UNIONIDAE
Genus ***Unio*** Philipsson

130. ***Unio*** sp.

Order VENEROIDA
Family CARDIIDAE
Genus ***Vepricardium*** Iredale

131. ***Vepricardium*** sp.

Family MACTRIDAE
Genus ***Mactra*** Linnaeus
Subgenus ***Nannomactra*** Iredale

132. ***Mactra* (*Nannomactra*)** sp.

Genus ***Rangia*** des Moulins
Subgenus ***Praerangia*** Cossmann

133. ***Rangia* (*Praerangia*)** sp.

Family MESODESMATIDAE
Genus ***Atactodea*** Dall

134. ***Atactodea*** sp.

SYSTEMATIC ACCOUNT

Phylum PROTOZOA
Subphylum SARCODINA
Class RHIZOPODA
Order FORAMINIFERA
Family ROTALIDAE
Genus ***Ammonia*** Brûnich

Ammonia beccari Linnaeus

***Diagnosis*:** Test free, biconvex, low trochospiral coil of 3-4 volutions, sutures slightly curved, thickened, depressed on umbilical side, septa primarily doubled; wall finely perforate, radial in structure, calcareous; umbilical surface with irregular granules along suture and over umbilical region; umbilicus with open umbilical fissures and plug in younger forms, which broken up into numerous fused pillars and bosses in matured specimens, umbilical plug extending inward to protoloculus, devoid of umbilical canals; aperture interio-marginal.

Locality: Nagaland: Zubza river section.

Geological horizon: Miocene.

Genus ***Dictyoconoides*** Nuttall

Dictyoconoides sp.

Diagnosis: Test conical, proloculus at apex, spiral side with thin imperforate lamina beneath which is layer of rectangular, spirally arranged chambers in multiple spire; umbilical side with radiating pillars of shell matter extending out from apex and 0.10 mm. diameter at surface, with intervening spaces of nearly same size, space divided by horizontal partitions; septa double, with medial interseptal canal and subsutural canal system; wall calcareous, umbilical side with granules, cavities in umbilical region separated by perforate plates and buttressing pillars; aperture multiple.

Locality: Nagaland: Tuensang.

Geological horizon: Eocene.

Family NODSARIIDAE

Genus ***Nodosaria*** Lamarck

Nodosaria sp.

Diagnosis: Test free, multilocular, rectilinear, rounded in section, sutures distinct and perpendicular to axis of test, surface smooth, costate, striate; aperture terminal.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family TURRILINIDAE

Genus ***Praebulimina*** Hofker

Praebulimina sp.

Diagnosis: Test flaring, inflated, chambers triserially arranged, wall calcareous, perforate, thick and opaque; aperture loop-shaped, with simple internal tooth plate.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family BOLIVINITIDAE

Genus ***Bolivina*** d' Orbigny

Bolivina sp.

Diagnosis: Test elongate, somewhat compressed; chambers broad, low, biserially arranged throughout, basal margins of chambers with retral process; wall calcareous, perforate, radial in structure, smooth, striate, or costate; aperture a narrow, elongate,

loop up chamber face, one margin bent upward as collar, opposite border attached to one side of doubly folded internal tooth plate, attached half of tooth plate projecting inward to coalesce with free half of tooth plate projecting through aperture at one extremity and bisecting it, narrowing rapidly inward.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family NUMMULITIDAE

Genus ***Nummulites*** Lamarck

Nummulites sp.

Diagnosis: Test involute to evolute; median chambers numerous, simple; without distinct lateral chambers, spiral sheet with or without vacuoles.

Locality: Nagaland: nr. Chizami

Geological horizon: Eocene

Family HETEROHELICIDAE

Genus ***Heterohelix*** Ehrenberg

Heterohelix sp.

Diagnosis: Early stage biserial, later develop chamber proliferation; aperture simple and interiomarginal.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family PLANOMALINIDAE

Genus ***Globigerinelloides*** Cushman

Globigerinelloides sp.

Diagnosis: Test free, plainspiral, biumbilicate, involute, lobulate in outline; chambers more or less rounded; sutures depressed, radial, straight or little curved; wall calcareous, finely perforate, radial in structure, surface nearly smooth; aperture slightly broad, low, interiomarginal equatorial arch, with lateral umbilical portions of successive apertures remaining open as relict apertures.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family ROTALIPORIDAE

Genus ***Hedbergella*** Broennimann & Brown

Hedbergella sp.

Diagnosis: Test free, trochospiral, biconvex umbilicate, periphery rounded, no indication of keel or poreless margin, chambers rounded; sutures depressed, radial, nearly straight; wall calcareous, finely perforate, radial in structure, surface slightly rugose or smooth; aperture an interiomarginal, extraumbilical-umbilical arch commonly bordered above by narrow lip or spatulate flap, successive apertural flaps become visible to show serrate or scalloped border around umbilicus.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Genus ***Rotalipora*** Brotzen

Rotalipora sp.

Diagnosis: Test free, trochospiral, biconvex to plano-convex, umbilicate, periphery angular, with single keel; chambers angular-rhomboid; sutures curved on spiral side, slightly elevated, on umbilical side radial to slightly curved; wall calcareous, perforate, radial in structure, surface slightly nodose; primary aperture interiomarginal and extraumbilical-umbilical in position with bordering lip, single secondary sutural aperture per suture on umbilical side, with bordering lip and thickened rim.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family GLOBIGERINIDAE

Genus ***Globigerina*** d' Orbigny

Globigerina sp.

Diagnosis: Test free, trochospiral, chambers spherical to ovate; wall calcareous, perforate, radial in structure, surface smooth or hispid; aperture interiomarginal, umbilical, often tend to slightly extraumbilical position, previous apertures remaining open into umbilicus.

Locality: Nagaland: between Luthur and Salumi.

Geological horizon: Tertiary.

Genus ***Globorotaloides*** Bolli

Globorotaloides sp.

Diagnosis: Test free, low trochospiral coil; chambers subglobular to spherical; sutures depressed; wall calcareous, finely perforate, surface pitted or hispid; aperture interiomarginal, extraumbilical to umbilical in position.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family LOXOSTOMIDAE

Genus ***Loxostomum*** Ehrenberg

Loxostomum sp.

Diagnosis: Test elongate, compressed, quadrate in section, with nearly flat or concave sides; chambers biserially arranged throughout, strongly overlapping and arched in adult with tendency to become uniserial; sutures limbate, arched, sutural thickening merging laterally into longitudinal carinae at four margins; wall calcareous, finely perforate; aperture terminal, slitlike to ovate, commonly with finely tuberculate lip.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family NONIONIDAE

Genus ***Nonion*** de Montfort

Nonion sp.

Diagnosis: Test free, planispiral and involute, slightly compressed, biumbonate, periphery rounded, peripheral outline lobulate; numerous chambers, increasing gradually in size as added; sutures distinct, depressed, radial, slightly curved; wall calcareous, finely perforate, granular in structure, surface smooth, umbonal region filled with secondarily deposited calcite, either as granules or solid boss; aperture arched, equatorial, interiomarginal slit.

Locality: Nagaland: between Luthur and Salumi.

Geological horizon: Late Cretaceous (Maestrichtian).

Family TEXTULARIDAE

Genus ***Bolivinopsis*** Yakovlev

Bolivinopsis sp.

Diagnosis: Test with large planispiral coil in early stage and later long, narrow biserial stage; wall calcareous, with agglutinated fine grained calcareous particles.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Genus ***Pseudobolivina*** Wiesner

Pseudobolivina sp.

Diagnosis: Test biserial but a tendency to become uniserial, axis slightly twisted; aperture high, narrow slit, interiomarginal in early biserial stage, nearly terminal in later stage.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Genus ***Textularia*** Defrance

Textularia sp.

Diagnosis: Test free, elongate, biserial, generally more or less compressed in plane of biseriality or rarely oval to circular in cross section; chambers numerous, generally closely appressed; wall agglutinated, simple; aperture single low arch at base of last chamber.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Family MILIOLIDAE

Genus ***Quinqueloculina*** d' Orbigny

Quinqueloculina sp.

Diagnosis: Test coiled, with chambers one half coil in length and alternating regularly in five planes of coiling about 72° apart, but with successive chambers in planes 144° apart, eventually three chambers visible from exterior on one side of test and four visible from opposite side; wall calcareous, porcelaneous, imperforate, with inner pseudochitinous layer, rarely with some agglutinated grains added to exterior; aperture terminal, rounded, with tooth.

Locality: Nagaland: Reguri.

Geological horizon: Late Cretaceous (Maestrichtian).

Family DISCORBIDAE

Genus ***Epistominella*** Husezima & Maruhasi

Epistominella sp.

Diagnosis: Test trochospiral; all chambers visible on spiral side, chambers of last whorl visible on umbilical side; sutures oblique on spiral side, nearly radial on umbilical side; wall calcareous, perforate, radial in structure and monolamellid; aperture an elongate vertical slit in face, near and parallel to peripheral keel.

Locality: Nagaland: South West of Moya.

Geological horizon: Late Cretaceous (Maestrichtian).

Class ACTINOPODA

Subclass RADIOLARIA

Order PORULOSIDA

Family BELONASPIDIDAE

Genus ***Cribrosphaera*** Popofsky

Cribrosphaera sp.

Diagnosis: Simple ellipsoidal lattice shells, two opposite equatorial spines larger than two others. Shell smooth, with many sutural and coronal pores in addition to parmal pores.

Locality: Nagaland: Wazeho.

Geological horizon: Cretaceous.

Family THALASSICOLIDAE

Genus ***Thalassicola*** Huxley

Thalassicola sp.

Diagnosis: Large spherical cells, with shells composed of fused spicules; nucleus spherical, unbranched; no intracapsular alveoles but large round ones in extracapsular calymma.

Locality: Nagaland: Between Pungrenbung and Fakimili.

Geological horizon: Cretaceous.

Family LIOSPHAERIDAE

Genus ***Liosphaera*** Haeckel

Liosphaera sp.

Diagnosis: Two concentric lattice shells joined by radial beams; devoid of spines on shell surface; both shells cortical, pores in shells nearly of equal size.

Locality: Nagaland: Chokla, Satuza, Reguri, Akhen.

Geological horizon: Cretaceous.

Genus ***Melitosphaera*** Haeckel

Melitosphaera sp.

Diagnosis: Two concentric lattice shells joined by radial beams, one shell medullary and one shell cortical.

Locality: Nagaland: Between Pungrenbung and Fakimi; between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Genus ***Ethmosphaera*** Haeckel

Ethmosphaera sp.

Diagnosis: Single lattice shell; pores prolonged outward in conical or cylindrical tubules.

Locality: Nagaland: Satuza, Reguri.

Geological horizon: Cretaceous.

Genus ***Cromyosphaera*** Haeckel

Cromyosphaera sp.

Diagnosis: Four concentric lattice shells joined by radial beams, two medullary shells and two cortical ones.

Locality: Nagaland: South of New Basti; Zoanger-Phokphur section, South West of Moya.

Geological horizon: Cretaceous.

Family DORYSPHAERIDAE

Genus ***Dorydictyum*** Hinde

Dorydictyum sp.

Diagnosis: Lattice shell single with uniform reticulate lattice, fine alveolus; single polar spine, robust styliform main spine with length nearly equal to shell diameter.

Locality: Nagaland: Between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Family ASTROSPHAERIDAE

Genus ***Sphaeropyle*** Dreyer

Sphaeropyle sp.

Diagnosis: Lattice shell single or concentrically multiple with a pylome at one pole of outermost shell, four radial spines in three mutually perpendicular planes.

Locality: Nagaland: Between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Genus ***Dorypyle*** Squinabol

Dorypyle sp.

Diagnosis: Single shell with large pylome and one spine at pole opposite pylome.

Locality: Nagaland: Between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Family DACTYLIOSPHAERIDAE

Genus ***Dactyliosphaera*** Squinabol

Dactyliosphaera sp.

***Diagnosis*:** Single spherical lattice shell surrounded by an elliptical latticed ring, rings bears two opposite radial spines and numerous shorter by-spines.

***Locality*:** Nagaland: Between Thanameir and Thamoremto.

***Geological horizon*:** Cretaceous.

Family ELLIPSIDIIDAE

Genus ***Cenellipsis*** Rûst

Cenellipsis sp.

***Diagnosis*:** Single elliptical lattice shell; without polar tubules, spines or internal rods.

***Locality*:** Nagaland: Reguri.

***Geological horizon*:** Cretaceous.

Family SPONGURIDAE

Genus ***Spongoprunum*** Haeckel

Spongoprunum sp.

***Diagnosis*:** Spongy elliptical or cylindrical shell without equatorial stricture; solid shell without lattice mantle, with two opposite polar spines.

***Locality*:** Nagaland: Between Zoanger and Phokphur; between Thanameir and Thamoremto.

***Geological horizon*:** Cretaceous.

Family CENODISCIDAE

Genus ***Cenodiscus*** Haeckel

Cenodiscus sp.

***Diagnosis*:** Discoidal fenestrated spongy shell; without medullary shell, margin without girdle or spines.

***Locality*:** Nagaland: Chokla; South of New Basti; Zoanger-Phokphur Section; between Pungrenbung and Fakimili; South West of Moya.

***Geological horizon*:** Cretaceous.

Family PHACODISCIDAE

Genus ***Phacodiscus*** Haeckel

Phacodiscus sp.

***Diagnosis*:** Single lenticular latticed cortical shell and double medullary shell, margin without girdle.

***Locality*:** Nagaland: Reguri

Geological horizon: Cretaceous.

Family EUCHITONIIDAE

Genus ***Perichlamydium*** Ehrenberg

Perichlamydium sp.

Diagnosis: Flat disc-shaped shell with a simple central chamber surrounded by concentric rings that are divided by radial beams; smooth shell margin with thin porous equatorial girdle.

Locality: Nagaland: Reguri

Geological horizon: Cretaceous.

Genus ***Ommatodiscus*** Stöhr

Ommatodiscus sp.

Diagnosis: Flat disc-shaped shell with a simple central chamber surrounded by concentric rings that are divided by radial beams; shell margin without chambered arms; disc with two pylomes.

Locality: Nagaland: Reguri

Geological horizon: Cretaceous.

Family SPONGODISCIDAE

Genus ***Spongotrochus*** Haeckel

Spongotrochus sp.

Diagnosis: Simple central chamber surrounded by spongy framework; without porous sieveplate; spongy disc, with more than five solid equatorial radial spines.

Locality: Nagaland: Between Zoanger and Phokphur.

Geological horizon: Cretaceous.

Family LARACARIIDAE

Genus ***Coccolarcus*** Haeckel

Coccolarcus sp.

Diagnosis: Lentelliptical fenestrated or spongy shell resulting from unequal growth in threeaxes; shell without domes or annular constrictions; surface smooth.

Locality: Nagaland: Reguri.

Geological horizon: Cretaceous.

Order OSCULOSIDA

Family STEPHANIIDAE

Genus ***Acanthocircus*** Squinabol

Acanthocircus sp.

Diagnosis: Skeleton composed of simple vertical sagittal ring, without secondary rings; no typical base feet; ring mostly elliptical; incomplete internal spine on each side of middle; spines simple.

Locality: Nagaland: Between Pungrenbung and Fakimili.

Geological horizon: Cretaceous.

Family ARCHIPHORMIDIDAE

Genus ***Bathropyramis*** Haeckel

Bathropyramis sp.

Diagnosis: Shell lacking joints or strictures; basal shell mouth open; pyramidal shell with simple lattice, without apical horn.

Locality: Nagaland: South of Naya Basti; between Pungrenbung and Fakimili; Reguri.

Geological horizon: Cretaceous.

Family ARCHIOCORYTHIDAE

Genus ***Archicorys*** Haeckel

Archicorys sp.

Diagnosis: No radial appophyses; ovate shell with simple lattice, basal shell mouth open, with an apical horn.

Locality: Nagaland: Chokla; between Pungrenbung and Fakimili; between Thanameir and Thamoremto; Reguri.

Geological horizon: Cretaceous.

Genus ***Cornutanna*** Haeckel

Cornutanna sp.

Diagnosis: Conical shell with simple lattice, basal shell mouth open; without apical horn.

Locality: Nagaland: Between Zoanger and Phokphur.

Geological horizon: Cretaceous.

Genus ***Cornutella*** Ehrenberg

Cornutella sp.

Diagnosis: Conical shell with simple lattice, basal shell mouth open; with a distinct apical horn.

Locality: Nagaland: South of New Basti; between Pungrenbung and Fakimili; South West of Moya; Reguri.

Geological horizon: Cretaceous.

Genus ***Archicapsa*** Haeckel

Archicapsa sp.

Diagnosis: Ovoid shell, basal shell mouth fenestrated; without apical horn.

Locality: Nagaland: South of Naya Basti; between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Genus ***Mitracalpis*** Haeckel

Mitracalpis sp.

Diagnosis: Ovoid shell with outer mantle; basal shell mouth open.

Locality: Nagaland: South of Naya Basti; between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Genus ***Sciadiocapsa*** Squinabol

Sciadiocapsa sp.

Diagnosis: Peripheral flange surrounds fenestrate mouth plate of lenslike shell; no apical spine.

Locality: Nagaland: Chokla; between Pungrenbung and Fakimili; Satuza.

Geological horizon: Cretaceous.

Family SETHOPILIIDAE

Genus ***Lychnocanium*** Ehrenberg

Lychnocanium sp.

Diagnosis: Shell divided by transverse stricture into cephalis and thorax, shell bears three radial appophyses, basal shell mouth open, three solid terminal feet on shell mouth; without thoracic ribs.

Locality: Nagaland:Wazeho.

Geological horizon: Cretaceous.

Family LOPHOPHAENIDAE

Genus ***Sethocyrtis*** Haeckel

Sethocyrtis sp.

Diagnosis: Shell divided by transverse stricture; without radial appophyses; basal

shell mouth open; thorax somewhat ovoid; constricted mouth without collar; single apical horn.

Locality: Nagaland: Between Zoanger and Phokphur; between Pungrenbung and Fakimili; Reguri.

Geological horizon: Cretaceous.

Genus ***Dictyocephalus*** Ehrenberg

Dictyocephalus sp.

Diagnosis: Features similar to *Sethocyrtis* but mouth become simply truncated or with collar; without apical horn.

Locality: Nagaland: Between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Genus ***Discolocapsa*** Haeckel

Discolocapsa sp.

Diagnosis: Shell divided by transverse stricture; without radial appophyses; basal shell mouth fenestrated; cephalis without apical horn.

Locality: Nagaland: Chokla; South of New Basti; between Zoanger and Phokphur; South of Moya.

Geological horizon: Cretaceous.

Family THEOCORYTHIDAE

Genus ***Theocyrtis*** Haeckel

Theocyrtis sp.

Diagnosis: Shell divided by two transverse strictures; into cephalis, thorax and abdomen; without appophyses; basal shell mouth open; cylindrical abdomen; thorax and abdomen of nearly similar breadth; with single apical horn.

Locality: Nagaland: Between Zoanger and Phokphur; between Pungrenbung and Fakimili; Wazeho.

Geological horizon: Cretaceous.

Genus ***Tricolocapsa*** Haeckel

Tricolocapsa sp.

Diagnosis: Shell divided by two transverse strictures into cephalis, thorax and abdomen; without basal appophyses; basal shell mouth fenestrated; without latticed septum between thorax and abdomen; no apical horn.

Locality: Nagaland: Chokla; between Tanameir and Thamoremto; Akhen.

Geological horizon: Cretaceous.

Genus ***Distylocapsa*** Squinabol

Distylocapsa sp.

Diagnosis: Shell divided into cephalis, thorax and abdomen by two transverse strictures; without basal appophyses; basal shell mouth fenestrated; single apical spine and two unequal apical horns.

Locality: Nagaland: Between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Genus ***Triacartus*** Haeckel

Triacartus sp.

Diagnosis: Shell divided into cephalis, thorax and abdomen by two transverse strictures; without basal appophyses; basal shell mouth open; three solid lateral ribs; without basal feet; with apical horn.

Locality: Nagaland: Wazeho.

Geological horizon: Cretaceous.

Family ARTOPHORMIDIDAE

Genus ***Cyrtophormis*** Haeckel

Cyrtophormis sp.

Diagnosis: Shell divided by three strictures into cephalis, thorax, abdomen and post-abdomen; with more than four radial appophyses; spindle-shaped shell; no radial ribs.

Locality: Nagaland: South of new Basti.

Geological horizon: Cretaceous.

Genus ***Kassina*** Chabakov

Kassina sp.

Diagnosis: Shell divided by three transverse strictures; with more than four radial appophyses; basal shell mouth fenestrated; tower shaped shell with more than three chambers.

Locality: Nagaland: South of New Basti; between Zoanger and Phokphur; between Pungrenbung and Fakimili; between Tanameir and Thamoremto.

Geological horizon: Cretaceous.

Family STICHOCORYTHIDAE

Genus ***Dictyomitra*** Zittel

Dictyomitra sp.

Diagnosis: Shell divided by more than three transverse strictures; with radial appophyses; basal shell mouth open; shell conical, without apical horn.

Locality: Nagaland: Chokla; South of new Basti; between Pungrenbung and Fakimili; between Tanameir and Thamoremto; South West of Moya; Satuza; Reguri.

Geological horizon: Cretaceous.

Genus ***Eucyrtidium*** Ehrenberg

Eucyrtidium sp.

Diagnosis: Shell divided by more than three transverse strictures; with radial appophyses; basal shell mouth open; spindle shaped shell; cephalis with apical horn.

Locality: Nagaland: Between Thanameir and Thamoremto.

Geological horizon: Cretaceous.

Genus ***Lithocampe*** Ehrenberg

Lithocampe sp.

Diagnosis: Shell divided by more than three transverse strictures; with radial appophyses; basal shell mouth open; spindle shaped shell; with constricted but not tubular mouth; cephalis without apical horn.

Locality: Nagaland: Chokla; South of new Basti; between Zoanger and Phokphur; South West of Moya; Salumi.

Geological horizon: Cretaceous.

Genus ***Spirocyrtis*** Haeckel

Spirocyrtis sp.

Diagnosis: Shell divided by more than three transverse strictures; with radial appophyses; basal shell mouth open; strictures spirally disposed; with apical horn.

Locality: Nagaland: Satuza; Reguri.

Geological horizon: Cretaceous.

Genus ***Stichocapsa*** Haeckel

Stichocapsa sp.

Diagnosis: Shell divided by more than three strictures; with radial appophyses; basal shell mouth fenestrated; last joint rounded but without basal spine or apical horn.

Locality: Nagaland: Wazeho.

Geological horizon: Cretaceous.

Phylum MOLLUSCA
Class GASTROPODA
Order ARCHAEOGASTROPODA
Family TROCHIDAE
Genus ***Solariella*** Wood

Solariella sp.

Diagnosis: Shell conical with open umbilicus; aperture more or less circular; last whorl rounded.

Locality: Nagaland, Phek District, Zoanger-Phokphur Section.

Geological horizon: Eocene.

Genus ***Jujubinus*** Monterosato

Jujubinus sp. [Pl 1. Fig. 1]

Diagnosis: Shell conical or turbiniform, ornamentation spiral; outer lip prosocline.

Measurements (in mm.): Height- 6.3, Height of last whorl- 2.2, Width of last whorl- 3.5.

Locality: Nagaland, Lasumi village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Jujubinus* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Isanda*** Adams & Adams

Isanda sp. [Pl. 1, Fig. 2]

Diagnosis: Shell small, somewhat globose, surface smooth; umbilicus bordered.

Measurements (in mm.): Height- 2.2; Width - 2.6.

Locality: Nagaland, Lasumi village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Isanda* sp. is recorded for the first time from the Disang series in Nagaland.

Family NERITIDAE

Genus ***Nerita*** Linnaeus

Nerita sp.

Diagnosis: Sturdy shell, few whorls, globose; operculum paucispiral, with a central pit nearly smooth, inflated, umbilicate; outer lip thickened, peristome entire.

Locality: Tuensang District, Phokphur.

***Geological horizon*:** Eocene.

Family MURCHISONIIDAE

Genus ***Murchisonia*** d' Archiac & de Verneuil

Subgenus ***Sinuspira*** Perner

Murchisonia (Sinuspira) sp. [Pl. 1, Fig. 3]

***Diagnosis*:** Shell high-spired with many whorls; outer lip with submedian sinus, labral sinus culminating at about middle of labrum in shallow notch.

Measurements (in mm.)**:** Height- 7.7, Width of last whorl- 1.9.

***Locality*:** Nagaland, Lasumi village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Murchisonia (Sinuspira)* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Ectomaria*** Koken

Ectomaria sp. [Pl. 1, Fig. 4]

***Diagnosis*:** Shell high-spired with many whorls; with deep angular labral sinus culminating between pair of strong spiral cords, without slit, rounded apex of sinus generating a pseudoselinizone.

Measurements (in mm.)**:** Specimen brocken; Width of one whorl- 1.2.

***Locality*:** Nagaland, Lasumi village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Ectomaria* sp. is recorded for the first time from the Disang series in Nagaland.

Family PLETHOSPIRIDAE

Genus *Wortheniopsis* **J. Böhn**

Wortheniopsis sp. [Pl. 1, Fig. 5]

***Diagnosis*:** Shell broadly fusiform, ovate-conical, acute-spired; whorls evenly convex; narrow selenizone, high on whorl-side; ornamented spiral threads and growth lines symmetrically recurved to selenizone.

Measurements (in mm.)**:** Height- 4.3, Width of last whorl- 1.8.

***Locality*:** Nagaland, Chobama village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Wortheniopsis* sp. is recorded for the first time from the Disang series in Nagaland.

Order MESOGASTROPODA

Family TURRITELLIDAE

Genus ***Turritella*** Lamarck

Turritella sp. [Pl. 1, Fig. 6]

Diagnosis: Shell high-spired, with number of whorls; whorls convex, conspicuous spiral ornamentation, neanic spirals starting in the order abapical-medial-apical; outer lip articulate, lateral sinus shallow, oblique; no basal sinus.

Measurements (in mm.): Height- 5.9, Width - 2.1.

Locality: Nagaland, Lasumi village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Genus ***Haustator*** Lamarck

Haustator sp. [Pl. 1, Fig. 7]

Diagnosis: Shell moderately large, acuminately turreted; aperture subquadrangular; sculptured with spiral ridge, intermediate grooves concave and spirally striated.

Measurements (in mm.): Height- 7.2, Width - 2.2.

Locality: Nagaland, Lasumi village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Haustator* sp. is recorded for the first time from the Disang series in Nagaland.

Family LITTORINIDAE

Genus ***Littorina*** Ferussac

Littorina sp.

Diagnosis: Shell moderately large, sculptured with spiral striae; spire more than half length of body whorl.

Locality: Tuensang District, Phokphur.

Geological horizon: Eocene.

Family CERETHIDAE

Genus ***Cerithium*** Bruguere

Cerithium sp.

Diagnosis: Shell moderately large, narrowly elongate and turreted with many whorls, heavy, sculptured with swollen nodules and spiral threads which become prominently nodulose towards base, aperture ovate.

Locality: Phek District, Meluri.

Geological horizon: Eocene.

Family RANELLIDAE

Genus ***Cymatium*** Roeding

Cymatium sp. [Pl. 1, Fig. 8]

***Diagnosis*:** Shell moderately large, spire high and pointed, body whorl elongate; aperture large; columella concave, coarsely lirate; sculptured with coarse spiral and axial ribs.

Measurements (in mm.): Height- 9.4, Width of last whorl - 6.2; height of last whorl- 5.11.

***Locality*:** Nagaland, Leshemi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Cymatium* sp. is recorded for the first time from the Disang series in Nagaland.

Order CAENOGASTROPODA

Family LOXONEMATIDAE

Genus ***Katoptychia*** Perner

Katoptychia sp. [Pl. 1, Fig. 9]

***Diagnosis*:** Shell fusiform, high-spired, with many whorls; whorls flat with shallow sutures; outer lip ophistocline almost to base, without sinus.

Measurements (in mm.): Height- 6.8, Width of last whorl – 2.4.

***Locality*:** Nagaland, Lasumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Katoptychia* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Polygyrina*** Koken

Polygyrina sp. [Pl. 1, Fig. 10]

***Diagnosis*:** Shell fusiform, high-spired, with several whorls; whorls strongly convex; protoconch dome-like and obtuse; growth lines forming broad, symmetrical sinus on spire whorls, their curvature parasigmoid.

Measurements (in mm.): Height- 6.7, Width of last whorl – 2.0.

***Locality*:** Nagaland, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Polygyrina* sp. is recorded for the first time from the Disang series in Nagaland.

Family PSEUDOMELANIIDAE

Genus ***Bourgetia*** Terquem & Jourdy

Bourgetia sp. [Pl. 1, Fig. 11]

***Diagnosis*:** Shell littorinform and turriculate; whorls moderately convex with shallow-canaliculate suture; periphery rounded, base convex and anomphalous; whorls and base covered by nearly equally spaced spiral striae, crossed by fine sigmoidal growth lines.

Measurements (in mm.)**:** Height- 4.05, Width of last whorl - 1.6.

***Locality*:** Nagaland, Lasumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Bourgetia* sp. is recorded for the first time from the Disang series in Nagaland.

Family ZYGOPLEURIDAE

Genus ***Allocosmia*** Cossmann

Allocosmia sp. [Pl. 1, Fig. 12]

***Diagnosis*:** Shell slender, protoconch smooth, three regularly increasing whorls, apex acute, whorls strongly convex, collateral riblets confined to early ones, spiral threads persistent.

Measurements (in mm.)**:** Height (part of broken specimen)- 4.9, Width of last whorl – 1.9.

***Locality*:** Nagaland, Lasumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Allocosmia* sp. is recorded for the first time from the Disang series in Nagaland.

Superorder ALLOGASTROPODA

Family PYRAMIDELLIDAE

Genus ***Niso*** Risso

Niso sp. [Pl. 1, Fig. 13]

***Diagnosis*:** Shell somewhat pyramidal in shape, with several whorls, whorls convx and slightly stepped at sutures, sutures grooved, umbilicus absent.

Measurements (in mm.)**:** Height- 3.5, Width of last whorl – 2.1.

***Locality*:** Nagaland, Leshemi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

Remarks: *Niso* sp. is recorded for the first time from the Disang series in Nagaland.

Order OPHISTOBRANCHIA

Family STREPTACIDIDAE

Genus ***Streptacis*** Meek

Streptacis sp. [Pl. 1, Fig. 14]

Diagnosis: Shell slender, high spired; protoconch with initial discoidal whorl that caps spire flatly, ornamented with growth lines.

Measurements (in mm.): Height- 5.1, Width of last whorl - 2.6.

Locality: Nagaland, Lasumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Streptacis* sp. is recorded for the first time from the Disang series in Nagaland.

Order NEOGASTROPODA

Family NASSARIIDAE

Genus ***Nassarius*** Dumeril

Nassarius sp. [Pl. 2, Fig. 15]

Diagnosis: Shell broadly ovate, thick, with several whorls and elevated spire; aperture broad, outer lip thick; sculptured with coarse, longitudinal ribs on the spire whorls and on the shoulder of body whorls.

Measurements (in mm.): Specimen broken; Width of last whorl - 2.8.

Locality: Nagaland, Chuba Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Nassarius* sp. is recorded for the first time from the Disang series in Nagaland.

Family OLIVIDAE

Genus ***Ancilla*** Lamarck

Ancilla sp. [Pl. 2, Fig. 16]

Diagnosis: Shell slender, elongate, spire elevated, suture shallow; aperture bifid anteriorly, outer lip thin, callus thinly extending over up to penultimate whorl; sculptured with fine axial striations.

Measurements (in mm.): Specimen broken; Height- 5.2.

Locality: Nagaland, Lasumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Ancilla* sp. is recorded for the first time from the Disang series in Nagaland.

Family VASIDAE

Genus ***Turbinella*** Lamarck

Turbinella sp. [Pl. 2, Fig. 17]

Diagnosis: Shell strong and spindle shaped; aperture wide with long and deep anterior canal; 3-4 columellar ridges.

Measurements (in mm.): Height- 8.9, Width of last whorl- 5.2.

Locality: Nagaland, Glory Peak, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Turbinella* sp. is recorded for the first time from the Disang series in Nagaland.

Family MITRIDAE

Genus ***Mitra*** Lamarck

Mitra sp. [Pl. 2, Fig. 18]

Diagnosis: Shell elongately ovate, spire high with multispiral protoconch; aperture elongate, longer than spire; shell surface with spiral ribs.

Measurements (in mm.): Height- 5.6, Width of last whorl- 2.6.

Locality: Nagaland, Leshemi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Mitra* sp. is recorded for the first time from the Disang series in Nagaland.

Family TEREBRIDAE

Genus ***Terebra*** Bruguiere

Terebra sp. [Pl. 2, Fig. 19]

Diagnosis: Shell long, narrow, with several whorls and a high pointed spire; aperture small, outer lip simple; columella thickened and smooth; spiral groove divides the whorls.

Measurements (in mm.): Height- 4.8, Width of last whorl- 2.3.

Locality: Nagaland, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Terebra* sp. is recorded for the first time from the Disang series in Nagaland.

Family TURRIDAE

Genus *Polystira* **Woodring**

Polystira sp. [Pl. 2, Fig. 20]

***Diagnosis*:** Shell fusiform with turret-shaped spire; spire high, shorter than body whorl; columella rather smooth; aperture narrowly elongate.

Measurements (in mm.)**:** Height- 7, Width of last whorl- 2.9.

***Locality*:** Nagaland, Mesulumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Polystira* sp. is recorded for the first time from the Disang series in Nagaland.

Order BASOMATOPHORA

Family LYMNAEIDAE

Genus ***Lymnaea*** Lamarck

Lymnaea sp.

***Diagnosis*:** Shell thin, body whorl large, spire exserted, columella spirally twisted.

***Locality*:** Phek District, nr. Meluri.

***Geological horizon*:** Paleocene.

***Remarks*:** Sinha & Chatterjee (1982) recorded *Lymnaea* sp. from upper Disang Formation; however the identification of the material remains doubtful as the *Lymnaea* are only freshwater inhabitants.

Class BIVALVIA (PELECYPODA)

Subclass PTERIOMORPHIA

Order PTERIOIDA

Family TERQUEIIDAE

Genus ***Enantiostreon*** Bittner

Enantiostreon sp.

***Diagnosis*:** Moderately large, oyster-like, not auriculate, strongly costate ornament; triangular cardinal area, less elongated longitudinally, relatively broader ligament pit.

***Locality*:** Nagaland, Phek District, nr. Meluri.

***Geological horizon*:** Eocene.

***Remarks*:** Sinha *et. al.* (1982) recorded *Alectryonia* sp. from near Meluri in Phek District which may be regarded as *Enantiostreon* sp.

Genus ***Anomia*** Rafinesque

Anomia sp.

Diagnosis: Shell thin, irregular in outline, partially attached, surface sculptured with radial striae, LV with three muscle scars on central area, foramen moderately large.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Miocene.

Order ARCOIDA

Family ARCIDAE

Genus ***Arca*** Linnaeus

Arca sp.

Diagnosis: Elongate, subtrapezoidal, inequilateral, expanded posteriorly, posterior umbonal carina prominent, many small teeth across middle of shell, surface sculpture radial.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Eocene.

Genus ***Barbatia*** Gray

Barbatia sp. [Pl. 2, Fig. 21]

Diagnosis: Small, elongate, ovoid, inequilateral, equivalve, umbonal carina low, rounded, cardinal area low; terminations rounded and slightly expanded; ligamental grooves closely spaced; ornamentation costellate, commonly fine.

Measurements (in mm.): Height- 6.1, Length- indetermined.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Eocene-Miocene.

Subgenus ***Cucullaearca*** Conrad

Barbatia (***Cucullaearca***) sp. [Pl. 2, Fig. 12]

Diagnosis: Elongate, subequivalve but rather distorted, ventral margin deeply sinuated by large byssal gape; cardinal area high, amphidetic; sculpture formed by fine to coarse subequal costae; hinge long; straight, teeth in continuous series, distal teeth large and oblique.

Measurements (in mm.): Height- 4.5, Length- 7.5.

Locality: Nagaland, Chuba Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Barbatia* (*Cucullaearca*) sp.is recorded for the first time from the Disang series in Nagaland.

Family CORBICULIDAE

Genus ***Corbula*** Bruguière

Corbula sp.

Diagnosis: Shell sturdy, valves inequilateral, left valve slightly smaller than right valve, without projecting chondrophore, moderately inflated, concentrically ribbed; posterior end somewhat rostrate.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Subgenus ***Bicorbula*** Fischer

Corbula (***Bicorbula***) sp. [Pl. 2, Fig. 23]

Diagnosis: Shell moderately large, inequivalve, keel obsolescent, sculpture weak, pallial sinus shallow-broad.

Measurements (in mm.): Height- 13.5; Length- 20.5.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Subgenus ***Varicorbula*** Grant & Gale

Corbula (***Varicorbula***) sp. [Pl. 2, Fig. 24]

Diagnosis: Shell small, sculpture discrepant, right valve with concentric ribbing pattern, left valve with concentric growth striae, pallial sinus indistinct.

Measurements (in mm.): Height- 4.5; Length- 6.3.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Corbula* (*Varicorbula*) sp. is recorded for the first time from the Disang series in Nagaland.

Family GLYCYMERIDAE

Genus ***Glycymeris*** da Costa

Glycymeris sp.

Diagnosis: Shell subcircular, subequilateral, with small umbones and beaks; teeth relatively short, transverse, becoming obsolescent medially; surface somewhat costate, ventral margins internally fluted.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Genus ***Nemocardium*** Meek

Subgenus ***Discors*** Lamarck

Nemocardium (***Discors***) sp.

Diagnosis: Shell ovoid, radial sculpture on surface, oblique secondary striae crossing ribs of central and anterior slopes, posterior ribs faint.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Genus ***Venericardia*** Lamarck

Venericardia sp.

Diagnosis: Shell rounded, trigonal, inequilateral, with many radial ribs evenly elevated.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Subgenus ***Venericor*** Stewart

Venericardia (***Venericor***) sp.

Diagnosis: Shell obliquely subtrigonal; immature ribs angular and evenly spaced, flat and low, approximate and ultimately obliterating.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Order MYTILOIDA

Suborder OSTREINA

Family OSTREIDAE

Genus ***Ostrea*** Linnaeus

Ostrea sp.

Diagnosis: Shell moderately to large size, variable outline but usually roughly orbicular with hardly prominent umbones pointed and flanked by small to large auricles, posterior auricle larger than anterior one; width about one-fourth of height. Right valve flat or gently convex, covered by many fragile flattish conchiolinous growth squamae, peripheral conchiolin fringe extensive, calcareous part of right valve much smaller than corresponding left valve. Concentric undulations distinct or indistinct. Left valve slightly convex, covered by many long unequal, rounded radial ribs

interrupted by free-standing frilled delicate growth squamae less abundant than those on right valve; some concentric undulations present. No hyote spine on radial ribs. Ligamental areas longer than high. Chomata present. Adductor muscle imprint reniform, both ends rounded with length about four times of height, more centrally located. Left valve without umbonal cavity.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Family PECTINIDAE

Genus ***Pecten*** Müller

Pecten sp.

Diagnosis: Right valve clearly convex, left valve gently convex or nearly flat; auricles nearly equal; radial ribs well developed, generally flat-topped, radially striated, grooved; hinge with cardinal crura extending from each side of ligament pit.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Subgenus ***Yabepecten*** Masuda

Pecten (***Yabepecten***) sp. [Pl. 2, Fig. 25]

Diagnosis: Moderately large, round, gently convex valves, right valve much convex in proportion to left valve, radial ribs well developed, radially striate, grooved; hinge with cardinal crura.

Measurements (in mm.): Height- 4.1; Length- 4.3.

Locality: Nagaland, Glory Peak, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Pecten* (*Yabepecten*) sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Pholadomya*** Swoerby

Pholadomya sp.

Diagnosis: Shells moderately large, equivalve, ovoid, inequilateral, ventricose, moderately inflated; umbones broadly rounded, moderately prominent, more or less anteriorly placed, valves gaping posteriorly, anterior gaping indistinct; postulation of surface delicate; ornamentation well developed; pallial sinus broad.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Subclass HETERODONTA
Order VENEROIDA
Family VENERIDAE
Genus ***Pitar*** Römer

Pitar sp.

Diagnosis: Shell inequilateral, subtrigonal, smooth or finely striate, pallial sinus deep and pointed; beaks anterior; cardinal teeth not tending to radiate, anterior laterals well developed, lunule superficial, escutcheon not distinct.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Genus ***Ventricolaria*** Keen

Ventricolaria sp. [Pl. 2, Fig. 26]

Diagnosis: Shell somewhat globose, concentric sculpture, lunule depressed, escutcheon smooth; anterior lateral tooth in left valve.

Measurements (in mm.): Height- 2.1; Length- 2.8.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Ventricolaria* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Chione*** Megerle von Muehlfeld

Chione sp. [Pl. 3, Fig. 27]

Diagnosis: Shell ovoid-trigonal, inequilateral, strong concentric sculpture; with distinct lunule and escutcheon; inner margins crenulate; well developed hinge plate and teeth.

Measurements (in mm.): Height- 2.1; Length- 2.8.

Locality: Nagaland, Chuba Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Chione* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Paphia*** Bolten

Paphia sp. [Pl. 3, Fig. 28]

Diagnosis: Shell medium sized, solid, equivalve, inequilateral, umbones well in anterior part of shell; outline elongate; hinge without lateral teeth; plate narrow.

Measurements (in mm.): Height- 2.53; Length- 3.52.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Paphia* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Timoclea*** Brown

Timoclea (s. str.) sp. [Pl. 3, Fig. 29]

Diagnosis: Shell ovoid, inequilateral, somewhat compressed, sculpture radial, concentric sculpture present as nodes on ribs; inner margins crenulate.

Measurements (in mm.): Height- 7.5; Length- 9.3.

Locality: Nagaland, Leshemi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Timoclea* (s. str.) sp. is recorded for the first time from the Disang series in Nagaland.

Family SOLENIDAE

Genus ***Solen*** Linnaeus

Solen sp.

Diagnosis: Shell valves somewhat cylindrical, long and nearly straight, beaks rather terminal, hinge with one tooth in either valve; anterior margin truncate, smooth within, anterior adductor muscle scar elongate.

Locality: Nagaland, Phek District, nr. Meluri.

Geological horizon: Oligocene-Eocene.

Family TELLINIDAE

Genus ***Tellina*** Linnaeus

Tellina sp. [Pl. 3, Fig. 30]

Diagnosis: Shell elongate, ligament internal, valves more or less unequal, cardinal hinge teeth in two valves.

Measurements (in mm.): Height- 2.5, Length- 3.1.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Subgenus ***Elliptoellina*** Cossmann

***Tellina* (*Elliptoellina*)** sp. [Pl. 3, Fig. 31]

***Diagnosis*:** Shell elongate, pointed behind, posterior slope with 1 or 2 radial ribs, fine concentric sculpture; left valve with indistinguishable lateral teeth.

Measurements (in mm.)**:** Height- 6.85; Length- 11.1.

***Locality*:** Nagaland, Chuba Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Tellina* (*Elliptoellina*) sp. is recorded for the first time from the Disang series in Nagaland.

Subgenus ***Cadella*** Dall, Bartsch & Rehder

***Tellina* (*Cadella*)** sp. [Pl. 3, Fig. 32]

***Diagnosis*:** Shell small, ovoid, somewhat cuneiform, anterior end longer, concentric striate sculpture on shell, ligament normal, with small pallial sinus.

Measurements (in mm.)**:** Height- 3.75; Length- 4.4.

***Locality*:** Nagaland, Lasumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Tellina* (*Cadella*) sp. is recorded for the first time from the Disang series in Nagaland.

Subgenus ***Gastranopsis*** Cossmann & Pissaro

***Tellina* (*Gastranopsis*)** sp. [Pl. 3, Fig. 33]

***Diagnosis*:** Shell oblique, thin surface with irregular concentric lamellae, pallial sinus rounded, lateral teeth in right valve.

Measurements (in mm.)**:** Height- 4.95; Length- 5.0.

***Locality*:** Nagaland, Glory Peak, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Tellina* (*Gastranopsis*) sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Hercodon*** Conrad

Hercodon sp. [Pl. 3, Fig. 34]

***Diagnosis*:** Shell elliptical, surface with irregular growth lines and numerous fine radials; hinge with angular linear pit for resilium deeply impressed; pallial sinus broad, rounded.

Measurements (in mm.): Height- 7.22; Length- 13.87.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Hercodon* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Macoma*** Leach

Subgenus ***Macoploma*** Pilsbry & Olsson

Macoma (***Macoploma***) sp. [Pl. 3, Fig. 35]

Diagnosis: Shell thin inequilateeral, twisted slightly at posterior end, pallial sinus tending to be discrepant, area of posterior slope near dorsal margin granulated.

Measurements (in mm.): Height- 3.87; Length- 7.25.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Macoma* (*Macoploma*) sp. is recorded for the first time from the Disang series in Nagaland.

Family DONACIDAE

Genus ***Donax*** Linnaeus

Subgenus *Capsella* **Gray**

Donax (***Capsella***) sp. [Pl. 3, Fig. 36]

Diagnosis: Shell elongate-ovoid, inequilateral, surface without radial sculpture, hinge with two cardinals and well developed laterals.

Measurements (in mm.): Height- 5.35; Length- 10.1.

Locality: Nagaland, Glory Peak, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Donax* (*Capsella*) sp. is recorded for the first time from the Disang series in Nagaland.

Family PSAMMOBIIDAE

Genus ***Gari*** Schumacher

Subgenus *Psammotaena* **Dall**

Gari (***Psammotaena***) sp. [Pl. 3, Fig. 37]

Diagnosis: Shell elongate-ovoid, sculptured, posterior end wider than anterior, posterior slope smooth.

Measurements (in mm.): Height- 7.4; Length- 15.2.

***Locality*:** Nagaland, Mesulumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Gari* (*Psammotaena*) sp. is recorded for the first time from the Disang series in Nagaland.

Subgenus ***Gobraeus*** Brown

***Gari* (*Gobraeus*)** sp. [Pl. 3, Fig. 38]

***Diagnosis*:** Shell elongate-ovoid, nearly smooth, concentric sculpture of only growth lines, posterior slope with superficial radial striae.

Measurements (in mm.)**:** Height- 6.5; Length- 17.1.

***Locality*:** Nagaland, between Kami and Lasumi Villages, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Gari* (*Gobraeus*) sp. is recorded for the first time from the Disang series in Nagaland.

Subgenus ***Psammoica*** Dall

***Gari* (*Psammoica*)** sp. [Pl. 4, Fig. 39]

***Diagnosis*:** Shell elongate-elliptical, smooth, compressed, truncate behind.

Measurements (in mm.)**:** Height- 5.4; Length- 9.6.

***Locality*:** Nagaland, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Gari* (*Psammoica*) sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Asaphis*** Modeer

Asaphis sp. [Pl. 4, Fig. 40]

***Diagnosis*:** Shell inequilateral, not gaping, ovoid-elliptical, with well developed radial ribs; hinge plate well developed.

Measurements (in mm.)**:** Height- 2.2; Length- 3.2.

***Locality*:** Nagaland, Chuba Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Asaphis* sp. is recorded for the first time from the Disang series in Nagaland

Family VESICOMYIDAE

Genus ***Calyptogena*** Dall

Calyptogena sp. [Pl. 4, Fig. 41]

Diagnosis: Shell elongate-ovoid; surface rather smooth, early texture, with periostracum; no lunule; ligament external; pallial line entire.

Measurements (in mm.): Height- 4.7; Length- 7.7.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Calyptogena* sp. is recorded for the first time from the Disang series in Nagaland.

Family CORBICULIDAE

Genus ***Corbicula*** Mergele von Muehlfeld

Subgenus *Donacopsis* **Sandberger**

Corbicula (***Donacopsis***) sp. [Pl. 4, Fig. 42]

Diagnosis: Shell somewhat trigonal, sculpture concentric, striate; lateral teeth serrate; pallial sinus short and wide.

Measurements (in mm.): Height- 3.1; Length- 4.8.

Locality: Nagaland, Chobama Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Corbicula* (*Donacopsis*) sp. is recorded for the first time from the Disang series in Nagaland.

Order NUCULOIDA

Family CTENODONTIDAE

Genus ***Tancrediopsis*** Beushausen

Tancrediopsis sp. [Pl. 4, Fig. 43]

Diagnosis: Shell equilateral, elongate, concentric sculptures indistinct.

Measurements (in mm.): Height- 4.5; Length- 7.23.

Locality: Nagaland, Lasumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Tancrediopsis* sp. is recorded for the first time from the Disang series in Nagaland.

Family NUCULIDAE

Genus *Nuculopsis* **Girty**

Nuculopsis sp. [Pl. 4, Fig. 44]

***Diagnosis*:** Shell equilateral, beaks ophistogyrate, inner ventral margin smooth.

Measurements (in mm.)**:** Height- 5.41; Length- 3.87.

***Locality*:** Nagaland, Mesulumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Nuculopsis* sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Nuculana*** Link

Nuculana sp. [Pl. 4, Fig. 45]

***Diagnosis*:** Shell elongate posteriorly, small corbuloid, inflated, rostrum blunt; pallial sinus present, shallow, restilifer present, ligament partially internal; with concentric sculpture.

Measurements (in mm.)**:** Height- 2.74; Length- 6.14.

***Locality*:** Nagaland, Mesulumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Nuculana* sp. is recorded for the first time from the Disang series in Nagaland.

Family NUCULANIDAE

Genus ***Yoldia*** Moeller

Yoldia sp. [Pl. 4, Fig. 46]

***Diagnosis*:** Shell elongate, ovate, thin walled, hinge series subequal; resilium pit large; pallial sinus deep and wide.

Measurements (in mm.)**:** Height- 2.05; Length- 3.1.

***Locality*:** Nagaland, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Yoldia* sp. is recorded for the first time from the Disang series in Nagaland.

Order ARCOIDA

Family NOETIDAE

Genus ***Arginopsis*** Mac Neil

Arginopsis sp. [Pl. 4, Fig. 47]

***Diagnosis*:** Shell subovate in lateral profile, evenly inflated umbonal ridge rounded,

obscure; beaks strongly prosogyre, situated anteriorly; ornamented with many regular costae; ligament ophistodetic, completely covering posterior part of cardinal area, interior series of teeth short, chevron shaped.

Measurements (in mm.)**:** Height- 6.1; Length- 3.95.

Locality**:** Nagaland, Lasumi Village, Pfutsero.

Geological horizon**:** Oligocene-Eocene.

Remarks**:** *Arginopsis* sp. is recorded for the first time from the Disang series in Nagaland

Order PTERIOIDA

Family INOCERAMIDAE

Genus ***Parainoceramus*** Voronetz

Parainoceramus sp. [Pl. 4, Fig. 48]

Diagnosis**:** Shell small, equivalve, moderately convex, somewhat rectangular, posteriorly subalate; umbones protruding slightly above hinge margin, beaks subterminal; anterior face of shell somewhat impressed; ligament area flat, many pits; short anterior and elongate posterior teeth; surface smooth with weak concentric plications.

Measurements (in mm.)**:** Height- 4.4; Length- 3.9.

Locality**:** Nagaland, Pfutsero.

Geological horizon**:** Oligocene-Eocene.

Remarks**:** *Parainoceramus* sp. is recorded for the first time from the Disang series in Nagaland

Family AVICULOPECTINIDAE

Genus ***Euchondria*** Meek

Euchondria sp. [Pl. 4, Fig. 49]

Diagnosis**:** Shell pectinaceous with dorsally divergent cardinal areas bearing closely spaced transverse alternating ridges and furrows; strongly prosocline, produced posteriorly; hinge with central resilifer.

Measurements (in mm.)**:** Height- 4.7; Length- 5.3.

Locality**:** Nagaland, Mesulumi Village, Pfutsero.

Geological horizon**:** Oligocene-Eocene.

Remarks**:** *Euchondria* sp. is recorded for the first time from the Disang series in Nagaland

Genus ***Decatopecten*** Rüppel

Subgenus *Sinectenolium* **Eames & Cox**

Decatopecten (***Sinectenolium***) sp. [Pl. 4, Fig. 50]

***Diagnosis*:** Shell elongate orbicular, subdepressed, auricles subequal, byssal notch almost indistinguishable, no ctenolium, ribs radially striated; hinge not recognizable; margin fluted.

Measurements (in mm.)**:** Height- 6.0; Length- 5.1.

***Locality*:** Nagaland, Mesulumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Decatopecten* (*Sinectenolium*) sp. is recorded for the first time from the Disang series in Nagaland

Family LIMIDAE

Genus ***Limea*** Bronn

Limea sp. [Pl. 5, Fig. 51]

***Diagnosis*:** Shell equivalve, small, suborbicular, no gaping; sculpture of radial ribs, margin crenate; narrow cardinal area; hinge with series of short denticles on each side; adductor impression subcentral.

Measurements (in mm.)**:** Height- 4.2; Length- 3.7.

***Locality*:** Nagaland, Chuba Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Limea* sp. is recorded for the first time from the Disang series in Nagaland

Order UNIONOIDA

Family UNIONIDAE

Genus ***Unio*** Philipsson

Unio sp. [Pl. 5, Fig. 52]

***Diagnosis*:** Shell equivalve, nacreous, with thick periostracum; umbonal sculpture concentric, posterior slope distinct, coarse ridges on umbo looped, remaining part of shell smooth.

Measurements (in mm.)**:** Length- 7.85.

***Locality*:** Nagaland, Lasumi Village, Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Unio* sp. is recorded for the first time from the Disang series in Nagaland

Order VENEROIDA

Family CARDIIDAE

Genus ***Vepricardium*** Iredale

Vepricardium sp. [Pl. 5, Fig. 53]

Diagnosis: Shell semicircular; hinge with two non-bifid cardinal teeth in either valve, cruciform in arrangement; lateral teeth present, one anterior and one posterior in left valve, two anterior and one posterior in right valve; rib ornamentation along rib crests, interspaces linear; dorsal margin with smooth areas.

Measurements (in mm.): Height- 2.7; Length- 2.0.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Vepricardium* sp. is recorded for the first time from the Disang series in Nagaland

Family MACTRIDAE

Genus ***Mactra*** Linnaeus

Subgenus *Nannomactra* **Iredale**

Mactra (***Nannomactra***) sp. [Pl. 5, Fig. 54]

Diagnosis: Shell subequilateral, trigonal, concentrically striate; hinge well developed, narrow; two cardinals of right valve somewhat joined.

Measurements (in mm.): Height- 1.8; Length- 2.7.

Locality: Nagaland, Mesulumi Village, Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Mactra* (*Nannomactra*) sp. is recorded for the first time from the Disang series in Nagaland.

Genus ***Rangia*** des Moulins

Subgenus *Praerangia* **Cossmann**

Rangia (***Praerangia***) sp. [Pl. 5, Fig. 55]

Diagnosis: Shell subequilateral, rather trigonal, lateral teeth elongate, cross-striate; pallial sinus small and shallow.

Measurements (in mm.): Height- 7.6; Length- 10.3.

Locality: Pfutsero.

Geological horizon: Oligocene-Eocene.

Remarks: *Rangia* (*Praerangia*) sp. is recorded for the first time from the Disang series in Nagaland.

Family MESODESMATIDAE

Genus ***Atactodea*** Dall

Atactodea sp. [Pl. 5, Fig. 56]

***Diagnosis*:** Shell subtrigonal, concentrically sculptured; hinge strong, ligament submarginal; resilium; pallial sinus short.

Measurements (in mm.)**:** Height- 8.05; Length- 12.9.

***Locality*:** Pfutsero.

***Geological horizon*:** Oligocene-Eocene.

***Remarks*:** *Atactodea* sp. is recorded for the first time from the Disang series in Nagaland

DISCUSSION

There are three primary rock units recognized in the territory of Nagaland *viz.*, i) the Schuppen belt, ii) the Patkai synclinorium and iii) the Kohima synclinorium. Structurally the Schuppen belt of Naga Hills is an assembly of well defined lithotectonic blocks, which are bounded by 6-7 major thrusts. In addition to the major thrusts, minor ones often truncate the lithological sequences (GSI, 1989).

The oldest known sediment within the Schuppen belt is the Barail Group of rocks of Late Eocene to Oligocene age. The rocks of Surma Group lie unconformably over the rocks of Barail Group. Surma Group is gradationally overlain by the rocks of Tipam Group. The lowest unit of Barail Group, the Laisong Formation, is exposed in Changki tectonic block in the southern part of the Schuppen belt. Acharyya *et al.* (1986) recorded several foraminifers *viz., Nummulites, Dictyoconoides, Assilina* spp. of Middle Eocene affinity; whereas, *Nummulites chavensis* and *Biplanispira* sp. of Upper Eocene age were recorded by Ranga Rao (1983). The facts open up a question whether the Laisong Formation would be traced down to Middle Eocene in the Belt of Schuppen.

The Surma Group in the Belt of Schuppen lies unconformably over the Barail rocks. Evans (1932) stated that the Bhuban beds of Naga Hills do not differ appreciably from the beds of this Formation in the Surma Valley. The Lower Bhubans are not represented in the Naga Hills. The age of Surma Group in the Schuppen belt of Nagaland has been uncertain. Ranga Rao (1983) recorded *Ammonia beccarii* in Zubza River Section that suggest Lower Miocene age of the Surma Group.

The Tipam Sandstone Formation exhibited marginal variation in the lithological make up and gradationally overlies the Surma group. The Tipam sandstone yielded some bivalve molluscs that are not age specific. The micrflora suggested a Middle-Upper Miocene age (GSI, 1989). The Namsang Formation overlies the Girujan clay with erosional umconformity.

GSI (1989) stated that the thrust system in the Schuppen Belt has cut off the folded Tertiary sediments into interlocking tectonic slices. The respective thrust blocks associated with folds and faults resulted in sequential deformation in the belt. Evans (1932) considered the correlation of the 'Disang Series' was one of the difficult problem of the Tertiary Geology of Assam. He (*op. cit.*) suggested that upper units of Disang Formation correspond probably to the Sylhet Limestone and Kopili Formations; however, the lower-age limit may extend down to Cretaceous period. Ranga Rao (1983) assigned a 'Lower Disang' status to the limestone bearing rocks of Kiphire and adjoining Manipur part and suggested Maestrichtian age for the horizon.

Mathur & Evans (1964) reported that the Upper Eocene microforaminifera were found in several sections of Disang Formation. Basu & Ranga Raju (1964) reported several species *viz., Discocyclina dispensa, Nummulites margoclari, Discocyclina omphalus* of Upper Eocene affinity, from the Disang rocks. The above finding pointed out to either of the possibilities, that the section containing Upper Eocene forms were part of the overlying Barail Group, or the top of the Disang Series were time transgressive.

Assessment of lower age limit of the lower sections of the Disang Formation becomes difficult in the absence of non availability of fossils. Sinha & Chatterjee (1982) reported *Dictyoconoides* of Middle Eocene affinity from Meluri area, but larger foraminifera of Lower Eocene age have been found from other locations of the Disang rocks. Thus the microfaunal evidences suggest that the Disang Formation ranges from Lower to Middle Eocene.

In the inner belt, the Liasong Formation is made primarily of multistoreyed sandstones with variable amounts of shaley interbands and which is overlain gradationally by Jenam Formation (GSI, 1989). The lower unit of Liasong Formation near Chizami yielded *Nummulites chavensis* and *Operculina* sp. of Upper Eocene age (Ranga Rao, 1983).

The ophiolite belt of Naga Hills is characterised by dismembered tectonic slices of serpentinites, cumulates and volcanic. Acharyya *et al.*, (1986) suggested a Maestrichtian age of the belt on the basis of fossil assemblages. They (*op. cit.*) recorded thick oceanic pelagic rocks with interbands. The pelagic limestone associated with Kamjong Formation yielded foraminifera *viz., Globorotalia* spp. and *Globigerina* spp. of Palaeocene to Lower Eocene age.

During the upliftment of ophiolites, there were interspersed submerged areas in the ophiolite domain where a different facies of rocks formed over the ophiolite basement (GSI, 1989). This has been designated as Phokphur Formation which contained long ranging molluscan forms. Ranga Rao (1983) suggested an Eocene age of the Formation. The limestones with radiolarian indicated a greater depth of basinal area. The shallowing of the sea during Eocene probably favoured accumulation of

contrasted lithotypes on an uneven basement. With the upliftment of ophiolites in Oligocene, the depositional process came to an end of this sedimentary domain (Acharyya *et al.*, 1986; GSI, 1989).

SUMMARY

The state of Nagaland, situated in the northeastern part of India covering an area of about 16,579 sq. km. in the northern extension of the Arakan Yoma which represent orogenic upheavals in this part of the country during Cretaceous and Tertiary periods. This region was a part of the Tethys Sea in Archaean period. Repeated orogenic movements accompanied by extensive igneous intrusions occurred in the successive periods that influenced the geologic and tectonic alignments of the region. The rock sequence is of geosynclinal facies represented by strata of Cretaceous to Tertiary age. Several fossil bearing localities have been recorded in recent past, especially in the Disang Group of sediments. The exploration and updating of records of animal fossils were conducted as a part of the programme of preparation of exhaustive faunal account of the state of Nagaland by the ZSI.

Altogether 134 species of animal fossils have been recorded, *viz.*, 19 species of Protozoa: Foraminifera, 41 species of Protozoa: Radiolaria, 25 species of Mollusca: Gastropoda and 49 species of Mollusca: Bivalvia (Pelecypoda). Of these, 19 species of Gastropoda and 33 species of Bivalvia (Pelecypoda) are recorded first time from the rock beds of Nagaland state. The assemblage of the fauna ranged from Late Cretaceous to Upper Eocene in age.

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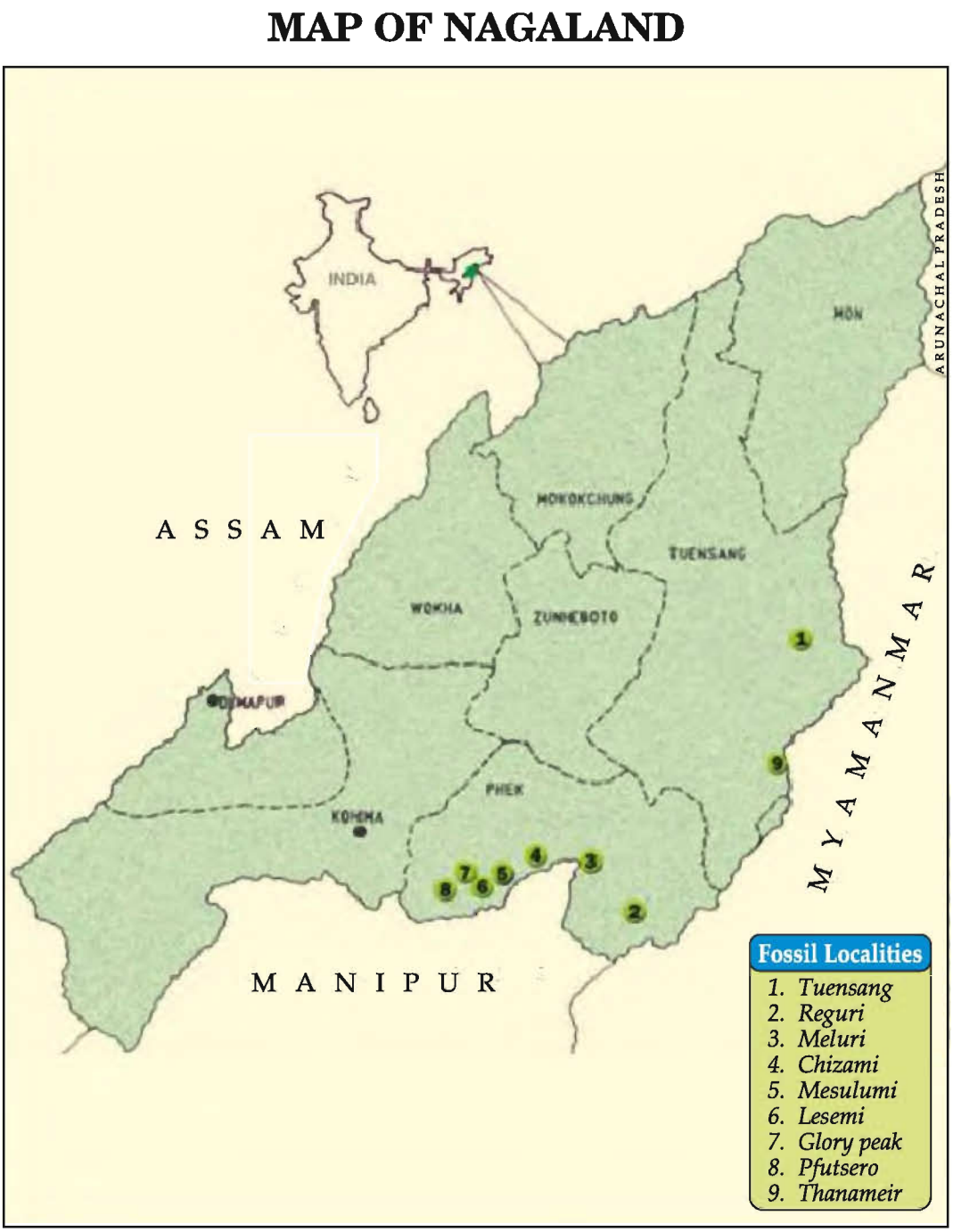

Fig. 1. Map of Nagaland State showing fossil localities

MAP OF NAGALAND (PHYSICAL)

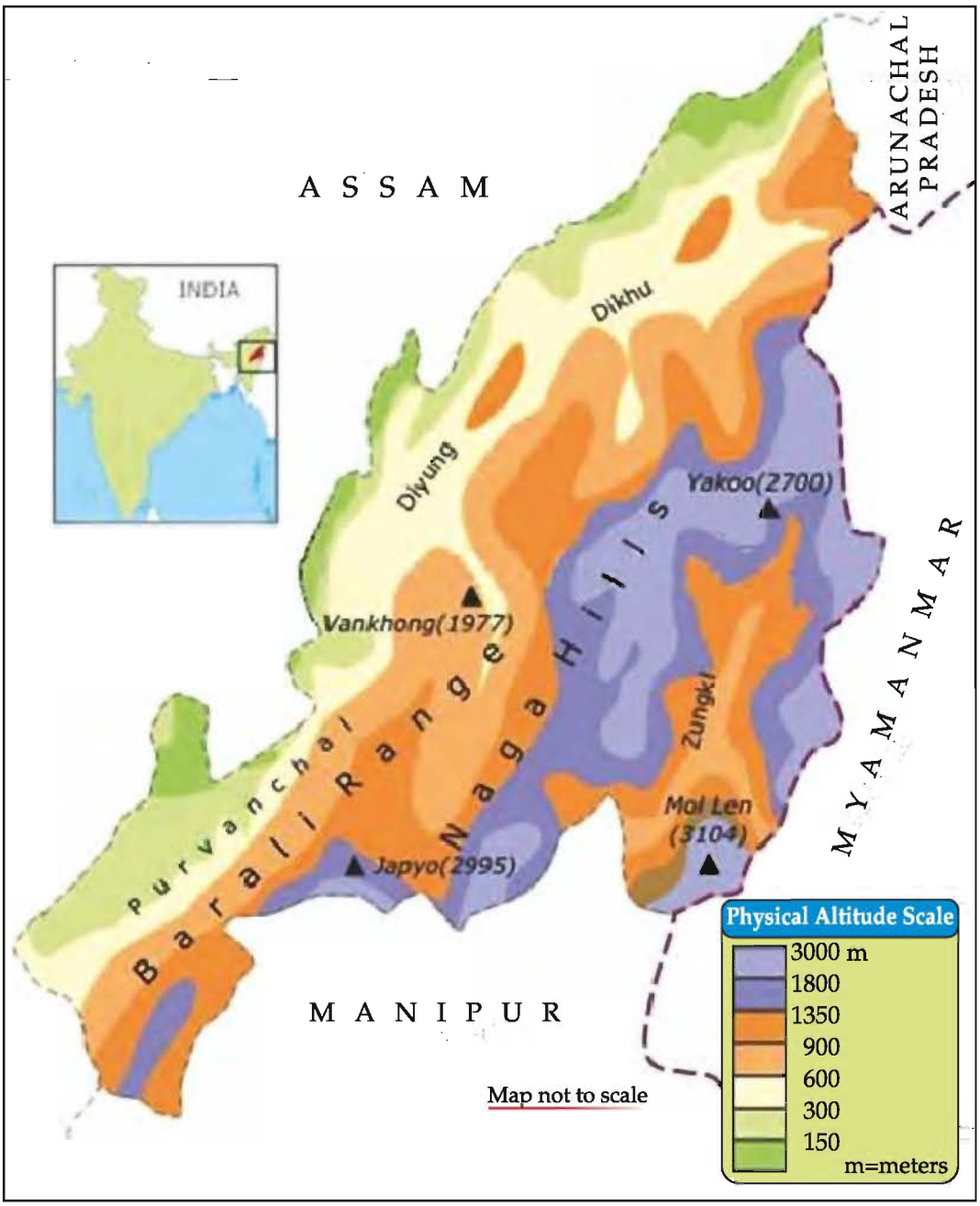

Fig. 2. Physical features of Nagaland State

MAP OF NAGALAND (AERIAL VIEW)

Fig. 3. Aerial view of Nagaland State [after www.googleearth]

Plate - 1

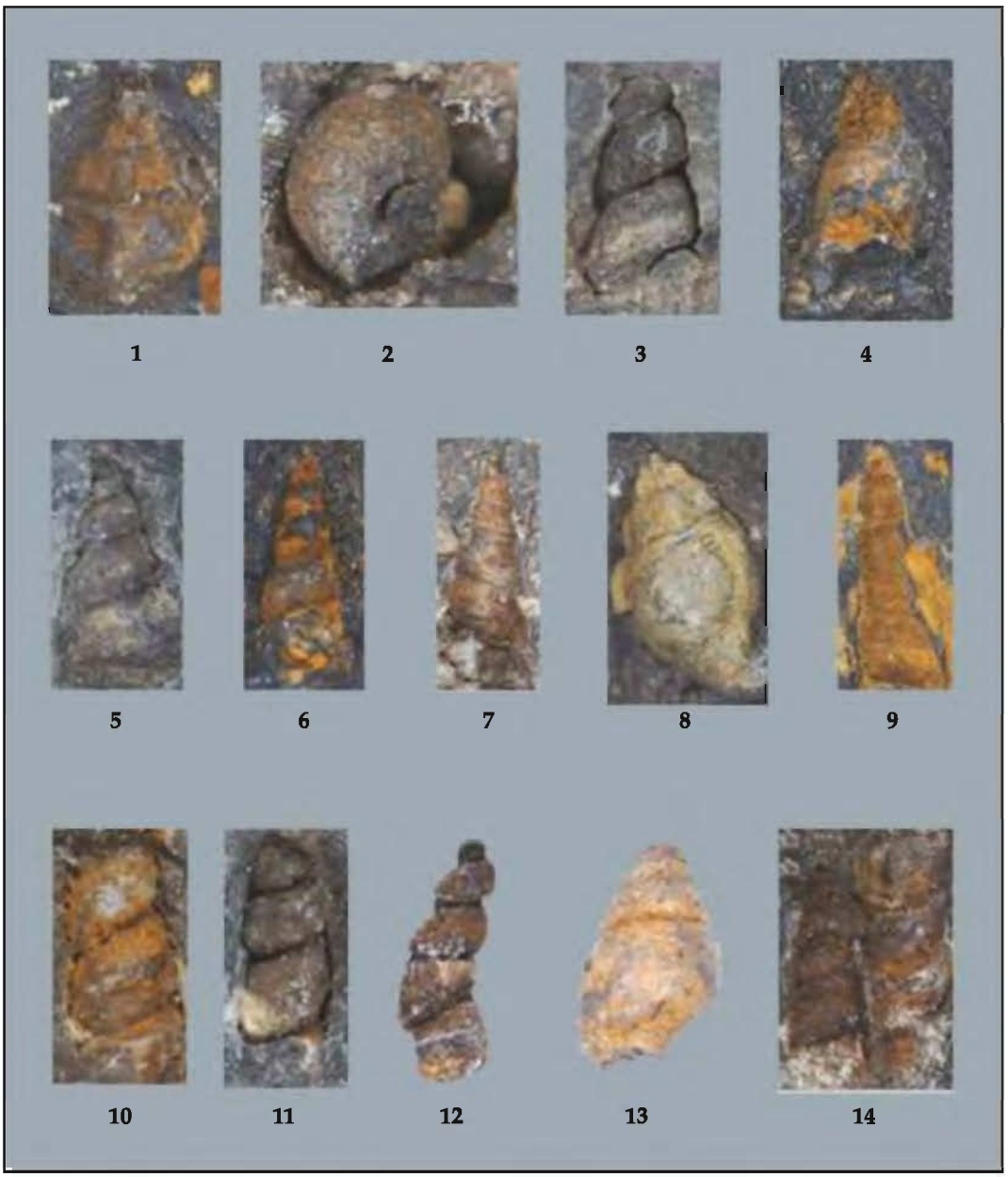

PLATE 1. Figs. 1-14: 1, *Jujubinus* sp. (5.0x); 2, *Isanda* sp. (14.0x); 3, *Murchisonia* (*Sinuspria*) sp. (3.8x); 4, *Ectomaria* sp. (9.1x); 5, *Wortheniopsis* sp. (7.3x); 6, *Turritella* sp. (5.5x); 7, *Haustator* sp. (4.5x); 8, *Cymatium* sp. (3.7x); 9, *Katoptychia* sp. (5.0x); 10, *Polygyrina* sp. (5.0x); 11, *Bourgetia* sp. (8.5x); 12, *Allocosmia* sp. (6.6x); 13, *Niso* sp. (7.8x); 14, *Streptacis* sp. (6.6x).

Plate - 2

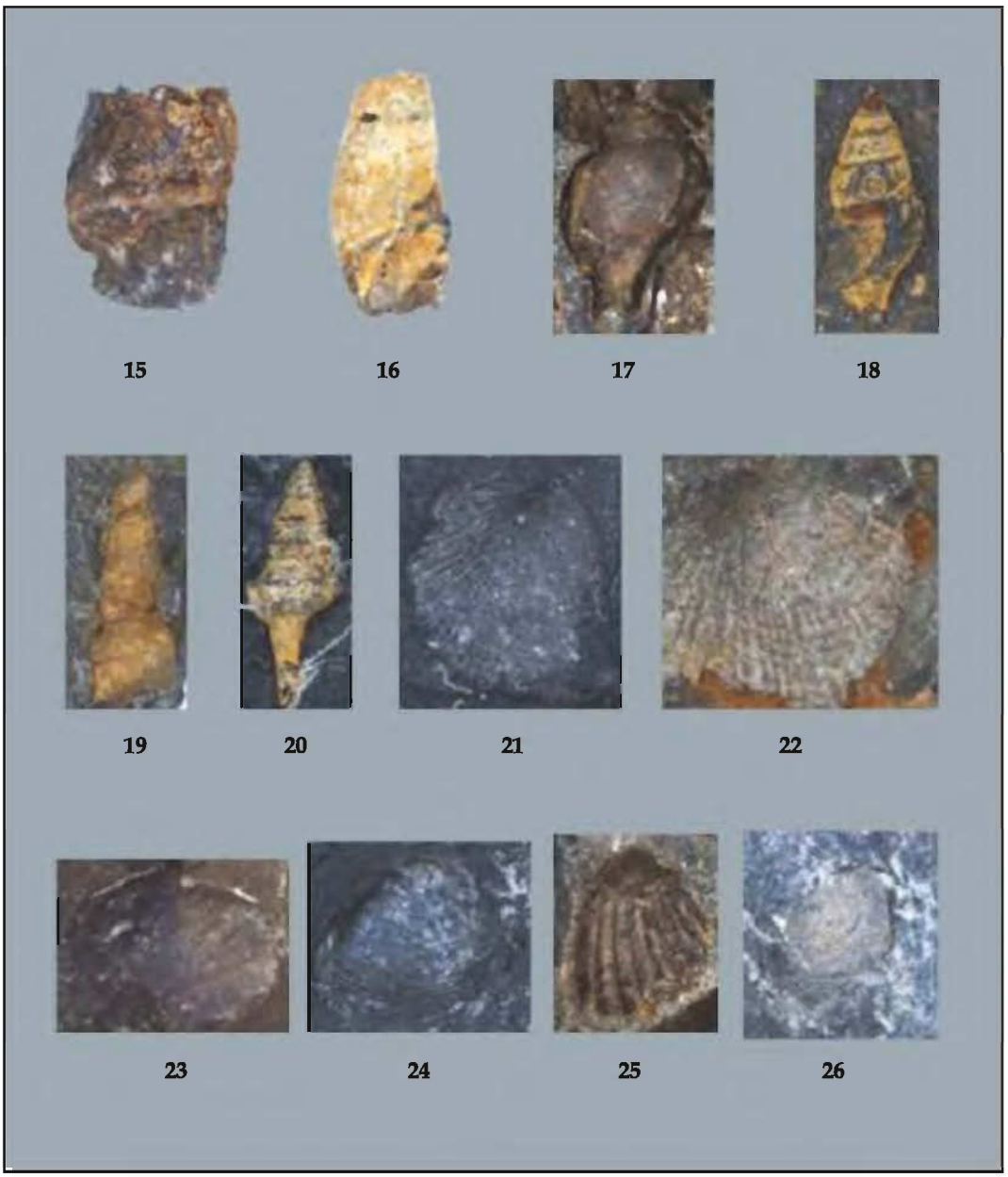

PLATE 2. Figs. 15-26. 15, *Nassarius* sp. (6.0x); 16, *Ancilla* sp. (6.3x); 17, *Turbinella* sp. (4.0x); 18, *Mitra* sp. (6.1x); 19, *Terebra* sp. (7.3x); 20, *Polystira* sp. (4.9x); 21, *Barbatia* sp. (4.9x); 22, *Barbatia* (*Cucullaearca*) sp. (7.4x); 23, *Corbula* (*Bicorbula*) sp. (1.5x); 24, *Corbula* (*Varicorbula*) sp. (5.3x); 25, *Pecten* (*Yabepecten*) sp. (6.5x); 26, *Ventricolaria* sp. (8.3x).

Plate - 3

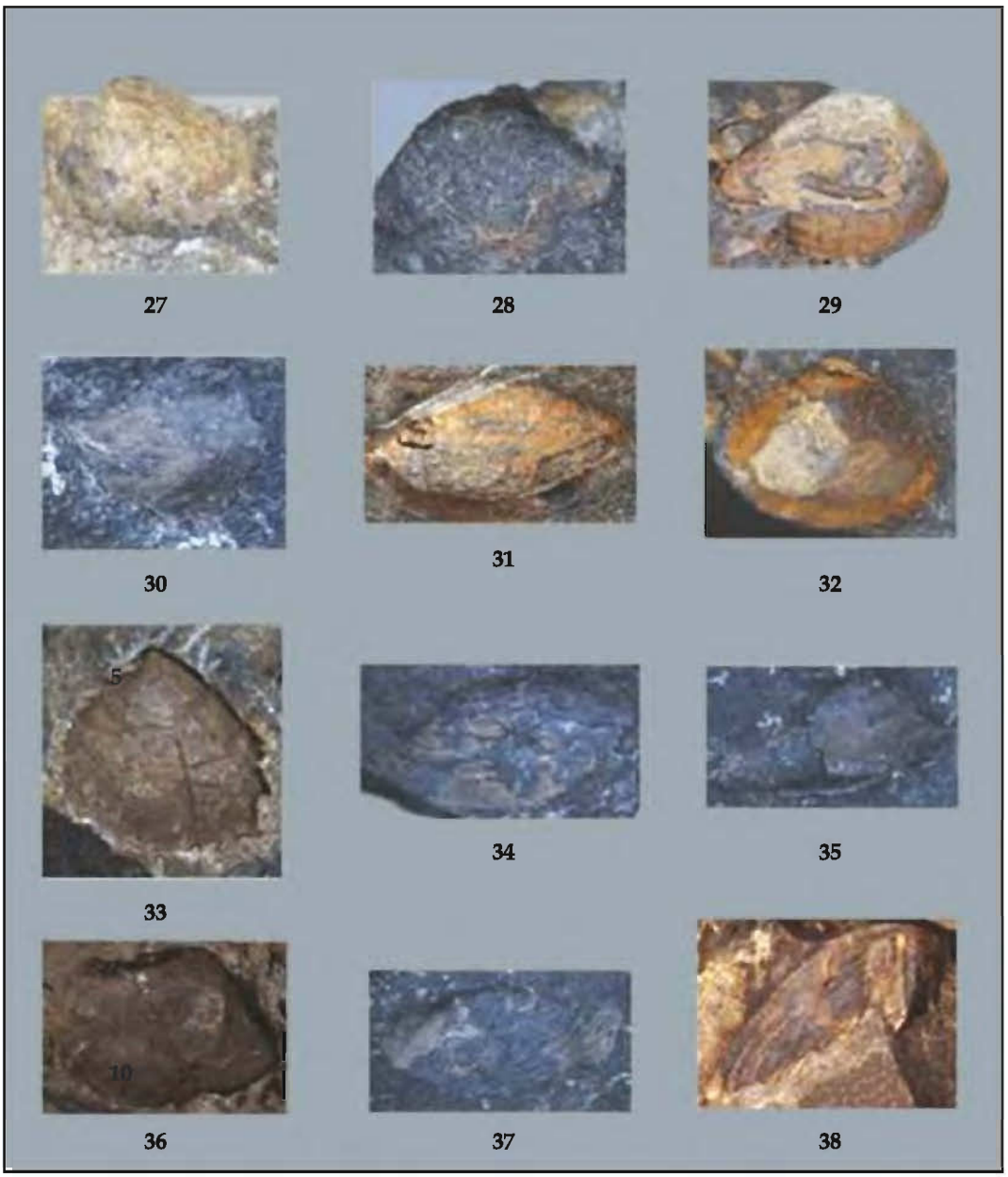

PLATE 3. Figs. 27-38. 27, *Chione* sp. (9.7x); 28, *Paphia* sp. (9.2x); 29, *Timoclea* sp. (3.2x); 30, *Tellina* sp. (7.8x); 31, *Tellina* (*Elliptotellina*) sp. (1.9x); 32, *Tellina* (*Cadella*) sp. (6.0x); 33, *Tellina* (*Gastranopsis*) sp. (5.4x); 34, *Hercodon* sp. (2.6x); 35, *Macoma* (*Macoploma*) sp. (4.2x); 36, *Donax* (*Capsella*) sp. (3.2x); 37, *Gari* (*Psammotaena*) sp. (2.1x); 38, *Gari* (*Gorbraeus*) sp. (2.2x).

Plate - 4

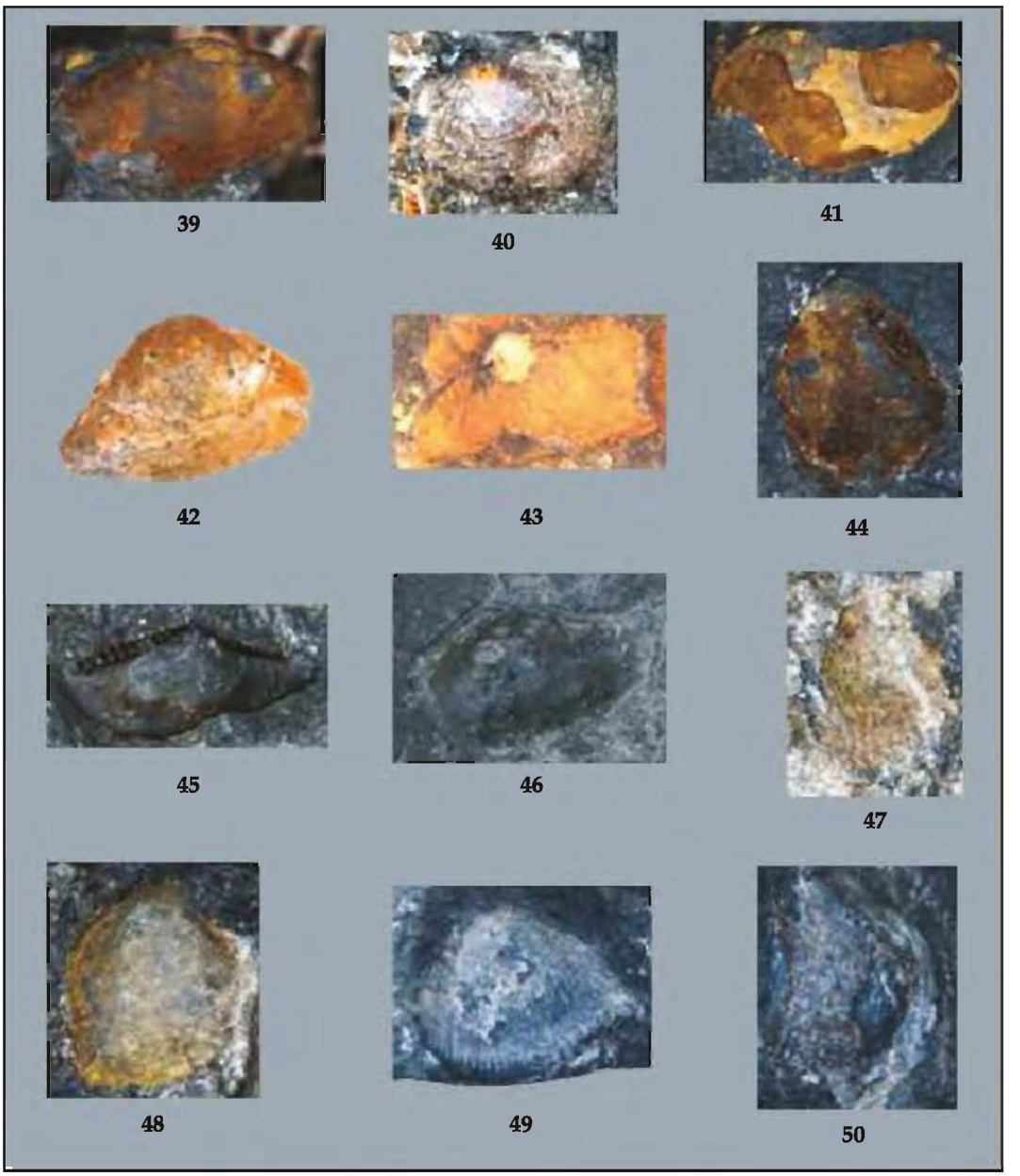

PLATE 4. Figs. 39-50. 39, *Gari* (*Psammoica*) sp. (3.8x); 40, *Asaphis* sp. (8.4x); 41, *Calyptogena* sp. (4.2x); 42, *Corbicula* (*Donacopsis*) sp. (6.9x); 43, *Tancrediopsis* sp. (4.6x); 44, *Nuculopsis* sp. (5.3x); 45, *Nuculana* sp. (5.3x); 46, *Yoldia* sp. (10.6x); 47, *Arginopsis* sp. (5.2x); 48, *Parainoceramus* sp. (6.9x); 49, *Euchondria* sp. (4.9x); 50, *Decatopecten* (*Sinectenolium*) sp. (4.7x).

Plate - 5

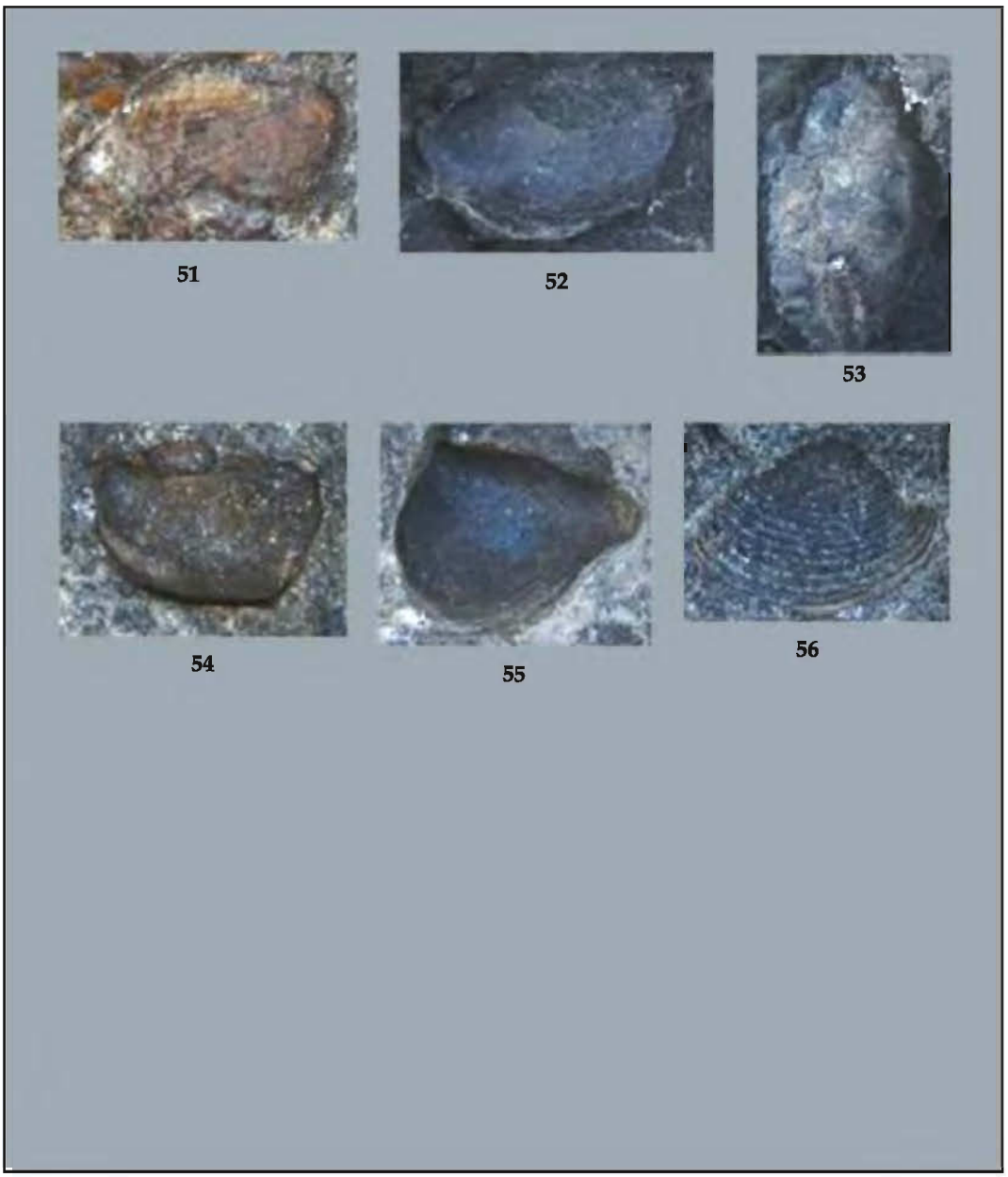

PLATE 5. Figs. 51-56. 51, *Limea* sp. (9.0x); 52, *Unio* sp. (4.7x); 53, *Vepricardium* sp. (14.2x); 54, *Mactra* (*Nannomactra*) sp. (11.1x); 55, *Rangia* (*Praerangia*) sp. (3.2x); 56, *Atactodea* sp. (2.7x).