LATE MIDDLE EOCENE CALCAREOUS NANNOPLANKTON FROM RAKHADI RIVER SECTION, HARUDI, KUTCH

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ABSTRACT

The paper records eighteen species of calcareous nannoplankton belonging to genera *Discolithus* Kamptner ex Deflandre, 1952, *Coccolithus* Schwarz, 1894, *Cyclococcolithina* Wilcoxon, 1970, *Cyclolithella* Loeblich and Tappan, 1963, *Discoaster* Tan Sin Hok 1927, *Braarudosphaera* Deflandre, 1947, *Micrantholithus* Deflandre and *Pemma* Klumpp, 1953 from the Harudi Formation and Fulra Limestone exposed in the Rakhadi river section. Palaeoenvironment of the aforementioned formations is suggested.

INTRODUCTION

VERY little work has so far been carried out on the calcareous nannoplankton of the Tertiary sequence of the Kutch region. Pant and Mamgain[1], Mathur[4] and Singh[3–5] studied the calcareous nannoplankton of this region. Biswas and Raju[6] described in detail the geology of this area. With a view to study the calcareous nannoplankton contents of the Palaeogene sequence exposed in the Rakhadi river section (Fig. 81), the samples (H^1–H^4) were collected from the Matanomadh Formation, Harudi Formation and Fulra Limestone. The samples (H^3, H^4) collected from the Matanomadh Formation (Fig. 81) have not yielded calcareous nannoplankton. The sample (H2), collected from the Harudi Formation, is composed of light yellowish, brown, fossiliferous, smooth, claystone and has yielded a rich assemblage of the calcareous nannoplankton, foraminiferids, ostracodes and bryozoa. The foraminiferids are represented by *Truncorotaloides topilensis* (Cushman), *T. rohri* Brönnimann and Bermudez, *Turborotalia broadermanni* (Cushman and Bermudez), *T. centralis* (Cushman and Bermudez), *Globigerina yeguaensis* Weinzierl and Applin, *Chiloguembelina martini* (Pijpers), *Nummulites* spp., *Florilus* sp., *Cibicides* spp., *Discorbis* spp., *Cycloloculina* sp., *Lockhartia* sp., *Heterolepa* sp., *Eistominella* sp., *Gavelinella* sp. and miliolids. The nannoplankton include *Braarudosphaera* sp., *B. discula* Bramlette and Riedel, *Coccolithus belagicus* (Wallich), *Cyclococcolithina* sp., *C. formosa* (Kamptner), *Cyclolithella pakistanica* Haq, *Discoaster aster* Bramlette and Riedel, *D. barbadiensis* Tan Sin Hok, *D. deflandrei* Bramlette and Riedel, *D. saipanensis* Bramlette and Riedel, *D. trinus* Stradner, *Discolithus* sp., *Micrantholithus aequalis* Sullivan, *M. basquensis* Martini, *M. crenulatus* Bramlette and Sullivan and *Pemma papillatum* Martini.

The sample (H^1), collected from the Fulra Limestone, is composed of cream coloured, argillaceous, fossiliferous limestone. The larger foraminiferids occur in abundance. It has yielded a fairly rich assemblage of foraminiferids, calcareous nannoplankton and ostracodes. The foraminiferids include *Asterocyclina* sp., *Discocyclina* (*Aktinocyclina*) sp., *Discocyclina* spp., *Nummulites* spp., *Cibicides* spp., *Truncorotaloides topilensis* (Cushman), *T. rohri* Bronnimann, *Turborotalia centralis* (Cushman and Bermudez), *Orbulinoides beckmanni* (Saito) and ostracodes. The nannoplankton assemblage consists of *Braarudosphaera discula* Bramlette and Riedel, *Coccolithus euopelagicus* (Bramlette and Riedel), *C. pelagicus* (Wallich), *Cyclococcolithina formosa* (Kamptner), *Discoaster aster* Bramlette and Riedel, *D. barbadiensis* Tan Sin Hok, *D. binodosus* Martini and *D. saipanensis* Bramlette and Riedel.

The aforementioned foraminiferal assemblage suggests a late Middle Eocene (=Lutetian, late) age to these samples (H^2, H^1).

The slides have been deposited in the Museum, Department of Geology, Lucknow University, Lucknow.

The recorded assemblages of calcareous nannoplankton and foraminiferids suggest that the sampled part of the Harudi Formation was deposited in a shelf environment having a bathymetry probably less than 50 metres. The rock represented by the sample H^1 of the Fulra Limestone was deposited in a shallower part of the shelf environment as evident from its microfossil contents.

SYSTEMATIC PALAEONTOLOGY

Family: COCCOLITHACEAE Kamptner, 1928.

Genus: *Discolithus* Kamptner ex Deflandre, 1952 *Discolithus*] sp.
Figs. 42–43.

Material: A complete coccolith, Slide No. N.L.U. 99.

Horizon: Harudi Formation.

Description: Coccolith consists of a rounded disc having a well-developed peripheral margin. Central

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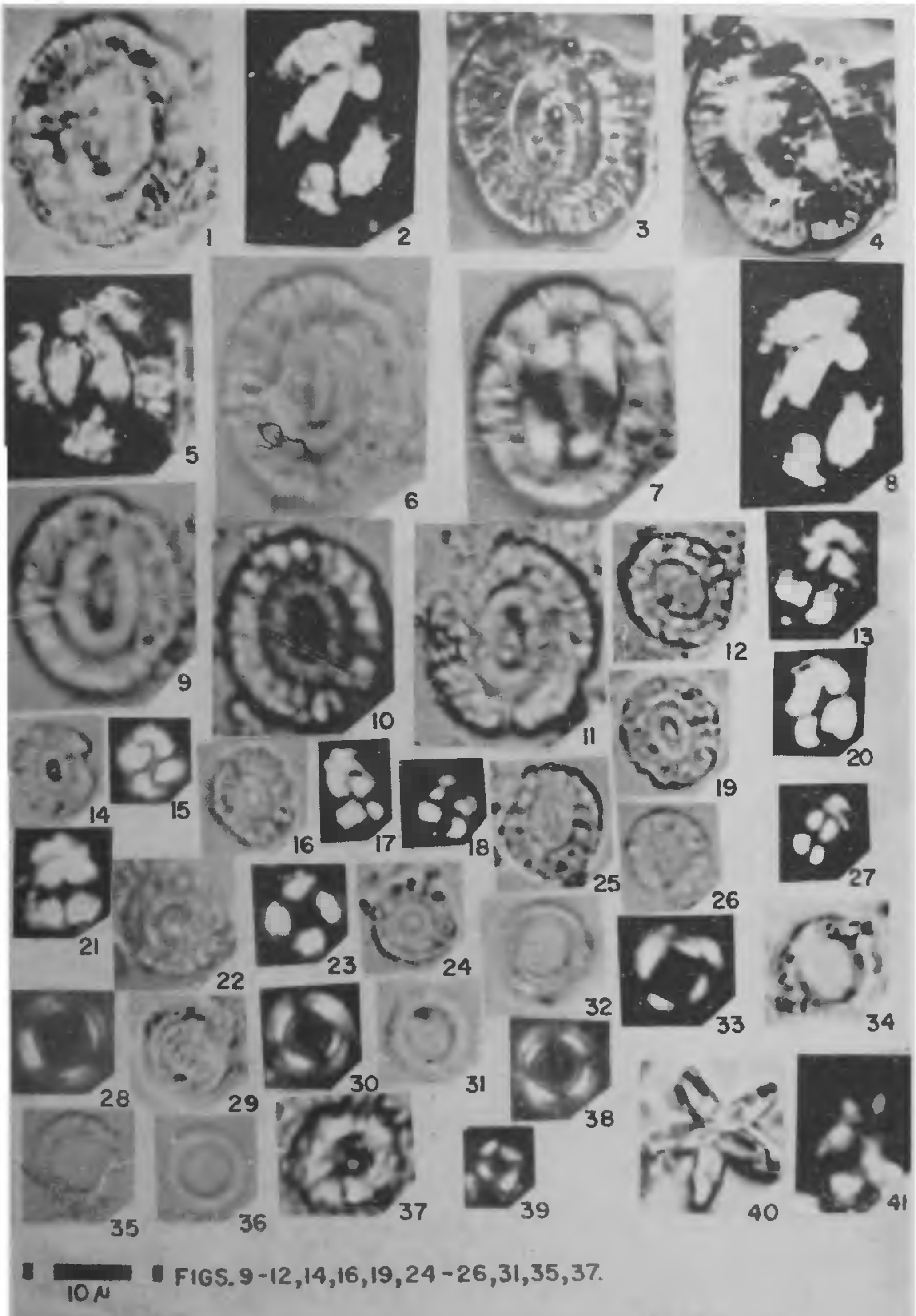
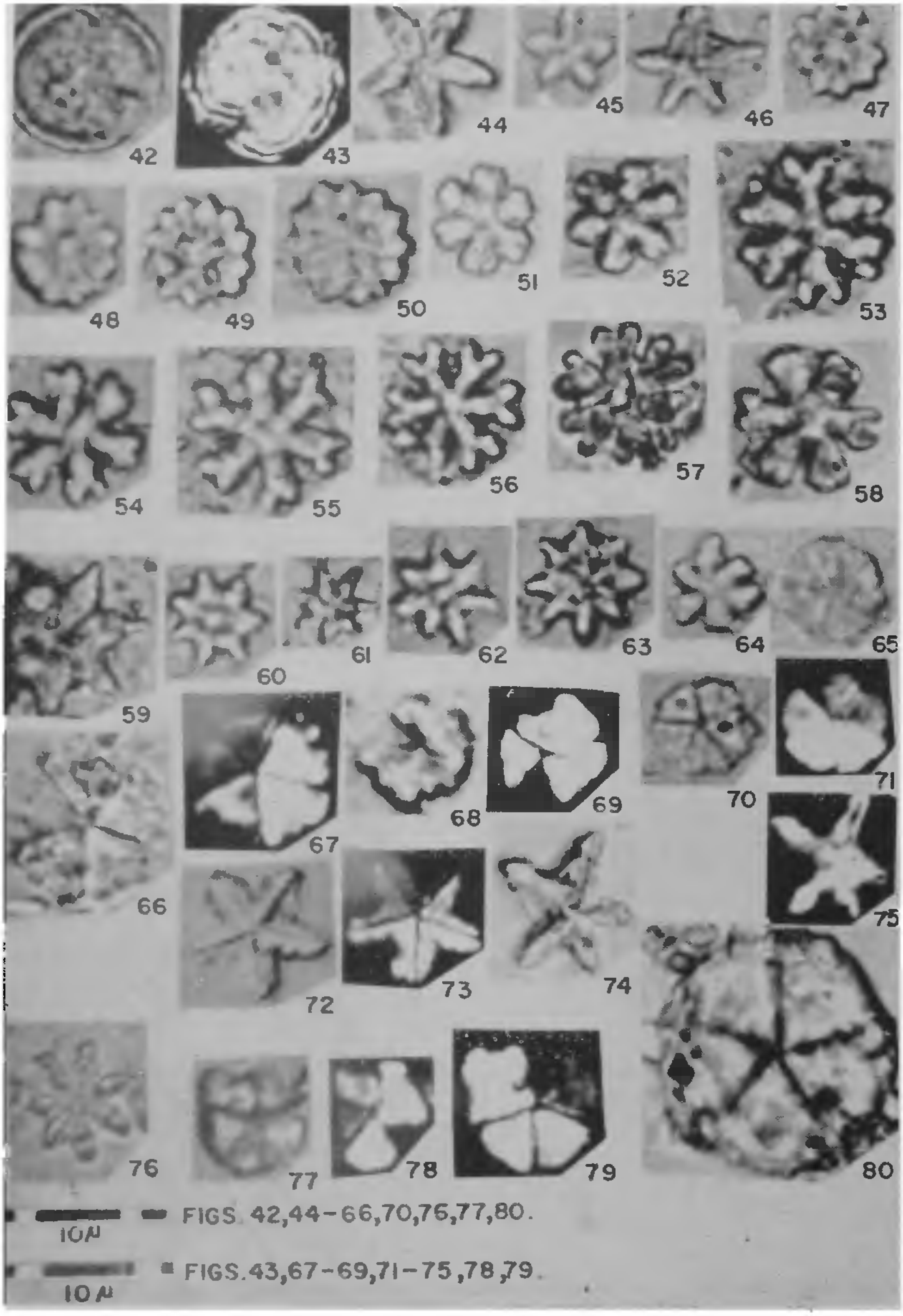


Figs. 1–41 **(Caprions on page 175)**



FIGS. 42–80 (Captions on page 175)

Figs. 1–41. Figs. 1–11. *Coccolithus eopelagicus* (Bramlette and Riedel). 1, 3, 6, 9, 10, 11, transmitted light; 2, 5, 8, crossed-nicols; 4, 7, long axis 45° to crossed-nicols. Figs. 12–21, 25–27, *Coccolithus pelagicus* (Wallich); 12, 14, 16, 19, 25, 26, transmitted light; 13, 15, 18, 21, 27, crossed-nicols; 17, 20, long axis 45° to crossed-nicols. Figs. 22–24. *Cyclococcolithina formosa* (Kamptner); 22, 24, transmitted light; 23, crossed-nicols. Figs. 28–36, 38. *Cyclolithella pakistanica* Haq; 28, 30, 33, 38, crossed-nicols; 29, 31, 32, 34–36, transmitted light. Figs. 37, 39. *Cyclococcolithina* sp. 37, transmitted light; 39, crossed-nicols; Figs. 40–41. *Discoaster aster* Bramlette and Riedel; 40, transmitted light; 41, crossed-nicols.

Figs. 42–80. Figs. 42–43. *Discolithus*] sp. 42, transmitted light; 43, crossed-nicols. Figs. 44–46. *Discoaster aster*, Bramlette and Riedel, transmitted light. Figs. 45–50. *Discoaster barbadiensis* Tan Sin Hok, transmitted light. Figs. 51–53. *Discoaster deflandrei* Bramlette and Riedel, transmitted light. Figs. 59–63. *Discoaster saipanensis* Bramlette and Riedel, transmitted light. Fig. 64. *Discoaster trinus* Stradner, transmitted light. Figs. 65, 79, 80. *Braarudosphaera discula* Bramlette and Riedel; 65, 80, transmitted light; 79, crossed-nicols. Figs. 66, 67. *Pemma papillatum* Martini; 66, transmitted light; 67, crossed-nicols. Figs. 68–69, *Micrantholithus crenulatus* Bramlette and Sullivan; 68, transmitted light; 69, crossed-nicols. Figs. 70–71. *Micrantholithus basquensis* Martini, 70, transmitted light; 71, crossed-nicols. Figs. 72–75, *Micrantholithus aequalis* Sullivan; 72, 74, transmitted light; 73, 75, crossed-nicols. Fig. 76, *Discoaster binodosus* Martini, transmitted light. Figs. 77–78, *Braarudosphaera* sp.; 77, transmitted light; 78, crossed-nicols.

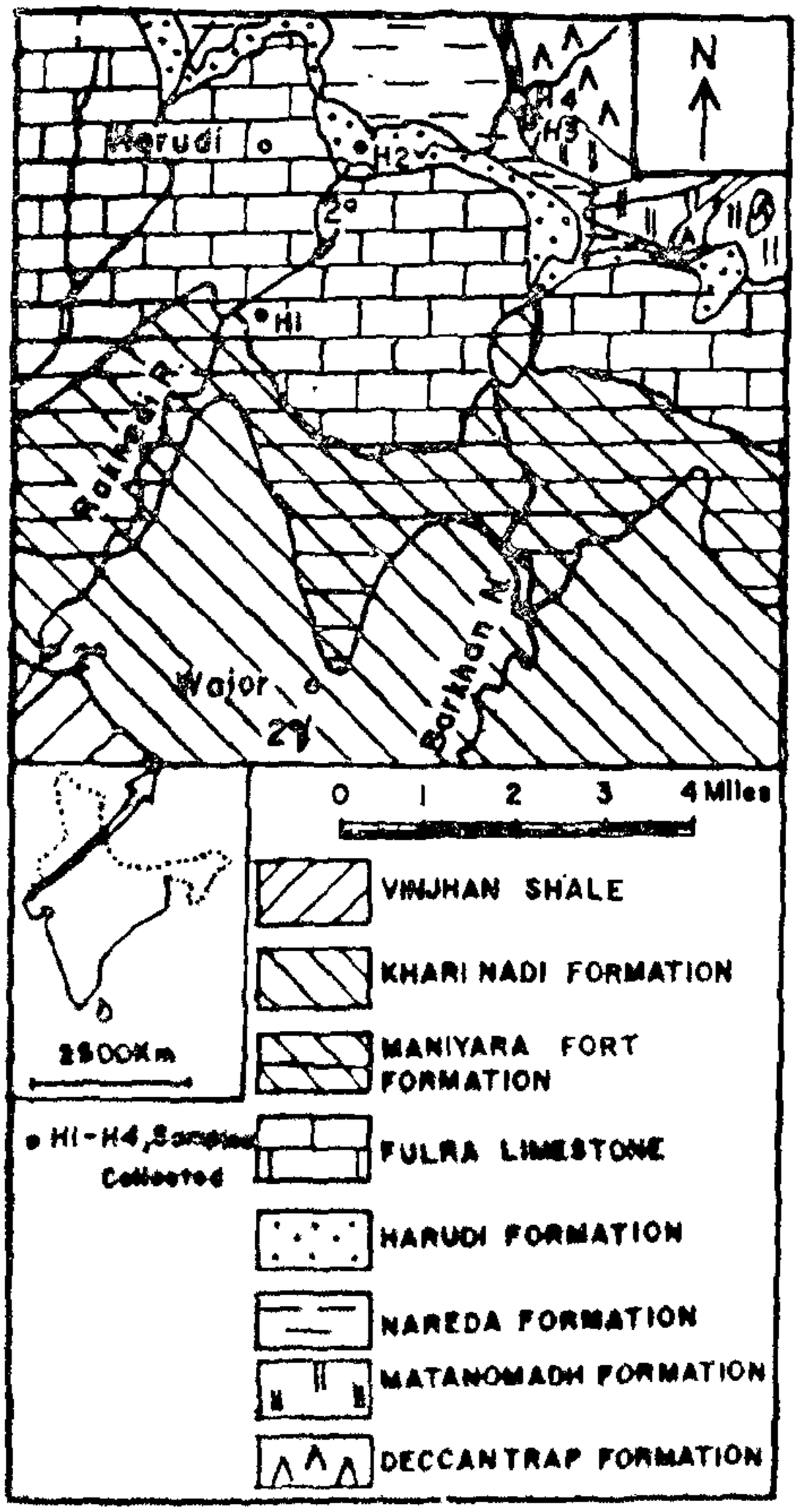


Fig. 81. Showing a part of geological map (Biswas and Raju[6]) and locations of samples.

SPECIES / SAMPLES	BRAARUDOSPHAERA SP	BRAARUDOSPHAERA DISCULA	COCCOLITHUS EUOPELAGICUS	COCCOLITHUS PELAGICUS	CYCLOCOCCOLITHINA SP	CYCLOCOCCOLITHINA FORMOSA	CYCLOLITHELLA PAKISTANICA	DISCOASTER ASTER	DISCOASTER BARBADIENSIS	DISCOASTER BINODOSUS	DISCOASTER DEFLANDREI	DISCOASTER SAIPANENSIS	DISCOASTER TRINUS	DISCOLITHUS SP	MICRANTHOLITHUS AEQUALIS	MICRANTHOLITHUS BASQUENSIS	MICRANTHOLITHUS CRENULATUS	PEMMA PAPILLATUM
H1		R	R	C		R		R	R	VR		C						
H2	R	F		A	VR	R	C	R	A		F	C	R	VR	R	VR	R	VR

INDEX

VR=VERY RARE, ONE SPECIMEN PER SLIDE (484 Sq mm area)
R=RARE, 2-5 SPECIMENS PER SLIDE (484 Sq.mm area)
C=COMMON, 6-10 SPECIMENS PER SLIDE (484 Sq mm area)
F=FREQUENT, 11-25 SPECIMENS PER SLIDE (484 Sq.mm area)
A=ABUNDANCE, MORE THAN 25 SPECIMENS PER SLIDE (484 Sq mm. area)

Fig. 82. Showing the frequency distribution of calcareous nannoplankton in the samples studied.

plate probably consists of minute grains of calcite. In crossed-nicols shows strong birefringence. Diameter 16·5 μ.

Genus: *Cyclococcolithina* Wilcoxon, 1970
Cyclococcolithina sp.
Figs. 37, 39.

Material: A coccolith, Slide No. N.L.U. 98.

Horizon: Harudi Formation.

Description: Coccolith medium sized and circular in outline. Distal shield contains fine striae. Central

area contains either a depression or an opening. In crossed-nicols shows strong birefringence. Diameter 11·2 μ.

Family: BRAARUDOSPHAERACEAE Deflandre, 1947

Genus: *Braarudosphaera* Deflandre, 1947
Braarudosphaera sp.
Figs. 77–78.

Material: A pentalith, Slide No. N.L.U. 98.

Horizon: Harudi Formation.

Description: Pentalith medium sized, pentagonal in shape and consists of five subtriangular segments. The tip of one of the segments is protruding out. In crossed-nicols shows strong birefringence. Diameter 11·2 μ.

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1. Pant, S. C. and Mamgain, V. D., *Rec. Geol. Surv. India*, 1969, **97**, 108.
2. Mathur, Y. K., *Curr. Sci.*, 1972, **41**, 488.
3. Singh, Pratap, *Jour. Pal. Soc. India*, 1977, **20**, 331.
4. —, *Curr. Sci.*, 1978, **47**, 53.
5. —, *Ibid.*, 1978, **47**, 87.
6. Biswas, S. K. and Raju, D. S. N., *Bull. O. N. G. Commission*, 1973, **10**, 37.

EFFECT OF GAMMA IRRADIATION ON THE ACTIVITIES OF ADENOSINE TRIPHOSPHATASE AND INORGANIC PYROPHOSPHATASE IN GRAM SEEDLINGS

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ABSTRACT

Seedling growth is inhibited by gamma-irradiation. The activities of mitochondrial adenosine triphosphatase and inorganic pyrophosphatase from cell-free preparation during early development of seedling from irradiated seeds are significantly reduced. Some disturbances in the biosynthetic pathways in irradiated seeds at later stages possibly cause the production of insufficient amount of enzymes which in turn result in reduced growth and development of such plants.

INTRODUCTION

MOST of the work on the effect of ionizing radiations in various plants is concerned with the injury that these radiations cause at the cytological level. Further, the work to establish a correlation between phenotypic effects and biochemical changes in the irradiated organisms is scanty.

Yealy and Stone[1] reported that germination of Grand Rapids lettuce seed was delayed by exposure to 100 kR gamma-irradiation. Ionizing radiations impaired mitosis resulting in reduced growth[2,3]. Presowing treatment with lower doses of gamma-irradiation (5 kR) stimulated seedling growth and an increase in the respiratory rate[4,5]. The respiratory quotient in irradiated corn wheat and sorghum, after 5–80 kR treatments, was lowered within 18 hours after beginning of water imbibition[6]. Metabolic processes like glycolysis and oxidative phosphorylation[4–7], cytochrome oxidase and catalase activities[8] were reported to be stimulated by growth inhibiting doses of radiation.

The present work was undertaken to study the effect of gamma-irradiation on seedling growth and the development of the activity of two enzymes involved in energy metabolism of the cell, adenosine triphosphatase (ATPase, E.C. 3.6.13) and inorganic pyrophosphatase (PPase, E.C. 3.6.1.1), during germination in chickpea.

MATERIAL AND METHODS

Seeds of L 144, C 214 and Hima varieties of gram (*Cicer arietinum* L.) were irradiated at room temperature with 5, 10, 20, 30 and 40 kR dose of gamma-irradiation in gammacell 900 (BARC) at a dose rate of 800 R per minute.

Germination and Growth

The seeds were soaked in 0·2% mercuric chloride solution for 10 minutes, washed thoroughly with distilled water and germinated at 25° C in the dark on moistened filter paper in petri plates, after removing the seed coat. The seeds of variety L 144 took longer to germinate. Taking elongation of embryo-axis as the criterion, it was found that the elongation in L 144 after 72 hours from removal of seed coat was comparable to that at 24 hours in the other two varieties. Thus the 'first