CHAPTER 1:

INTRODUCTION
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1.1 THE AREA:

Maharashtra state has been shared between two major geographical divisions viz., West coast (Konkan) and Plateau (Desh). They exhibit striking differences in terms of physiography, vegetation and climate.

The present study is concerned with the Quaternary rocks of the west coast of Maharashtra and Goa, occupying an area between Bordi in the north and Karwar in the south (Text fig. 1). This region is nearly 750 kms long and 30-50 kms wide between $20^\circ$ & $15^\circ$ N latitude and $73^\circ$ & $74^\circ$E longitude. Thus covering entire coastal tract of Maharashtra i.e. Bombay, Thane, Raigad, Ratnagiri, Sindhudurg districts and Goa state.

1.2 PHYSIOGRAPHY:

The area under study is a narrow coastal strip of land sandwiched between the Western Ghats on the east and Arabian sea on the west. In common parlance, this coastal strip is known as "Konkan" except Goa. The coastal region is relatively wider in the north than in the south. The width of the coastal region is controlled by Western Ghat escarpments. North of Bombay, the region has a width of about 100 km, while towards south it narrows down to 40-50 km
Text Fig. 1 - Locality Map
and is being characterised by headlands of Western Ghat ranges and high sea-cliffs. The transverse ridges of the Ghats extend westward, producing an appearance of general ruggedness identified by bare rock expanses. The foot hills of the Ghats are thinly populated and villages are located along main river courses and local plateaux.

The region is highly dissected by westerly flowing rivers and their small tributaries viz., Vaitarna, Ulhas, Gad, Amba, Kundalika, Mandad, Savitri, Vashisti, Shastri, Mandovi etc. Extensive development of mud flats, marshy lands and swamps is the special feature of these rivers (Powar et al., 1978; Patil, 1981). Because of the narrowing of the coastal strip, these rivers have limited lengths and steep gradients and as such development of deltas is not being observed. Geomorphologically, this coastal strip appears to be a plain of marine erosion, the inclined surfaces in the Deccan lava capped by isolated hills which look like somewhat old off-shore islands (Spate et al., 1967; Dikshit, 1976; Guzder, 1980). The significant features of the northern coast are the sand spits with mud flats in the vicinity of shore and low coastal ranges with alternating valleys. While, southern portion is marked by rocky, undulating plateaux and intersecting creeks. Along the coast line one can observe the development of sea-cliffs,
sea caves, wave cut platforms and headlands on the coast alternate with bays giving this part of the coast its ria-like appearance (Guzder, 1980; Sukhtankar, 1990).

1.3 GEOLOGY:

The geological formations of the west coast can be divided into: i) Precambrian metamorphics ii) Deccan Traps of Cretaceous-Eocene age iii) Tertiary formations constitute laterites and iv) Quaternary shell limestone, plastic mud and sandy clays.

The Precambrian metamorphics constitute granites, gneisses, Dharwarian schists, quartzites etc. and the indurated shales and quartzites of Cuddapah Series are exposed mainly in the Ratnagiri district and southwards upto Karwar. While, Kaladgis are exposed at Malvan and Phonda region. The great thickness of quartzite with minor conglomerates, slates and limestones are exposed beneath the Trap. Further, there are westerly extensions of the Kaladgis observed in Karnataka and southern parts of Kolhapur district.

The basalt flows cover majority of the area and are invariably capped by the laterite. They are horizontal and produce a step like topography and hence termed as trap flows or Deccan traps. They have incredibly
uniform composition being dominantly “Tholeiitic”. However, from Agashi creek to south up to Shrivardhan the basaltic flows are marked by the acid intermediate differentiates associated with lava flows, intruded by basic dykes of dolerites and lamprophyric composition and also by anorthositic plugs.

There are three types of trap rocks noticed

i) coarse grained-massive rocks characteristic of spheroidal weathering,
ii) amygdaloidal basalts, and
iii) Agglomerates and Breccias. Only around Bombay acid differentiates occur.

They show a gentle deep (12°-15°) a little south of west Bombay (Sukheswala, 1953; Guzder, 1980).

Sensu stricto high level laterites do not exist in Konkan region as they occur along the Western Ghat plateau tops ranging in height from 1000 m to 1200 m or so. The laterites occurring in Konkan and Goa may be primary profiles or secondary profiles having plant beds below the bottom. The thickness varies greatly depending on the development and penetration of weathering profile. Laterites occupy practically all the altitudes and can even occur at the sea level. The laterites at some places are grades in to bauxite. The texture of rock is mottled with red and white irregular veined patches. Thick spread of lateritic soil is common near Sangameshwar. The laterite of Deogad is more
ferruginous and contains trifling segregations of bauxitic nodules. Near Malvan laterite caps the Archaeans.

Wilkinson (1871) reported patches of blue and white clays lying on the weathered trap surface at Ratnagiri. This clay contains embedded fruit and thin carbonaceous seams composed for the most part of levels. These beds overlain by laterite. Around Kalviwadi, Sahasrabudhe and Suryanarayana (1970) reported fossil fruit belonging to genera *Terminalia* and *Nyssa*. These carbonaceous clays constitute pyritic and ferruginous shells, foraminifera, pollen and spores.

The author has examined the deposits excavated from wells at Ratnagiri, Pavas (Plate B, Fig.1), Nandivade and Jayagad and surface exposures at Bankot-Velas, Gudeghar, Amberiwadi and Kalvi. Most of the fossil wood, pollen, leaf impressions and fossil fruits are found in the excavated clays. The most significant discovery is the presence of pyritised foraminifera in the section excavated at Bankot-Velas. The age of these beds is so far remains a subject of a great controversy. However, Guzder (1980) believed that these beds are homotaxial with the Cuddalore Sandstones of Tertiary age. While, Phadtare and Kulkarni (1984) have compared the palynoflora of Ratnagiri
district with palynoflora of Tertiary and Quaternary deposits of Kerla basin, India. They observed the great similarity both at generic as well as specific levels among the floras of Ratnagiri lignite beds and that of Tertiary and Quaternary deposits. Therefore, they have assigned the age of Ratnagiri lignite beds as Neogene.

The marine Quaternary rocks are exposed along the coast mainly comprise shell limestones, plastic muds and sandy clays occurring in intertidal zone invariably extending upto 400 to 500 m in the supratidal region. They are better developed parallel to the existing coast and also along creeks and tidal inlets, abounding in variety of well preserved invertebrate fauna. In Indian Geology these rocks are commonly Known as "Beach rocks" or "littoral concrete" (Buist, 1851; Carter, 1852; Pascoe, 1964; Setty and Wagle, 1971) or colloquially they are termed as "Karal" (Guzder, 1980). The plastic mud is exposed at Nagaon, Revdanda, Sion and Koparkhairna. The surface exposure of plastic mud is scarce being mostly concealed below the sandy soil. The plastic mud exposed at Nagaon is highly sticky, greenish-grey coloured and is rich in bryozoans, foraminifers, ostracods, etc. These rocks alone have been studied by the author and are discussed in greater detail ahead.
1.4 TECTONIC SETTING:

The tectonic history of the west coast comprises two principle tectonic elements. These are the Panvel Flexure and the West Coast Fault. The Panvel Flexure is exposed to the east of the Konkan and is believed to die out in the Kolaba district (Powar et al., 1978; Sukhtankar, 1990).

Another important tectonic feature is the presence of West Coast Fault. There is conflict among the geologists concerning with its exact location. Gubin (1969) has placed this fault paralleling the coast line, off 25 km from it and extending for a distance of about 1300 km. However, Auden (1975) has placed the fault about 10 km off the coastline. Whereas, Guha et al. (1974a & b) suggested that the West Coast fault running along the coastline and even across the promontaries Moreover, they have located the fault 7 km to 20 km off the shore of the West coast. Surendra Kumar (1975 a & b) has shown that the West Coast Fault is parallel to the fault zone of the continental shelf.

Powar et al. (1978) and Sukhtankar (1990) have revealed the evidences of brecciation, found to the north of Revas, presence of anorthositic plug at Korlai-Borlai and orientation and location of majority of the shear zones and emplacement of swarm of dykes along these shear zones.
(Sawant, 1980; Deshpande & Chakranarayan, 1973) lead to suggest the location of the fault along the coastline (Sukhtankar, 1990).

Hot water springs of the West coast of Maharashtra are the important active sources of geothermal energy. Around 60 warm to hot springs are found to be extending along the coast for a distance of about 300 km from Koknere in the north and Rajapur in the south. This hot spring belt has an average width of 20 km occupying central part of the districts of Thane, Raigad and Ratnagiri (Pitale et al., 1987; Deshpande and Pitale, 1993). According to Pitale et al., (1987) all these hot water springs have almost identical geological, hydrological and tectonic setting. While, Deshpande and Pitale (1993) suggested that this hot spring activity is controlled by the dykes north of Bombay and en-echelon flexure zone in southern extension of Panvel Flexure.

1.5 THE SHORELINE:

Johnson (1919) had categorised the shoreline as compound type, while Shepard (1963) opined the present shoreline is formed by marine agencies hence, it can be termed as secondary or mature. Ahmed (1972) has also classified the present shoreline tentatively as Atlantic
Number of headlands can be observed around the shore line. They were well seen at Murud, Rajapuri creek, Shrivardhan and up to the Karwar. Development of sea-cliffs is significant near the Kundalika creek.

Sea caves are commonly associated with sea-cliffs, sea-stacks and wave-cut platforms. They vary in their size and extent. At Bankot-Velas number of such 8-10 m above sea level the sea-caves and wave-cut platforms are observed. Besides this, one can observe the boxwork in Deccan traps at Bankot-Velas, which are formed due to the strong current action of the sea. Therefore, the boxwork above the sea level is the indication of past sea level.

Innumerable undercuttings in basalts are observed at Are-Khurd 4.5 kilometers from Roha. Moreover, development of sand bars, tidal and mud flat is the most common feature observed along the shoreline. The raised beaches adjacent to modern beach have been exposed all along the coast from north to south in the form of discontinuous patches. The present bryozoan fauna studied by author has been retrieved from these raised beaches of Holocene age.

1.6 CLIMATE :

The climate of the west coast is warm. The mean temperature is generally around 26°C and the average
rainfall is approximately 250 cm. The monsoon is the most important in controlling the climate. The favourable season for carrying out geological field work is the dry season, over the months from December to April. Thunderstorms occur in April and May and again in late September to November. These are associated with cyclonic storms, which develop in the Arabian sea.

1.7 VEGETATION:

In general, the west coast is highly wooded, following distinct type of vegetation are found: i) The tidal marshes, lagoons and banks of estuaries inhabited by the mangrove species. These are, *Rhizophora mucronata* Lamk., *Avicenia alba* non Bl., *Acanthus ilicifolius* L., *Ceriops candalleana* Am., *Clerodendron inerme* (L.) Gaertn., etc., ii) Tropical forests: In which important species are, *Syzygium cumini* (L.) (Jambul), *Mangifera indica* (L.) (Aamb), *Bridelia retusa* L. Spreng. (Hsana), *Ficus racemosa* (L.) Spreng. (Umber), (Sag), and iii) Scrub, bamboo vegetation and grasses are also found. The entire west coast and Goa are planted with coconut palms *Cocos nucifera* L. and *Casuarina equisetifolia* J.R.& G.

1.8 PURPOSE AND SCOPE OF THESIS:

Although Mathur (1986) has contributed
initially to the bryozoan fauna of the coastal tract of the Raigad district, considering the recent advancement in the taxonomy of Bryozoa and improvised high resolution microscopy, the author felt the need to improve up on the above work and also extend the study by taking the entire coastal tract of Maharashtra and Goa to understand the diversity in the faunal contents.

In the present work the author has paid much attention to the following: a) to correct the systematic positions of some species of Bryozoa on the basis of the recent literature, b) high resolution photomicrographs with the help of SEM for the illustration of each species in order to reveal detailed morphological features. Finally, based on the palaeoecological information and observation on the bryozoan species, the author has attempted to deduce the palaeoenvironmental aspects of the Quaternary rocks of Maharashtra and Goa. Moreover, the author has made comments on the stratigraphic classification and emendations to already existing classification.