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Orbulina universa D'ORBIGNY in Central Japan

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Abstract

Orbulina universa D'ORBIGNY made its first appearance in the *Globoquadrina dehiscens* zones though still it was extremely rare of the Saigo formation in Shizuoka prefecture, central Japan. It is most probable that the "*Orbulina* surface" in central Japan lies at the middle Miocene (f_3 stage).

The central Japan record indicates the abundance of *Orbulina universa* D'ORBIGNY in the upper Miocene but apparently none in the lower Miocene. More datails of the vertical range of *Orbulina universa* in Japan is mentioned and the lowest limit of this species is possibly assumed to be the middle Miocene. Accounts on the biostratigraphy on the basis of smaller and larger foraminifers are given establishing 7 zones and 26 zonules. The materials have been obtained from the Neogene rocks of Shizuoka prefecture.

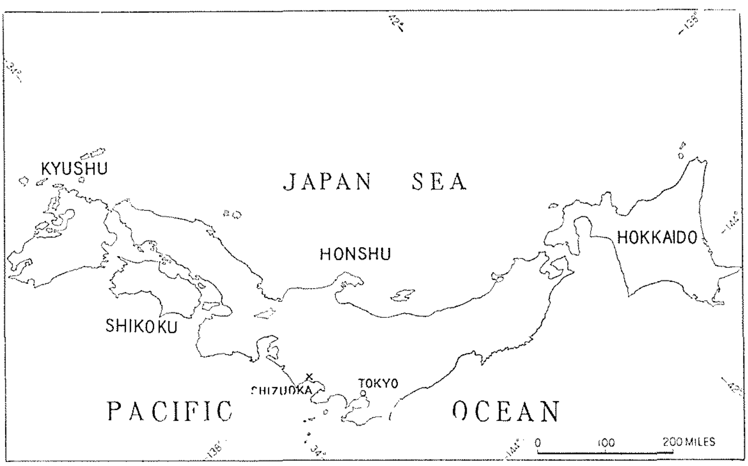

Figure 1. Index map.

INTRODUCTION

The purpose of this paper is to disclose the *Orbulina* surface (LEROY, 1948) of the Miocene deposits in central Japan.

The final conclusion was arrived with a rich materials obtained from numerous surface section of Pacific coast of central Japan (Fig. 4–18).

LEROY (1948) suggested that points of lowest stratigraphic occurrence of *Orbulina universa* D'ORBIGNY, and its related form, *Candorbulina universa* JEDLITSCKA, in a continuously deposited, open sea, deepwater globigerine biofacies, fall on or in close proximity to a time horizon within middle Tertiary sections through tropical and subtropical zones of the world.

It has been recommended by LEROY that biostratigraphic points of the first appearance constitute a datum to be termed the "*Orbulina* surface". The

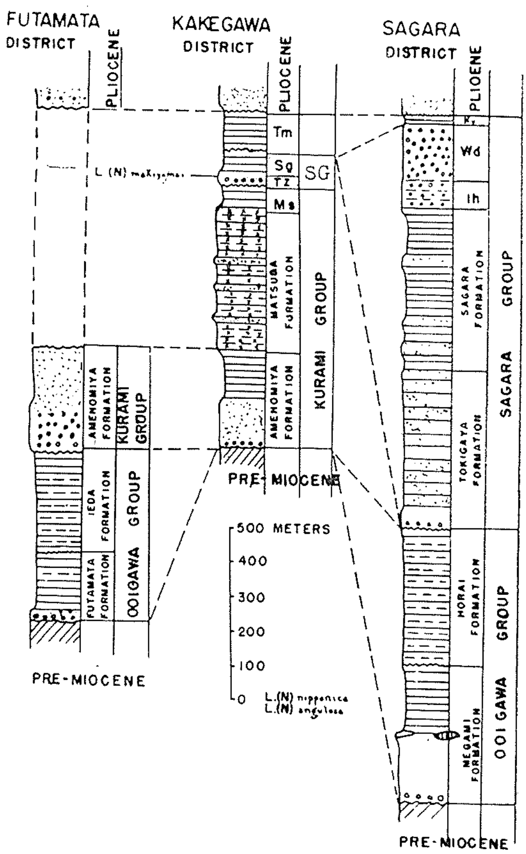

Figure 2. Lithostratigraphy established by previous works.

Ih, Ishiharada bed; Ky, Kiriyama formation; Ms, Masago formation; Sg, Saigo formation; SG, Saigo Group; Tm, Tamari formation; TZ, Tozawa bed; Wd, Wada conglomerate.

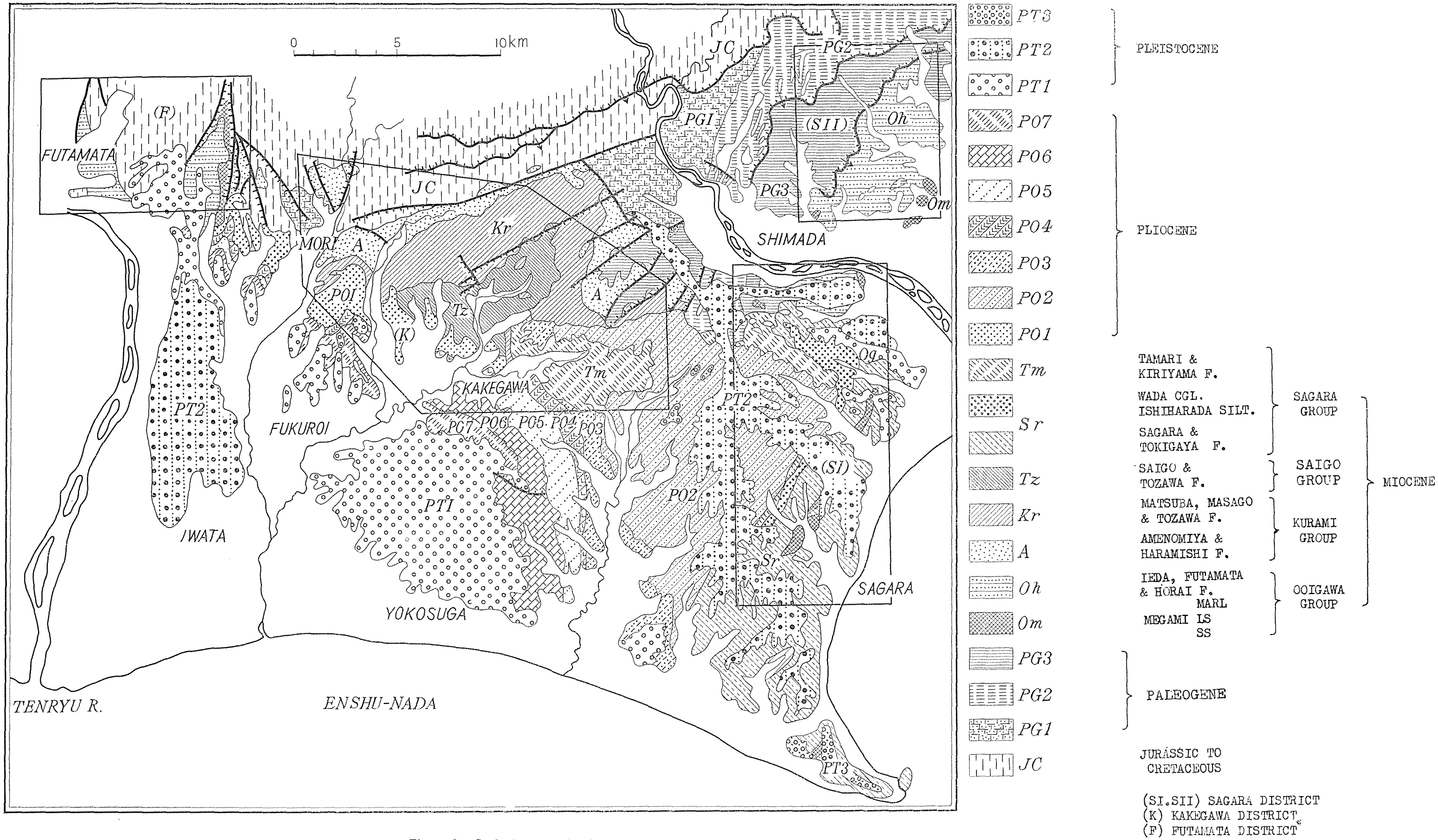

Figure 3. Geologic map with index of the district described in this paper.

recognition of this surface would assist materially in establishing world-wide Tertiary time-stratigraphic correlations. The Kassikan section of central Sumatra is believed to contain a qualified point for the *Orbulina* surface and is recommended as the type for the western portion of the East Indian Archipelago and he has requested discussion from micropaleontologists of *Orbulina* in various Tertiary sections.

The geology and paleontology of the western part of Shizuoka prefecture in the central Japan has been worked out by many authors [3),5),41),42),45)-50),61)-73),78),80),86)-88),99),103)]. Particularly discovery of larger Foraminifers by Jirô MAKIYAMA (1947) has contributed to the age determination. MAKIYAMA states two horizons of nephrolepidina type of *Lepidocyclines*, one of *Lepidocyclina* (*Nephrolepidina*) *angulosa*, *L.* (*N*) *nipponica*, *L.* (*N.*) *perornata* and the other of *L.* (*N.*) *makiyamai*; the former is in a lower horizon in Japan to f_{1-2} of East Indies, the latter is the top-most horizon referable to in Japan being about equal to f_3 of East Indies.

The lithostratigraphic sequences of the Miocene sedimentary rocks and their biostratigraphical characteristics are shown in Table (1, 2, 3, 4) and Fig. (2, 3). The writer examined samples collected from the Futamata, Kakegawa and Sagara districts on purpose to identify microbiostratigraphic units and "Orbulina surface" of these deposits durings the times between 1948 and 1961. The Miocene biostratigraphy of this district established thus far has given a good standard column of the Miocene sections of various basins in central Japan. The microbiostratigraphic research on the Miocene deposits will be carried on. Hence although this report appears to be preliminary, the analyses of the faunas are by no means premature.

ACKNOWLEDGEMENTS

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LITHOSTRATIGRAPHY

According to MAKIYAMA and others [45)-48),50),62)-69),71)-73),86),87)], the stratigraphy of the Miocene sedimentary deposits in Futamata, Kakegawa and Sagara districts, western part of Shizuoka prefecture is summarized as follows in descending order.

The combined thickness of these deposits attains up to 2,500 m.. The chronological scale and unit of the rock sequence deposited during corresponding time intervals are shown by the Letter Nomination (IKEBE, 1948).

		Pliocene	
		unconformity	
G	SAGARA GROUP	Kiriyama & Tamari formation	**Yuian**
		Wada conglomerate	
		Ishiharada bed	
		Sagara formation	
		Tokigaya formation	
		unconformity (well marked)	
F_3	SAIGO GROUP	Saigo formation	**Tozawan**
		Tozawa bed	
		unconformity (well marked)	
F_2	KURAMI GROUP	Masago formation	**Tagarian**
		Matsuba formation	
		Amenomiya formation	
		unconformity	
F_1	OOIGAWA GROUP	Hôrai & Ieda formations	**Ooigawan**
		unconformity	
		Futamata & Megami formation	
		unconformity (well marked)	
		Pre-Miocene	

FUTAMATA DISTRICT

The outline lithostratigraphy is as follows

		Pliocene
		unconformity
Kurami Group	III	Amenomiya formation
Ooigawa Group	II	Ieda formation
		unconformity
	I	Futamata formation
		unconformity
		Pre-Miocene

Ooigawa Group

I. Futamata formation

3. Upper conglomerate and sandstone; pebbles in the conglomerate are those derived from the Pre-Miocene rooks. .... 50 m ±

2. Middle mudstone; composed of mudstones mainly, with subordinate siltstones, mudstones non-bedded, monotonous, black and gray. ... 350 m. ±

1. Lower conglomerate; made of conglomerate and sandstones (medium to coarse grained), the conglomerate thick to the south, changing in the sandstones to the north. .... 50 m. ±

II. Ieda formation

Consisting of Flysch-like alternations of sandstone and mudstone. A little below the middle level several seams of conglomerate take places among the alternating beds. .... 300 m. ±

Kurami Group

III. Amenomiya formation

2. Amenomiya sandstone; light grey homogeneous medium-grained sandstone, Onion weathering distinct. .... 200 m.

1. Haramishi conglomerate; Essentially made of conglomerate, with intercalated sandstone in some portions, changing eastwards to sandstone totally. .... 100–120 m.

KAKEGAWA DISTRICT

The outline lithostratigraphy is as follows.

		Pliocene
		unconformity
Sagara Groug	VI	Tamari formation
		unconformity
Saigo Group	V	Saigo formation
	IV	Tozawa ss. cgl.
		unconformity
Kurami Group	III	Masago formation
	II	Matsuba formation
	I	Amenomiya farmation
		unconformity
		Pre-Miocene

Kurami Group

The Kurami group represents all the deposits of the second stage (**Togarian** or F_2) of the Miocene series in Japan.

It is made of three chief subdivisions—the Amenomiya, Matsuba and Masago formations. The middle subdivision or the Matsuba formation is much pyroclatsic in material making a very thick accumulation over 500 m. While the lower and upper formations are made of unmixed terrigenous sediments. The outline stratigraphy is as follows:

I. Amenomiya formation.

(b) Towata mudstone; blue grey mudstone with ill-marked bedding several thin beds of siltstone in lower part, changing downwards to the sandstone. .... 160 m.

(a) Amenomiya sandstone; light grey homogeneous medium-grained sandstone with *Cultellur izumoensis*, *Turritella s-hatai* etc.. The top is finer and the very base is conglomerate—Haramishi conglomerate. The conglomerate is thicker to the west. .... 80–200 m.

II. Matsuba formation; pyroclastic and indurated

(c) Upper Matsuba beds; light green tuffaceous silstones and mudstones in unregular alternation. .... 170 m.+

(b) Middle Matsuba beds; very much like the Upper Matsuba, but with 3 distinct sandstones: Awagatake sandstones, no. 1. at the base and no. 3 at the top of the beds. The sandstones are dark green coarse-grained and tuffaceous, more resistant to erosion. .... 180 m.+

(a) Lower Matsuba beds; made of tuffaceous siltstone, with marine mollusks but not very frequent, for example *Yoldia* and *Tellina*. ...... 80 m.

III. Masago formation

Chiefly mudstone, homogeneous, with a great number of irregular-shaped calcareous nodules. .... 50 m.+

Saigo group

IV. The Saigo group is the third stage (**Tozawan** or F_3) of the Miocene series in Japan. It lies unconformably over the Kurami group.

The Saigo group is divided into two parts; the lower Tozawa bed which is comprising sandstones and conglomerates yields *Lepidocyclina* (*Nephrolepidina*) *makiyamai* MORISHIMA and *Miogypsina kotoi* HANZAWA at some portions (50 m.). The upper occupying the main part of the formation and consisting of non-bedded monotonous black mudstone and tuff has the name Saigo formation. .... 150 m.+

V. Tamari formation. This formation is chiefly made of muds. It passes insensibly to silts, but never to regular alternations. .... 100 m.+

Tamari formation lies underneath the overlapping Horinouchi Group with a marked unconformity. This unconformity is a sort of angular type or non-conformity.

The Tamari exposes in a small area between the two stations of Kikugawa and Kakegawa of the Tôkaidô line, and the north. The rock is well exposed throughout the area, nevertheless the dip is little known for its homogeneity and its irregular joints.

The base of the Tamari beds is exposed nowhere in the area, but it seems that the relation to the underlying Ooigawa is quite similar to the relation of the Sagara to the Ooigawa.

The Tamari beds yield *Limopsis tajimae* SOWERBY, *Limopsis crenata* A. ADAMS, *Lora regulata* (TROSHEL), *Lora totomiensis* MAKIYAMA, *Lora* cf. *exarata* (MÖLLER). *Euspira pallida* (BRODERIP & SOWERVY), *Turrcicula argenteonitene* (LISCHEKE), *Turricula subdeclivis* (YOKOYAMA) and a young *Inquisitor* cf. *pseudo-principalis* (YOKOYAMA).

SAGARA DISTRICT

The outline lithostratigraphy is as follows.

		Pliocene
		unconformity
Sagara Group	VII	Kiriyama formation
	VI	Wada conglomerate
	V	Ishiharada formation
	IV	Sagara formation
	III	Tokigaya formation
		unconformity
Ooigawa Group	II	Hôrai formation
		unconformity
	I	Megami formation
		unconformity
		Pre-Miocene

Ooigawa Group

I. The Ooigawa group is made of the deposits of the first stage (**Ooigawan** or F_1) of the Miocene series in Japan.

The Ooigawa group is divided into two parts; the lower Megami formation is consisting of a homogeneous sandstone (200 m.) and mudstone (200 m.), with small patches of limestone near Sagara. They are showing an evident shallow water origin. The limestones were reefs composed of corals, calcareous algae *Lithothamnium*, very small number of Mollusca and nephrolepidina types of *Lepidocyclina*. The larger foraminifers include *Lepidocyclina* (*Nephrolepidina*) *nipponica*, *L.* (*N.*) *angulosa* and *L.* (*N.*) *perornata*.

II. The upper Hôrai formation (500 m.+) is flysch-type alternations in the main but changing downwards into sandstone and conglomerate. It lies unconformably on the Setogawa group (Pre-Miocene).

Sagara Group

The Sagara group represents the fourth stage (**Yuian** or G).

The consolidation of the Sagara rocks is just intermediate between that of the Pliocene and the Miocene. It contains Foraminifera and a monoaxonid sponge (*Sagarites chitanii*). The latter is a characteristic fossil of the Tertiary rocks of this country and has been brought to the attention of geologists and paleontologists.

The outline sequence is as follows.

III. Tokigaya formation; chiefly composed of alternating layers of shale and sandstone. Near to the base, there are some seams of conglomerate intercalated in the muddy rocks. .... 500 m.

IV. Sagara formation; chiefly consist of massive mudstone and sandstone accompanying in the middle part of them. .... 500 m.

V. Ishiharada formation; chiefly consists of alternating layers of siltstone and pebble. .... 100 m.

VI. Wada conglomerate; pebbles in the conglomerate are largly derived from the Pre-Miocene rocks; intercalations of thin layers of sandstone and mudstone. .... 200 m.

VII. Kiriyama formation; massive dark grey mudstone and alternating fine sandstones and mudstones. .... 50 m.

BIOSTRATIGRAPHY

The biostratigraphic investigation with larger Foraminiferas and Mollusca by MAKIYAMA (1939) has been used as a general stratigraphical scale of the Neogen Tertiary. MAKIYAMA was the pioneer in the stage names as time-stratigraphic units for the Japonic Miocene. The concept has been followed by IKEBE 1948, but he preferred this "Letter Nomination" for the units.

Miocene	**Yuian** (G)	.... no greater Foraminifera, but for some *Operculines.*
	Tozawan (F_3)	...... *Lepidocyclina makiyamai, Miogipsina kotoi.*
	Togarian (F_2)	...... *Lepidocyclina japonica, Miogypsina kotoi.*
	Ooigawan (F_1)	...... *Lepidocyclina nipponica, Miogypsina kotoi.*

The writer studied the samples collected from around Futamata, Kakegawa and Sagara in western part of Shizuoka prefecture, central Japan. The purpose of this paper is to make more accurate redefinition based upon the smaller Foraminifera of the stages. The description will be given here. The lowest stratigraphic horizon of *Orbulina universa* D'ORBIGNY in central Japan is exactly classified as the upper part of the Saigo Group (F_3-stage). This species occurs in the upper (50 m.) of the Saigo formation and makes its first appearance in the *Globoquadrina dehiscens* zone though it is extremely rare. *Orbulina universa* D'ORBIGNY is very common in the Sagara Group (G) and problematical in the lower part of the Saigo Group (F_3), but the Kurami Group (F_2) and Ooigawa Group (F_1) contain perfectly none of the same species, even none of fragments that remind this planktonic test.

The biostratigraphical sequence of the Miocene deposits in central Japan are in descending order as follows refering to the stage names and the letter marks.

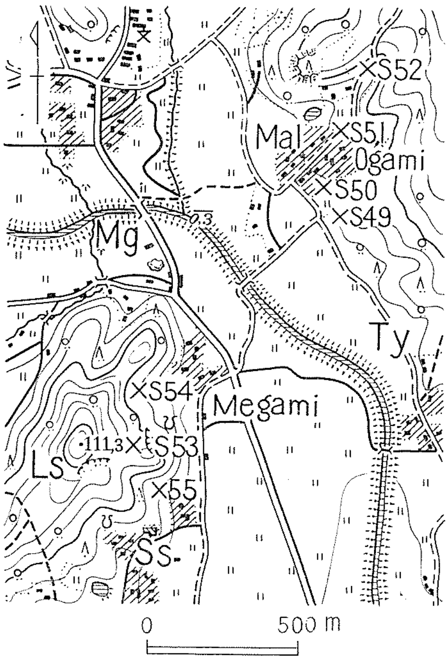


Figure 4. Route map showing sampling localities in the Megami Section.
Mg ; Megami formation, Ls ; limestone,
Ty ; Tokinoya formation, Mal ; Megam marl,
Ss ; Megami sandstone.

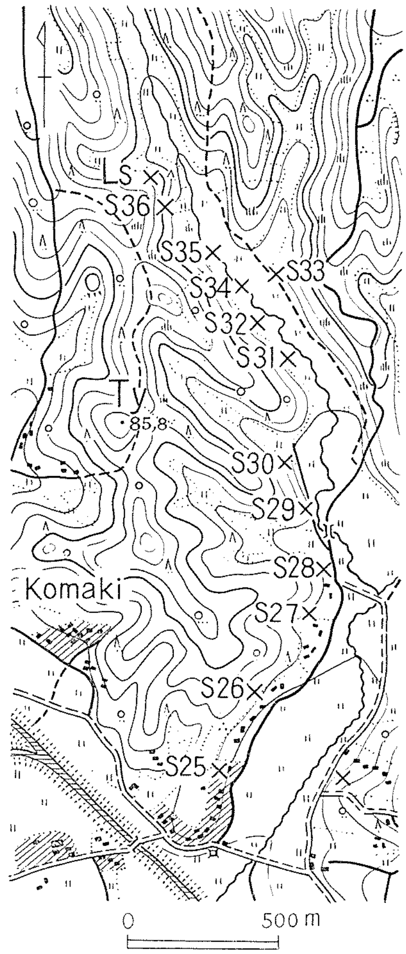


Figure 5. Route map showing sampling localities in the Komaki Section.
Ty ; Tokigaya formation,
Ls ; Limestone.

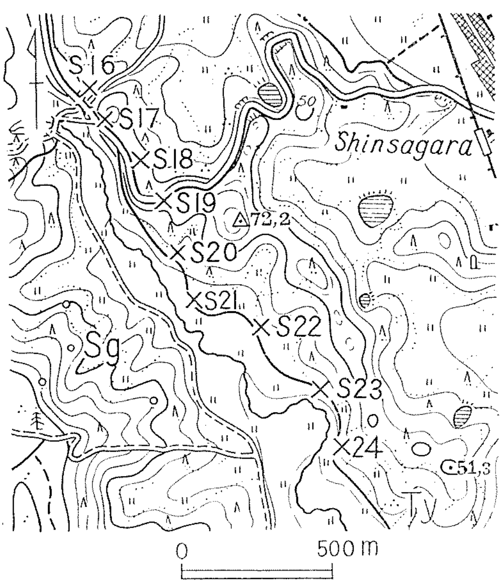


Figure 6. Route map showing sampling localities in the Sagara Section.
Sg ; Sagara formation.

Geographical location map
(SAGARA DISTRICT)

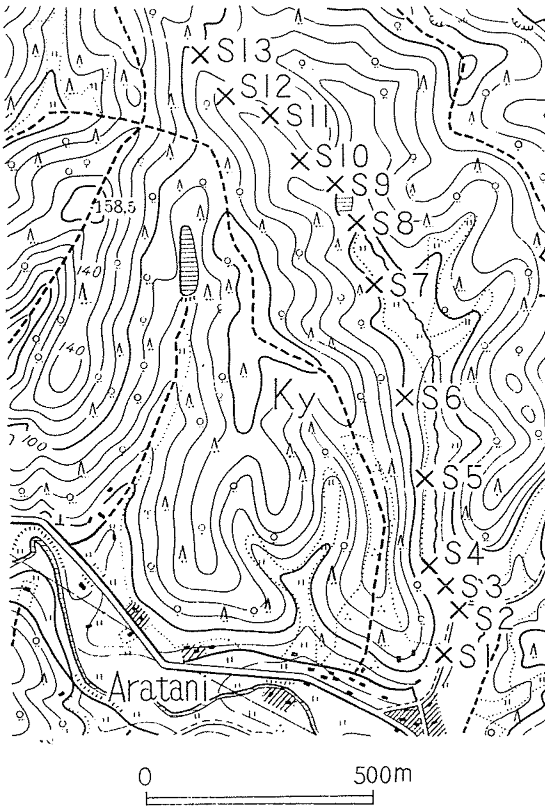


Figure 7. Route map showing sampling localities in the Kiriyama Section.
Ky; Kiriyama formation.

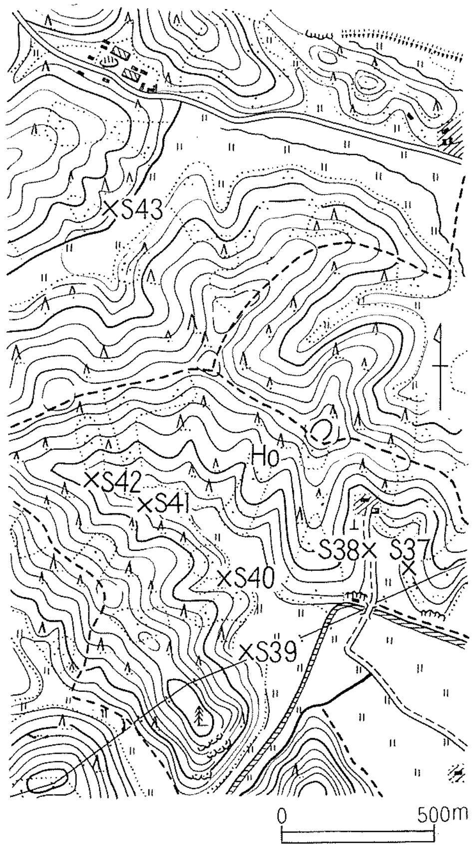


Figure 8. Route map showing sampling localities in the Eboshiyama Section.
Ho; Hôrai formation.

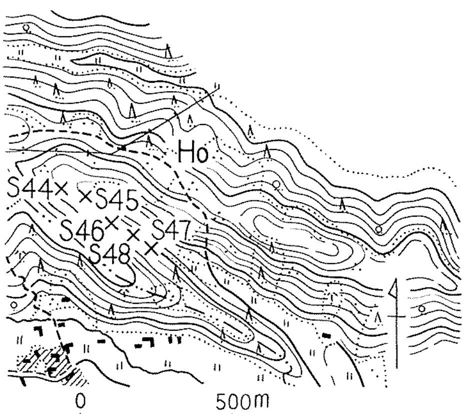


Figure 9. Route map showing sampling localities in the Kami-Aoshima Section.
Ho; Hôrai formation.

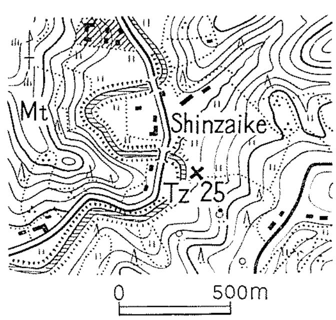


Figure 10. Route map showing sampling localities in the Shinzaike Section.
Mt; Matsuba formation,
Tz; Tozawa bed.

Geographical location map
(SAGARA DISTRICT)

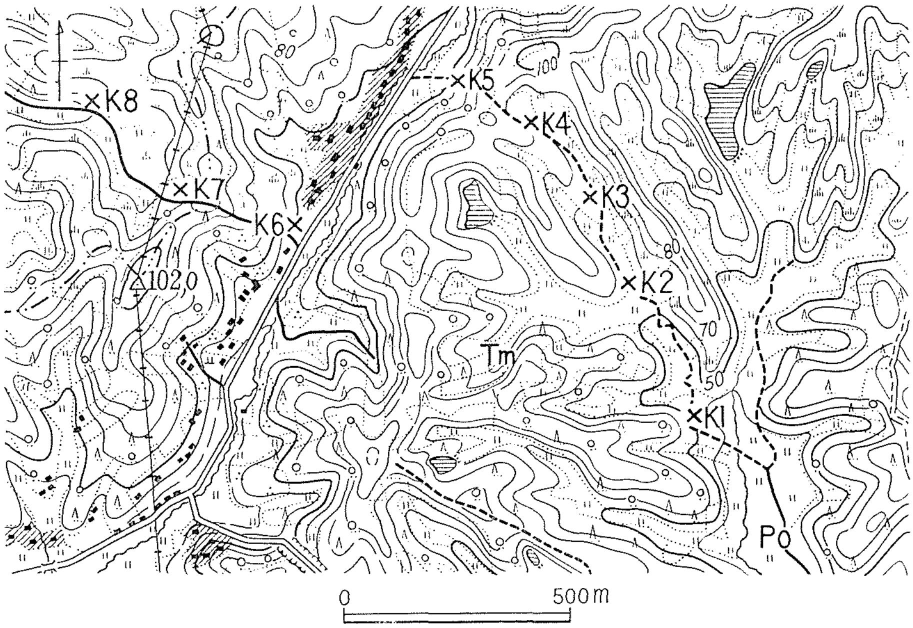
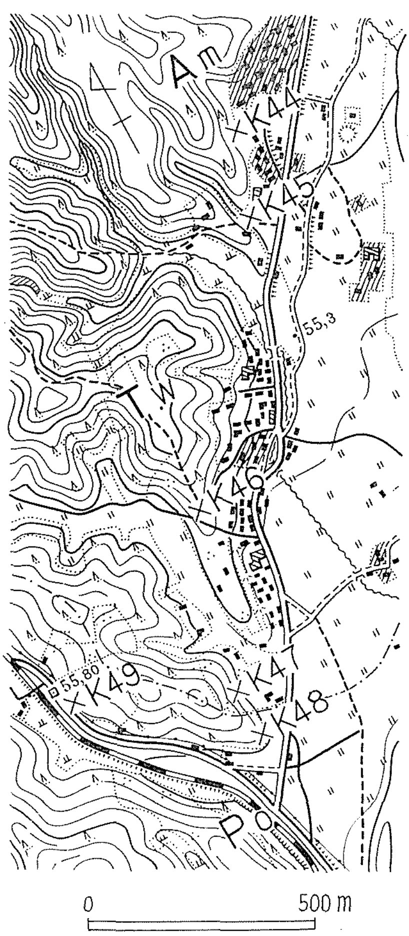


Figure 11. Route map showing sampling localities in the Tamari Section.
Tm; Tamari formation, Po; Pliocene.



Geographical location map
(KAKEGAWA DISTRICT)

Figure 12. Route map showing sampling localities in the Towata Section.
Am; Amenomiya formation,
Tw; Towata formation.

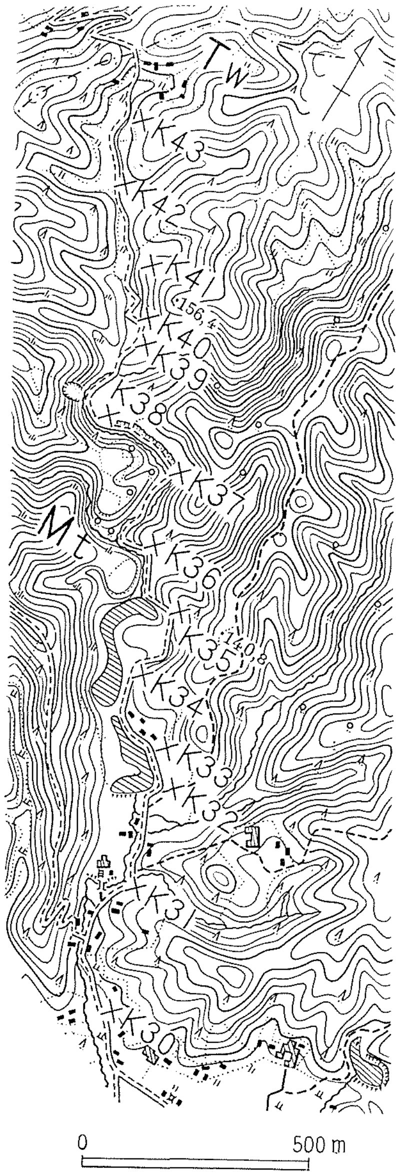


Figure 13. Route map showing sampling localities in the Tochihara-Hamitaruki Section.

Mt ; Matsuba formation,
Tw ; Towata formation.

Figure 14. Route map showing sampling localities in the Sakashita Section.

Ms ; Masago formation,
Mt ; Matsuba formation.

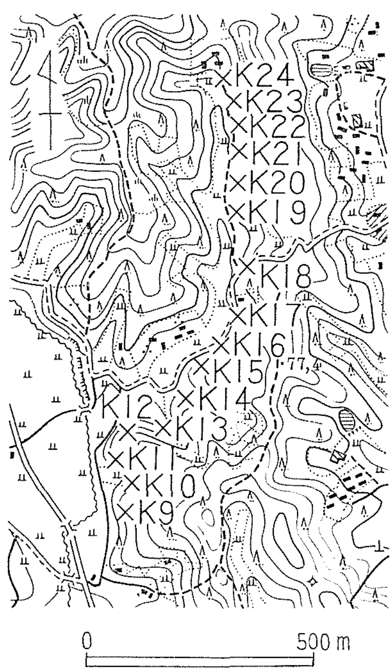


Figure 15. Route map showing sampling localities in the Nishigawa Section. (Saigo formation)

Geographical location map (KAKEGAWA DISTRICT)

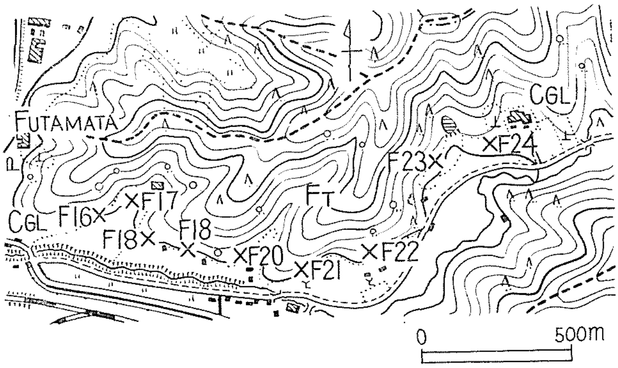


Figure 16. Route map showing sampling localities in the Futamata Section.

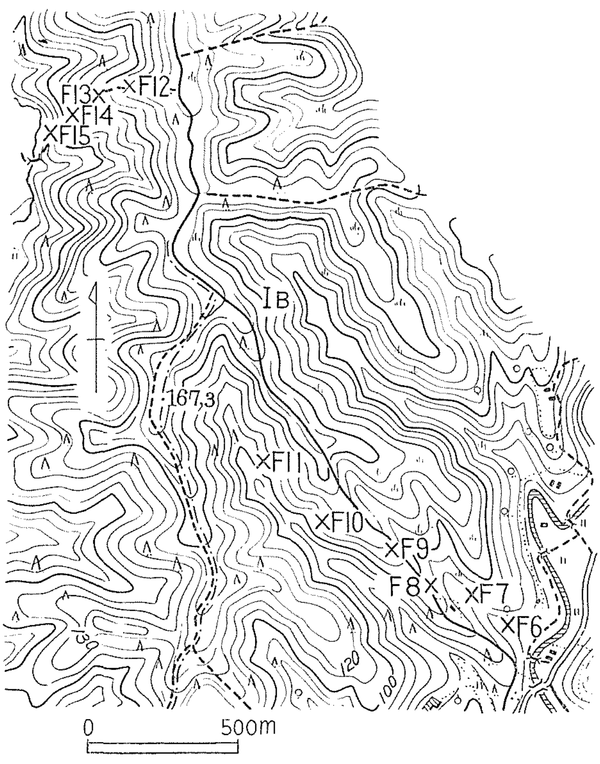


Figure 17. Route map showing sampling localities in the Ieda Section.

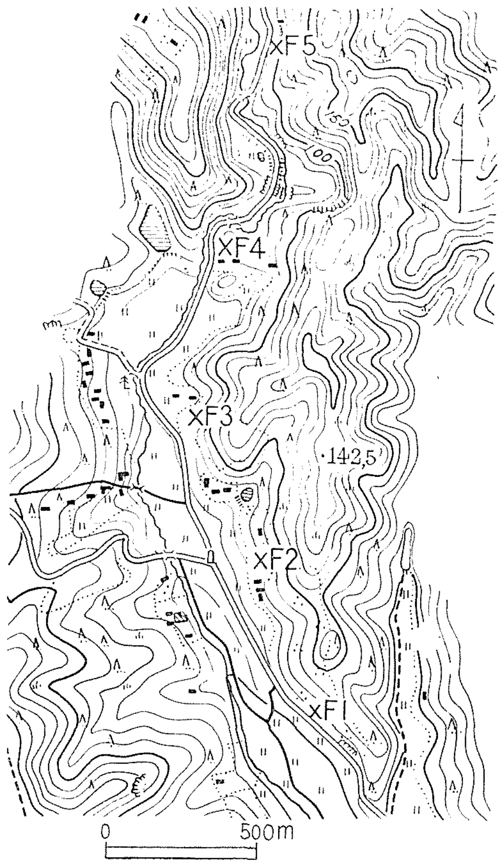


Figure 18. Route map showing sampling localities in the Mori Section.

Geographical location map (FUTAMATA DISTRICT)

Table 1: Check List of the Miocene

	FORMATION	AMENOMIYA			
	ZONE	***CYCLAMMINA JAPONICA* (Z)**			
	ZONULE		I	II	
	SPECIES / LOC. NO. (F)	1 2	3	4	5
1	*Bathysipon eocenica* CUSHMAN & HANNA		3	—	—
2	*Reophax* cf. *cylindricus* (BRADY)		2	—	—
3	*Ammodiscus incertus* (D'ORBIGNY)		1	—	—
4	*Cyclammina japonica* ASANO		8	4	6
5	*pacifica* BECK		5	2	2
6	*pusilla* BRADY		6	—	—
7	sp.		10	—	2
8	*Haplophragmoides compressum* LEROY		—	—	—
9	cf. *renzi* ASANO		—	—	—
10	cf. *rotulatus* (BRADY)		—	—	—
11	cf. *rogosa* CUSHMAN and WATERS		—	—	—
12	cf. *subglobosum* (SARIS)	No Forams	—	—	—
13	cf. *trullissatum* (BRADY)		—	—	—
14	sp.		—	—	—
15	*Martinottiella* cf. *communis* (D'ORBIGNY)		—	—	—
16	sp.		—	—	—
17	*Gaudrina triangularis* CUSHMAN		—	—	4
18	*Göesella schencki* ASANO		—	—	2
19	*Textularia* sp.		—	6	—
20	*Sigmoilina miocenica* BRADY		20	—	—
21	*Nonion japonicum* ASANO		—	—	12
22	*Dentalina* sp·		—	2	—
23	*Rotalia beccarii* (LINNAEUS)		—	—	—
24	*Cibicides* cf. *lobatulus* (WALKER and JACOB)		—	—	—
25	*Catapsydrax* cf. *dissimilis* (CUSHMAN and BERMUDEZ)		—	—	—
	Number of species (Total 25)		8	4	6
	Population (Total 295)		55	14	28
	Benthonic Foraminiferal Number (%)		100	100	100
	Pelagic Foraminiferal Number (%)		0	0	0

ZONULE I (*Sigmoilina miocenica*)
ZONULE III (*Rotalia beccarii*)
ZONULE V (Upper *Martinottiella* cf. *communis*—*Haplophragmoides* sp.)

Foraminifera in the Futamata District

IEDA													FUTAMATA					
MARTINOTTIELLA COMMUNIS ZONE																		
III		IV								V			VI					
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
—	—	—	—		—	—	—		1	—	—	—	—	—	—	—	—	—
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—	—	—	—		1	—	—		—	—	—	—	—	—	—	—	—	—
—	—	2	1		1	—	13		—	—	2	2	—	—	5	—	—	—
—	—	—	—		—	4	10		1	3	1	—	—	—	—	2	—	—
—	—	—	—		—	—	—		—	—	—	—	—	—	2	—	—	—
—	—	—	—		—	—	7		—	—	—	—	—	—	—	1	—	—
—	—	—	—		—	—	—		—	—	—	—	—	—	2	—	—	—
—	—	—	—		—	—	10		—	—	—	—	—	—	—	—	—	—
2	—	—	—	No Forams	—	—	5	No Forams	—	—	—	—	—	—	—	—	—	—
—	—	—	—		2	—	—		—	—	—	—	—	—	—	—	—	—
1	1	2	5		—	4	12		2	2	2	4	1	3	5	2	1	2
—	—	—	2		—	6	2		2	—	—	—	2	2	7	6	1	4
—	—	—	—		—	—	2		1	—	—	—	—	—	—	—	—	—
—	—	—	—		—	—	—		—	—	—	—	—	—	—	—	—	—
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—	—	—	—		—	—	—		—	—	—	—	22	—	—	—	—	1
—	—	—	—		—	—	—		—	—	—	—	—	—	—	—	—	—
—	—	—	—		—	—	—		—	—	—	—	—	—	2	—	—	—
1	3	—	—		—	—	—		—	—	—	—	—	—	—	—	—	—
—	—	—	—		—	—	—		—	—	—	—	—	—	2	—	—	—
—	—	—	—		—	—	—		1	—	—	—	—	—	—	—	—	—
3	2	2	3		3	3	8		6	2	3	2	3	2	7	4	2	3
4	4	4	8		4	14	61		8	5	5	6	35	5	25	11	2	7
100	100	100	100		100	100	100		83	100	100	100	100	100	100	100	100	100
0	0	0	0		0	0	0		17	0	0	0	0	0	0	0	0	0

ZONULE II (*Nonion japonicum*)
ZONULE IV (*Cyclammina pusilla*)
ZONULE VI (Lower *Martinottiella* cf. *communis*—*Haplophragmoides* sp.)

Yuian (G) .... *Globigerina inflata* zone
Orbulina universa zone
Tozawan (F_3) .... *Globoquadrina dehiscens* zone
Lepidocyclina makiyamai zone
Togarian (F_2) .... *Cyclammina japonica* zone
Martinottiella communis zone
Ooigawan (F_1) .... *Lepidocyclina nipponica* zone

Samples were collected at intervals of about 5–20 m. along the control sections. Moreover some checksamples were collected at random from good outcrops. Each sample amounts about 500 grams. 100 grams of each sample was washed with the size of 200 meshes and all the microorganism in the residues were picked up and their frequencies were counted.

Some microscopic volumes (100–200 g) have been supplemented when difficult to determine microfossil faunule. In order to get the outline of faunule of this region, check list was made at first (table 1–3).

I. OOIGAWAN

The Ooigawan stage is the first division of the Miocene series. The time-stratigraphic unit is represented by the Ooigawa Group in the Sagara region in the mapped area.

Lepidocyclina (Nephrolepidina) angulosa (PROVAL), *L. (N.) nipponica* (HANZAWA), *L. (N.)* H. DOUVILLE and *Miogypsina kotoi* HANZAWA are the most characteristic larger foraminifers of the Ooigawan stage.

The limestones in a lower horizon yield such large foraminifers in addition to corals, calcareous algae and a very small number of Mollusca all suggesting a condition of warm water. Upper Hôrai formation, the upper subdivision being made of flysch-type alternations has *Thyasira bisecta*, a well-known of a cold and deep sea bottom. The Ooigawan rocks contain besides a considerable amount of arenaceous foraminiferas. The Ooigawa Group is covered by the Togarian rocks unconformably and the base lies unconformably over the Pre-Miocene Setogawa Group.

There are two conspicuous zones in the Ooigawan namely the *Lepidocyclina (N.) nipponica* zone and *Martinottiella* cf. *communis* zone, which are also well recognized in the Sagara and Futamata regions.

(A) *Lepidocyclina nipponica* zone

This zone is characterized by *Lepidocyclina angulosa, L. nipponica, L. perornata* and *Miogypsina kotoi*. The strata belonging to this zone yield sporadicaly these larger foraminifers which are scattered benthos. The pelagic forms are completely absent.

The upper limit of *Lepidocyclina nipponica* zone is the Megami marl and the lower limit is the base of Megami formation (Megami sandstone).

Table 2: Check List of the Miocene Foraminifera in the Kakegawa District

	FORMATION		TAMARI								SAIGO															
	ZONE		*GLOBIGERINA INFLATA* ZONE								*GLOBOQUADRINA DEHISCENS* ZONE															
	ZONULE		I	II				III					IV					V								
SPECIES		LOC. NO. (K)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	*Astrorhiza*	sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	*Rhabdammina*	cf. *irregularis* BRADY	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
3		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	1	—	—	—	—	—
4	*Bathysiphon*	*eocenica* CUSHMAN and HANNA	—	—	—	—	—	—	—	—	—		—	2	—	—	—	—	—	—	—	—	—	—	—	—
5		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	2	—	—	—	—	—
6	*Leptodermella*	*arenata* (CUSHMAN)	—	—	—	—	—	1	—	—	2		—	—	—	—	—	1	2	—	—	—	—	—	—	—
7	*Hormosina*	*globulifera* BRADY	—	—	—	—	—	—	—	—	2		—	—	—	—	—	—	—	—	—	—	—	—	—	—
8		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	*Reophax*	*cylindricus* BRADY	—	—	—	—	—	—	—	—	5		—	2	—	—	—	—	—	—	—	—	—	—	—	—
10		sp.	—	—	—	—	—	—	—	—	4		—	—	—	—	—	—	—	—	—	—	—	—	—	1
11	*Ammodiscus*	*incertus* (D'ORBIGNY)	—	—	—	—	—	—	—	—	4		—	4	—	—	—	2	2	1	5	3	1	2	2	1
12		sp.	—	—	—	—	—	—	—	—	—		—	—	—	4	—	—	—	—	—	—	—	—	—	—
13	*Ammobaculites*	sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	*Cyclammina*	cf. *cancellata* BRADY	—	—	—	—	—	—	—	—	4		—	—	—	7	—	—	—	—	—	—	—	—	—	—
15		*japonica* ASANO	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
16		*orbicularis* BRADY	—	—	—	—	—	—	—	—	—		—	—	—	5	—	—	—	—	—	—	—	—	—	—
17		*pacifica* BECK	—	—	—	—	—	—	—	—	—		—	—	—	2	—	—	—	—	—	—	—	—	—	—
18		*pusilla* BRADY	—	—	—	—	—	—	—	—	2		—	8	—	—	—	4	—	—	3	—	2	—	—	—
19		sp.	—	—	—	—	—	—	—	—	—		—	—	—	4	—	3	—	—	—	—	—	—	—	—
20	*Haplophragmoides*	*compressum* LEROY	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
21		*renzi* ASANO	—	—	—	—	—	—	—	—	—		—	5	—	5	—	4	—	—	—	—	1	—	—	—
22		*subglobosa* SARS	—	—	—	—	—	—	—	—	—		—	7	—	4	—	5	—	—	—	—	—	—	—	—
23		cf. *trullisatum* (BRADY)	—	—	—	—	—	—	—	—	—		—	—	—	3	—	—	—	—	—	—	—	—	—	—
24		sp.	—	—	—	—	—	—	—	—	3		—	—	—	3	—	6	—	1	2	—	—	—	—	—
25	*Textularia*	*conica* D'ORBIGNY	—	1	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
26		sp.	—	—	—	—	1	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
27	*Gaudrinella*	sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
28	*Gaudrina*	*arenaria* GALLOWAY and WISSLER	—	—	—	—	4	—	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
29		*ogasaensis* ASANO	—	—	—	—	2	2	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
30		*robusta* CUSHMANN	5	—	3	16	15	5	3	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
31	*Clavulina*	sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
32	*Karreriella*	*baccata japonica* ASANO	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	2	2	—	—	—	—
33	*Martinottiella*	*communis* (D'ORBIGNY)	—	—	—	—	—	—	—	—	—		3	—	2	—	—	—	—	—	—	—	—	—	—	—
34		sp.	—	1	—	—	—	1	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
35	*Tritaxilina*	sp.	—	—	—	1	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
36	*Pyrgo*	*depressa* (D'ORBIGNY)	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
37		*murrhina* (SCHWAGER)	—	—	—	—	—	—	—	—	—		1	—	—	—	1	—	—	—	—	—	—	—	—	—
38		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
39	*Quinqueloculina*	*seminula* (LINNAEUS)	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
40		*vulgaris* D'ORBIGNY	—	—	—	—	—	—	—	—	—		—	—	1	—	1	—	—	—	—	—	—	—	—	—
41		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
42	*Sigmoilina*	*arenaria* (BRADY)	—	—	—	—	2	—	5	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
43		*miocenia* BRADY	20	17	1	6	21	12	3	—	3		15	22	16	9	7	5	—	—	1	3	1	—	—	—
44	*Spiroloculina*	cf. *tenuimargo* CUSHMAN	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
45		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
46	*Cornuspila*	*fragilis* LEROY	—	—	—	—	—	—	—	—	5		—	—	—	—	—	—	—	—	—	—	—	—	—	—
47		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	1	—	1
48	*Trochammina*	cf. *pacifica* CUSHMAN	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
49		sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	1	—	1	1
50	*Dentalina*	*communis* D'ORBIGNY	—	—	—	—	—	1	3	—	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—
51		cf. *emaciata* REUSS	2	—	—	—	—	—	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
52		cf. *filiformis* (D'ORBIGNY)	2	—	—	—	—	1	—	—	—		2	—	—	—	1	—	—	—	—	—	—	—	—	—
53		*setanaensis* (CUSHMAN)	2	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
54		sp.	1	—	3	—	—	2	3	—	—		—	—	—	—	—	—	—	—	—	2	—	—	—	—
55	*Lagena*	*acuticosta* REUSS	1	—	—	—	—	—	—	—	—		3	—	—	—	—	—	—	—	—	—	—	—	—	—
56		*clavata* WILLIAMSON	1	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
57		*dentaliniformis* BAGG	—	—	—	—	—	—	—	—	—	N.F	—	—	—	—	—	—	—	—	—	—	—	—	—	—
58		*elongata* (EHRENBERG)	15	7	17	12	3	—	5	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
59		*sulcata spicata* CUSHMANN and MCCULLOCH	—	—	—	—	—	—	—	—	—		—	—	3	—	2	—	—	—	—	—	—	—	—	—
60		sp.	1	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
61	*Lagenodosaria*	*hirsuta* (D'ORBIGNY)	—	1	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
62		*scalaris* (D'ORBIGNY)	—	—	—	4	2	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
63	*Nodosaria*	*subraphana* ASANO	—	—	—	1	—	—	1	—	—		1	—	3	—	7	—	—	—	—	—	—	—	—	—
64	*Parafrondicularia*	*japonica* ASANO	—	—	—	1	—	—	1	—	—		2	—	4	—	2	—	—	—	—	—	—	—	—	—
65	*Planularia*	*planulata* (GALLOWAY and MCCLLOCK)	—	—	—	—	—	—	—	—	—		—	—	2	—	—	—	—	—	—	—	—	—	—	—
66	*Robules*	*calcar* (LINNAEUS)	1	—	—	1	—	10	3	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
67		*nikobarensis* (SCHWAGER)	—	—	1	5	4	2	—	1	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
68		*pseudorotulatus* ASANO	7	—	—	—	10	3	4	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
69		sp.	3	2	10	1	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
70	*Saracenaria*	*latiformis* (BRADY)	—	—	—	—	—	—	—	—	—		1	—	—	—	—	—	—	—	—	—	—	—	—	—
71	*Vaginulina*	cf. *yoshihamaensis* INOUE and NAKASEKO	—	—	—	—	1	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
72	*Glandulina*	*nipponica* ASANO	—	—	—	—	—	—	—	—	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—
73	*Guttulina*	sp.	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
74	*Pseudopolymorphina*	sp.	—	—	—	—	—	—	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
75	*Elphidium*	*advenum* (CUSHMAN)	—	—	—	—	—	1	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
76		*fax barbarense* (NICOL)	—	—	—	1	—	1	—	—	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—
77		*subgranulsum* ASANO	—	—	—	—	—	1	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
78	*Nonion*	*nicobarense* CUSHMAN	9	2	11	35	—	11	25	—	—		18	—	6	—	2	—	—	—	—	—	—	—	—	—
79		*pacificum* (CUSHMAN)	—	1	—	2	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
80	*Amphimorphina*	*haueriana* NEUGEBOREN	2	—	—	—	5	—	—	—	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—
81	*Bolivinita*	*quardilatera* (SCHWAGER)	21	—	2	—	5	1	7	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
82	*Bolivina*	*alata* (SEGUENZA)	—	—	—	—	—	—	—	—	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—
83		*robusta* BRADY	—	3	2	8	1	7	10	2	—		2	—	—	1	—	—	—	—	—	—	—	—	—	—
84		*subangularis* ASANO	—	—	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
85	*Bulminai*	*aculeata* D'ORBIGNY	8	—	1	—	25	50	2	—	—		—	—	2	—	—	—	—	—	—	—	—	—	—	—
86		(*Dessenobulimina*) *auriculata* BAILEY	—	—	—	—	—	—	—	—	—		—	—	—	—	1	—	—	—	—	—	—	—	—	—
87		*brady* (WEINZIERI and APPLIN)	4	1	5	—	10	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
88		*elongata subsoluta* CUSHMAN and PARKER	—	—	—	—	—	3	5	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
89		*inflata* SEGUENZA	1	—	1	2	2	5	5	—	—		—	—	2	1	—	—	—	—	—	—	—	—	—	—
90		*marginata* (MONTAGU)	—	—	—	—	5	—	10	1	—		—	—	2	—	—	—	—	—	—	—	—	—	—	—
91		cf. *nojimaensis* ASANO	—	—	—	—	—	—	—	—	—		—	—	2	—	—	—	—	—	—	—	—	—	—	—
92		cf. *pupoides* (SEGUENZA)	44	—	—	—	—	—	5	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
93	*Entosolenia*	*hexagona* WILLIAMSON	—	—	—	—	—	1	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
94		*lucida* WILLIAMSON	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
95		*marginata* (MONTAGU)	—	—	—	—	2	1	2	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
96		*orbignyana* (SEGUENZA)	—	—	—	—	—	—	—	—	—		1	—	—	—	—	—	—	—	—	—	—	—	—	—
97	*Loxostoma*	cf. *bradyi* (ASANO)	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
98		*karrerianum* (BRADY)	—	—	—	—	1	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
99	*Siphogenerina*	*columellaris* (BRADY)	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
100		*raphanus* (PARKER and JONES)	—	—	—	2	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
101		sp.	—	—	4	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
102	*Uvigerina*	*crassicostata* SCHWAGER	6	—	8	2	7	7	5	—	—		—	—	—	2	—	—	—	—	—	—	—	—	—	—
103		*excellens* TODD	—	2	—	—	—	1	3	—	—		2	—	4	—	—	—	—	—	—	—	—	—	—	—
104		*farinosa* (HANTKEN)	5	6	—	—	—	12	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
105		cf. *hootsi* RANKIN	—	—	—	—	—	—	—	—	—		1	—	1	—	—	—	—	—	—	—	—	—	—	—
106		*peregrina dirupta* TODD	4	—	—	1	—	—	—	—	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—
107		cf. *proboscidea* SCHWAGER	55	27	—	3	—	50	32	—	—		2	—	8	5	—	—	—	—	—	—	—	—	—	—
108		*schwageri* BRADY	—	—	—	—	—	2	1	—	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—
109	*Ellipsonodosaria*	cf. *hyugaensis* ISHIZAKI	—	—	1	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
110		*ketisiensis* ISHIZAKI	—	3	—	—	—	2	3	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
111		*lepidula* (SCHWAGER)	20	—	1	1	2	1	2	—	—		3	—	1	—	1	—	—	—	—	—	—	—	—	—
112		*oinomikadoi* ISHIZAKI	—	—	1	1	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
113		sp.	—	—	—	—	—	7	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
114	*Epistomina*	*elegans* (D'ORBIGNY)	—	20	—	4	—	7	5	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
115	*Eponides*	*haidingerii* (D'ORBIGNY)	—	—	—	—	—	—	—	—	—		—	—	5	2	—	—	—	—	—	—	—	—	—	—
116		*umbonatus* (RESS)	9	—	1	1	—	—	—	—	—		10	—	5	2	2	—	—	—	—	—	—	—	—	—
117		sp.	4	—	1	5	—	—	—	—	—		—	—	—	—	2	—	—	—	—	—	—	—	—	—
118	*Gyroidina*	*orbicularis* D'ORBIGNY	27	10	8	15	5	12	5	—	—		1	—	3	4	1	—	—	—	—	—	—	—	—	—
119		*soldanii* D'ORBIGNY	1	—	—	4	4	—	5	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
120	*Pseudoeponides*	*japonicus* UCHIO	—	—	—	16	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
121	*Rotalia*	*ketienziensis* (ISHIZAKI)	4	—	—	—	25	—	10	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
122	*Cassidulina*	*papillosa* BRADY	—	—	—	2	—	—	2	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
123		*asanoi* UCHIO	—	—	—	—	—	1	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
124		*pacifica* CUSHMAN	—	—	—	—	—	—	—	—	—		1	—	—	—	—	—	—	—	—	—	—	—	—	—
125		*subglobosa* BRADY	—	2	—	1	2	—	—	—	—		—	—	2	2	—	—	—	—	—	—	—	—	—	—
126	*Pullenia*	*bulloides* D'ORBIGNY	1	1	—	—	4	3	—	—	—		6	—	—	2	—	—	—	—	—	—	—	—	—	—
127	*Sphaeroidina*	*austriaca* D'ORBIGNY	—	2	1	—	—	2	—	—	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—
128	*Anomalina*	*balthica* (SCHROETER)	—	—	—	7	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
129		*globulosa* CUSHMAN and PARR	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
130	*Cibicides*	*aknerianus* (D'ORBIGNY)	—	5	—	10	2	7	2	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
131		*lobatulus* (WALKER and JACOB)	10	—	—	—	—	—	3	1	—		3	—	—	—	—	—	—	—	—	—	—	—	—	—
132		*Pseudoungerianus* (CUSHMANN)	2	—	—	—	—	—	—	—	—		2	—	2	—	—	—	—	—	—	—	—	—	—	—
133		cf. *refulgens* (MONTFORT)	—	—	—	2	—	—	—	—	—		—	—	2	—	—	—	—	—	—	—	—	—	—	—
134		*tenuimargo* (BRADY)	—	—	1	—	—	—	—	—	—	N.F	—	—	—	—	—	—	—	—	—	—	—	—	—	—
135		sp.	—	—	—	1	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
136	*Hanzawaia*	*nipponica* ASANO	7	—	—	—	15	—	—	—	—		2	—	2	—	—	—	—	—	—	—	—	—	—	—
137	*Lepidocyclina*	(*Neophrolepidina*) *makiyamai* MORISHIMA	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
138	*Miogypsina*	*kotoi* HANZAWA	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
139	*Catapsydrax*	*dissimilis* (CUSHMAN and BERMUDEZ)	2	4	2	—	2	2	10	20	—		—	—	—	—	—	2	—	—	—	—	—	—	—	—
140	*Globigerina*	*borealis* BRADY	3	10	5	—	5	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
141		*bulloides* D'ORBIGNY	8	60	30	30	20	20	—	3	4		30	—	10	—	5	10	—	—	—	—	—	—	—	—
142		*conglomerata* SCHWAGER	—	—	—	—	—	—	1	1	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
143		*diplostoma* REUSS	—	—	—	3	—	1	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
144		*eggeri* RHUMBLER	—	30	—	—	—	—	1	2	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
145		*globularis* ROEMER	—	—	—	—	—	—	—	—	—		20	1	10	—	—	—	—	—	—	—	—	—	—	—
146		*inflata* D'ORBIGNY	4	2	3	6	4	70	100	7	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
147		*tirioculinoides* PLUMMER	3	10	—	—	5	20	120	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
148		sp.	—	10	—	5	—	—	—	—	—		10	—	—	—	—	—	—	—	—	—	—	—	—	—
149	*Globigerinoides*	*bilobata* D'ORBIGNY	—	—	—	—	—	—	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
150		*bisphericus* TODD	—	—	—	—	—	—	—	—	—		15	—	01	—	—	—	—	—	—	—	—	—	—	1
151		*conglobata* (BRADY)	—	2	—	3	—	12	2	—	—		20	—	7	—	10	—	—	—	—	—	—	—	—	—
152		*cyclostoma* (GALLOWAY and WISSLER)	1	5	5	10	3	22	20	—	—		20	—	7	—	5	—	—	—	—	—	—	—	—	—
153		*rubra* D'ORBIGNY	—	2	—	1	3	—	—	—	2		—	—	—	—	—	—	—	—	—	—	—	—	—	—
154		*triloba* (REUSS)	—	10	7	15	5	7	13	—	6		30	—	20	—	20	2	—	—	—	—	—	—	—	1
155	*Orbulina*	*universa* D'ORBIGNY	—	3	—	8	—	—	2	2	—		3	4	—	—	—	—	—	—	—	—	—	—	—	—
156	*Sphaeroidinella*	*dehiscens* (PARKER and JONE)	—	—	—	—	—	1	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
157	*Globorotalia*	*fohsi* CUSHMAN and ELLISOR	3	—	—	4	4	4	3	—	—		5	—	2	—	4	—	—	—	—	—	—	—	—	—
158		*mayeri* (CUSHMAN and ELLISOR)	—	—	—	—	—	—	—	—	—		4	—	—	—	—	—	—	—	—	—	—	—	—	—
159		*menardii* (D'ORBIGNY)	—	—	—	—	—	3	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
160		*punctulata* D'ORBIGNY	—	—	2	2	—	5	12	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
161		*tumida* (BRADY)	—	—	—	—	—	3	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
162		*truncatulinoides* (D'ORBIGNY)	3	7	—	2	—	—	10	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
163	*Globoquadrina*	*altispira* (CUSHMAN and JARVIS)	—	—	—	—	—	—	—	—	—		15	—	—	—	5	—	—	—	—	—	—	—	—	—
164		*dehiscense* CHAPMAN, PARR and COLINS	—	—	—	—	—	—	—	—	1		45	1	20	—	15	5	1	—	—	1	—	—	—	1
	Number of species (Total 164)		42	33	30	45	38	49	50	10	14		40	10	33	19	20	12	3	2	7	5	5	2	2	7
	Population (Total 3795)		342	269	140	263	238	406	484	40	47	0	311	56	169	67	94	49	5	2	16	11	6	3	3	7
	Benthonic Foraminiferal Number (%)		93	42	61	66	78	57	38	13	73		30	89	48	100	32	61	80	100	100	90	100	100	100	70
	Pelagic Foraminiferal Number (%)		7	58	39	34	22	43	62	87	27		70	11	52	0	68	39	20	0	0	10	0	0	0	40
	Arenaceous Foraminiferal Number (%)		2	0.7	2	6	10	10	2	0	72		0.9	50	30	55	0	50	80	100	93	45	66	66	66	30

	FORMATION		TOZAWA	MASAGO				MATSUBA														TOWATA						AMENOMIYA
	ZONE		*LEPIDOCYCLINA MAKIYAMAI* (Z)	*CYCLAMMINA JAPONICA* ZONE																								
	ZONULE		VI		VII			VIII														IX						
SPECIES		LOC. NO. (K)	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
1	*Astrorhiza*	sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	—	—	
2	*Rhabdammina*	cf. *irregularis* BRADY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3		sp.	—		3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	*Bathysiphon*	*eocenica* CUSHMAN and HANNA	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	2	—	4	
5		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	2	
6	*Leptodermella*	*arenata* (CUSHMAN)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
7	*Hormosina*	*globulifera* BRADY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
8		sp.	—		2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
9	*Reophax*	*cylindricus* BRADY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
10		sp.	—		—	—	—	—	—	2	2	—	—	—	3	1	—	—	3	—	—	—	—	—	—	—	—	
11	*Ammodiscus*	*incertus* (D'ORBIGNY)	—		—	2	1	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	
12		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
13	*Ammobaculites*	sp.	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
14	*Cyclammina*	cf. *cancellata* BRADY	—		1	—	—	1	—	—	—	—	—	—	4	—	7	—	5	—	—	—	—	1	1	—	—	
15		*japonica* ASANO	—		2	2	1	4	2	2	2	2	1	3	3	4	10	2	20	5	4	1	1	8	5	10	18	
16		*orbicularis* BRADY	—		—	—	—	—	—	—	—	—	—	—	—	—	15	—	8	2	—	—	—	—	1	1	7	
17		*pacifica* BECK	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	2	10	7	
18		*pusilla* BRADY	—		—	—	—	3	—	17	—	—	—	3	—	2	5	—	—	3	—	3	6	6	8	11	19	
19		sp.	—		5	8	—	4	2	2	2	3	2	2	7	2	7	2	1	—	2	1	2	3	5	5	10	
20	*Haplophragmoides*	*compressum* LEROY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	
21		*renzi* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	
22		*subglobosa* SARS	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
23		cf. *trullisatum* (BRADY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
24		sp.	—		—	—	—	2	—	—	—	—	—	—	6	—	—	2	2	3	2	—	1	—	3	—	20	
25	*Textularia*	*conica* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
26		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
27	*Gaudrinella*	sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
28	*Gaudrina*	*arenaria* GALLOWAY and WISSLER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
29		*ogasaensis* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
30		*robusta* CUSHMANN	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
31	*Clavulina*	sp.	—		—	—	—	1	1	1	1	—	3	7	6	1	—	—	3	—	1	—	—	10	2	—	—	
32	*Karreriella*	*baccata japonica* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	
33	*Martinottiella*	*communis* (D'ORBIGNY)	—		8	8	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	2	—	—	
34		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
35	*Tritaxilina*	sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
36	*Pyrgo*	*depressa* (D'ORBIGNY)	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
37		*murrhina* (SCHWAGER)	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
38		sp.	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
39	*Quinqueloculina*	*seminula* (LINNAEUS)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
40		*vulgaris* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
41		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	
42	*Sigmoilina*	*arenaria* (BRADY)	—		2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
43		*miocenia* BRADY	—		2	—	—	12	—	—	—	2	3	—	—	4	—	—	—	—	1	—	—	—	—	—	—	
44	*Spiroloculina*	cf. *tenuimargo* CUSHMAN	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
45		sp.	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
46	*Cornuspila*	*fragilis* LEROY	—		—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
47		sp.	—		—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
48	*Trochammina*	cf. *pacifica* CUSHMAN	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
49		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
50	*Dentalina*	*communis* D'ORBIGNY	—		—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
51		cf. *emaciata* REUSS	—		—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
52		cf. *filiformis* (D'ORBIGNY)	—		—	—	5	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
53		*setanaensis* (CUSHMAN)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
54		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
55	*Lagena*	*acuticosta* REUSS	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
56		*clavata* WILLIAMSON	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
57		*dentaliniformis* BAGG	—	N.F	—	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N.F
58		*elongata* (EHRENBERG)	—		—	—	7	—	—	—	5	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	
59		*sulcata spicata* CUSHMANN and MCCULLOCH	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60		sp.	—		—	—	1	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
61	*Lagenodosaria*	*hirsuta* (D'ORBIGNY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
62		*scalaris* (D'ORBIGNY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
63	*Nodosaria*	*subraphana* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
64	*Parafrondicularia*	*japonica* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
65	*Planularia*	*planulata* (GALLOWAY and MCCLLOCK)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
66	*Robules*	*calcar* (LINNAEUS)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	
67		*nikobarensis* (SCHWAGER)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	
68		*pseudorotulatus* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	
69		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
70	*Saracenaria*	*latiformis* (BRADY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
71	*Vaginulina*	cf. *yoshihamaensis* INOUE and NAKASEKO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
72	*Glandulina*	*nipponica* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
73	*Guttulina*	sp.	—		—	—	—	—	—	7	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
74	*Pseudopolymorphina*	sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
75	*Elphidium*	*advenum* (CUSHMAN)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
76		*fax barbarense* (NICOL)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
77		*subgranulsum* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	
78	*Nonion*	*nicobarense* CUSHMAN	—		—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
79		*pacificum* (CUSHMAN)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
80	*Amphimorphina*	*haueriana* NEUGEBOREN	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
81	*Bolivinita*	*quardilatera* (SCHWAGER)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
82	*Bolivina*	*alata* (SEGUENZA)	—		—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
83		*robusta* BRADY	—		—	—	—	—	—	2	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
84		*subangularis* ASANO	—		—	—	—	—	—	1	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
85	*Bulminai*	*aculeata* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
86		(*Dessenobulimina*) *auriculata* BAILEY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
87		*brady* (WEINZIERI and APPLIN)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
88		*elongata subsoluta* CUSHMAN and PARKER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
89		*inflata* SEGUENZA	—		—	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
90		*marginata* (MONTAGU)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
91		cf. *nojimaensis* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
92		cf. *pupoides* (SEGUENZA)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
93	*Entosolenia*	*hexagona* WILLIAMSON	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
94		*lucida* WILLIAMSON	—		—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
95		*marginata* (MONTAGU)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
96		*orbignyana* (SEGUENZA)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
97	*Loxostoma*	cf. *bradyi* (ASANO)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
98		*karrerianum* (BRADY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
99	*Siphogenerina*	*columellaris* (BRADY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
100		*raphanus* (PARKER and JONES)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
101		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
102	*Uvigerina*	*crassicostata* SCHWAGER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
103		*excellens* TODD	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
104		*farinosa* (HANTKEN)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
105		cf. *hootsi* RANKIN	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
106		*peregrina dirupta* TODD	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
107		cf. *proboscidea* SCHWAGER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
108		*schwageri* BRADY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	
109	*Ellipsonodosaria*	cf. *hyugaensis* ISHIZAKI	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	
110		*ketisiensis* ISHIZAKI	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
111		*lepidula* (SCHWAGER)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
112		*oinomikadoi* ISHIZAKI	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
113		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
114	*Epistomina*	*elegans* (D'ORBIGNY)	—		4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
115	*Eponides*	*haidingerii* (D'ORBIGNY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
116		*umbonatus* (RESS)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
117		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
118	*Gyroidina*	*orbicularis* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
119		*soldanii* D'ORBIGNY	—		2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
120	*Pseudoeponides*	*japonicus* UCHIO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
121	*Rotalia*	*ketienziensis* (ISHIZAKI)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
122	*Cassidulina*	*papillosa* BRADY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
123		*asanoi* UCHIO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
124		*pacifica* CUSHMAN	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
125		*subglobosa* BRADY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
126	*Pullenia*	*bulloides* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
127	*Sphaeroidina*	*austriaca* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
128	*Anomalina*	*balthica* (SCHROETER)	—		—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
129		*globulosa* CUSHMAN and PARR	—		—	—	—	—	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
130	*Cibicides*	*aknerianus* (D'ORBIGNY)	R		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
131		*lobatulus* (WALKER and JACOB)	R		—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	
132		*Pseudoungerianus* (CUSHMANN)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
133		cf. *refulgens* (MONTFORT)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	
134		*tenuimargo* (BRADY)	—	N.F	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N.F
135		sp.	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
136	*Hanzawaia*	*nipponica* ASANO	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
137	*Lepidocyclina*	(*Neophrolepidina*) *makiyamai* MORISHIMA	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
138	*Miogypsina*	*kotoi* HANZAWA	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
139	*Catapsydrax*	*dissimilis* (CUSHMAN and BERMUDEZ)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
140	*Globigerina*	*borealis* BRADY	—		—	—	10	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—	
141		*bulloides* D'ORBIGNY	—		—	—	40	—	1	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	
142		*conglomerata* SCHWAGER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
143		*diplostoma* REUSS	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
144		*eggeri* RHUMBLER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
145		*globularis* ROEMER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
146		*inflata* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
147		*tirioculinoides* PLUMMER	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
148		sp.	—		—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
149	*Globigerinoides*	*bilobata* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
150		*bisphericus* TODD	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
151		*conglobata* (BRADY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
152		*cyclostoma* (GALLOWAY and WISSLER)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
153		*rubra* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
154		*triloba* (REUSS)	—		—	—	10	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
155	*Orbulina*	*universa* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
156	*Sphaeroidinella*	*dehiscens* (PARKER and JONE)	—		—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
157	*Globorotalia*	*fohsi* CUSHMAN and ELLISOR	—		—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
158		*mayeri* (CUSHMAN and ELLISOR)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
159		*menardii* (D'ORBIGNY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
160		*punctulata* D'ORBIGNY	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
161		*tumida* (BRADY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
162		*truncatulinoides* (D'ORBIGNY)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
163	*Globoquadrina*	*altispira* (CUSHMAN and JARVIS)	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
164		*dehiscense* CHAPMAN, PARR and COLINS	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Number of species (Total 164)		2		12	5	25	8	6	13	6	3	4	4	6	6	5	3	27	4	5	3	5	10	10	5	10	
	Population (Total 3795)		7	0	35	22	22	28	14	46	14	7	9	15	29	14	44	6	90	13	10	5	12	62	31	37	102	
	Benthonic Foraminiferal Number (%)		100		100	100	42	96	92	100	100	100	100	100	100	100	100	100	91	100	100	100	100	100	100	100	100	
	Pelagic Foraminiferal Number (%)		0		0	0	58	4	8	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	
	Arenaceous Foraminiferal Number (%)		70		70	100	8	53	35	52	50	71	66	100	100	71	95	100	51	100	90	100	100	100	100	100	100	

ZONULE I (*Bulimina pupoides-Uvigerina proboscidea*) ZONULE II (*Globigerina bulloides*) ZONULE III (*Globigerina inflata*) ZONULE IV (*Globoquadrina dehiscens*) ZONULE V (*Ammodiscus incertus*) ZONULE VI (*Lepidocyclina makiyamai*)
ZONULE VII (*Globigerina bulloides*) ZONULE VIII (*Cyclammina japonica*) ZONULE IX (*Cyclammina pusilla*)

Table 3: Check List of the Miocen Foraminifera in the Sagara District

		FORMATION	KIRIYAMA													WADA	ISHIHARADA	SAGARA									TOKIGAYA												HÔRAI												MEGAMI						
																																																		MAL				LS	SS	
		ZONE	*GLOBIGERINA INFLATA* ZONE															*ORBULINA UNIVERSA* ZONE																					*MARTINOTTIELLA* cf. *COMMUNIS* ZONE																*LEPIDOCYCLINA NIPPONICA* (Z)		
		ZONULE	I					II					III					IV				V					VI	VII					VIII						IX							X									XI	XII	
SPECIES		LOC. NO. (S)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
1	*Astrorhiza*	sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
2	*Bathysiphon*	*eocenica* CUSHMAN and HANNA	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	2	2	3	3	2		—	—	—	—	—	—	—	—	—	—	—	—
3		sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	2	—	—	—	—	—
4	*Reophax*	*cylindricus* BRADY	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	2	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
5	*Saccammia*	*sphaerica* SARIS	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	—	—		—	—	—	—	—	—	—	—	—	—	—	—
6	*Proteonia*	cf. *ovata* CUSHMAN	1	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—
7	*Ammodicus*	*incertus* (D'ORBIGNY)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	2		—	2	—	—	—	—	—	—	—	—	—	—
8		sp.	—	—	—	—	—	—	1	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
9	*Ammobaculites*	sp.	1	—	—	—	—	—	1	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
10	*Cyclammina*	*incisa* (STACHE)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—		—	—	—	—	—	—	—	—	—	—	—	—
11		*pacifica* BECK	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	2	—		—	—	—	—	—	—	—	—	—	—	—	—
12		*pusilla* BRADY	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	4	2	2	2	3		—	1	—	—	1	—	—	2	—	—	—	—
13		sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	4	2	—	—	2		—	—	—	—	1	—	—	—	—	—	—	—
14	*Haplophragmoides*	*compressum* LEROY	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3	—	1	3	—		—	—	—	—	—	—	—	—	—	—	—	—
15		sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	2	—	1		—	—	—	1	—	2	—	—	3	—	3	4
16	*Textularia*	sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—		—	—	—	—	—	—	—	—	—	—	—	—
17	*Verneuilina*	sp.	1	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3	—		—	—	—	—	—	—	—	—	—	—	—	—
18	*Clavulina*	*yabei* ASANO	—	1	1	—	—	—	—	—	—		—	—	—			—	2	—	—	1	2	—	—	—	—	1	—	—	2	—	—	—	—	1	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
19	*Karreriella*	*baccata japonica* ASANO	—	—	—	—	—	—	—	—	1		—	—	—			4	10	1	1	—	—	—	—	—	—	—	—	—	—	2	—	—	5	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
20	*Martinottiella*	cf. *communis* (D'ORBIGNY)	—	—	1	1	—	1	—	—	—		—	—	—			—	—	—	—	1	3	5	3	—	—	3	—	—	—	3	—	—	—	—	—	1	12	5	4	2	4	10		3	4	2	2	2	12	10	10	4	—	4	3
21	*Miliammina*	sp.	—	1	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	1	1	—	—	—
22	*Quinqueloculina*	cf. *lamarcklina* D'ORBIGNY	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
23		*vulgaris* D'ORBIGNY	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
24		sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
25	*Sigmoilina*	*arenaria* (BRADY)	1	2	—	2	—	—	—	—	1	N.F	—	—	—	N.F	N.F	—	—	—	—	—	—	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N.F	—	—	—	—	—	—	—	—	—	—	—	—
26		*miocenica* BRADY	—	1	—	—	—	—	—	—	—		—	—	—			1	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—		—	2	—	—	—	5	10	4	—	—	—	—
27	*Trochammina*	*nobensis* ASANO	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5		—	—	—	—	—	—	—	—	—	—	—	—
28		cf. PACIFICA (CUSHMAN)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	3		—	3	1	—	—	—	—	—	—	—	—	—
29		sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	2		—	—	—	—	—	—	—	—	—	—	—	—
30	*Dentalia*	*communis* D'ORBIGNY	—	1	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	2	—	—	—	—	3	—	—	3	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
31		*emaciata* REUSS	—	1	—	3	—	—	—	—	—		—	2	4			1	3	2	—	—	—	—	—	1	4	—	4	2	—	—	—	—	5	8	—	3	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
32		cf. *filiformis* (D'ORBIGNY)	1	—	—	—	—	—	—	—	—		—	1	1			1	3	—	—	—	—	—	—	1	2	—	4	—	—	5	—	—	6	5	—	3	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
33		*inflex* REUSS	—	1	—	—	—	—	—	—	—		—	3	—			1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
34		*setanaensis* ASANO	—	—	—	—	—	—	—	—	—		—	—	—			—	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
35		*subsoluta* (CUSHMAN)	—	—	1	2	—	—	—	—	—		—	5	7			4	—	—	2	—	—	1	—	3	—	—	10	—	—	2	—	—	5	—	1	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
36		sp.	—	—	—	—	—	—	—	—	—		—	—	—			1	—	—	—	—	3	—	—	—	4	—	5	—	2	—	—	—	2	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
37	*Frondicularia*	*foliacea* SCHWAGER	—	—	—	1	—	—	—	—	—		—	—	—			1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
38	*Legena*	*dentaliniformis* BAGG	—	—	—	—	—	—	—	—	—		—	3	10			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
39		*elongata* (EHRENBERG)	—	—	—	—	1	—	—	—	5		1	4	25			7	10	1	5	—	—	1	3	4	—	—	15	2	10	10	—	2	—	—	7	7	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
40		*Laevis* (MONTAGU)	1	—	—	—	—	—	—	—	—		—	—	—			—	3	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
41		sp.	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	2	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
42	*Lagenodosaria*	*scalaris* (D'ORBIGNY)	—	—	—	—	—	—	—	—	—		—	—	—			—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
43	*Nodosaria*	*pyrula* D'ORBIGNY	—	—	—	—	—	1	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	2	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
44		*raphanus* (LINNAUS)	—	2	—	—	—	—	—	—	—		—	—	—			—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
45		*subraphana* ASANO	—	—	1	1	1	—	—	1	—		—	3	12			—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
46	*Parafrondicularia*	*japonica* ASANO	—	1	—	4	—	—	—	—	—		—	—	—			2	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
47	*Pseudoglandulina*	*laevigata* (D'ORBIGNY)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
48	*Robulus*	*calcar* (LINNAEUS)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
49		*costatus* (FICHTEL and MOLL)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
50		*lucidus* (CUSHMAN)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
51		*nikobarensis* (SCHWAGER)	1	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
52		*pseudorotulatus* ASANO	1	3	1	—	—	—	—	—	—		—	—	—			—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
53		sp.	1	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
54	*Saracenaria*	sp.	—	—	—	—	—	—	—	—	—		—	1	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
55	*Globulina*	sp.	—	1	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
56	*Glandulina*	*nipponica* ASANO	—	—	—	—	—	—	—	—	—		—	—	—			—	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
57	*Guttulina*	sp.	—	1	1	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
58	*Pseudopolymorphina*	*ishikawaensis* CUSHMAN and OZAWA	—	—	—	—	—	—	—	—	—		—	—	—			—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
59	*Elphidium*	*fax barbasense* (NICOL)	1	11	2	5	10	—	—	—	3	N.F	—	1	1	N.F	N.F	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	N.F	—	—	—	—	—	—	—	—	—	—	—	—
60	*Nonion*	*nicobarense* CUSHMAN	—	—	—	—	—	—	—	—	—		—	—	—			—	10	2	4	—	—	10	—	2	—	—	6	—	20	10	—	—	—	—	1	3	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
61		*pacificum* (CUSHMAN)	—	2	—	—	—	—	—	—	—		—	—	—			2	—	1	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
62		*pompilioides* (FICHTEL and MOLL)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
63		*scaphum* (FICHTEL and MOLL)	—	—	2	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
64	*Amphimorphina*	*haueriana* NEUGEBOREN	—	1	—	—	—	—	—	—	—		—	—	—			—	1	1	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	2	2	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
65	*Bolivinita*	*quadrilatera* (SCHWAGER)	4	32	26	47	2	—	—	—	1		—	—	—			2	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
66	*Boliviva*	*alata* (SEGUENZA)	—	—	3	—	—	—	—	—	—		—	—	—			—	2	2	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
67		*compacta* (SIDEBOTTOM)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
68		*subangularis ogasaensis* ASANO	—	—	—	—	—	—	—	—	—		—	—	—			—	3	1	—	—	—	3	—	—	—	—	—	—	8	—	—	—	—	—	—	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
69	*Bulimina*	*aculeata* D'ORBIGNY	—	10	5	2	—	—	—	—	—		—	—	—			—	—	1	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
70		cf. *inflata* SEGUENZA	2	10	10	5	—	—	—	—	—		—	1	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
71		*marginata* D'ORBIGNY	—	5	—	—	—	—	—	—	—		—	—	—			1	2	—	—	—	—	2	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
72		*pupoides* (SEGUENZA)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
73		*subcalva* CUSHMAN and STEWART	—	5	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
74		sp.	1	5	—	—	—	—	—	—	—		1	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
75	*Entosolenia*	*lucida* WILLIAMSON	—	—	—	—	—	—	—	—	—		1	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
76		*marginata* (MONTAGU)	—	—	—	—	—	—	—	—	—		—	—	—			1	2	—	—	—	—	2	—	1	—	—	3	—	—	—	—	—	2	—	—	5	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
77		*orbignyana* (SEGUENZA)	—	—	1	—	—	—	—	—	1		—	—	—			—	—	—	—	—	—	1	—	1	—	—	1	2	—	—	—	—	2	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
78		sp.	—	—	—	—	—	—	—	—	—		—	—	1			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
79	*Siphogeneria*	cf. *columellaris* (BRADY)	—	—	1	—	—	—	—	—	—		—	—	—			—	1	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
80		sp.	—	1	—	—	—	—	—	—	—		—	—	—			—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
81	*Uvigerina*	*aculeata* D'ORBIGNY	—	—	1	—	—	—	—	—	—		—	—	—			—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
82		*crassicostata* SCHWAGER	—	—	3	—	—	—	—	—	1		—	—	—			20	10	3	7	—	—	—	—	—	—	—	3	—	—	2	—	—	45	40	—	24	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
83		*excellens* TODD	—	—	7	2	—	—	—	—	—		—	—	—			10	—	3	5	—	—	2	—	—	—	—	—	—	—	—	—	—	—	50	—	25	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
84		cf. *hootsi* RAINKIN	1	10	10	25	30	—	—	—	3		—	35	10			—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
85		*nitidula* SCHWAGER	—	—	—	—	—	—	1	—	—		—	—	—			12	7	3	5	—	—	—	2	—	—	—	—	—	—	—	—	—	25	45	—	25	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
86		*proboscidea* SCHWAGER	—	5	7	5	7	—	—	—	—		—	12	5			7	80	—	1	—	—	180	—	—	—	—	2	2	35	—	—	—	—	20	—	20	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
87		*subperegrina* CUSHMAN and KLEINPELL	1	2	—	2	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
88		*yabei* ASANO	—	6	6	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
89	*Virgulina*	*ishikiensis* ASANO	—	—	—	—	—	—	—	—	—		—	—	—			—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	12	—	4	1	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
90		*shcreibersiana* CZJZEK	—	—	5	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
91	*Ellipsonodosaria*	*ketienziensis* ISHIZAKI	1	—	2	2	—	—	—	—	6		—	15	—			3	6	1	6	—	—	3	—	1	8	—	2	—	10	3	—	—	—	—	10	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
92		*lepidula* (SCHWAGER)	—	1	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
93		*oinomikadoi* ISHIZAKI	—	—	—	—	—	—	—	—	—		—	—	3			—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
94	*Epistomina*	*elegans* (D'ORBIGNY)	1	—	—	1	5	—	—	—	—		—	—	—			1	50	15	15	—	—	6	—	1	—	—	—	—	5	—	—	—	—	—	—	6	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
95	*Eponides*	*haidingerii* (D'ORBIGNY)	—	4	—	3	1	—	—	—	4		—	40	50			3	—	—	—	—	—	3	—	—	20	—	12	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
96		*umbonatus* (REUSS)	—	—	—	—	—	—	—	—	—		—	—	—			1	10	7	3	—	—	2	—	1	14	—	—	—	—	—	—	—	—	—	8	10	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
97		sp.	1	—	—	—	—	—	—	—	1		—	—	—			—	—	—	—	—	—	2	—	1	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
98	*Gyroidina*	*orbicularis* D'ORBIGNY	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	1	—	—	—	—	3	—	—	—	—	—	8	3	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
99		*soldanii* D'ORBIGNY	1	—	—	—	—	—	—	—	—	N.F	—	7	—	N.F	N.F	—	3	1	2	—	—	—	—	1	4	—	7	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	N.F	—	—	—	—	—	—	—	—	—	—	—	—
100	*Rotalia*	cf. *beccarii* (LINNAEUS)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
101		*inflata* (SEGUENZA)	—	—	—	—	—	—	—	—	—		—	—	—			—	2	—	3	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
102		*papillosa* BRADY	1	4	—	—	—	—	—	—	1		—	—	1			—	3	1	8	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
103	*Cassidulina*	*subglobosa* BRADY	1	—	—	—	—	—	—	—	1		—	—	2			—	2	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	2	—	1	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
104		*subglobosa depressa* ASANO and NAKAMURA	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
105	*Pullenia*	*bulloides* (D'ORBIGNY)	—	—	—	—	—	—	—	—	1		—	—	12			—	—	—	—	—	—	4	—	—	—	—	1	—	3	—	—	—	5	—	—	3	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
106	*Sphaeroidina*	*bulloides* (D'ORBIGNY)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
107	*Cibicides*	*lobtaulus* (WALKER and JACOB)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
108		*pseudoungerianus* (CUSHMAN)	—	—	—	—	—	2	1	4	5		—	—	1			1	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	6	7	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
109		cf. *refulgens* (MONTFORT)	—	—	—	—	—	—	—	—	—		—	—	1			—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18	11	2	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
110	*Hanzawaia*	*nipponica* ASANO	—	—	2	—	—	—	—	—	3		—	20	12			—	3	—	—	—	—	3	—	1	4	—	1	—	—	—	—	—	3	12	1	3	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
111	*Planulina*	*wuellerstorfi* (SCHWAGER)	—	—	—	—	—	—	—	—	—		—	—	—			—	3	1	1	—	—	—	—	—	—	—	—	—	2	—	—	—	—	1	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
112	*Lepidocyclina*	(*Neophrolepidina*) *angulosa* (PROVALE)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	R	—	—
113		*nipponica* (HANZAWA)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	R	—	—
114		*perornata* H. DOUVILLE	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	R	—	—
115	*Miogypsina*	*kotoi* (HANZAWA)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	R	—	—
116	*Catapsydrax*	*dissimilis* (CUSHMAN and BERMUDEZ)	—	—	—	—	—	—	—	—	1		—	—	—			—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
117	*Globigerina*	*borealis* BRADY	—	3	6	3	3	—	—	—	—		—	—	—			—	3	—	10	—	—	—	—	15	20	1	15	—	—	—	—	—	12	3	3	15	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
118		*bulloides* D'ORBIGNY	6	20	12	3	3	—	—	—	3		—	20	20			40	30	30	—	—	—	4	20	20	200	1	30	18	20	—	—	2	45	40	10	70	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
119		*conglomerata* SCHWAGER	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	20	—	—	—	—	—	—	—	22	—	—	20	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
120		*diplostoma* REUSS	—	—	—	—	—	—	—	—	—		—	—	—			7	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	12	5	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
121		*eggeri* RHUMBLER	—	—	—	—	—	—	—	—	—		—	—	—			—	3	5	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	3	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
122		*inflata* D'ORBIGNY	3	—	4	3	—	—	—	—	—		1	80	12			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
123		*quinqueloba* NATLAND	—	—	4	—	1	1	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
124		*subcretacea* LOMNIKI	—	—	10	—	—	—	—	—	—		—	—	—			—	—	10	—	—	—	—	—	5	10	—	—	—	—	—	—	—	25	10	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
125		*triloculinoides* PLUMMER	—	—	—	—	—	—	—	—	—		—	—	—			—	28	—	10	—	—	—	—	—	10	—	—	—	—	20	—	—	30	—	—	10	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
126		sp.	3	—	20	3	—	1	1	1	—		—	20	—			5	—	—	—	—	—	2	—	—	—	—	10	10	—	10	2	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
127	*Globigorinella*	*aequilateralis* (BRADY)	—	10	—	—	—	—	—	—	—		—	—	—			20	—	—	—	—	—	1	2	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
128	*Globigerinoides*	*bilobata* D'ORBIGNY	—	1	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
129		*conglobata* (BRADY)	2	—	10	2	2	—	—	—	3		—	35	10			10	8	15	—	—	—	—	—	10	50	—	10	—	—	20	—	—	—	7	10	20	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
130		*cyclostoma* (GALLOWAY and WISSLER)	—	5	—	—	—	—	—	—	—		—	10	2			7	—	—	—	—	—	1	—	—	30	—	8	4	10	5	—	—	13	7	13	10	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
131		*bisphericus* TODD	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
132		*rubra* (D'ORBIGNY)	—	2	—	—	—	—	—	—	—		—	—	3			5	5	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
133		*sacculifera* (BRADY)	2	—	3	—	1	—	—	—	—		—	—	—			—	—	10	—	—	—	—	—	—	10	—	—	2	—	5	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
134		*triloba* (REUSS)	—	—	6	—	—	—	—	—	3		—	—	10			25	26	20	10	—	—	4	20	10	30	—	20	16	15	7	—	—	30	—	16	30	—	—	—	—	—	1		—	—	—	—	—	—	—	—	—	—	—	—
135		sp.	—	2	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
136	*Orbulina*	*universa* D'ORBIGNY	2	—	2	—	1	—	—	—	1		—	20	—			25	3	12	15	4	10	2	20	7	20	3	15	25	2	20	2	2	40	7	5	20	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
137	*Pulleniatina*	*obliquiloculata* (PARKER and JONES)	—	2	3	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
138	*Sphaeroidinella*	*dehiscens* (PARKER and JONES)	—	3	—	—	—	—	—	—	—		—	—	—			10	6	5	20	—	—	—	—	3	40	—	15	—	5	7	—	2	50	45	28	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
139		cf. *grimsdalei* (KEIJZEN)	—	—	—	—	—	—	—	—	—		—	—	—			—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
140	*Globorotalia*	*crassula* CUSHMAN and STEWART	—	2	3	2	—	—	—	—	—		—	10	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
141		*fohsi* CUSHMAN and ELLISOR	—	—	—	—	—	—	—	—	—		—	—	—			20	—	—	5	—	—	—	—	—	20	—	—	—	—	—	—	—	14	20	10	10	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
142		*menardii* (D'ORBIGNY)	—	—	2	—	—	—	—	—	—		—	50	20			—	3	5	7	—	—	—	—	3	20	—	—	4	—	10	—	—	12	—	—	5	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
143		*tumida* (BRADY)	—	—	—	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	3	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
144		*truncatalinoides* (D'ORBIGNY)	2	—	1	—	—	—	—	—	—		—	—	—			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—
	Number of species (Total 144)		27	39	37	24	14	5	5	3	21		4	24	25			35	45	34	30	3	7	30	11	25	26	6	32	12	18	23	3	5	38	30	22	38	8	9	6	11	6	10		1	5	2	2	3	3	2	4	3	4	2	1
	Population (Total 5312)		45	177	185	129	68	6	5	6	48		4	398	235			266	276	169	151	6	24	260	84	97	558	11	221	89	157	159	7	10	464	358	149	396	46	29	13	20	17	31		3	12	3	3	4	17	22	17	8	R	7	4
	Benthonic Foraminiferal Number (%)		56	72	54	88	84	67	80	84	80		78	39	68			34	70	34	48	34	46	94	18	28	14	37	43	12	67	28	0	40	35	60	33	35	100	100	100	100	100	97		100	100	100	100	100	100	100	100	100		100	100
	Pelagic Foraminiferal Number (%)		44	28	46	12	16	33	20	16	20		22	61	32			66	30	66	52	66	54	6	82	76	86	63	57	88	33	72	100	60	65	40	67	65	0	0	0	0	0	3		0	0	0	0	0	0	0	0	0		0	0
	Arenaceous Foraminiferal Number (%)		9	2	1	2	0	16	40	0	4		0	0	0			2	3	0.6	0.6	34	24	3	6	1	0	37	0	0	1	3	0	0	2	0.5	0.7	0.3	91	100	100	100	100	97		100	100	100	100	100	70	55	77	100		100	100

ZONULE I (*Globigerina bulloides—Bolivinita quadrilatera*)
ZONULE II (*Cibicides pseudoungerianus*)
ZONULE III (*Globigerina inflata*)
ZONULE IV (*Orbulina universa—Sphaeroidinella dehiscens*)
ZONULE V (*Orbulina universa—Globigerinoides triloba*)
ZONULE VI (*Globigerinoides conglobata—Sphaeroidinella dehiscns*)
ZONULE VII (*Orbulina universa*)
ZONULE VIII (*Orbulina universa—Globorotalia fohsi*)
ZONULE XI (*Lepidocyclina* (*Nephrolepidina*) *nipponica*)
ZONULE X (*Martinottiella* cf. *communis*)
ZONULE IX (*Martinottiella* cf. *communis—cyclammina pusilla*)
ZONULE XII (*Martinottiella* cf. *Communus*)

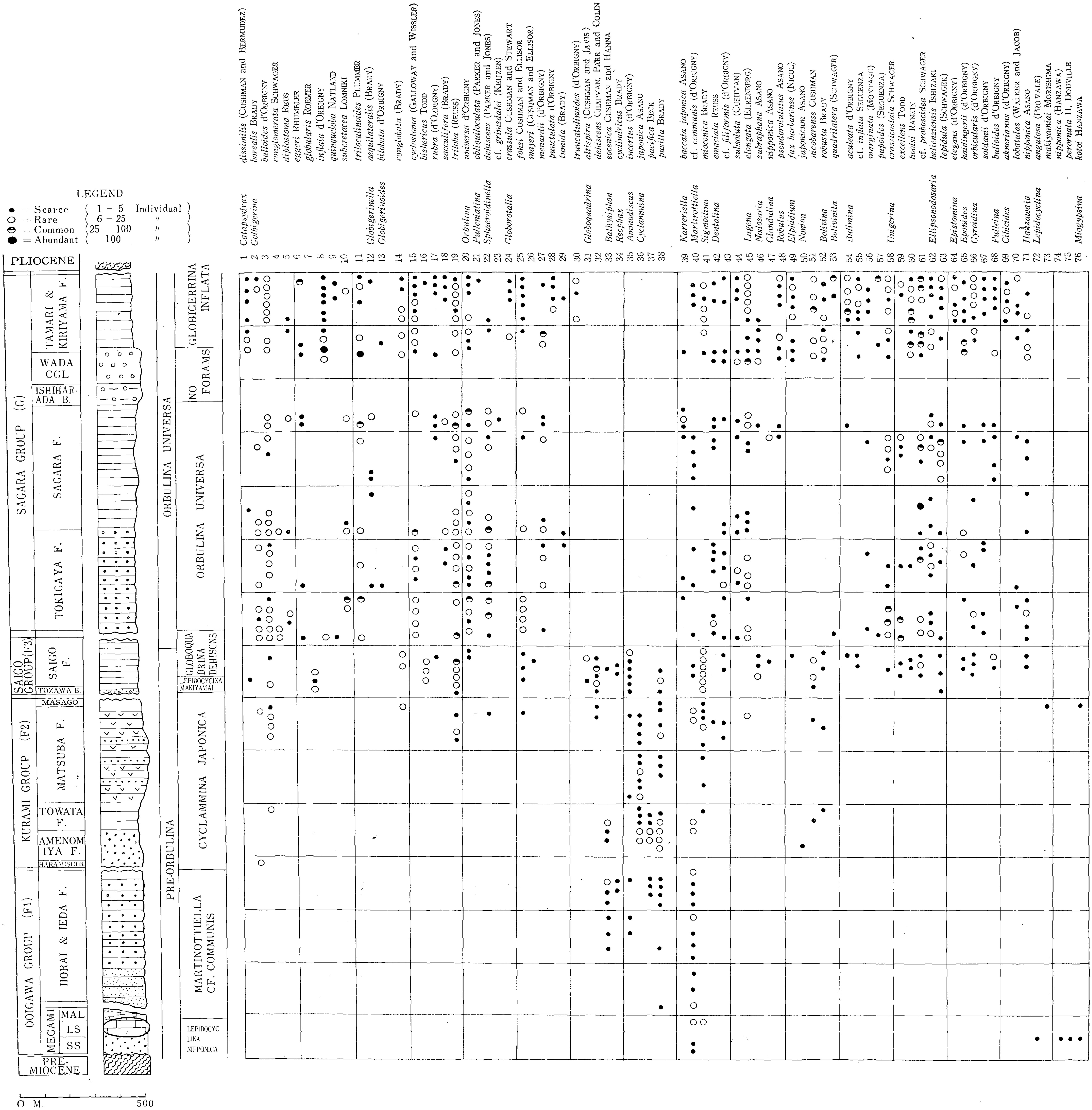

Table 4.—Foraminiferal distribution chart of the Shizuoka section of Central Japan.

The type section of this zone is the exposure of the Lower Megami formation (Ooigawa Group) in the vicinity of Sagara.

The following two zonules of this zone, are recognized.

(2) *Lepidocyclina nipponica* zonule
(1) *Lower Martinotiella* cf. *communis* zonule

(1) *Martinotiella* cf. *communis* zonule

The corresponding lithologic subdivision is the lower Megami formation (Megami sandstone). This zonule is characterized by sporadic benthonic arenaceous foraminiferas such as *Martinottiella* cf. *communis* and *Haplopharagmoides* sp.. In general, neither pelagic form nor benthonic form is present.

(2) *Lepidocyclina nipponica* zonule

This zonule is characterized by *Lepidocyclina* (*Nephrolepidina*) *nipponica*, *L.* (*N.*) *angulosa*, *L.* (*N.*) *perornata* and *Miogysina kotoi*, etc. representing a lithologic subdivision known as the lower Megami formation (limestone). The limestones of this zonule have in them sporadically these larger Foraminifers, while it has none of smaller foraminiferas. *Lepidocyclina* (*N.*) *nipponica*, *L.* (*N.*) *angulosa* and *L.* (*N.*) *perornata* make their first appearances in this zonule of the Miocene epoch of Japan Island. The fact is remarkable. These species are tropical forms living in shallow water in association with reef corals.

(B) ***Martinottiella* cf. *communis* zone**

This zone is characterized by *Martionttiella* cf. *communis*, *Bathysiphon eocenica*, *B.* sp. *Cyclammina pacifica*, *C. pusilla* and *Trochammina* cf. *pacifica*, etc.. It is a noteworthy fact that the strata belonging to this zone have extremely rare pelagic forms in the upper part and that benthonic forms other than those in the above list are completely absent at least in Sagara district.

The type section of this zone is consisting of a set of the exposures of the upper Megami, Hôrai, Futamata and Ieda formations in the mapped area. The upper limit of this zone is the top of the Hôrai and Ieda formations and the lower limit is the base of the Megami marl and Futamata formation. This zone may be subdivided into the following six conspicuous zonules in descending order.

Sagara district	Futamata district
(2) *Martinottiella* cf. *communis* —*Cyclammina pussilla* zonule	(4) *Rotalia beccarii* zonule
(1) *Martinottiella* cf. *communis* zonule	(3) *Cyclammina pusilla* zonule
	(2) Upper *Martinottiella* cf. *communis* —*Haplophragmoides* sp. zonule
	(1) Lower *Martinottiella* cf. *communis* —*Haplophragmoides* sp. zonule

Sagara district

(1) *Martinottiella* cf. *communis* zonule

The corresponding lithologic subdivision of this zonule is the upper Megami formation as well as lower Hôrai formation. This zonule is characterized by dominanciy of arenaceous forms such as *Martinottiella* cf. *communis*, *Sigmolina miocenica* and *Haplophragmoides* sp. etc.. Absence of another benthonic forms and pelagic forms is remarkable. Generally speaking number of species in this zonule is smaller than in the superjacent zonule.

(2) *Martinottiella* cf. *communis*—*Cyclammina pusilla* zonule

The corresponding lithologic subdivision is the upper Hôrai formation. This zonule is characterized by dominant forms such arenaceous forms as *Martinottiella* cf. *communis*, *Bathysiphon eocenica*, *B.* sp., *Ammodiscus incertus*, *Cyclammina incisa*, *C. pacifica*, *C. pusilla*, *C.* sp., *Sigmoilina arenaria*, *S. miocenica*, *Trochammina nobensis* and *T.* sp., while on the other hand it has extremely rare pelagic forms. *Globigerinoides triloba* occurs very rarely in the upper Hôrai formation, and this is assumed to be the appearance at least in the area under consideration.

The most remarkable characteristic of this zonule is the predominant occurrence of arenaceous forms such as *Martinottiella* cf. *communis* and *Cyclammina pusilla.*

A larger number of species than those in the underlying upper *Martinottiella* cf. *communis* zonule may be noted again.

Futamata district

(1) Lower *Martinottiella* cf. *communis*—*Haplophragmoides* sp. zonule

The uniquely corresponding lithologic subdivision is the lower Futamata formation. This zonule is characterized by common occurrences of such benthonic forms as *Martinottiella* cf. *communis*, *M.* sp., *Haplophragmoides* sp., *Sigmoilina miocenica*, *Cyclammina pusilla* and *Cibicides* cf. *lobatulus.* None of pelagic forms is found in this zonule.

It will be worthy to mention that *Martinottiella* cf. *communis* and *Haplophragmoides* sp. and *Sigmoillina miocenica* are predominate among the members.

(2) Upper *Martinottiella* cf. *communis*—*Haplophragmoides* zonule

The uniquely corresponding lithologic subdivision is the upper Futamata formation. This zonule is characterized by common arenaceous forms: *Martinottiella* cf. *communis*, *Haplophragmoides* sp., *Cyclammina pusilla*, *C.* sp. etc.. Pelagic form is absent.

(3) *Cyclammina pusilla* zonule

The uniquely corresponding lithologic subdivision is the lower Ieda formation. This zonule is characterized by the dominant arenaceous form—*Cyclammina pusilla*, *C.* sp., *Haplophragmoides* cf. *renzi*, *H. rugosa.*, *H.* cf. *subgrobosum*, *H.* sp., *Martinottiella* cf. *communis* and *M.* sp., etc.. *Catapsydrax* cf. *dissimilis* occurs very rarely in the lower part.

(4) **Rotalia beccarii zonule**

The uniquely corresponding lithologic subdivision is upper Ieda formation. This zonule is characterized by more or less frequent occurrences of :—*Rotalia beccarii*, *Haplophragmoides subglobosum* and *H.* sp., etc.

No pelagic form occurs in this zonule also.

II. TOGARIAN

The Togarian stage is the second division of the Miocene series. Its type is the lower division of the Mizunami Group which yields a skull of *Desmostylus japonicus* at Togari near Mizunami City about 30 km. northeast of Nagoya.

The Kurami Group here in Shizuoka prefecture corresponds lithostratigraphically to MAKIYAMA's Togari Group, the type of his Togarian stage.

The Togarian rocks are recognized with *Anadara ogawai*, *Chlamys kaneharai*, *Kaneharaia kaneharai*, *Macoma optiva*, *Cultellus izumoensis*, *Turritella s-hataii*, *Doliocassis japonicus*, *Vicarya yokoyamai*, *Vicaryella ishiiana*, and *Batillaria minoensis* throughout the different basins in northeastern Japan. *Lepidocyclina japonica* and *Miogypsina kotoi* seem to be common in a certain lower level of the Togarian. The land was then warmer than it is now—the condition is well seen with the flora, represented by *Liquidambar formosa*, *Comptoniphyllum naumanni*, *Ficus tiliaefolia*, *Cinnanomum*, *Sabalites* etc.. The Hiramaki formation in the Mitake Basin, not far from the Toki Bain, being a land facies of the Togari formation has yielded mammalian remains *Bunolophodon annectens*, *Amphitragulus minoensis*, *Teloceras pugnator*, *Palaeotapirus annectens*, *Amphitragulus minoensis*, *Teloceras pugnator*, *Palaeotapirus yagii*, and *Amphitherium minoensis*. MAKIYAMA (1939) stated that the Togarian is the Japonic equivalent of the European Vindobonian.

The top of the Togarian rocks is covered by the Tozawa bed (Saigo Group) unconformably and the base is overlying unconformably the Ooigawa Group. The Togarian in the area occupies the same place as the Kurami Group and it contains a considerable number of benthonic foraminiferas and a few pelagic foraminiferas. There is a significant zone in the Togarian named *Cyclammina japonica* zone. This biozone is well recognized both in the Kakegawa and Futamata districts.

***Cyclammina japonica* zone**

This zone is characterized by *Cyclammina japonica*, *C.* cf. *cancellata*, *C. orbicularis*, *C. pacifica*, *C. pusilla*, *Haplophragmoides* sp., *Clavulina* sp., *Martinottiella* cf. *communis*.

These arenaceous forms are abundant everywhere in this zone, but the calcareous benthonic forms are common in the upper part of the same zone only.

The five conspicous zonules of this zone are as follows in descending order:

Kakegawa district

(3) *Globigerina bulloides*
—*Martinottiella* cf. *communis* zonule
(2) *Cyclammina japonica* zonule
(1) *Cyclammina pusilla* zonule

Futamata district

(2) *Sigmoilina miocenica* zonule
(1) *Nonion japonicum* zonule

Kakegawa district

(1) *Cyclammina pusilla* zonule

The corresponding lithologic subdivision is the Towata formation.

This zonule is characterized by dominant arenaceous forms such as *Cyclammina* cf. *cancellata*, *C. japonica*, *C. orbicularis*, *C. pacifica*, *C. pusilla*, *Haplopharagmoides compressum*, *H. renzi*, *H.* sp., *Clavulina* sp., *Martinottiella* cf. *communis*, *Textularia* sp. and *Bathysiphon eocenica*. The pelagic forms are totally absent. The most typical mark of this zonule is that it has dominant arenaceous forms such as *Cyclammina pusilla* ranging in the entire zonule.

(2) *Cyclammina japonica* zonule

The corresponding lithologic subdivision is the Matsuba formation.

This zonule is characterized by dominant species (i) benthonic forms, *Cyclammina* cf. *cancellata*, *C. japonica*, *C. orbicularis*, *C. pacifica*, *C. pusilla*, *Haplophragmoides* sp., *Clavulina* sp., *Sigmoilina miocenica*, *Lagena elongata*, *Pseudopolymorphina* sp., *Nonion nicobarense*, *Bolivina robusta*, and *Anomalina globulosa*, etc.. (ii) Pelagic forms, *Globigerina bulloides*, *G. borealis* and *Globigerinoides triloba*, etc.. The predominate arenaceous form *Cyclammina japonica* is the most characteristics species.

(3) *Globigerina bulloides*—*Martinottiella communis* zonule

The Masago formation is the corresponding lithologic subdivision.

This zonule is characterized by common benthonic forms such as *Rhabdammina* sp., *Cyclammina japonica*, *C.* sp., *Martinottiella communis*, *Sigmoilina arenaria*, *Dentalia filiformis*, *D. setanaensis*, *Lagena elongata*, *L. sulcata spicata*, *Bulimina inflata*, and *Epistomina elegans*, as well as the pelagic forms such as *Globigerina borealis*, *G. bulloides*, *Globigerinoides bilobata*, *G. triloba*, *Sphaeroidienlla dehiscens* and *Globorotalia fohsi*, *Globigerina bulloides* and *Martinottiella communis* are the most predominant species.

Futamata district

(1) *Nonion japonicum* zonule

The lower Amenomiya formation is the corresponding lithologic subdivision.

This zonule is characterized by *Nonion japonicum*, *Cyclammina japonica*, *C. pacifica*, *C.* sp., *Gaudrina triangularis*, *Göesella schencki*, *Textularia* sp., and *Dentalia* sp.. *Nonion japonicum* occurs abundantly in the lower part of this zonule. Absence of pelagic form is a remarkable fact.

(2) *Sigmoilina miocenica* zonule

The upper Amenomiya formation is the correspoding lithologic subdivision.

This zonule is characterized by *Sigmoilina miocenica*, *Bathysiphon eocenica*, *Reophax* cf. *cylindricus*, *Cyclammina japonica*, *C. pacifica*, *C. pusilla* and *C.* sp., *Sigmoilina miocenica* occurs abundantly in the lower part of this zonule. Absence of pelagic form in this zonule is a remarkable fact.

III. TOZAWAN

The Tozawan stage is the third division of the Miocene series. Its type is the Saigo Group in the Kakegawa area.

The Tozawan strata yield *Lepidocyclina* (*Nephrolepidina*) *makiyamai* MORISHIMA and *Miogypsina kotoi* HANZAWA in some protions of the lower subdivisions of Tozawa bed.

The Tozawan rocks contain prevailing benthonic foraminiferas and subordinate but rather poor pelagic foraminiferas. Among the latter forms there is *Orbulina universa* D'ORBIGNY which is decidedly absent in the strata beneath the *Globoquadrina dehiscens* zone. It is very rare in this zone, suggesting that this is one of most remarkable points. The Tozawan stage is limited by the superjacent Yuian deposits (Sagara Group) below with an unconformity. Two conspicuous zones are recognizeable in the Tozawan, the *Lepidocyclina* (*N.*) *makiyamai* zone and *Globoquadrina dehiscens* zone.

(A) *Lepidocyclina makiyamai* zone

This zone is characterized by *Lepidocyclina makiyamai* MORISHIMA and *Miogypsina kotoi* HANZAWA. These larger foraminifers occur sporadically in the sandstone.

However, this zone has a very few doubtful smaller foraminiferas only. Both the top and base limits of *Lepidocyclina makiyamai* zone are coincident with those of the Tozawa bed.

Lepidocyclina (*Nephrolepidina*) *makiyamai* MORISHIMA represents the final member of the genus and this zone is the top of all the *Lepidocyclina* horizons in Japan supposed to be equal to f_3 stage of East Indies. This tropical form lived in shallow sandy sea bottoms.

(B) *Globoquadrina dehiscens* zone

This zone is characterized by *Globoquadrina dehiscens*, *G. altispira*, *Globigerina globularis*, *Orbulina universa*, *Globorotalia fohsi*, *G. mayeri*, etc.. The strata belonging to the upper part of this zone contain these planktonic foraminiferas, while they are replaced by more dominant benthonic forms in the lower part. The *Globoquadrina dehiscens* zone is nearly perfectly represented by the Saigo formation. That *Orbulina universa* D'ORBIGNY makes its first appearance in this zone, is the paramount interest.

The type section of this zone is predeterminate to that of the Saigo formation in Kakegawa district. The *Globoquadrina dehiscens* zone is divided into two zonules. They are in descending order as follows.

(2) *Globoquadrina dehiscens* zonule
(1) *Ammodiscus incertus* zonule

(1) *Ammodiscus incertus* zonule

The corresponding lithologic subdivision is the lower Saigo formation.

This zonule is represented by a set of species such as: pelagic forms—*Globigerina bulloides*, *Globoquadrina dehiscens* and *Catapsydrax dissimilis* and those benthonic forms—*Ammodiscus incertus*, *Cyclammina pusilla*, *Haplophragmoides subglobosa*, *H.* sp., *Karreriella baccata japonica*, *Sigmoilina miocenica* and *Texturalis* sp..

This zonule is characterized more weightly with abundant arenaceous forms such as *Ammodiscus incertus*, *Cyclammina pusilla* and *Sigmoilina miocenica* than a few scattering occurrence of the pelagic forms. It has to be noted that very obscure specimens of questionable "Orbulina" occur in this zonule.

The Pelagic forms are absent in the middle part of this zonule.

(2) *Globoquadrina dehiscens* zonule

The corresponding lithologic subdivision is the upper Saigo formation.

This zonule is characterized by dominant occurrences of such pelagic forms as *Globigerina bulloides*, *G. globularis*, *G.* sp., *Globigerinoides bisphericus*, *G. conglobata*, *G. cyclostoma*, *G. triloba*, *Orbulina universa*, *Globorotalia fohsi*, *G. mayeri*, *Globoquadrina dehiscens*, *Globoquadrina altispira* etc. and such benthonic forms as *Ammodiscus incertus*, *Cyclammina cancellata*, *C. pusilla*, *Haplophragmoides renzi*, *H. subglobosa*, *Sigmoilina miocenica*, *Nodosaria subraphana*, *Nonion nicobarense* etc..

The most conspicuous characteristic of this sonule is that it has such predominant pelagic forms as *Globoquadrina dehiscens*, *G. altispira*, *Globorotalia fohsi*, *Globigerinoides triloba*.

It is specially noteworthy that *Globigerina globularis*, *Globigernoides bisphericus*, *Globorotalia mayeri* and *Orbulina universa* make their first appearance in this zonule, *Orbulina universa* D'ORBIGNY occurs extremely rare while *Candorbulina* is absent. This zonule is comprehended in qualified points for the "*Orubulina* surface".

IV. YUIAN

The Yuian stage is the last division of the Miocene series. Its type is the Sagara Group at Sagara. The Yuian strata yeild Sagarites chitanii very frequently, but few molluscan remains.

The top of the Yuian is covered by the Pliocene deposits (Kakegawa Group) unconformably and the base is overlying unconformably the Ooigawa Group.

The flysch-like mudstones are more predominant in the lower part than in the upper part. The Yuian occupies the same position as the Sagara Group. It contains numerous planktonic foraminiferas, and a small number of benthonic foraminiferas.

There are two conspicuous zones in the Yuian, namely the *Orbulina universa* zone and *Globigerina inflata* zone. They are well-recognized both in the Sagara and Kakegawa districts alike.

(A) *Orbulina universa* zone

This zone is characterized by *Orbulina universa, Globorotalia fohsi, Globigerinoides conglobata, G. triloba* and *Sphaeroidinella dehiscens.*

All the strata of this zone have more predominant foraminiferal planktons than benthos. The upper limit of the *Orbulina universa* zone is at a level in the upper part of the Sagara formation, while the lower limit of it is placed upon the very base of the Sagara Group (Tokigaya formation).

The type section of this zone is consisting of a series of exposure around Sagara.

The five zonules of the *Orbulina universa* zone are in descending order as follows.

(5) *Orbulina universa—Sphaeroidinella dehiscens* zonule
(4) *Orbulina universa—Globigerinoides triloba* zonule
(3) *Globigerinoides conglobata—Sphaeroidinella dehiscens* zonule
(2) *Orbulina universa* zonule
(1) *Orbulina universa—Globorotalia fohsi* zonule

(1) *Orbulina universa—Globorotalia fohsi* zonule

The lower Tokigaya formation is the corresponding lithologic subdivision.

This zonule is characterized by the following dominant occurrence (i) pelagic forms—*Orbulina universa, Globorotalia fohsi, Globigerina borealis, G. bulloides, G. conglomerata, G. diplostoma, G. inflata, G. quinqueloba, G. subcretacesa, Globigerinoides conglobata, G. cyclostoma, G. triloba, Sphaeroidinella dehiscens, Globorotalia menardii*, etc.. (ii) Benthonic forms—*Karreriella baccata japonica, Sigmoilina arenaria, Dentalina emaciata, D.* cf. *filiformis, D. subsoluta, Lagena elongata, Amphimorphina haueriana, Entosolenia marginata, Uvigerina ishikiensis, Ellipsonodosaria ketienziensis, Eponides umbonatus, Gyroidina orbicularis, Pullenia bulloides, Cibicides pseudongernaus, C. refulgens, Hanzawaia nipponica* etc..

This zonule is *Orbulina universa, Globorotalia fohsi, G. menardii* and *Sphaeroidinella dehiscens* are the most predominant pelagic forms.

Orbulina universa is the most prevailing species during the times especially in the early times. Generally speaking, content of the fauna increases toward the lower part of the Tokigaya formation.

(2) *Orbulina universa* zonule

The middle Tokigaya formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrences (i) Pelagic forms —*Orbulina universa, Globigerina bulloides, G. triloculinoides, Globigerinoides conglobata, G. cyclostoma, G. sacculifera, G. trloba, G.* sp., *Sphaeroidinella dehiscens, Globorotalia menardii, G. tumida* etc.. (ii) Benthonic forms—*Dentalina subsoluta,* *Lagena elongata*, *Nonion nicobarense*, *Uvigerina proboscidea*, *Eponides haidingerii*, etc..

Among the listed species the superior pelagic forms are *Orbulina universa*, *Globigerina triloculinoides*, *Globorotalia menardii*, and *G. tumida*.

(3) *Globigerinoides conglobata—Sphaeroidinella* zonule

The upper Tokigaya formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrences (i) Pelagic forms —*Globigerinoides conglobata*, *Sphaeroidinella dehiscens*, *Globigerina bulloides*, *G. subcretacea*, *G. triloculinoides*, *Globigerinoides cyclostoma*, *G. sacculifera*, *G. triloba*, *Orbulina universa*, *Globorotalia fohsi*, *G. menardii*, etc.. (ii) Benthonic forms—*Ellipsonodosaria ketienziensis*, *Eponides haidingerii*, *E. umbonatus*, *Sphaeroidina bulloides*, etc..

The commonest pelagic forms are *Globigerinoides conglobata*, *Sphaeroidinella dehiscens*, *Orbulina universa*, *Globorotalia fohsi* and *G. menardii* etc.. The pelagic forms are much more abundant than the benthonic forms in general. Arenaceous forms, discovered in the other zonules under this zone, are quite absent in this limited zonule.

(4) *Orbulina universa—Globigerinoides triloba* zonule

The lower Sagara formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrences (i) Pelagic forms —*Orbulina universa*, *Globigerinoides triloba*, *Globigerina borealis*, *G. bulloides*, *Globorotalia menardii*, *Globigerinoides conglobata* and *G. triloba*, etc.. (ii) Benthonic forms—*Martirottiella* cf. *communis*, *Nonion nicobarense*, *Bolivina subangularis ogasaensis*, *Uvigerina proboscidea* and *Eponides haidingerii* etc..

Orbulina universa and *Globigerinoides triloba*, are very common, while *Uvigerina probosoidea* occurs abundantly in the lower levels of this zonule. *Orbulina* was *persistent*.

(5) *Orbulina universa—Sphaeroidinella dehiscens* zonule

The upper Sagara formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrence (i) Pelagic forms —*Globigerina borealis*, *G. bulloides*, *G. subcretacea*, *G. triloculinoides*, *Globigerinella aequilateralis*, *Globigerinoides conglobata*, *G. conglomerata*, *G. rubra*, *Orbulina universa*, *Sphaeroidinella dehiscens*, *Globorotalia fohsi* and *G. menardii*, etc.. (ii) Benthonic forms—*Karreriella baccata japonica*, *Lagena elongata Glandulina nipponica*, *Nonion nicobarense*, *Uvigerina crassicostata*, *U. excellens U. nitidula*, *U. proboscidea*, *Ellipsonodosaria ketienziensis*, *Epistomina elegans*, *Eponides umbonatus* and *Rotalia papillosa*, etc..

Orbulina universa and *Sphaeroidinella dehiscens* in every part of this zonule.

(B) ***Globigerina inflata*** **zone**

This zone is characterized by *Globigerina inflata*, *G. bulloides*, *G. borealis*, *Catapsydrax dissimilis*, *Globigerinoides triloba* and *Orbulina universa*.

The planktons are common, while the benthonic forms are dominant.

The upper limit of this zone is in the upper part of the Kiriyama formation as well as the Tamari formation, while the lower limit is just the base of the Kiriyama and Tamari formations. The pelagic foraminiferas seem to be decreasing in number than in the *Orbulina universa* zone. *Globigerina inflata* zone may be divided into six zonules in descending order as follows:

Kakegawa district	Sagara district
(3) *Bulimina pupoides* —*Uvigerina proboscidea* zonule	(3) *Globigerina bulloides* —*Bolivinita quadrilatera* zonule
(2) *Globigerina bulloides* zonule	(2) *Cibicides pseudoungerianus* zonule
(1) *Globigerina inflata* zonule	(1) *Globigerina inflata* zonule

Kakegawa district

(1) *Globigerina inflata* zonule

The lower Tamari formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrences of (i) Pelagic forms—*Globigerina inflata, G. bulloides, G. triloculinoides, Catapsydrax dissimilis, Globigerinoides conglobata, G. cyclostoma, G. triloba, Globorotalia punctulata, G. truncaturinoides* etc.. (ii) Benthonic forms—*Sigmoilina miocenica, Robulus calcar, Nonion nicobarense, Bolivina robusta, Bulimina aculeata, B. inflata, B. nojimaensis,* etc.. *Uvigerina crassicostata, U.* cf. *proboscidea, Epistomina elegans.*

The most predominant forms are *Globigerina inflata, G. triloculinoides, Globorotalia truncaturinoides, G. punctulata, Catapsydrax dissimilies, Globigerina inflata, Gyroidina orbicularis* and *Rotalia ketienziensis, Globigerina inflata, Globorotalia punctulata* and *G. trucaturinoides* appeared first in this zonule at least in the worked area.

(2) *Globigerina bulloides* zonule

The middle Tamari formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrences (i) Palagic forms —*Catapsydrax dissimilis, Globigerina borealis, G. bulloides, G. eggeri, G. inflata, G. triloculinoides, G.* sp., *Globigerinoides cyclostoma, G. triloba, Orbulina universa* and *Globorotalia truncaturinoides* etc.. (ii) Benthonic forms—*Gaudrina arenaria, Sigmoilina miocenica, Lagena elongata, Robulus nikobarensis, R. pseudorotulatus, Nonion nicobarense, Bolivina robusta, Bulimina aculeata, B. brady, Uvigerina crassicostata, U. proboscidea, Epistomina elegans, Gyroidina orbicularis, Pseudoeponides japonicus, Cibicides aknerianus* and *Hanzawaia nipponica*, etc.. This zonule is typified by its predominant pelagic forms such as *Globigerina bulloides, G. inflata, Globigerinoides cyclostama, G. triloba*, etc..

Though *Globigerina inflata* is not very common, it is found in all the samples, so as the name *Globigerina inflata* zonule is given.

(3) *Bulimina* cf. *pupoides*—*Uvigerina* cf. *proboscidea* zonule

The upper Tamari formation is the corresponding lithologic subdivision.

This zonule is characterized by the more or less occurrences (i) Pelagic forms—*Globigerina borealis, G. bulloides, G. inflata, G. triloculinoides, Globorotalia fohsi* and *Globoratalia truncaturinoides,* etc.. (ii) Benthonic forms—*Sigmoilina miocenica, Lagena elongata, Robulus pseudorotulatus, Nonion nicobarense, Bolivinita quardrilatera, Bulimina aculeata, B.* cf. *pupoides, Uvigerina crassicostata, U. proboscidea, Ellipsonodosaria ketienziensis, Gyroidina orbicularis, Cibicides lobatulus* and *Hanzawaia nipponica,* etc..

There are abundant benthonic forms such as *Bolvinita quardrilatera, Bulimina* cf. *pupoides, Uvigerina* cf. *proboscidea* and *Gyroidina orbicularis,* while the benthonic forms are very few and scattered.

Sagara district

(1) *Globigerina inflata* zonule

The lower Kiriyama formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrences (i) Pelagic forms —*Globigerina bulloides, G. inflata, G.* sp., *Globigerinoides conglobata, G. cyclostoma, C. triloba, Orbulina universa, Globorotalia crassula* and *G. menardii,* etc.. (ii) Benthonic forms—*Lagena dentaliniformis, L. elongata, Nodosaria subraphana, Uvigerina excellens, U. nitidula, Ellipsonodosaria ketienziensis, Eponides haidingerii, Pullenia bulloides* and *Hanzawaia nipponica,* etc..

This zonule is also rich in pelagic forms such as *Globigerina inflata, Orbulina universa* and *Globorotalia menardii,* etc.. Practically no arenaceous form occurs here in this zonule in Sagara, while there are so many arenaceous forms in the same level of the other district.

(2) *Cibicides pseduoungerianus* zonule

The middle Kiriyama formation is the corresponding lithologic subdivision.

This zonule is characterized by the more or less occurrences (i) Pelagic forms—*Globigerina bulloides, G.* sp., *Globigerinoides conglobata G. triloba* and *Orbulina universa,* etc.. (ii) Benthonic forms—*Legena elongata, Elphidium fax barbarense, Uvigerina excellens, Ellipsonodosaria ketienziensis, Eponides haidingerii, Cibides pseudoungerianus* and *Hanzawaia nipponica* etc..

This zonule is marked with abundant benthonic form *Cibicides pseudoungerianus,* but the pelagic forms are scattered throughout the zonule. The contents of fauna appear to be meagre compared with other zonules of the *Globigerina inflata* zone.

(3) *Globigerina bulloides—Bolivinita quadrilatera* zonule

The upper Kiriyama formation is the corresponding lithologic subdivision.

This zonule is characterized by the dominant occurrences (i) Pelagic forms —*Globigerina berealis, G. bulloides, G. quinqueloba, G. subcretacea, G.* sp., *Globigerinoides conglobata,* and *Globorotalia crassula,* etc.. (ii) Benthonic forms—*Bulimina aculeata, B. inflata, Uvigerina* cf. *hootsi, U. proboscidea, Epistomina elegans* and *Eponides haidingerii,* etc..

Globigerina bulloides and *Bolivinita quardrilatera* are the most supreme representatives.

PALEOECOLOGY

Paleoecological analyses of the faunal assemblages may be made on the basis of the recent foraminiferal assemblages under the known important factors, such as temperature, depth, salinity, food, oxygen content, light, acidity of waters etc.

NATLAND (1933) suggests that temperature has a greater influence on the zonation of Foraminifera than depth. LEROY (1948) observed that the pelagic foraminiferas are more or less independent of bottom environment. Their distribution development and dispersal are controlled by the physical and chemical natures of the upper layers of the sea, wind patterns, type and intensity of currents and inter-connection of sea ways.

PHLEGER (1951) recognized that shallow water faunas which had been displaced downslope into deeper water.

BUTCHER (1951) examined temperature and salinity are considered to be the most important ecological factors affecting these faunal facies.

CROUCH (1952) studied the Foraminifera from cross taken in the deep basins off southern California. He was able to establish four biozones which are more closely correlated with temperatures than oxygen or salinity variations:

T_4	Depth range	900 - 2,000 ft.
T_5	"	2,000 - 4,000 ft.
T_6	"	4,000 - 7,500 ft.
T_7	"	approx. 7,500 ft. — ?

CROUCH found that the foraminiferal faunas were uniform from the sill depths to the bottom of the basins which correspond to the nearly constant temperatures exisiting there.

BANDY (1953) suggests temperature being the dominant ecological factor that controlls the depth zonation, but he points out that other factors may be important since depth zonations are present where no temperature gradation exists. Five depth zones were established:

Brackish (Polyhaline) zone	
Middle-neritic zone	0 - 150 ft.
Lower-neritic zone	150 - 600 ft.
Bathyal zone	600 - 6,000 ft.
Abyssal zone	6,000 ft.

NAGAHAMA, M. (1954) states that the distribution of foraminiferal assemblages coincides with the distribution of water masses in the Suruga Bay. In the deep bottom of bay, foraminiferas are very poor and the association of benthos forms is supposed to be accidental.

WALTON (1955) suggests that benthonic Foraminiferal distributions are apparently related to depth changes and associated temperature variations. The production of benthonic Foraminifera varies seasonally in Tods Santos Bay and the maximum abundances occur in June and August. Each species apparently does not have its maximum abundance during the same season. The population maxima in June and August are apparently related to the late spring and late summer flowering of phytophankton in the area.

The seasomal temperature maximum which occurs in August may influence the greater production during that month.

The writer (1957, 1958) mentioned that arenaceous foraminiferal assemblages are usually good indicators of their origin in good embayments (Hiuchi-nada). Generally number of arenaceous forms increases towards the interior part of the Kii Strait. This group is regarded to represent the embayment waters.

However, inasmuch as we do not know any direct method to prove the coincidence between a fossil and a living set of ecological elements, it is impossible to discuss details very precisely. If it is permissible to refer some ecological criteria further of the Recent Foraminifera to the material at hand the following statements may be introduced here.

I. OOIGAWAN

(A) *Lepidocyclina (Nephrolepidina) nipponica* zone

(1) *Martinottiella* cf. *communis* zonule

The zonule is characterized by *Martinottiella* cf. *communis* together with some arenaceous forms. Pelagic form absent.

The occurrence of *Martinottiella* cf. *communis* shows an environment under the sea that is cold, deep, and poor in oxygen. It may be assumed that this zonule was under a little influence of any current.

(2) *Lepidocyclina (Nephrolepidina) nipponica* zonule, the second zonule and the zone with the same representative *Lepidocyclina (Nephrolepidina) nipponica*, *L. (N.) angulosa*, *L. (N.) peronata* and *Miogypsina kotoi*, but for a few ill-defined smaller forms.

These larger foraminifers are closely retated to the Indo-Pacific tropical forms which lived in the shallow waters over coral reefs. Anyway this zonule was influenced by the warm shallow waters.

(B) *Martinottiella* cf. *communis* zone

Sagara district

(1) Lower *Martinottiella* cf. *communis* zonule

The occurrences of *Martinottiella* cf. *communis*, *Cyclammina pusilla*, *Sigmoilina miocenica* and *Haplophragmoides* sp. show the cold and deep sea-bottoms poor in oxygen. It may be assumed this assemblage be under a slight influence of currents.

(2) Upper *Martinottiella* cf. *communis*—*Cyclammina pusilla* zonule

This zonule is the characterized by *Martinottiella* cf. *communis* and *Cyclam-*

mina pusilla, while *Globigerinoides triloba* is extremely rare presumably suggesting the first appearance in this time. In addition to this, the presence of *Globigerinoides* tells warm-waters elsewhere around.

Generally speaking, this zonule may not be regarded representing a temperate circumstance upon a continental shelf, but it may be under a more considerable influences of the Kuroshio (the warm current) than the Lower *Martinottiella—Cyclammina* zonule.

Futamata district

(1) Lower *Martinottiella* cf. *communis—Haplophragmoides* sp. zonule

Judging from the set of members, this zonule is ascribed to an origin under a littoral zone little influenced by current.

(2) Upper *Martinottiella* cf. *communis—Haplophragmoides* sp. zonule.

It may be assumed that this zonule was made under a little influences of current.

(3) *Cyclammina pusilla* zonule

Cyclammina pusilla, *Haplophragmoides* cf. *renzi*, *H. rugosa*, *H. subglobosa* and *Martinottiella* cf. *communis* are the chief members.

Catapsydrax dissimilis is extremely rare in this zonule, suggesting presumable lowest horizon. The presence of *Catapsydrax dissimilis* shows the open sea condition, but the whole assemblage shows a little influence of current.

(4) *Rotalia beccarii*

According to NORTON, *Rotalia beccarii* is a dweller of littoral zones, 1 foot at low tide, variants of this species occur in shallow waters, all along the shores of Osaka Bay, Kii Strait, Suruga Bay and Tokyo Bay etc.. This zonule shows the shallow water environment.

II. TOGARIAN

The Togarian is represented by only one zone the *Cyclammina japonica* zone which is subdivided into the five zonules.

Kakegawa district

(1) *Cyclammina pusilla* zonule

The dominant arenaceous form *Cyclammina pusilla* occurs at every part of this zonule. Absence of pelagic form must be noticed again. These arenaceous assemblage are regarded to represent an embayment.

(2) *Cyclammina japonica* zonule

The benthonic members indicate a bay water condition. The presence of a few *Globigerina borealis*, the kurile form together with tropical to subtropical forms such as *Globigerinoides triloba* is a remarkable fact. This zonule is ascribed to originate under the Lower neritic bathyal part a little influenced by the mixed currents.

(3) *Globigerina bulloides—Martinottiella* cf. *communis* zonule

The mixed assemblage; the occurrences of *Globorotalia fohsi* and *Sphaeroidinella dehiscens* indicate tropical waters opened to the out side ocean.

The Benthonic members are of neritic. This zonule may have originated from an environment under the mixing currents.

Futamata district

(1) *Nonion japonicum* zonule

The members of this zonule are those inferable to shallow neritic waters since it has no pelagic member.

(2) *Sigmoilina miocenica* zonule

The characteristic members such as *Sigmoilina miocenica*, *Bathysiphon eocenica*, *Reophax* cf. *cylindricus*, *Cyclaminu japonica*, *C. pacifica*, and and *C. pusilla*, but none of pelagic form suggest an embayed littoral origin.

III. TOZAWAN

(A) *Lepidocyclina (Nephrolepidina) makiyamai* zone

The larger foraminifers dwelled in the warm shallow clean waters. The zonule is ascribed to originate under neritic part a little influenced by the currents.

(B) *Globoquadrina dehiscens* zone

Globoquadrina dehiscens, *G. altispira*, *Globigerina globularis*, *Orbulina universa*, *Globorotalia fohsi* and *G. mayeri*, etc..

(1) *Ammodiscus incertus* zonule

The commonest species *Ammodiscus incertus*, *Cyclammina pusilla*, *Haplophragmoides subglobosa*, *Karreriella baccata japonica*, *Sigmoilina miocenica* and *Texturalia* sp. remind conditions existed in a deep sea slightly influenced by currents.

In addition to this, the presence of *Globigerina bulloides*, *Globoquadrina dehiscens*, and *Catapsydrax dissimilis* show an open deep water emvironment.

Generally speaking, the environment may be ascribed neritic to bathyal part under a slight influence of currents.

(2) *Globoquadrina dehiscens* zonule

Globoquadrina dehiscens, *G. altispira*, *Globorotalia fohsi*, *G. meyeri*, *Orbulina universa*, *Globigerinoides triloba* and *Globigerna globularis* indicate the deep waters of the basin under the influence of the Indo-Pacific warm current.

IV. YUIAN

(A) *Orbulina universa* zone

All the strata of this zone have more predominant planktons than benthos.

(1) *Orbulina universa—Globorotalia fohsi* zonule

The occurrence of *Orbulina universa, Globorotalia fohsi, G. menardii, Globigerinoides conglobata* and *Sphaeroidinella dehiscens* indicate the warm open sea conditions that were in connection with the subtropic to tropic waters, while there are a few specimens of northern species *Globigerina borealis.* The benthonic forms tell that they were members of a middle neritic fauna.

The assemblage of this zonule originate in a neritic zone dominantly influenced by the Kuroshio current, but a little influence of the cold current cannot be denied.

(2) *Orbulina universa* zonule

This zonule has abundant tropical pelagic forms such as *Globorotalia menardii, Sphaeroidinella dehiscens* with the predominant *Orbulina universa* while the benthonic forms by no means characterize the zonule.

The disappearance of *Globigerina borealis* and *Globorotalia fohsi* is remarkable. The benthonic forms such as *Dentalina subsoluta, Lagena elongata, Nonion nicobarense, Uvigerina proboscidea* and *Eponides haidingerii* suggest an environment under fairly warm and deep waters.

Most probably the fauna was born in the bathyal bottom under the Kuroshio.

(3) *Globigerinoides conglobata—Sphaeroidinella dehiscens* zonule

In addition to the superior members *Globigerinoides conglobata* and *Sphaeroidinella dehiscens,* there are abundant tropical and subtropical forms such as *Orbulina universa, Globigerinoides conglobata, Globorotalia fohsi* and *G. menardii.*

The benthonic forms consist only a small portion of the fauna and has no arenareous members that flourished in the other zonules of this zone. The bathyal part of open sea under the Kuroshio was the environment.

(4) *Orbulina universa—Globigerinoides triloba* zonule

Besides the representing members there are abundant tropical forms such as *Globigerinoides conglobata, G. triloba* and *Globorotalia menardii* and a northern form *Globigerina borealis. Globigerina bulloides* is the well known temperate zone inhabitant.

The benthonic forms such as *Martinottiella* cf. *communis, Bolivina subangularis ogasaensis, Uvigerina proboscidea* and *Eponives haidingerii* show Lower neritic loci.

The environment may be ascribed to bathyal part under mixing currents.

(5) *Orbulina universa—Sphaeroidinella dehiscens* zonule

This zonule is represented by abundant tropical pelagic forms such as *Globorotalia fohsi, G. menardii* and *Globigerinoides conglobata, Globigerina borealis* though small in number occurs as well.

The other pelagic forms show a temperate condition. The common benthonic forms indicate an environment under fairly middle neritic condition.

Generally speaking, this zonule is ascribed to the neritic to bathyal origin, but a slight mixture of cold current may be mentioned.

(B) ***Globigerina inflata* zone**

Kagawa district

(1) *Globigerina inflata* zonule

In addition to the dominant *Globigerina inflata* and *G. bulloides* there are abundant Kuroshio forms such as *Globigerina triloculinoides*, *Globigerinoides Cyclostoma*, *Globorotalia punctulata* and *G. truncatulinoides*, and tropical to subtropical forms such as *Orbulina universa* and *Globigerinoides conglobata* and *Globgerinoides triloba*, besides a northern form *G. borealis*.

The dominant benthonic forms such as *Sigmoilina miocenica*, *Robulus calcar*, *Nonion nicobarense*, *Bolivina robusta*, *Bulimina aculeata*, *B. inflata*, *B. nojimaensis*, *Uvigerina crassicostata*, *U.* cf. *proboscidea* and *Epistomina elegans* indicate an environment under fairly warm but deep water. This zonule is ascribed to originate under the neritic—bathyal part of mixing currents.

(2) *Globigerina bulloides* zonule

The dominant forms such as *Globigerina bulloides*, *G. inflata*, *Globigerinoides cyclostoma* and *G. triloba* together with the other members for instance *Globigerina eggeri*, *G. triloculinoides*, *G.* sp. and *Globoratalia truncaturinoides* show an environment referable to warm and deep sea under the Kuroshio. *Globigerina borealis* though not very common occurs with tropic to subtropical form such as *Orbulina universa* and *Globigerinoides triloba*.

The benthonic resemblance to element is subordinate, but suggest a neritic —bathyal origin.

(3) *Bulimina* cf. *pupoides*—*Uvigerina* cf. *proboscidea* zonule

Bulimina cf. *pupoides*, *Uvigerina* cf. *probocidea*, *Bolivinita quardrilatera* and other benthonic elements play only subordinate rôles while on the other hand the pelagic forms are sporadical and less common. The presences of *Globigerina borealis* and *Globorotalia fohsi* suggest a slight influence of the mixing current. The conclusion is that this zonule has neritic—bathyal origin.

Sagara district

(1) *Globigerina inflata* zonule

The predominant forms *Globigerina inflata*, *Orbulina universa* and *Globorotalia menardii* and the common pelagic forms *Globigerina*, *G.* sp., *Globigerinoides conglobata*, *G. cyclostoma*, *G. triloba*, *Globorotalia crassula* may give an ecological assumption. *Globorotalia menardii*, *Orbulina universa* and *Globigerinoides conglobata* belong to the tropical to subtropical open sea element. There is no *Globigerina boreales*.

The benthonic fauna resembles that of the same level in the Kakegawa district, but for arenaceous forms. The fauna may be considered as born in the neritic—bathyal part of warm current.

(2) *Cibicides pseudoungerianus* zonule

The predominant benthonic form *Cibicides pseudoungerianus*, *Lagena elongata*, *Elphidium fax barbarense, Uvigerina excellens, Ellipsonodosaria ketienziensis, Eponides haidingerii* and *Hanzawaia nipponica* show a littoral environment. The pelagic forms are scattered throughout the zonule.

Globigerinoides conglobata and *Orbulina universa* indicate a subtropical open sea while other pelagic forms suggest an open warm water.

The contents discolose rather a shallower environment as compared with *Globigerina inflata* zonule.

(3) *Globigerina bulloides—Bolivinita quardrilatera* zonule

Globigerina bulloides and *Bolivinita quardrilatera* are the most supreme representatives. The occurrence of *Globigerina bulloides, G. quinqueloba, G. subcretacea, G.* sp. and *Globorotalia crassula* indicate the warm Kuroshio water environment.

In addition to this the presence of the few Kurile form *Globigerina borealis* and subtropical dweller such as *Globigerinoides conglobata.*

The benthonic forms indicate the conditions inferable to the middle neritic environment.

Generally speaking, this fauna was born in the neritic part under the warm current with a slight mixture of cold water.

ORUBLINA SURFACE

LEROY (1948) suggested that points of lowest stratigraphic occurrence of *Orbulina universa* D'ORBIGNY and *Candorbulina universa* JEDLITSCKA will permit definition of a time horizon—*Orbulina* surface—within the Middle Tertiary sequences throughout tropic and subtropic regions.

The Kassikan section of central Sumatra is believed to fulfill all requirements for establishing a qualified point on the *Orbulina* surface and is designated as a type for the East Indian Archipelago.

LEROY (1952) is requesting discussions from micro-paleontologists of *Orbulina* in various Tertiary sections. He emphasizes the importance of the lower limit of this species as possible middle Tertiary time indicator in proper marine Tertiary sections within present-day low latitudes of the world.

According to BOWEN (1955), *Orbulina universa* D'ORBIGNY does not occur below the basal Miocene. Stratigraphical and micropaleontological evidences support his statement. The *Orbulina*-surface is shown to be confined to the middle Tertiary, though possibly not strictly contemporaneous in its lateral extent. The genus *Orbulina* is extremely valuable as a Neogens zone-fossil.

The purpose of this investigation is to find the extension of the *Orbulina* surface to the Miocene rocks in central Japan.

The geology and paleontology of the western part of Shizuoka perfecture in the central Japan has been worked out by many authors.

Especially the knowledge on larger foraminifers has made progress by MAKIYAMA.

The section prepared by MAKIYAMA in this area are adopted in this paper.

A great number of samples collected from the Futamata, Kakegawa and Sagara districts were examined to find out the *Orbulina* surface.

The result of micropaleontological analysis is shown in the check list (table 1–3). As a result of pursuits the lowest limit of *Orbulina universa* D'ORBIGNY is known to be the *Globoquadrina dehiscens* zone, though it is extremly rare in the Saigo formation.

It seems probable that the *Orbulina* surface in central Japan lies at the middle Miocene (f_3-stage).

The record indicators predominate in the upper Miocene, but not at all in the lower Miocene.

The absence of *Candorbulina universa* JEDLITSCKA, which is common in central Sumatra has to be noticed in this connection.

The lowest limit of the vertical range of the *Orbulina universa* D'ORBIGNY is in the middle Miocene (f_3-stage) of central Japan and may also indicate the first invasion of the modern warm temperate zone into Japan.

The writer has been informed that *Orbulina universa* had not been discovered in the Miocene sequences on Japan sea coast.

SUMMARY

(1) The biostratigraphical sequence of the Miocene deposits in central Japan are in descending order as follows refering to the stage names and the letter marks.

	Globigerina inflata zone
Yuian (G)	*Orbulina universa* zone
	Globoquadrina dehiscens zone
Tozawan (F_3)	*Lepidocyclina makiyamai* zone
Togarian (F_2)	*Cyclammina japonica* zone
	Martinattiella communis zone
Ooigawan (F_1)	*Lepidocyclina nipponica* zone

(2) It is confirmed that the lowest stratigraphic horizon of *Orbulina universa* D'ORBIGNY in central Japan is in the upper part of the Saigo Group (F_3-stage), exactly 50 m. below the top, its first appearance being in the *Globoqaudrina dehiscens* zone.

Orbulina universa D'ORBIGNY is very common in the Sagara Group (G). All the horizons below this level mentioned above the lower Saigo, Kurami (F_2) and Ooigawa (F_1) contain none of this remarkable species, even none of fragment that reminds this planktonic test, but for problematical spherules in the Lower Saigo.

(3) The Miocene of central Japan seems to be characterized by the complete absence of *Candorbulina universa* JEDLILSCKA which is related to *Orbulina universa* D'ORBIGNY in central Sumatra.

(4) The occurrence of *Globigerina inflata* and other common planktonic forms both in the Tamari and the Kiriyama formations assures the lithological correlation.

(5) During the G–F_3 ages sea became warmer than in the F_2–F_1, and it may be assumed that G–F_3 stages were under a predominant influence of the Kuroshio current.

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PLATE I

Fig. 1.	*Robulus nikobarensis* (SCHWAGER) ×30
Fig. 2.	*Robulus calcar* (LINNAEUS) ×30
Fig. 3.	*Robulus pseudorotulatus* ASANO ×60
Fig. 4.	*Nonion japanicum* ASANO ×45
Fig. 5.	*Nonion nicobarense* CUSHMAN ×60
Figs. 6, 7.	*Ellipsonodosaria ketienziensis* ISHIZAKI ×50
Fig. 8.	*Bolivina robusta* BRADY ×80
Fig. 9.	*Karreriella baccata japonica* ASANO ×120
Fig. 10.	*Bathysiphon eocenica* ASANO ×40
Fig. 11.	*Martinottiella communis* (D'ORBIGNY) ×50
Figs. 12, 13.	*Cyclammina japonica* ASANO ×35
Fig. 14.	*Cyclammina pusilla* BRADY ×35
Fig. 15.	*Sigmoilina miocenica* BRADY ×50
Fig. 16.	*Ammodiscus incertus* (D'ORBIGNY) ×45
Fig. 17.	*Hanzawaia nipponica* ASANO ×60
Fig. 18.	*Elphidium fax barbarense* (NICOL) ×65
Fig. 19.	*Haplophragmoides compressum* LEROY ×45
Fig. 20.	*Haplophragmoides trullisatum* (BRADY) ×60
Fig. 21.	*Cyclammina pacifica* BEEK ×60

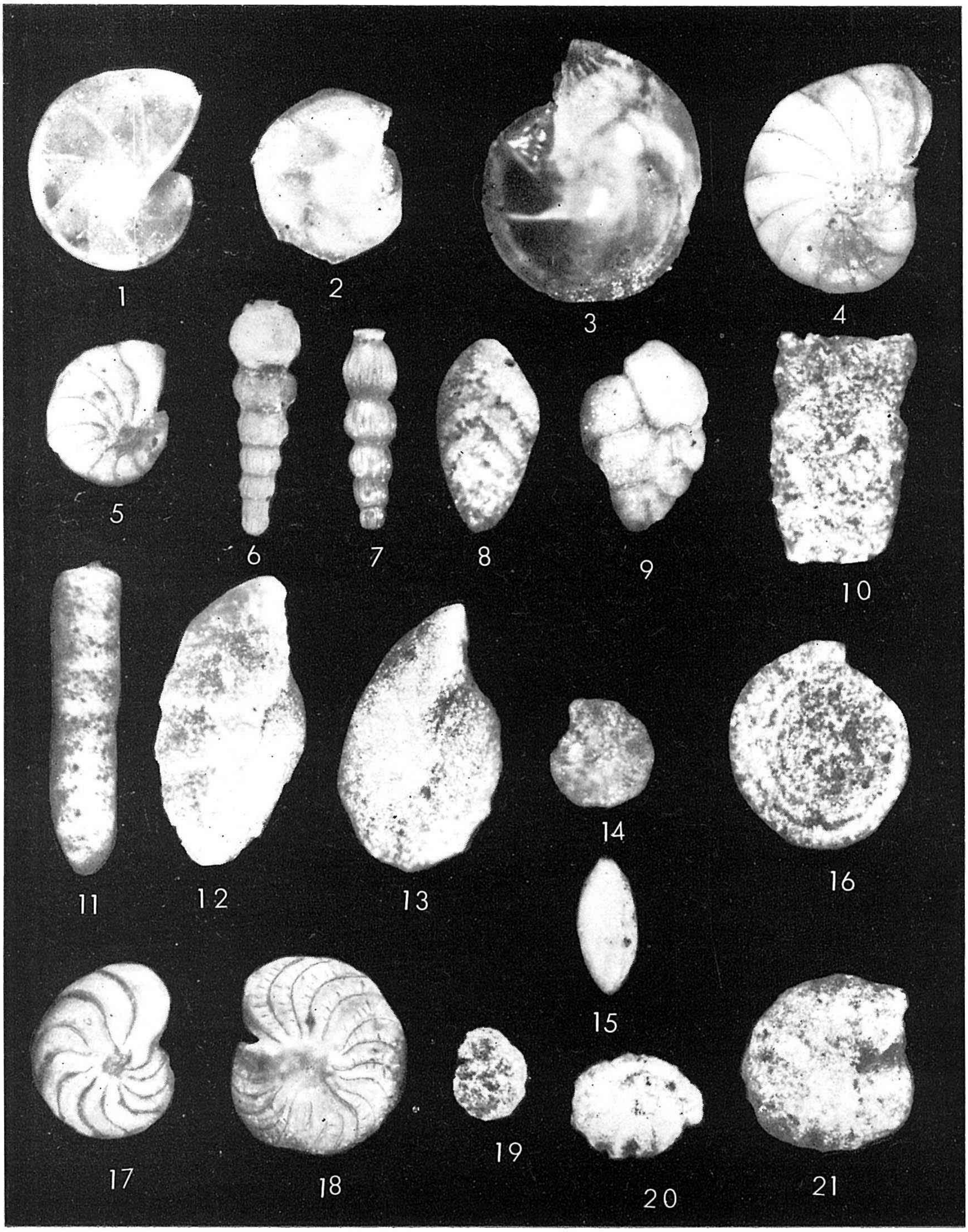
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PLATE II

Figs. 1, 5.	*Dentalina emaciata* REUSS ×40
Figs. 2, 3, 4.	*Dentalina setanaensis* ASANO ×80
Fig. 6.	*Dentalina inflex* REUSS ×30
Fig. 7.	*Dentalina subsoluta* (CUSHMAN) ×30
Fig. 8.	*Lagena elongata* (EHRENBERG) ×50
Fig. 9.	*Siphogenerina raphanus* (PARKER and JONES) ×60
Fig. 10.	*Bulimina aculeata* D'ORBIGNY ×80
Fig. 11.	*Bulimina marginata* (MONTAGU) ×100
Fig. 12.	*Bulimina inflata* SEGENZA ×80
Figs. 13, 16 a, b.	*Uvigerina excellens* TODD ×80
Fig. 14.	*Uvigerina crassicostata* SCHWAGER ×70
Fig. 15.	*Bolivinita quadrilatera* (SCHWAGER) ×50
Figs. 17, 18.	*Uvigerina subpergrina* BRADY ×60
Fig. 19.	*Uvigerina proboscidea* SCHWAGER ×80
Fig. 20.	*Uvigerina* cf. *hootsi* RANKIN ×80
Fig. 21.	*Gyroidina soldanii* D'ORBIGNY ×70
Fig. 22.	*Rotalia beccarii* (LINNAEUS) ×70
Fig. 23.	*Cibicides aknerianus* (D'ORBIGNY) ×70
Fig. 24.	*Cibicides lobatulus* (WALKER and JACOB) ×60
Fig. 25.	*Cibicides pseduongerianus* (CUSHMAN) ×60

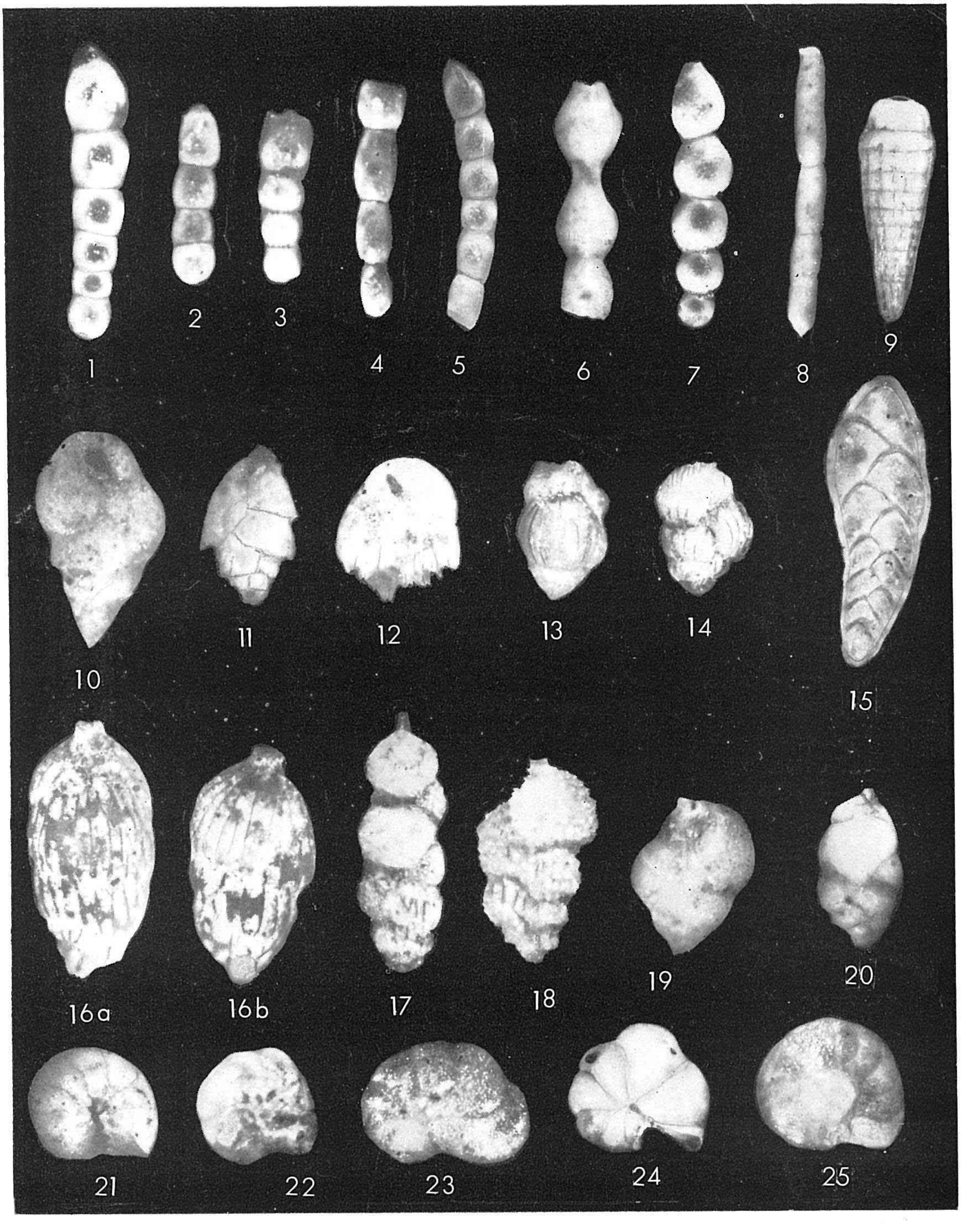
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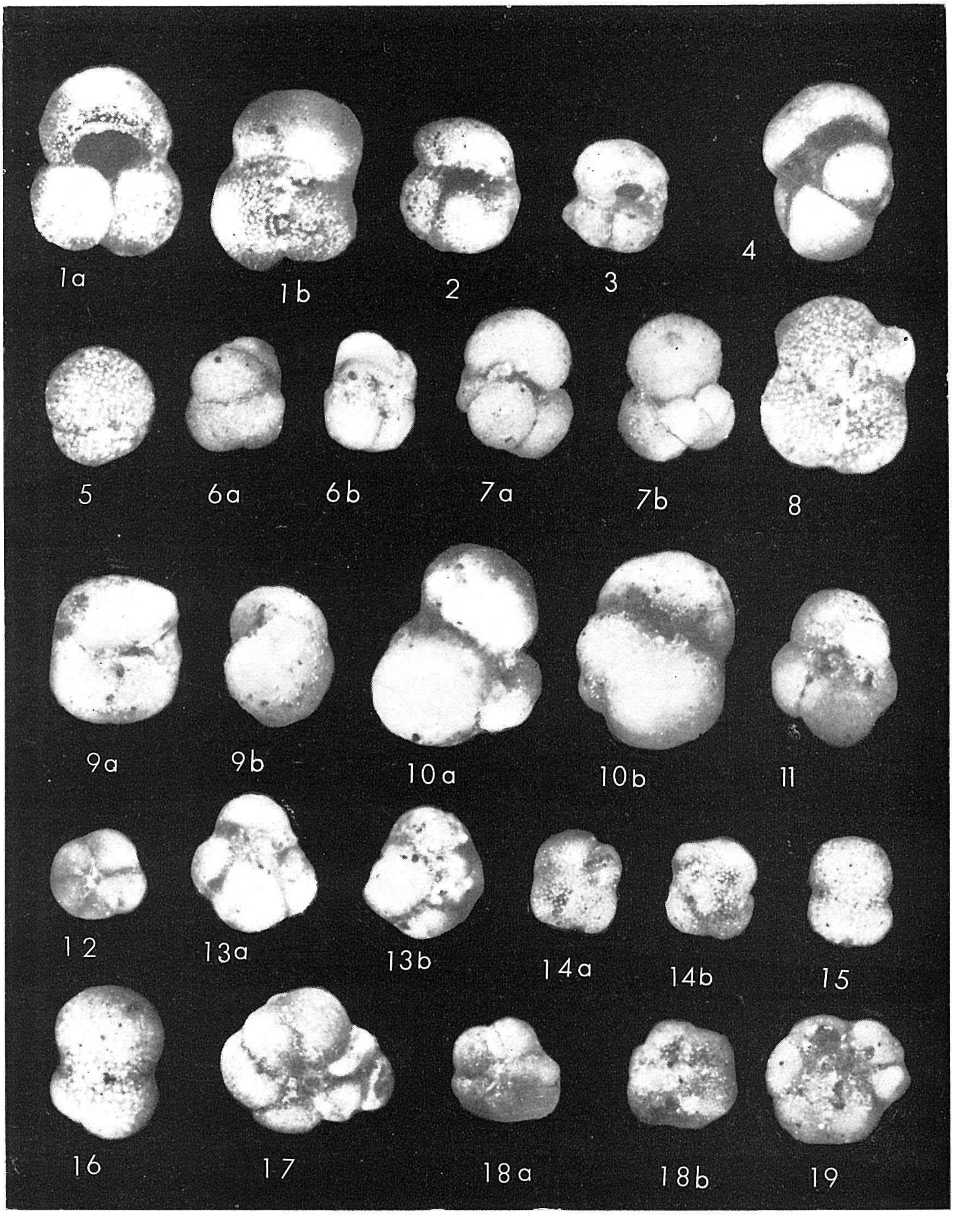
PLATE III

Figs. 1 a, b.	*Globigerinoides rubra* (D'ORBIGNY) ×100
Fig. 2.	*Globigerinoides conglobata* (BRADY) ×80
Figs. 3, 6 a, b.	*Globigerinoides cyclostoma* (GALLOWAY and WISSLER) ×50
Fig. 4.	*Globigerinella aequilateralis* (BRADY) ×90
Fig. 5.	*Globigerinoides bisphericus* TODD ×60
Figs. 7 a, b.	*Globigerina bulloides* D'ORBIGNY ×65
Fig. 8.	*Globigerina diplostoma* REUSS ×60
Figs. 9 a, b.	*Globigerina inflata* D'ORBIGNY ×80
Figs. 10 a, b.	*Globigerina triloculinoides* PHUMMER ×50
Figs. 11, 13 a, b.	*Globigerina conglomerata* SCHWAGER ×80
Figs. 12, 18 a, b.	*Globorotalia fohsi* CUSHMAN and ELLISOR ×50
Figs. 14 a, b.	*Globigerina borealia* BRADY ×50
Figs. 15, 16.	*Globigerinoides triloba* (REUSS) ×65
Fig. 17.	*Globigerina eggeri* RHUMBLER ×65
Fig. 19.	*Globigerina subcretacea* LOMNIKI ×70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14a
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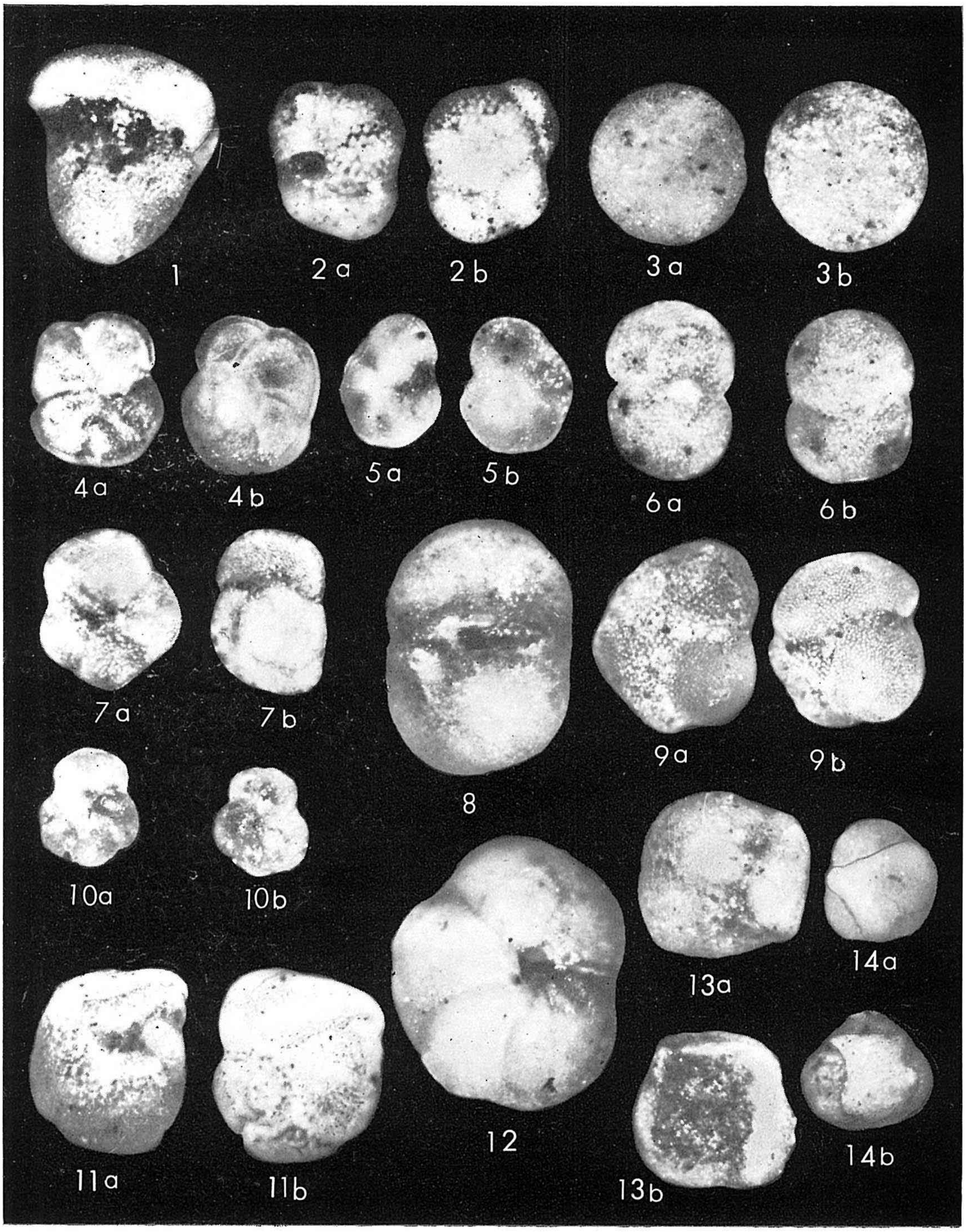
18a
18b
19

PLATE IV

Fig. 1.	*Pulleniatina obliquiloculata* (PARKER and JONES) ×50
Figs. 2a, b.	*Sphaeroidinella grimsdalei* (KEIJZEN) ×40
Figs. 3a, b.	*Orbulina universa* D'ORBIGNY ×65
Figs. 4a, b.	*Globorotalia menardii* (D'ORBIGNY) ×50
Figs. 5a, b.	*Globorotalia fohsi* CUSHMAN and ELLISOR ×60
Figs. 6a, b.	*Globigerina globularis* ROEMER ×60
Figs. 7a, b.	*Globorotalia crassula* CUSHMAN and STEWART ×40
Fig. 8.	*Sphaeroidinella dehiscens* (PARKER and JONES) ×50
Figs. 9a, b	*Globoquadrina altispira* (CHAPMAN, PARR and COLINS) ×65
Figs. 10a, b.	*Globorotalia canariensis* (D'ORBIGNY) ×80
Figs. 11a, b.	*Globoquadrina dehiscens* (CUSHMAN and JARVIS) ×60
Figs. 12.	*Globorotalia tumida* (BRADY) ×40
Figs. 13a, b.	*Globorotalia truncatulinoides* (D'ORBIGNY) ×50
Figs. 14a, b.	*Catapsydrax dissimilis* (CUSHMAN and BERMUDEZ) ×100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