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ORIGIN AND GEOLOGY OF NEILL ISLAND, SOUTH ANDAMAN, INDIA.

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ABSTRACT

The paper incorporates the view that the Ritchie's Archipelago Group of the islands of the Andaman Sea originated from the splitting of a big island termed here 'SAHNI Island' which, it is believed, emerged out from the Sea in the Early Pliocene. During Pliocene-Pleistocene times, the islands started drifting from each other and gradually occupied their present positions. The geology of Neill island is discussed. The boundary between Zone N. 21 and Zone N. 22 is suggested to lie within the Sawai Bay Limestone. The Pliocene-Pleistocene boundary also lies within the Sawai Bay Limestone.

INTRODUCTION

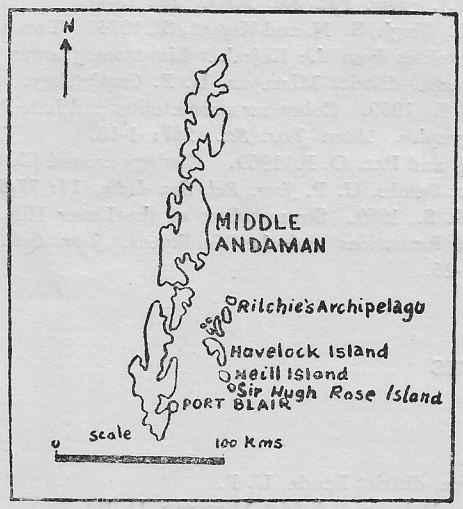

Fig. 1 Showing location of Neill Island.

Neill island (Fig. 1), the member of the Ritchie's Archipelago Group of islands of the Andaman Sea, has very good exposures of the Neogene rocks which are fossiliferous. Singh, *et al.* (1972, 1973 a, b, 1974) for the first time recorded the various microfossils from these rocks. The stratigraphic sequence of the different formations in Neill Island is shown in the Table 1, 2 and in the Fig. 2.

Singh and Vimal (1973a) classified the various beds exposed in Neill Island under the Neill Island Formation. But now the writers consider it better to classify these beds under the Archipelago Group, earlier proposed for receiving the various geological formations exposed in the Andaman-Nicobar islands.

Tipper (1911), Gee (1927), Jacob and Sastri (1951), Chatterjee (1967), Karunakaran (1962), and Karunakaran *et al.* (1968) worked out the stratigraphy of the Andaman islands. Recently, Srinivasan and Sharma (1973, 1974) demarcated five formations within the Archipelago Group of the Andaman-Nicobar islands. Srinivasan and Srivastava (1972) described the geology and foraminifera of the Nancowry and Kamorta islands.

The writers have identified four distinct mappable lithounits of the rank of formations—the Sawai Bay Mudstone, the Sawai Bay Limestone, the Malacca Limestone, and the Neill Island Coral Beds—in the Archipelago Group exposed in Neill Island. The lower three formations—the Sawai Bay Mudstone, the Sawai Bay Limestone and the Malacca Limestone—have been described from the Nancowry, Kamorta and Car Nicobar islands by Srinivasan *et al.* (1972, 1973) and these formations are being discussed below in detail for their suitable amendments.

Sawai Bay Mudstone: Srinivasan and Srivastava (1972) identified the lower part of this formation as the Nancowry Silty Mudstone Formation in the Nancowry and Kamorta islands and dated it as the Middle Miocene (the upper part of Zone N. 10, *Globorotalia* (*T.*) *peripheroacuta* Consecutive—range zone, Blow and Banner, 1965—Lower part of Zone N11, *Globorotalia* (*G.*) *praefohsi* Zone, Blow and Banner, 1965). According to them, it is moderately hard, greyish (non-calcareous) to greenish grey (calcareous) silty mudstone with occasionally interbedded layers of conglomerate and thin fine-gained sandstone. They suggested Nancowry island as the type locality for

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Table 1

Showing the stratigraphy of Neill island:

Singh, *et al.* (1972)	Singh & Vimal (1973a)		Singh & Vimal (1973b)		Singh & Vimal (1974)	Present work
						Formations
	Coral beds (Pleistocene to Recent) ..... ?		Coral beds (Recent) ....Unconformity....		Coastal Coral beds, beach sands and soils (Recent). ...Unconformity.....	Neill island coral Beds (Holocene). ...Unconformity...
	Neill island Formation		Neill island Formation	White coloured fossiliferous argillaceous limestone (Late Pleistocene). ...Unconformity...	Neill island Lime - stone (Late Pleistocene). ...Unconformity...	Malacca Limestone (Late Pleistocene). .....? .....? .....
Cream coloured fossiliferous marl (Early Pliocene).	Cream coloured fossiliferous marl	Early Pliocene	Cream coloured fossiliferous marl	Early Pliocene	Western Coast Limestone (Pliocene).	Sawai Bay Limestone (Late Pliocene—Early Pleistocene).
	Grey fossiliferous mudstone beds.		Grey fossiliferous mudstone beds.		Eastern Coast Mudstone (Late Miocene—Early Pliocene).	...Unconformity... Sawai Bay Mudstone (Late Miocene—Early Pliocene).
	Base not exposed		Base not exposed.		Base not exposed.	(Base not exposed.)

Table 2

Showing the stratigraphy of the Nancowry, Kamorta, Car Nicobar and Neill islands:

Group	Stratigraphy of the Nancowry and Kamorta islands (Srinivasan & Srivastava, 1972)	Stratigraphy of Car Nicobar islands (Srinivasan & Sharma, 1973, 1974)		Stratigraphy of Neill island
	FORMATIONS	FORMATIONS	MEMBERS	FORMATIONS
	Coral rags and Beach sand (Recent).	Malacca Limestone Formation (Plio-Pleistocene) .. ....Unconformity....		Neill island coral Beds (Holocene). ....Unconformity.... Malacca Limestone (Late Pleistocene) .. ? .. ? .....
			Sawai Bay Limestone Member (Middle Pliocene)	Sawai Bay Limestone (Late Pliocene—Early Pleistocene) ....Unconformity....
		Sawai Bay Formation Base obscure.	Sawai Bay Mudstone Member (Early Pliocene) ..	Sawai Bay Mudstone. (Late Miocene—Early Pliocene). ..
Archipelago ..	Nancowry Silty mudstone Formation (Grey calcareous to non-calcareous Silty Mudstone with interbedded conglomerate bands and thin fine-grained sandstone layers (Middle Miocene). ....Unconformity.... Basic igneous rocks (Dolerites and Basalts) .. (Early Tertiary).			

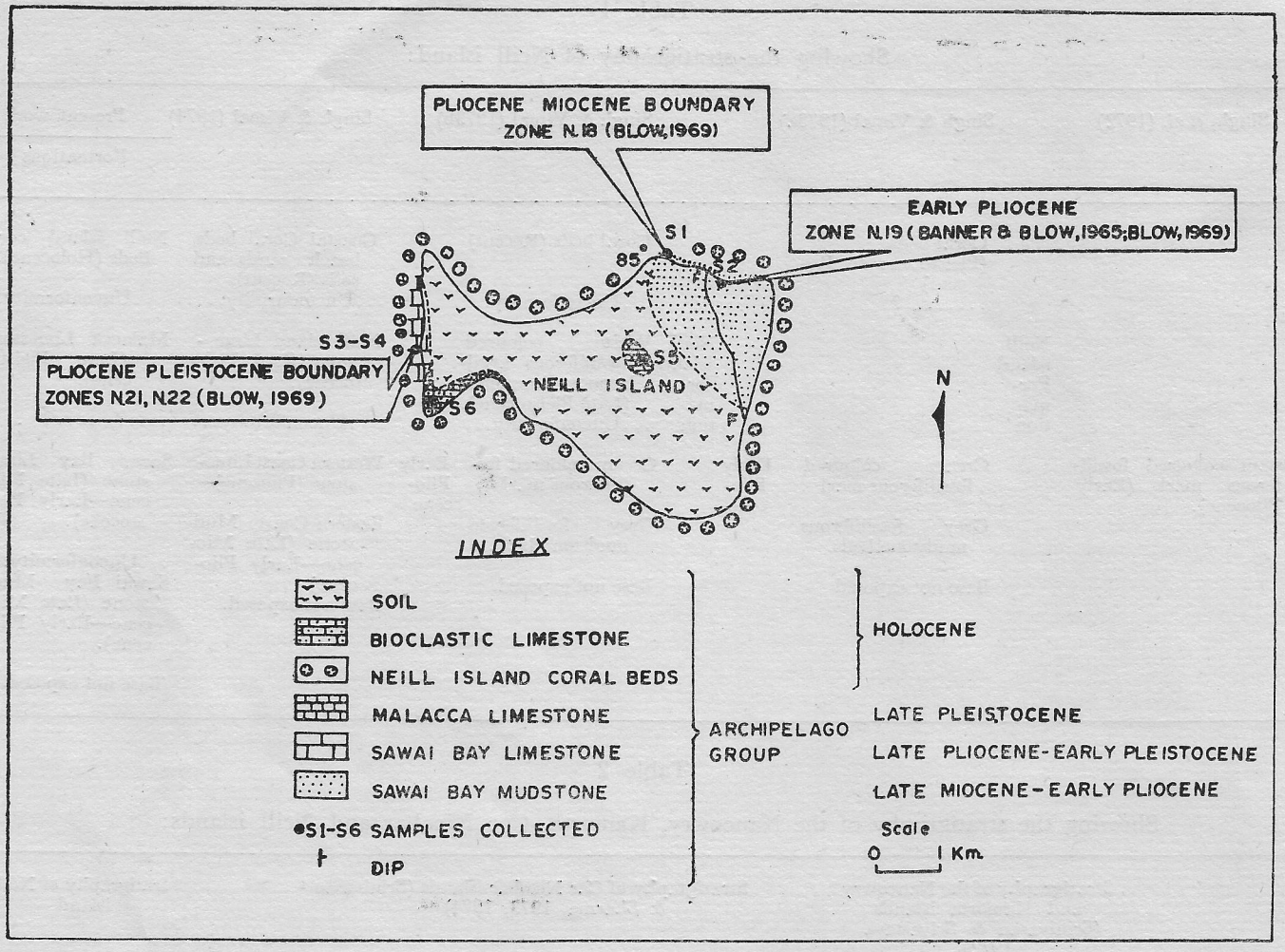

Fig. 2 Geological Map of Neill Island.

the Nancowry Silty Mudstone Formation and recorded only 27 foraminifera in their paper which are as follows:

Globigerina praebulloides Blow, *G. ruber* (d' Orbigny), *G. trilobus trilobus* Reuss, *Globigerinella siphonifera*, (d' Orbigny), *Globorotalia peripheronda* Blow and Banner, *G. peripheroacuta* Blow & Banner, *G. mayeri* (Cushman and Ellisor), *G. siakensis* LeRoy, *G. praefohsi* Blow & Banner, *Globoquadrina altispira* (Cushman & Jarvis), *G. baromoensis* (LeRoy), *Orbulina universa* (d' Orbigny), *O. suturalis* Bronnimann, *Sphaeroidinella seminulina* (Schwager), *Stilostomella lepidula* (Schwager), *Rotamorphina minuta* (Schubert), *Planulina wuellerstorfi* (Schwager), *Eggerella bradyi* (Cushman), *Protoglobobulimina globosa* (LeRoy), *Neouvigerina proboscidea* (Schwager), *Brizalina bilaensis* (LeRoy), *Euuvigerida hispida* (Schwager), *Melonis pompilioides* (Fichtel & Moll), *Globocassidulina murrhyna* (Schwager), *M. nicobarensis* (Cushman), *Bulimina alazanensis* (Cushman) and *Pullenia bulloides* (d' Orbigny)

In the years 1973, 1974, Srinivasan and Sharma proposed that the Sawai Bay Formation is divisible into two members—the Sawai Bay Mudstone Member (800 ft. thick) and the Sawai Bay Limestone (90 ft. thick) Member. These two rock-units are quite thick and mappable and are well-exposed in Car Nicobar island (type locality) as well as in Neill, Havelock, and Sir Hugh Rose islands. In the light of the above fact and in accordance with the Preliminary Report on Lithostratigraphic Units (*Int. Geol. Congr.*, Montreal, Canada, 1970), it would be better to raise the status of the Sawai Bay Mudstone and the Sawai Bay Limestone from Member to Formation, thus deleting the original Sawai Bay Formation of Srinivasan and Sharma (1973). The Sawai Bay Mudstone (type locality) is moderately hard and highly calcareous and shows light to bluish grey colour. Srinivasan and Sharma (1973) recorded a rich assemblage of foraminifera—*Chiloguembelina globigera* (Schwager), *Globigerina nepenthes* Todd, *Globigerinoides conglobatus* Brady, *G. obliquus obliquus* Bolli, *G. obliquus extremus* Bolli and Bermúdez, *G. quadrilobatus quadrilobatus* (d' Orbigny), *G. sacculifer* (Brady),

G. fistulosus (Schubert), *Globoquadrina altispira* (Cushman & Jarvis), *G. conglomerata* (Schwager), *G. dehiscens* (Chapmann, Parr & Collins), *G. indica* Srinivasan & Srivastava, *Globorotalia banneri* Srinivasan & Srivastava, *G. cultrata* (d' Orbigny), *G. hirsuta* (d' Orbigny), .*G margaritae* Bolli & Bermudez, *G. multicamerata* Cushman & Jarvis, *G. nicobarica* Srinivasan & Sharma, *G. obesa pseudocalido*, Srinivasan & Srivastava, *G. tumida tumida* (Brady), *G. tumida flexuosa* (Koch), *Protentella prolira* Lipps, *Sphaeroidinella dehiscens* S. S. (Parker & Jones), *Sphaeroidinellopsis dehiscens subdehiscens* Blow, *S. seminulina* (Schwager), *Neogloboquadrina dutertrei subcretacea* (Lomnicki), *Pulleniatina obliqueloculata* (Parker & Jones), *P. obliqueloculata praecursor* Banner & Blow, *P. primalis* Banner & Blow and *Orbulina universa* d' Orbigny from this formation (type locality) and suggested to it an Early Pliocene age. (Equivalent to Zone N 19, Banner & Blow, 1965, 1967).

The lithology of the Nancowry Silty Mudstone Formation and the Sawai Bay Mudstone Member suggests that they constitute a single lithounit and not the two as earlier proposed by Srinivasan and his associates. The writers, are, therefore, inclined to unite them into a single Formation—Sawai Bay Mudstone. The Sawai Bay Mudstone which is exposed in Neill island (Fig. 2) is in fact an extension of the Sawai Bay Mudstone of Car Nicobar island, the type locality. In Neill island, the Sawai Bay Mudstone is about 155 m. thick, having the greyish white lower part (sample No. S1) and the grey coloured upper part (sample No. S2). It is made up of foraminifera, radiolaria, sponge spicules, nannofossils, diatoms, and silicoflagellates (Pl. I, figs. 1 & 2). The lower part (S1) has yielded a very rich assemblage of microfossils which are as follows:—

Foraminifera: *Catapsydarx* sp., *Candeina nitida nitida* (d' Orbigny), *Globigerinoides* spp., G. *bolli* Blow, *G. conglobatus conglobatus* (Brady), *G. obliquus extremus* Bolli & Bermudez, *G. obliquus obliquus* Bolli, *G.* aff. *G. quadrilobatus altiaperturus* Bolli, *G. quadrilobatus immaturus* LeRoy, *G. quadrilobatus quadrilobatus* (d' Orbigny), *G. quadrilobatus sacculifer* (Brady), *G. quadrilobatus trilobus* (Reuss), *G. ruber* (d' Orbigny), *Globigerina angustiumbilicata* Bolli, *G. bulloides apertura* Cushman, *G. bulloides bulloides* d' Orbigny, *G. bulloides parabulloides* Blow, *G.* aff. *eggeri eggeri* Rhumbler, *G. falconensis* Blow, *G. foliata* Bolli, *G. nepenthes* Todd, *G. riveroae* Bolli & Bermudez, *Globigerinita glutinata* (Egger), *Globorotalia* spp,. *G. crassula crassula* Cushman & Stewart, *G. cultrata cultrata* (d' Orbigny), *G. cultrata limbata* (Fornasini), *G. margaritae* Bolli & Bermudez, *G. merotumida* Blow & Banner, *G. multicamerata* Cushman & Jarvis, *G. tumida plesiotumida* Blow & Banner, *G. tumida tumida* (Brady), *Globoquadrina altispira altispira* (Cushman & Jarvis), *G. conglomerata* (Schwager), *G. dehiscens dehiscens* (Chapman, Parr & Collins), *G. larmeui obesa* Akers, *G. venezuelana* (Hedberg), *Hastigerina* (*H.*) *siphonifera involuta* (Cushman), *H.* (*H.*) *siphonifera siphonifera* (d'Orbigny), *Neogloboquadrina acostaensis acostaensis* (Blow), *N. acostaensis humerosa* (Takayanagi & Saito), *Orbulina universa* d' Orbigny, *Sphaeroidinellopsis seminulina kochi* (Caudri), *S. seminulina seminulina* (Schwager), *S. subdehiscens panedehiscens* Blow, *S. subdehiscens subdehiscens* (Blow), *Turborotalia crassaformis crassaformis* (Gallowy & Wissler), *T. obesa* Bolli, *T. scitula scitula* (Brady), *Ammobaculoides* sp., *Amphicoryna ? scalaris* (Batsch), *Astacolous* sp., *Bulimina inflata* Seguenza, *B. ? ovata* (d' Orbigny), *Cibicides lobatulus* (Walker & Jacob), *Cribrostomoides* sp., *Dentalina* spp., *D. japonica* (Cushman), *D. subsoluta* (Cushman), *Eggerella bradyi* (Cushman), *Euuvigerina asperula* Czizek, *E. hispida* (Schwager), *Eponides praecintus* (Karrer), *Fissurina* spp., *Globocassidulina subglobosa* (Brady), *Gyroidina soldani* (d' Orbigny), *Heterolepa pseudoungerians* (Cushman), *H. mentaweinsis* LeRoy, *Lagena* sp., *L. advena* Cushman, *Melonis affinis* (Reuss), *M. pompilioides* (Fitchel & Moll), *Nodosaria* spp.; *N. tympaniplectiformis* Schwager, *Orthomorphina* sp., *O. jedlitschkari* (Thalmann), *Parafissurina* sp., *Planulina wuellerstorfi* (Schwager), *Plectofrondicularia vaughani* Cushman, *Pleurostomella* sp., *P. alternnans* Schwager, *Sigmoilopsis schlumbergeri* (Silvestri), *Sphaeroidina* sp., *S. bulloides* d' Orbigny, *Stilostomella insecta* Schwager var. *spinifera* LeRoy, *S. lepidula* (Schwager).

Calcareous nannoplankton: *Ceratolithus* sp., *Coccolithus* spp., *C. andamanensis* Singh n. sp., *Discoaster andamanensis* Singh & Vimal, *D. archipelagoensis* Singh & Vimal, *D. berggreni* Bukry, *D. brouweri* Tan Sin Hok, *D. challengeri neillensis* Singh & Vimal, *D. deflandrei* Bramlette & Riedel, *D. extensus* Hay, *D. indica* Singh & Vimal, *D. intercalaris* Bukry, *D. pentaradiatus* Tan Sin Hok, *D. raoi* Singh & Vimal, *D. trinidadensis* Hay, *D. variabilis* Martini & Bramlette, *D. variabilis sastrii* Singh & Vimal, *Discolithus neillensis* Singh, n. sp., *D. panti* Singh n. sp., and *Helicosphaera carteri* (Wallich).

Diatoms: *Actinocyclus ellipticus* Grunow, *Actinoptychus undulatus* (Bailey) Ralfs in Pritchard 1961 var. *undulatus f. undulatus*, *Arachnoidiscus ehrenbergii* Bailey, *A. rajui* Singh, Vimal & Nautiyal n. sp., *A. sastrii* Singh, Vimal & Nautiyal, n. sp., *A. talukdari* Singh, Vimal & Nautiyal n. sp., *Asteromphalus* spp., *A. ? marylandica* (Ehrenberg), *Campyloneis* sp., *? Campylodiscus* sp., *Cocconeis* spp., *C. punctatissima* Graville & Karsten, *Cladogramma* sp., *Coscinodiscus asteromphalus* Ehrenberg, *C. asteromphalus* var. *omphalantha* (Ehrenberg) Grunow, *C. excentricus* var. *leasareolatus* Kanaya, *C. lineatus* Ehrenberg, *C. marginatus* Ehrenberg, *C. oculus-irridis* Ehrenberg, *C. pacificus* Rattray, *C. rothii* Grunow, *Cyclotella* sp., *Diploneis crabro* (Ehrenberg) Ehrenberg, *Navicula ? lyra* Ehrenberg, and *Triceratium favus* Ehrenberg, Silicoflagellates: *Dicyocha ausonia* Deflandre, *D. fibula*

Ehrenberg, *Distephanus speculum* (Ehrenberg) and *Mesocena circulus* var. *apiculata* Lemmermann.

Earlier, the writers (1974) dated this lower part of the Sawai Bay Mudstone in Neill island as Late Miocene-Early Pliocene (Zone N. 18, *Globorotalia (G.) tumida tumida-Sphaeroidinellopsis subdehiscens panedehiscens* Partial-range zone, Blow, 1969) on the basis of its planktonic foraminifera. The assemblage of calcareous nannoplankton from this part (S1) is correlative with the *Ceratolithus rugosus* Zone, NN 13 (Late Miocene-Early Pliocene, Martini, 1970).

Its upper part (S2) in our area has yielded the following microfossils:

Foraminifera: *Biorbulina bilobata* (d' Orbigny), *Candeina nitida nitida* d' Orbigny, *Globigerinoides* sp., *G. bolli* Blow, G. *conglobatus* (Brady), *G. obliquus extremus* Bolli & Bermudez, *G. obliquus obliquus* Bolli, *G.* aff. *G. quadrilobatus altiaperturus* Bolli, *G. quadrilobatus immaturus* LeRoy, *G. quadrilobatus quadrilobatus* (d' Orbigny), *G. quadrilobatus sacculifer* (Brady), *G. quadrilobatus trilobus* (Reuss), *G. ruber* (d' Orbigny), *Globigerina bulloides bulloides* d' Orbigny, *G. decoraperta* Takayanagi & Saito, *G. eggeri eggeri* Rhumbler, *G. eamsi* Blow *G. falconensis* Blow, *Globigerinita glutinata* (Egger),*Globorotalia* spp., *G. cerotonensis* Conato & Follador, *G. cultrata cultrata* (d' Orbigny), *G. cultrata limbata* (Farnasini), *G. miocenica* Palmer, *G. multicamerata* Cushman & Jarvis, *G. tumida tumida* (Brady), *Globoquadrina altispira altispira* (Cushman & Jarvis), *G. conglomerata* (Schwager) *G. dehiscens dehiscens* (Chapman, Parr & Collins), *G. venezuelana* (Hedberg) *Neogloboquadrina acostaensis acostaensis* (Blow), *N. acostaensis humerosa* (Takayanagi & Saito), *Orbulina universa* d' Orbigny, *Sphaeroidinella dehiscens dehiscens* forma *immatura* Blow, *Sphaeroidinellopsis semunulina seminulina* (Schwager), *S. subdehiscens panedehiscens* Blow, *S. subdehiscens subdehiscens* (Blow), *Ammobaculoides* sp., *Bolivinopsis bulbosus* (Cushman), *Bulimina inflata* Seguenza, *Dentalina* spp., *D.* aff. *D. consorbrina* d' Orbigny, *D. consorbrina* var. *emaciata* (Reuss), *D. elegans* (d' Orbigny), *D. inornata bradyensis* (Dervieux), *D. insecta* (Schwager), *D. neugeboreni* (Schwager), *Eggerella bradyi* (Cushman), *Eponides praecintus* (Karrer) *Euuvigerina hispida* (Schwager), *Fissurina* spp., *F. orbignyana* Seguneza, *F. radiata* Seguenza, *Globocassidulina* sp., *Gyroidina soldanii* (d' Orbigny), *Hetero-, lepa mentaweiensis* (LeRoy), *Hoeglundina elegans* (d' Orbigny) *Lagena advena* Cushman, *Laticarinina holophora* (Stache), *L.* aff. *münsteri* (Reuss) *Martinottiella? communis* (d' Orbigny), *Nodosaria* spp., *N. hochstetteri* Schwager var. *spinicosta* Koch, *N. longiscata* d' Orbigny, *N. tosta* Schwager, *Orthomorphina jedlitschkai* (Thalmann), *Planulina wuellerstorfi* (Schwager), *Plectofrondicularia* sp., *P. vaughani* Cushman, *Pleurostomella alternans* Schwager, *P. brevis* Schwager, *Pullenia bulloides* (d'Orbigny), *Pyrgo subspherica* (d' Orbigny), *Sigmoilopsis schlumbergeri* (Silvestri), *Siphouvigerina proboscidea* (Schwager), *Sphaeroidina bulloides* LeRoy, *Stilostomella lepidula* (Schwager) and *S. insceta* Schwager var. *spinifera* LeRoy.

Calcareous Nannoplankton : *Coccolithus andamanensis* Singhn. sp. ,*Coccolithus* sp., *Discoaster andamanensis* Singh & Vimal, *D. archipelagoensis* Singh & Vimal, *D. brouweri* Tan Sin Hok, *D. challengeri neillensis* Singh & Vimal, *D. deflandrei* Bramlette & Riedel, *D. extensus* Hay, *D. trinidadensis* Hay, *D. variabilis* Martini & Bramlette, *Helicosphaera carteri* (Wallich).

Diatoms: *Actinocyclus ellipticus* Grunow, *Actinoptychus undulatus* (Bailey) Ralfs in Pritchard 1961 var. *undulatus f. undulatus*, *Asteromphalus* sp., *Coscinodiscus lineatus* Ehrenberg, *C. marginatus* Ehrenberg, *Cyclotella* sp., *Diploneis crabro* (Ehrenberg) Ehrenberg, and *Triceratium favus* Ehrenberg.

Silicoflagellates: *Dictyocha ausonia* Deflandre, *D. fibula* Ehrenberg.

The planktonic foraminiferal assemblage is suggestive of an Early Pliocene age (Zone N. 19, *Sphaeroidinella dehiscens dehiscens—Globoquadrina altispira altispira* Partial—range zone, Banner & Blow, 1965, Blow, 1969) for the upper part (S2) of the Sawai Bay Mudstone.

While summing up the above data, we can say that the age of the Sawai Bay Mudstone ranges from the Middle Miocene to the Early Pliocene. Its lower part is exposed in the Nancowry and Kamorta islands, whereas the upper part is exposed in the Car Nicobar and Neill islands. It is unconformably overlain by the Sawai Bay Limestone in Neill island, and the writers are of the opinion that the similar unconformable contact between these two formations may be present in Car Nicobar island. It was deposited in the middle to upper bathyal environment.

Sawai Bay Limestone: At Sawai Bay in Car Nicobar island, Srinivasan and Sharma (1973) recorded the limestone strata conformably overlying the Sawai Bay Mudstone. The limestone, according to them, is arenaceous in character having fine to coarse grained sand particles and contains the broken fragments of lamellibranch and gastropod shells. Its upper part is very hard, fine-grained, and pinkish yellow in colour. These workers have enlisted a fairly rich assemblage of foraminifera from this limestone which comprised *Chiloguembelina globigera* (Schwager), *Globigerinoides conglobatus* (Brady), *G. obliquus extremus* Bolli & Bermudez, *G. obliquus obliquus* Bolli, *G. quadrilobatus quadrilobatus* (d' Orbigny), *G. quad-*

rilobatus sacculifer (Brady), *Orbulina universa* d' Orbigny, *Sphaeroidinella dehiscens* s. s. (Parker & Jones), *S. seminulina* (Schwager), *Globoquadrina conglomerata* (Lomnicki), *Pulleniatina obliqueloculata* (Parker & Jones), *Globorotalia cultrata* (d'Orbigny), *G. multicamerata* Cushman & Jarvis, *G. nicobarica* Srinivasan & Sharma, and *G. obesa pseudocalido* Srinivasan & Srivastava. Their record from the Sawai Bay Limestone also includes some reworked larger foraminifera (*Amphistegina* cf. *radiata*, *Lepidocyclina* (*Nephrolepidina*) cf. *tournoueri* Douville, *Cycloclypeus posteidae* Tan, *Operculina* sp., *Heterostegina* sp. *Miogypsina* sp. *indet*, and *Spiroclypeus* sp.). They assigned a Middle Pliocene age (Zone N. 20, *Globorotalia* (*G.*)*multicamerata—Pulleniatina obliqueloculata obliqueloculata* Partial—range zone, Banner & Blow, 1965, Blow, 1969) to this limestone.

The Sawai Bay Limestone which is exposed on the western coast of Neill island is a cream-coloured biomicrite containing grains of silica (Pl. I, fig. 3), shells of lamellibranch, gastropod, echinoderms, ostracoda, and algae. The lower portion (S3) of the limestone has yielded a fairly rich assemblage of foraminifera which are identified as: *Globigerinoides quadrilobatus immaturus* LeRoy, *G. quadrilobatus trilobus* (Reuss), *G. ruber* (d' Orbigny), *Globorotalia tumida tumida* (Brady), *G. cultrata limbata* (Fornasini) *T. tosaensis tenuitheca* Blow, *Neogloboquadrina acostaensis acostaensis* Blow, *N. acostaensis humerosa* (Takayanagi & Saito), *Turborotalia inflata* (d' Orbigny), *T. obesa* Bolli, *Pulleniatina obliqueloculata obliqueloculata* (Parker & Jones), *P. obliqueloculata praecursor* Banner & Blow, *Amphistegina* spp., *Anomalinella rostrata* (Brady), *Bolivina* spp., *B.* aff. *B. robusta* Brady var. *pacifica* Boomgaart, *B. subspathulata* Boomgaart, *B. striata* d' Orbigny, *Bolivinita quadrilatera* (Schwager), *Cibicides* spp., *C.* aff. *floridinus* (Cushman) *C. lobatulus* (Walker & Jacob), *C. ? poei* (d' Orbigny), *Cibicidoides* sp., *Dentalina* sp., *Discorbis* sp., *Elphidium craticulatum* (Fichtel & Moll), *E. chapmani* Cushman, *Florilus boueanum* (d' Orbigny), *Fissurina lacunata* (Burrows & Holland), *Guttulina* sp., *G. regina* (Brady, Parker & Jones), *Heterolepa* spp., *H. umbonatus* (Reuss), *Hyalina balthica* (Schroeter), *Lagena* sp., *Lenticulina advena* Cushman, *Marsipella elongata* Norman, *Melonis affinis* (Reuss), *Nodosaria* spp., *N. koina* Schwager, *N. tubulata* Koch, *Osangularia* sp., *Planorbulinella larvata* (Parker & Jones), *Plectofrondicularia* sp., *Pseudonodosaria* sp., *P. acuta* LeRoy, *Pseudorotalia gaimardii* (d' Orbigny), *Quinqueloculina* spp., *Rectobolivina columellaris* (Brady), *Reussella spinulosa* (Reuss), *Rotalia* spp., *Siphogenerinoides raphanus* (Parker & Jones) var. *costulata* Cushman, *Siphouvigerina ? ampullacea* Brady, and *Textularia rubra* Boomgaart. The present planktonic foraminiferal assemblage suggests a Late Pliocene to the extreme basal Pleistocene age for the lower part of the Sawai Bay Limestone and is correlative with Blow's zone N. 21, *Globoratalia* (T) *tosaensis tenuitheca* Consecutive-range zone (Blow, 1969). The presence of Zone N. 21 indicates that Plio-Pleistocene boundary lies somewhere in this formation.

The upper part (S4) of this Limestone has yielded *Globigerinoides quadrilobatus immaturus* LeRoy, *G. quadrilobatus trilobus* (Reuss); *G. ruber* (d' Orbigny), *Globorotalia tumida tumida* (Brady), *G. truncatulinoides truncatulinoides* (d' Orbigny), *Neogloboquadrina acostaensis humerosa* (Takayanagi & Saito), *Turborotalia obesa* Bolli, and *T. inflata* (d' Orbigny).

The appearance of *G. trancatulinoides truncatulinoides* (d' Orbigny) coincides with the base of Zone N. 22 (Blow, 1969), and its presence in the upper part of the Sawai Bay Limestone (Neill island) might lead to a conclusive suggestion that this part of the limestone belongs to the *G. truncatulinoides truncatulinoides* appearance datum line which begins with the base of Zone N. 22 (*Globorotalia* (*G.*) *truncatulinoides truncatulinoides* Partial—range Zone).

Based on the above data, it can be stated that the Zone N. 21/Zone N. 22 boundary lies within the Sawai Bay Limestone (Neill island); Plio-Pleistocene Boundary is also found to lie somewhere in the Sawai Bay Limestone. Plio-Pleistocene and Zone N. 21/Zone N. 22 boundaries may clearly be demarcated by the study of closely spaced samples. The detailed study on the closely-spaced samples is in progress and will be published elsewhere. The lower part of the Sawai Bay Limestone is exposed in Car Nicobar island (the type locality), while the upper part is exposed in Neill island. The age of this formation ranges from the Early Pliocene to the Early Pleistocene. The deposition of this limestone took place in the inner neritic environment.

Malacca Limestone: Srinivasan & Sharma (1973) recorded a white limestone exposed in a well adjacent to the Malacca Post Office and named it after the village Malacca. They described the Malacca Limestone as hard, compact, semicrystalline limestone with abundant larger foraminifera and identified few foraminifera as *Operculina* cf. *venosa* (Fichtel & Moll), *Marginopora vertebralis*, *Amphistegina* sp., *Carpenteris* sp., *Gypsina* sp., *Heterostegina* sp., *Planorbulinella* sp., and *Pulleniatina* sp., and *P. obliqueloculata* (S. S.). They referred this limestone to the Plio-Pleistocene age. The writers have found the similar limestone overlying the Sawai Bay Limestone in the central part of Neill island (Fig. 2). It is a white fossiliferous, argillaceous limestone containing foraminifera, ostracoda, big corals, algae and shells of lamellibranchs and gastropods. Petrological study reveals that it is a biomicrite (Pl. I—4-6) having detrital sand grade quartz. It has yielded a fairly rich assemblage of foraminifera—*Alveolinella* sp., *Amphistegina* spp., *Calcarina*

sp., *C. calcar* d' Orbigny, *C. nicobarensis* Schwager, *Flinitina ? bradyana* Cushman, *Peneroplis* spp., *Quinqueloculina* sp., *Q. pseudorecticulata* Parr, *Q. ? sagra* d' Orbigny, *Spiroloculina sublimbata* Parr, *S. elegans* Cushman, *S. communis* Cushman & Todd, *Sorites* spp., *Triloculina ? involuta* Todd, *T. terquemina* (Brady), *T. tricarinata* d' Orbigny and *Textularia* sp. Singh and Vimal (1973) assigned it to a Late Pleistocene age. It is an extension of the Malacca Limestone exposed in Car Nicobar island. The shallower inner neritic depths, probably less than 30 m., influenced the deposition of this formation.

Neil island coral Beds: The formation includes the following Holocene deposits:

	Approximate Thickness:
Bioclastic Limestone ..	1.5 m.
Shelly Limestone	30 cms.
Coral beds	3 m.

Coral beds: It is exposed all around the coast of Neill island and is made up of corals, bryozoa, and shells of mollusca.

Shelly Limestone: It is a thin bed composed of the shells of gastropods and lamellibranchs.

Bioclastic Limestone: It conformably overlies the shelly limestone (Fig. 2) and is 1.5 m. thick. It is dirty white, fossiliferous, hard limestone and is composed of detrital sand grade quartz (about 10%), occasional feldspar (orthoclase & Oligoclase), and fossils (about 30%)—fragments of mollusc shells and algae (Pl. 1, figs. 7 & 8) which are embedded in the micritic cement. The foraminifera are represented by *Sprillina* sp., *Elphidium* spp., *Calcarina* sp., *C. calcar* d' Orbigny, *Spiroloculina* sp., and *Quinqueloculina* spp., It was deposited in the littoral environment.

Island Drifting: The topographical map of the islands of the Ritchie's Archipelago Group suggests that these islands were positively the parts of a big island named here as "Sahni island" (named in honour of Prof. M. R. Sahni, a leading geologist and palaeontologist). We think so because these separated islands can be easily fitted with each other.

Neill island has a deep and distinct concave depression at its northern coast and a small concave depression at its southwestern coast. These concave scars represent the lines of separation and faulting. Moreover, this island is situated south of Havelock island at a distance of about 5 km. The southeastern portion of Havelock island is long and has a rounded end indicating a line of

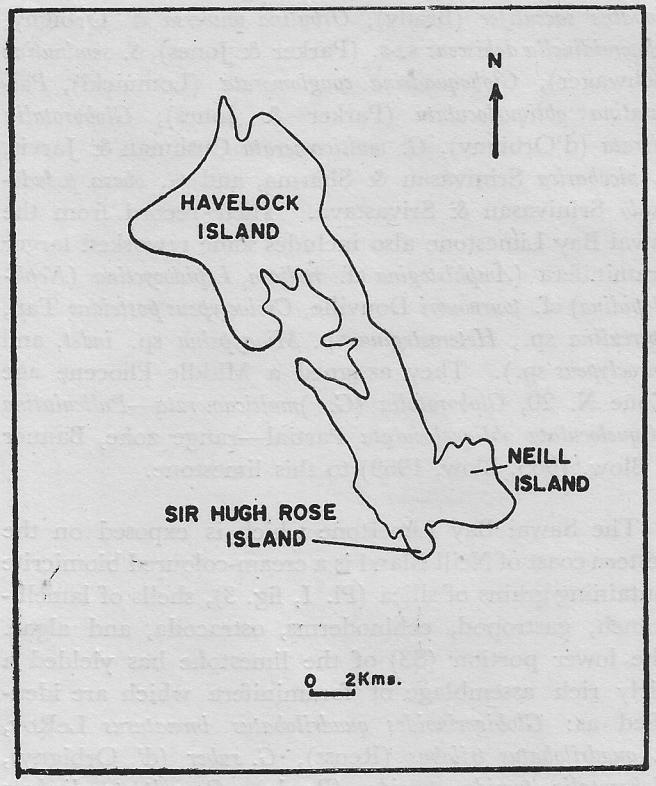

Fig. 3 Showing undivide flavelock Island probably during the Early Pliocene.

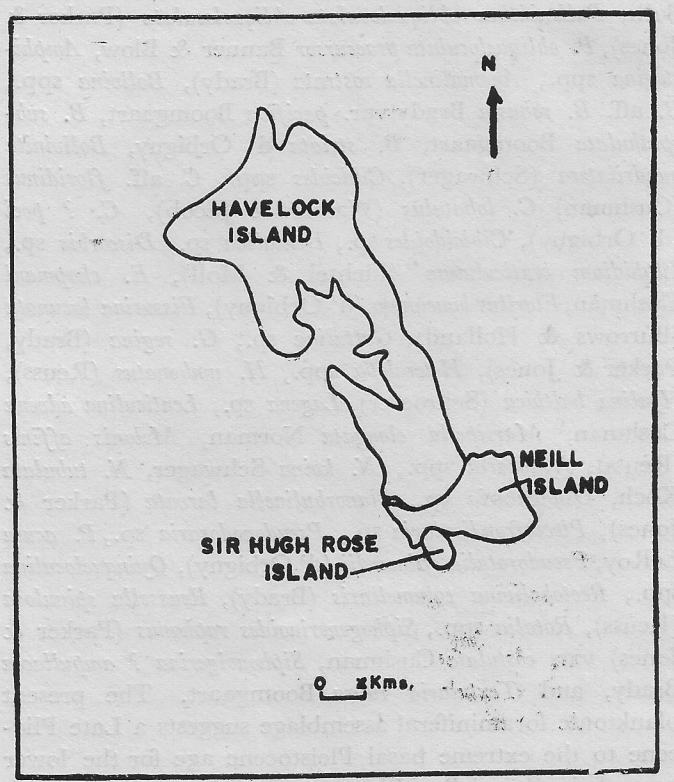

Fig. 4 Showing splitting of Havelock island into the Neill and Sir Hugh Rose Islands during the Pliocene,

separation and faulting. If the northern concave depression of Neill island is brought closer to this rounded end of Havelock island, it can be joined with Havelock island at this point (Fig. 4). Similarly, Sir Hugh Rose island can be fitted in the south western depression of Neill island. In one way or the other, perhaps all these islands can be put closer together to result in a single, large island—"Sahni Island."

After the deposition of the Sawai Bay Mudstone, the tectonic activity shook this region. As a result, Sahni island rose above the sea to be later broken into several islands—Button, Havelock, Henery Lawrence, Inglish, John Lawrence, Middle Button, Nicholson, Neill, Outram, Peel, Sir Hugh Rose and Wilson islands (Early Pliocene). This drifting is presumed to have occurred during the Pliocene—Pleistocene time. Havelock island got broken into Neill island and Sir Hugh Rose island, a part of Neill island (Figs. 3, 4 & 5). The Neill and Sir Hugh Rose islands, after their origin, started drifting probably in the Pliocene to Pleistocene times from Havelock island. Neill island drifted towards south-west about 5 km. away from Havelock island and occupied its present position (Fig. 6). Sir Hugh Rose island, on the other hand, drifted towards southeast about 7 km. away from Neill island and occupied the present position.

The Sawai Bay Mudstone which forms the major part of Neill island is also exposed on the southeastern part of Havelock island and on the northeastern part of Sir Hugh Rose island. The exposure of the Sawai Bay Mudstone in all these three islands—Neill, Havelock and Sir Hugh Rose—lends further support to our island drift hypothesis.

There was a break in sedimentation in the Pliocene (? Zone N. 20, Blow, 1969) due to this unstable uplift; the major part of this island drifting might have taken place during this time. After this phenomenon, the islands were again submerged and the Sawai Bay Limestone was deposited unconformably over the Sawai Bay Mudstone. The contact between the Sawai Bay Limestone and the Malacca Limestone is not seen by the writers in Neill island. Probably the sedimentation was continuous and the Malacca Limestone was deposited over the Sawai Bay Limestone. After the deposition of the Malacca Limestone, these islands were again uplifted. This uplift is still active, though very slow, as evidenced by the raised beaches of Neill island.

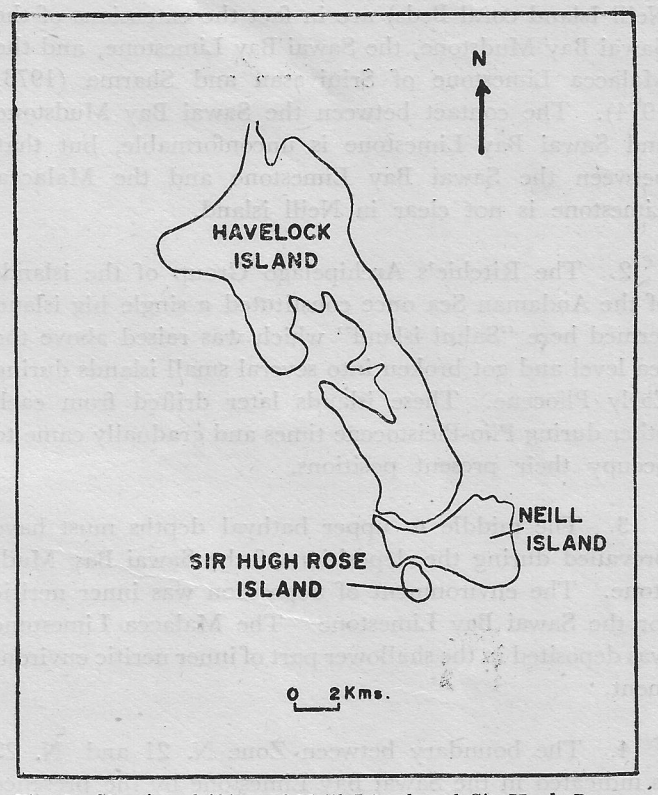

Fig. 5 Showing drifting of Neill Island and Sir Hugh Rose Island from Havelock Island probably during the Pliocene—Early Pleistocene times.

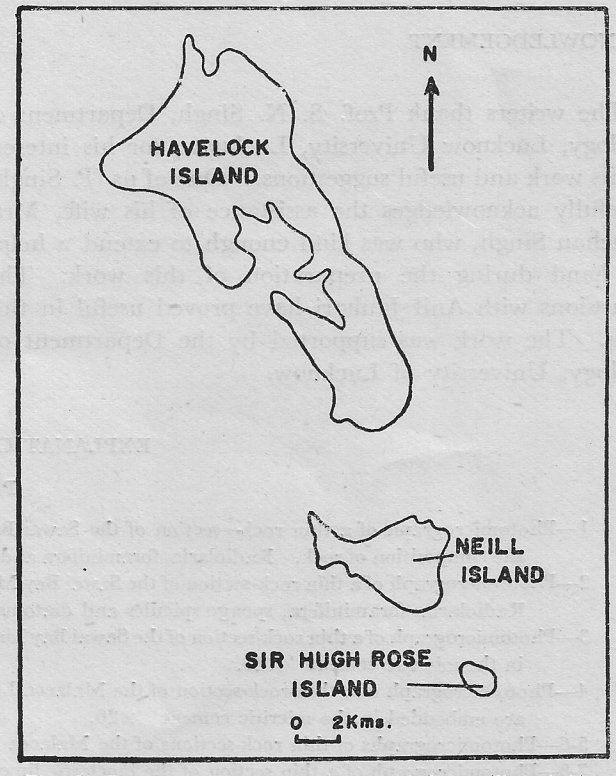

Fig. 6 Showing the present position of the Neill and Sir Hugh Rose Island.

CONCLUSIONS

1. In Neill Island, the various lithounits recognised as separate formations are classified under the Archipelago Group. The three lithounits (excepting the Recent

Neill Island coral Beds) are in fact the extensions of the Sawai Bay Mudstone, the Sawai Bay Limestone, and the Malacca Limestone of Srinivasan and Sharma (1973, 1974). The contact between the Sawai Bay Mudstone and Sawai Bay Limestone is unconformable, but that between the Sawai Bay Limestone and the Malacca Limestone is not clear in Neill island.

2. The Ritchie's Archipelago Group of the islands of the Andaman Sea once constituted a single big island termed here "Sahni island" which was raised above the sea level and got broken into several small islands during Early Pliocene. These islands later drifted from each other during Plio-Pleistocene times and gradually came to occupy their present positions.

3. The middle to upper bathyal depths must have prevailed during the deposition of the Sawai Bay Mudstone. The environment of deposition was inner neritic for the Sawai Bay Limestone. The Malacca Limestone was deposited in the shallower part of inner neritic environment.

4. The boundary between Zone N. 21 and N. 22 is indicated in the Sawai Bay Limestone by the presence of *G. truncatulinoides truncatulinoides*. Pliocene-Pleistocene boundary also lies within the Sawai Bay Limestone.

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EXPLANATION OF PLATES

PLATE-I

1—Photomicrograph of a thin rock—section of the Sawai Bay Mudstone (Sample No. S_1, Late Miocene—Early Pliocene) showing the composition of rock. Radiolaria, foraminifera and sponge spicules are embedded in the clay matrix ×110.

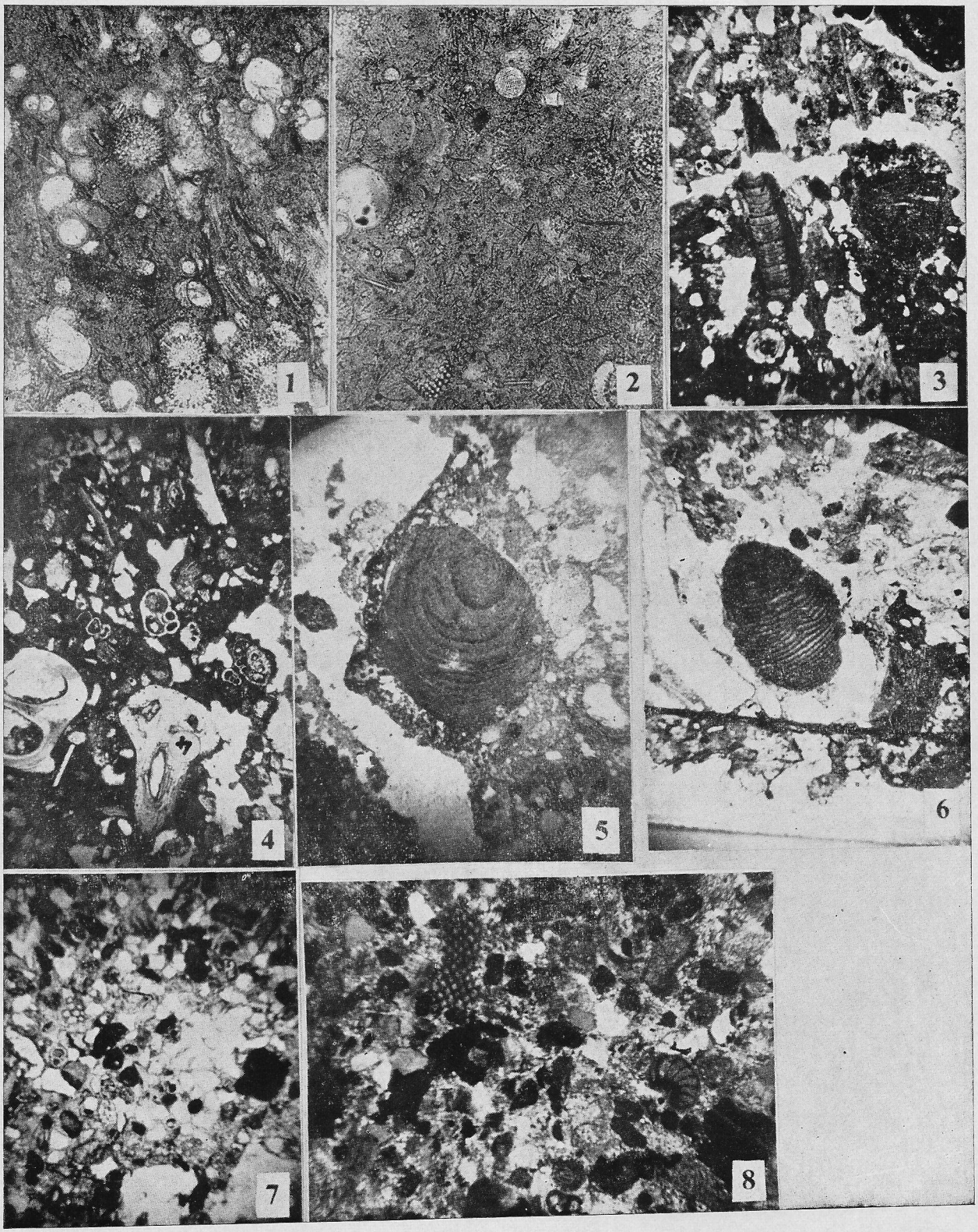
2—Photomicrograph of a thin rock-section of the Sawai Bay Mudstone (Sample No. S_2, Early Pliocene) showing the composition of rock. Radiolaria, foraminifera, sponge spicules and diatoms are embedded in the clay matrx ×110.

3—Photomicrograph of a thin rock-section of the Sawai Bay Limestone showing algae, foraminifera and quartz grains which are embedded in the micritic cement ×20.

4—Photomicrograph of a thin rock-section of the Malacca Limestone showing foraminifera, shells of mollusca and quartz grains which are embedded in the micritic cement ×20.

5-6—Photomicrographs of thin rock-sections of the Malacca Limestone showing algae ×20

7-8—Photomicrograph of a thin section of the bioclastic limestone showing foraminifera and quartz grains. Fig. 3, transmitted light, ×20; Fig. 4, crossed-nicols, ×30.



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