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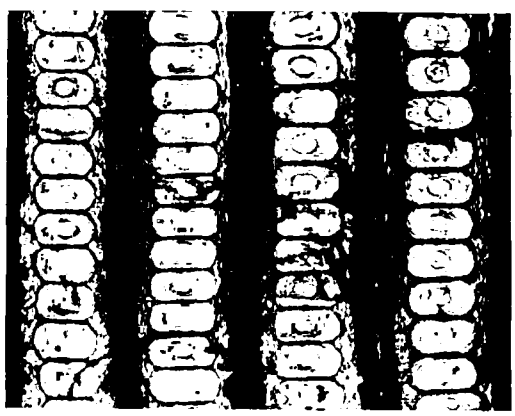

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422. CRETACEOUS PLANKTONIC FORAMINIFERA FROM THE MIDDLE YEZO GROUP OF THE IKUSHUMBETSU, MIRUTO, AND HATONOSU AREAS, HOKKAIDO*

YOKICHI TAKAYANAGI

Institute of Geology and Paleontology, Tohoku University

and

HISAICHI IWAMOTO

Technical Institute, Japan Petroleum Exploration Co.

北海道幾春別・美流渡・鳩巣地域の中部エゾ層群の白亜紀浮游性有孔虫：中部エゾ層群下部に発見された 4 種・1 新亜種を記載し，あわせてそれらに基く時代論を行った。

高柳洋吉・岩本寿一

Preface

In the previous work (TAKAYANAGI, 1960) the Cretaceous Foraminifera ranging approximately from the Aptian to Campanian in age were investigated. As the result the stratigraphic and geographic distributions of those Foraminifera in the meridional zone of Hokkaido became clear. However successive work on the Foraminifera from the Middle Yezo group of the Ikushumbetsu, Miruto and Hatonosu areas resulted in finding a number of forms hitherto unknown from the Cretaceous of Hokkaido. Among the above-mentioned areas, the Ikushumbetsu is a classic field where YABE (1909) first established the standard stratigraphic division of the Cretaceous System in Hokkaido. Since then, numerous stratigraphic and macropaleontologic works on this area have been published. Accordingly it may be significant to record the Foraminifera because they provide a new tool for interregional correlation. The present paper on the planktonic Foraminifera is the first of the series concerning the above theme which will be published separately for convenience.

* Received Sept. 29, 1961, read Sept. 23, 1961.

Introduction

In the Ikushumbetsu area a sequence of strata which range from the Lower Cretaceous to Lower Tertiary and form an anticlinal structure is developed. The trend of the anticlinal axis is about NNE to SSW in direction in the north but about NS in the south. It plunges southwards, however, Cretaceous strata reappear in the Miruto and Hatonosu areas on the southern extension of the axis of the plunging anticline. The sequence of the Cretaceous strata is

typically seen along the Ikushumbetsu Valley which traverses from SE to NW the afore-said anticline. These rocks were stratigraphically classified into three major units by YABE (1909, 1926), namely the Lower Ammonite Beds, *Trigonia* Sandstone, and Upper Ammonite Beds in ascending order. Later a formation in which conglomerate and sandstone predominate was found in the upper stream of a branch of the Ikushumbetsu River, and it was assumed as an equivalent of the Hakobuchi group lying just above the Upper Ammonite Beds, though the exact relationship was not certain (NAGAO, SAITO and MATSUMOTO, 1938; FUKADA, ISHII, ICHIKAWA and SARAKI, 1953). Recently MATSUMOTO (1954, 1959) revised the classification of authors as follows:

Hakobuchi group	Hakobuchi group
—relation uncertain—	—relation uncertain—
Upper Yezo group	Upper Ammonite Beds
Middle Yezo group: Mikasa formation	Trigonia Sandstone
Middle Yezo group: Lower part of the Middle Yezo group	Lower Ammonite Beds

The lower part of the Middle Yezo group which forms the core of the anticline is here divided into three units as Ma, Mb and Mc in ascending order. Their lithologic characters in the studied areas are:

Unit	*Lithologic character*	*Thickness*
Mc	Black shale, frequently laminated; upper part interbedded with thinlayered, gray fine-grained sandstone; uppermost part interbedded with greenish grey massive sandstone; coarse materials increase and thickness somewhat reduces southward	390–330m.
Mb	Bluish grey fine- to medium-grained sandstone interbeded with laminated shale in the middle part: shale layers increase in number and thickness southwards	180–260m.
Ma	Black laminated shale with marly nodules; thin alternations with fine-grained sandstone in the middle part; sandstone dominate comparatively northwards	approximately 570m.

The unit Ma coincides with Ia of the division by FUKADA *et al.* (1953) in the Ikushumbetsu Valley, Mb with Ib, and Mc with Ic and Id. MATSUMOTO (1959) also presented a columnar section taken along the Ikushumbetsu Valley (the eastern wing), but the details of his stratigraphic investigation have not been published to the present time. Therefore, although he divided the lower part of the Middle Yezo group into three unnamed units similar to the present ones, the exact relationship is not certain. However, he emphasized on the occurrence of *Mortoniceras* (*Durnovarites*) sp. in the upper part of his middle unit, and *Graysonites lozoi* YOUNG in the upper part of his basal member of the Mikasa formation, because the former subgenus indicates the upper Upper Albian and the latter genus the lower Lower Cenomanian. Hence, in the strict sense, the Cenomanian/Albian boundary may be between these horizons but the exact position of the boundary has not been ascertained. According to FUKADA *et al.*, a specimen of *Mortoniceras* sp. was collected from their unit Id, though the result of their paleontological study has not been published. If it is permitted to lay stress upon this record, it

will be most probable that the Cenomanian/Albian boundary will be at the base of the Mikasa formation.

The samples studied are all from the lower part of the Middle Yezo group, and they were collected from localities distributed in the mentioned areas. In this paper only the planktonic forms are described. They are few in number and found sporadically throughout the whole areas, but seem to provide a reliable means for interregional correlation. The types in the present paper are deposited in the Institute of Geology and Paleontology, Tohoku University, and a set of unfigured specimens are also deposited in the Technical Institute of the Japan Petroleum Exploration Co., Tokyo.

Acknowledgements

The authors are indebted to the Japan Petroleum Exploration Co. for the permission to publish the present paper. They wish to thank Professor Kiyoshi ASANO of the Institute of Geology and Paleontology, Tohoku University for his guidance, and Professor Kotora HATAI of the same institution for his criticism.

Planktonic Foraminifera and their Age Consideration

Examining the samples from the lower part of the Middle Yezo group, only five forms are found except for the unit Mb. They are *Biticinella ? breggiensis* (GANDOLFI), *Hedbergella delrioensis* (CARSEY), *Hedbergella trocoidea* (GANDOLFI), *Hedbergella trocoidea yezoana*, n. subsp., and *Hedbergella washitensis* (CARSEY), but the first mentioned species is not detected from unit Ma. Their occurrence and frequency are shown in Table 1, and the numbers appearing in the chart are the number of specimens per

Table 1. Distribution of planktonic Foraminifera in the lower part of the Middle Yezo group of the Ikushumbetsu, Miruto and Hatonosu areas.

	Ma									Mc											
	Im-12354*	-12353	-12651	-12406	-12403	-12614	-12611	-12252	-12342	-12478	-12176	-12153	-12454	-12317	-12322	-12222	-12546	-12585	-12584	-12632	-12393
Biticinella ? breggiensis	..	..	..	..	..	..	..	..	..	..	1	2	..	..	2	1	..	..	3	..	..
Hedbergella delrioensis	..	..	..	4	2	..	..	..	3	1	1	1	..	..	4	..	..	..	..	..	..
Hedbergella trocoidea	1	..	..	16	3	..	2	..	..	..	1	5	5	3	19	1	..	..	6	..	1
Hedbergella trocoidea yezoana, n. subsp.	..	..	..	2	..	..	..	..	..	..	..	..	1	..	1	..	..	..	1	2	..
Hedbergella washitensis	..	1	1	..	4	1	..	1	..	..	..	..	..	..	..	..	1	2	..	2	..
total	1	1	1	22	9	1	2	1	3	1	3	8	6	3	26	2	1	2	10	4	1

* The sample localities are arranged from left to right in ascending order of stratigraphic sequence.

100 grams of the original sample. Although taxonomic remarks concerning these forms are given in the next systematic part, their stratigraphic records are summarized as follows.

Biticinella ? breggiensis (originally *Anomalina*) was first described from the basal part of the Scaglia bianca (Albian to lowest Cenomanian) of Balerna, Canton Ticino, Switzerland by GANDOLFI (1942). It was successively recorded from the Vranconian (uppermost Albian) of Djebel Bejaoua, Tunisia (SIGAL, 1956a), probably the upper Albian strata of Madagascar (SIGAL, 1956b), the upper Albian-Vranconian of central Algeria (BUSSON et al., 1956), and the basal series of the "Complexe schisteux intermédiaire" (upper Albian) of Forclaz, near Gruyères, Canton Fribourg, Switzerland (KLAUS, 1960). Thus this species seems to be confined in its occurrence to the upper Albian, though it has not been recorded outside the Tethys regions.

Hedbergella delrioensis, originally regarded as a variety of "*Globigerina cretacea*", was described by CARSEY from the upper part of the Washita group of Texas, U.S.A. It was later recognized in various horizons of the Washita and Eagle Ford groups (middle Albian to Turonian) (TAPPAN, 1940, 1943; LOEBLICH and TAPPAN, 1951; JONES, 1960). In Trinidad BRÖNNIMANN (1952) found "*Globigerina gautierensis*", a junior synonym of *H. delrioensis*, from the Cenomanian to lowest Maestrichtian, and in 1959 BOLLI reaffirmed its occurrence in the Maridale, Gautier and the lower part of the Naparima Hill formations (his zone of *Biglobigerinella barri, Praeglobotruncana rohri, Rotalipora ticinensis ticinensis, Globigerina washitensis, Rotalipora appenninica appenninica, Globotruncana inornata*, and *Globotruncana renzi* in ascending order). At that time BOLLI correlated the Maridale formation with the Fredericksburg and Trinity groups of the Gulf Coast, Gautier with the Washita group, and the lower Naparima Hill with Eagle Ford and lower Austin. As clearly discussed by LOEBLICH and TAPAN (1961), however, it seems to be most probable that the Gautier and the upper Maridale formations are equivalent to the Washita group and only the *Rotalipora appenninica appenninica* zone is of early Cenomanian age. Concerning the age of the *Globotruncana renzi* zone, BOLLI assigned it to the Coniacian. Moreover *H. delrioensis* was recorded from a submarine core of the Blake Plateau, north of the Grand Bahama Island (probably the middle Cenomanian) by LOEBLICH and TAPPAN (1961), and from the Lower Gyliakian (Cenomanian) of Hokkaido (TAKAYANAGI, 1960). "*Globigerina cretacea*" reported by CRESPIN (1953) from the Lower Cretaceous of the Great Artesian Basin, Australia also appears to be referable to the present species. Based upon these records, the occurrence of this species is mostly concentrated to the Atlantic side of North and Central America, and it seems to have a fairly long range from the upper Aptian? to Coniacian.

Hedbergella trocoidea is also one of the species recorded by GANDOLFI (1942) from the Scaglia variegata (Aptian or Albian) and the basal part of the Scaglia bianca of Balerna, Canton Ticino, Switzerland. Up to the present time it has been recorded from the following localities: "Mergel mit Exoten" (Albian) of Leonstein, Austria (NOTH, 1951); throughout the "Complexe schisteux intermédiaire" (Aptian or lower Albian to upper Turonian) of Gruyères, Canton Fribourg, Switzerland (KLAUS, 1960); two localities of Las Villas Province,

Cuba (BRÖNNIMANN and BROWN, 1956; they did not give exact stratigraphic data, but as for the total range they designated it from the Aptian or Albian to Cenomanian); submarine Blake Plateau, north of the Grand Bahama Island (probably the middle Cenomanian) (LOEBLICH and TAPPAN, 1961). In addition, it was recorded from the Cretaceous strata near New Almaden, California, U. S. A. under the name of *Globigerina almadensis* CUSHMAN and TODD (1948). The age of the strata is recently considered as of the middle to late Cenomanian (LOEBLICH and TAPPAN, 1961). In this way so far as concerns the previous records, this species appears to range from the Aptian or Albian to late Turonian in the European and American regions, though its record from the Turonian is scarce.

Hedbergella washitensis, currently assumed as a typical Cretaceous *Globigerina*, was originally from the Washita group (middle Albian to lowest Cenomanian) of Texas, U. S. A. (CARSEY, 1926). It has been recorded from many localities of the Washita and Fredericksburg groups in the Gulf Coast Regions of U. S. A., submarine Blake Plateau, Trinidad, North Africa, western Europe and Hokkaido (TAPPAN, 1940, 1943; LOEBLICH and TAPPAN, 1949, 1961; SIGAL, 1952; CHEYLAN, MAGNÉ, SIGAL and GREKOFF, 1954; TAKAYANAGI, 1960; etc.). DUBOURDIEU and SIGAL (1949) gave the range of this species from the Albian (Zone of *Hoplites tardefurcatus*) to the middle Cenomanian (Zone of *Acanthoceras mantelli*) in Algeria. Thus it is generally accepted as a marker species for the Albian to Cenomanian age.

Except for *Biticinella*? *breggiensis*, there is no remarkable difference between the assemblages of the units Ma and Mc, both consisting of the same species of *Hedbergella*. In short the presence of *Biticinella*? *breggiensis* in the upper units, Mc, should be marked for age determination. It is noteworthy that a similar feature was observed in the subsurface of Madagascar by SIGAL (1956b). As already cited by LOEBLICH and TAPPAN (1961), in the Diégo-Suarez region, he found *Hedbergella washitensis* in the lower strata (middle or lower Albian), and *Biticinella breggiensis* with *Ticinella roberti* (GANDOLFI) in the middle, and *Planomalina buxtorfi* (GANDOLFI) and *Rotalipora appenninica* (RENZ) in the upper. As the last mentioned species is regarded to mark the base of the Cenomanian, the horizon with *B. breggiensis* will probably correspond to the unit Mc, and the horizon with *Hedbergella washitensis* with the unit Ma. In the same way the unit Mc is correlated with the lower part of the Scaglia bianca (with *Biticinella*? *breggiensis*) and Ma with the upper half of the Scaglia variegata of Balerna, Canton Ticino, Switzerland. In the Cretaceous of Hokkaido including the present studied areas, there has been discovered no such marker species for the basal Cenomanian as *Rotalipora appenninica appenninica*, though it is possible that it will be found in the basal part of the Mikasa formation because of the presence of *Graysonites lozoi*. Under these circumstances, evidence does not strictly favor correlating the lower part of the Middle Yezo group with the Cretaceous of U. S. A. and Trinidad. But these parts will possibly be correlated with the greater part of the Washita group (except for the Grayson formation and its equivalents in the upper part) and the Fredericksburg group of the Gulf Coast Region, and also with the larger part of the Gautier formation (except for the *Rotalipora appenninica appenninica* zone) and most of the Maridale formation of Trinidad. Consequently the joint

occurrence of the four species will provide solid grounds for correlating the lower part of the Middle Yezo group of the studied areas with the strata assigned to be Albian in Europe, Africa, America and their adjacent regions.

Systematic Descriptions

Family Planomalinidae BOLLI, LOEBLICH and TAPPAN, 1957

Genus *Biticinella* SIGAL, 1956

Biticinella ? breggiensis (GANDOLFI), 1942

Pl. 28, figures 7a-9c.

Anomalina breggiensis GANDOLFI, 1942, p. 102, 103, pl. 3, figs. 6a-c, pl. 5, fig. 3, pl. 9, fig. 1, pl. 13, figs. 7a-8b, text-fig. 34 (1-4).
Biticinella breggiensis (GANDOLFI). SIGAL, 1956a, p. 35, 36, text-fig. in p. 35.
Biticinella ? breggiensis (GANDOLFI). KLAUS, 1960, p. 830, 831, pl. 8, figs. 6a-c.

Hypotypes:—Figs. 7a-c, IGPS coll. cat. no. 75130 from sample Im-12584; figs. 8a-c, IGPS coll. cat. no. 75131 from sample Im-12584; figs. 9a-c, IGPS coll. cat. no. 75132 from sample Im-12453.

Size ranges from 0.21 to 0.48 mm. in maximum diameter.

Remarks:—In the original description of this species as an *Anomalina*, GANDOLFI (*loc. cit.*) displayedt hree interesting vertical sections in the text figure. The first section is a form coiled planispirally throughout; the second is almost planispiral except for the earliest whorl which is trochospiral; and the third is trochospiral except for the last planispiral whorl. In addition, the proloculum of the first form is nearly 3.3 times and that of the second in nearly 1.3 times as large as that of the third form being 0.027 mm. in diameter. These morphological differences seem to be due to trimorphism (HOFKER, 1930). Concerning trimorphism, CUSHMAN (1948, p. 52) stated as follows:

Form A_1: "With the largest megalospheric proloculum, the adult characters are taken on almost at once."

Form A_2: "With the smaller megalospheric proloculum, some of the early stages skipped in the proceeding are now present."

Form B: "With the microspheric proloculum, the greatest number of early stages are present."

Thus it may be recognized that the first form corresponds to Form A_1, the second to A_2 and the third to B. HOFKER (*op. cit.*, p. 98) stated that the microspheric form had more "primitive" characteristics than the megalospheric one, and that A_2 was also more "primitive" than A_1. And the trochospiral coiling in the early stages of the microspheric form of "*Anomalina*" *breggiensis* will suggest a primitive form from which the species was derived. Accordingly this feature seems to be essential for the character of the species.

SIGAL (*loc. cit.*) described a "morphogenre" *Biticinella* with *Anomalina breggiensis* as a type. He stressed that the genus had accessory intraumbilical apertures at the posterior border of the chambers, and one side was sometimes irregularly developed so as to assume an asymmetrical form. He also distinguished it from the carinate *Planomalina*, *Thalmanninella* and *Rotalipora*, and found a close relation to the trochospiral *Ticinella*. However, BOLLI, LOEBLICH and TAPPAN (1957, p. 41) referred briefly to *Biticinella* as follows: "If there are true accessory apertures at the posterior border of the chambers and the test is asymmetrically coiled as described it would seem to be related to the Glo-

borotaliidae, although no other genus of this family has accessory apertures on both sides. If "apertures" should prove to be relict apertures instead, *Biticinella* would become a synonym of *Planomalina*." Later BANNER and BLOW (1959) included this genus into the synonymy of *Globigerinelloides* CUSHMAN and TEN DAM. LOEBLICH and TAPPAN (1961) also regarded *Biticinella* as a synonym of *Globigerinelloides* by restricting *Planomalina* to keeled forms. Referring to the relationship of *Biticinella breggiensis* and "*Anomalina*" *bentonensis* MORROW (= *Globigerinelloides bentonensis* of LOEBLICH and TAPPAN), both SIGAL and LOEBLICH and TAPPAN considered that they might be synonymous, though no comparative study was done. However as already mentioned, the trochospiral coiling is ascertained in the early stage of *B. breggiensis*. Therefore both species may not be synonymous unless the early trochospiral coiling stage is detected in *G. bentonensis*. Moreover it should not be adequate to include *B. breggiensis* under the genus *Globigerinelloides* which is defined as being planispiral throughout.

HOFKER (1960) assumed also *Biticinella breggiensis* as a *Planomalina*, though he did not recognize *Praeglobotruncana*, *Planomalina* and *Biglobigerinella* as taxonomically valid genera. He exemplified that the three above-mentioned genera appeared successively from the base to the top of a sequence of the Albian clay of the Netherlands. HOFKER's concepts of these genera are somewhat different from those of LOEBLICH and TAPPAN (1961), and his *Praeglobotruncana* is equal to *Hedbergella* of LOEBLICH and TAPPAN, and *Planomalina* is *Globigerinelloides*, respectively. In short, HOFKER found in the Albian clay a successive occurrences of *Hedbergella*, *Globigerinelloides* and *Biglobigerinella*. Based upon this occurrence, he believed these three genera were "artificial" and expressed different developmental stages of a single biological unit ("*Globigerina caseyi* gens"). His concept in taxonomy is biologically basic (genetic), and he has assumed a critical attitude in paleontologic (morphologic) classification. For that reason he often differs from other paleontologists in opinions on taxonomy. Leaving aside this question, the fact that the primitive form of this group shows trochospiral coiling and the planispiral form develops in the next stage indicates a phylogenetic developmental trend of the group, and this seems to correspond will with the ontogenetic one deduced from trimorphism. Therefore this may be accepted as an evolutional trend of the group. From this point of view, "*Anomalina*" *bentonensis* must be a form more advanced than *B. breggiensis*, if it is really planispiral throughout (*Globigerinelloides*). However, in the original description, MORROW (1934, p. 201) wrote that.... "aperture peripheral, passing onto the dorsal side"....and the test is "nearly planispiral". In the remarks on *Globigerinelloides bentonensis*, these expressions were criticized by LOEBLICH and TAPPAN (1961) as "misleading", perhaps in the meaning of obscure definition of symmetricity or asymmetricity. But it also rises doubt about the presence of trochospiral coiling in the early stage of this species. On this point further study of vertical sections will be necessary to settle this problem. As mentioned above, it seems to be adequate to refer this species to *Biticinella* rather than to *Globigerinelloides*, though the apertural character of the former genus should be reexamined.

The Ikushumbetsu specimens show eight to nine chambers in the last whorl,

which is planispiral. They are biumbilicate, and nearly symmetrical in side view, but both sides are not completely symmetrical owing to the more or less trochospirally coiled early whorls. The surface is generally smooth but roughly finished in the early portion of the last whorl. The aperture is a broad, low interiomarginal, equatorial and bordered above by a narrow lip. In some well preserved specimens, the lateral portions of the previous apertures and lips remain uncovered by later chambers, as mentioned by LOEBLICH and TAPPAN in their description of *Globigerinelloides bentonensis* (1961, p. 267). But such accessory sutural apertures as figured by SIGAL are not observed in the present specimens in the same way as the one figured by KLAUS from Switzerland. On that account this species is herein tentatively referred to *Biticinella* ?

Occurrence:—Sporadically found in the unit Mc of the Middle Yezo group.

Family Rotaliporidae SIGAL, 1958

Subfamily Hedbergellinae LOEBLICH and TAPPAN, 1961

Genus *Hedbergella* BRÖNNIMANN and BROWN, 1958

Hedbergella delrioensis (CARSEY), 1926

Pl. 28, figures 10a-12c.

Globigerina cretacea D'ORBIGNY var. *delrioensis* CARSEY, 1926, p. 43.

Globigerina cretacea D'ORBIGNY. TAPPAN, 1940, p. 121, 122, pl. 19, figs. 11a-c (not of D'ORBIGNY); TAPPAN, 1943, p. 512, pl. 82, figs. 16a-17 (not of D'ORBIGNY); CRESPIN, 1953, p. 35, pl. 6, figs. 15a-c (not of D'ORBIGNY); TAKAYANAGI, 1960, p. 137, 138, pl. 10, figs. 8a-c (not of D'ORBIGNY).

Globigerina gautierensis BRÖNNIMANN, 1952, p. 11-14, pl. 1, figs. 1-3, text-figs. 2a-m.

Globigerina delrioensis CARSEY. FRIZZELL, 1954, p. 127, pl. 20, figs. 1a-c.

Praeglobotruncana gautierensis (BRÖNNIMANN). BOLLI, 1959, p. 265, 266, pl. 21, figs. 3a-6; JONES, 1960, p. 102, pl. 15, figs. 1a-9c.

Praeglobotruncana cf. *gautierensis* (BRÖNNIMANN). BOLLI, 1959, p. 266, pl. 21, figs. 7a-8.

Praeglobotruncana (*Hedbergella*) *delrioensis* (CARSEY). BANNER and BLOW, 1959, p. 8.

Globigerina cf. *delrioensis* CARSEY. TAKAYANAGI, 1960, p. 138, pl. 10, figs. 9a-c.

Hedbergella delrioensis (CARSEY). LOEBLICH and TAPPAN, 1961, p. 275, pl. 2, figs. 11a-13c.

Hypotypes:—Figs. 10a-c, IGPS coll. cat. no. 75139 from sample Im-12476; figs. 11a-c, IGPS coll. cat. no. 75140 from sample Im-12403; figs. 12-ac, IGPS coll. cat. no. 75141 from sample Im-12403.

Size ranges from 0.14 to 0.38 mm. in maximum diameter.

Remarks:—There is a considerable variation in size and shape among the present specimens referred to this species. In the former study (TAKAYANAGI, 1960) this species was distinguished from "*Globigerina cretacea*" in having much inflated and globular chambers and distinctly protruded last chamber. Examining the specimens from the Ikushumbetsu area, however, such characters mentioned above are not so distinct in juvenile specimens. They show usually about five subglobular chambers in the final whorl, and rather strongly lobulated peripheral outline. In juvenile specimens the proportion of thickness to diameter of the test is smaller than that of the adult, and is rather nearer to that of *Hedbergella amabilis* LOEBLICH and TAPPAN. But in comparing with *H. amabilis*, this species is not so prominently lobulate in peripheral outline.

Although it should be said that such forms assuming a juvenile stage are dominant in the present material, they are all referred to *H. delrioensis*, because of the presence of all gradations between those and the typical forms. Owing to bad preservation, the fine surface ornamentation of the wall is not seen in the present specimens in the same way as the other *Hedbergella* specimens.

Occurrence:—Not common, but found in the units Ma and Mc of the Middle Yezo group.

Hedbergella trocoidea (GANDOLFI), 1942

Pl. 28, figures 3a-6c.

Anomalina lorneiana (D'ORBIGNY) var. *trocoidea* GANDOLFI, 1942, p. 98, 99, pl. 2, figs. 1a-c, pl. 4, figs. 2, 3, pl. 13, figs. 2a, b, 5a, b; NOTH, 1951, p. 80, pl. 4, figs. 27a-28b.

Anomalina lorneiana (D'ORBIGNY). GANDOLFI, 1942, p. 98, 99, pl. 4, figs. 1. 19, pl. 8, fig. 2, pl. 13, figs. 1a, b, 4a, b (not *Rosalina lorneiana* D'ORBIGNY).

Globigerina almadensis CUSHMAN and TODD, 1948, p. 95, pl. 16; figs. 18, 19.

Hedbergella seminolensis (HARLTON). BRÖNNIMANN and BROWN, 1956, p. 529, p. 30, pl. 20, figs. 4-6.

Hedbergella trocoidea (GANDOLFI). BRÖNNIMANN and BROWN, 1958, p. 16, 17, text-fig. 1 (a-c); KLAUS, 1960, p. 792, pl. 1, figs. 1a-c; LOEBLICH and TAPPAN, 1961, p. 277, 278, pl. 5, figs. 1a-2c.

Praeglobotruncana (*Hedbergella*) *trocoidea* (GANDOLFI). BANNER and BLOW, 1959, p. 18.

Hypotypes:—Figs. 3a-c, IGPS coll. cat. no. 75135 from sample Im-12454; figs. 4a-c, IGPS coll. cat. no. 75136 from sample Im-12454; figs. 5a-c, IGPS coll. no. 75137 from sample Im-12584; figs. 6a-c, IGPS coll. cat. no. 75138 from sample Im-12454.

Size ranges from 0.17 to 0.35 mm. in maximum diameter.

Remarks:—This species is characterized by the low trochospirally coiled form with six to seven, most commonly six and one-half chambers in the final whorl; nearly flat to slightly concave spiral side and rather deep and narrow umbilicus on the opposite side; the last one or two chambers are more inflated on the umbilical side and show a tendency to extend towards the umbilicus; and the aperture is interiomarginal, extraumbilical-umbilical in position and bordered above by a narrow lip.

The size range of the Ikushumbetsu specimens is wider than that given by LOEBLICH and TAPPAN (*loc. cit.*), and the smaller specimens are somewhat similar to *H. planispira* (TAPPAN) in feature. But in comparing with the latter species, they show a thicker test with more radially elongate chambers.

Occurrence:—Rather commonly found in both the units Ma and Mc of the Middle Yezo group.

Hedbergella trocoidea (GANDOLFI) *yezoana* TAKAYANAGI and IWAMOTO, n. subsp.

Pl. 28, figures 1a-2c.

Test medium in size, low trochospiral, consisting of about two whorls, nearly flat to slightly concave on spiral side, broadly and rather deeply umbilicate on opposite side, periphery broadly rounded, peripheral outline distinctly lobulate; chambers inflated, subglobular to radially rather elongate, about seven to eight in final whorl, increasing gradually in size as added; sutures distinct, depressed, nearly radial on both sides; wall calcareous, perforate, radial in structure, surface smooth; aperture a low interiomarginal, extraumbilical-umbilical arch

bordered above with or without a slight lip.

Maximum diameter of holotype (figs. 2a-c) 0.38 mm., maximum thickness 0.16 mm. Maximum diameter of paratype (figs. 1a-c) 0.30 mm., maximum thickness 0.15 mm.

Types:—Holotype, IGPS coll. cat. no. 75142 from sample Im-12632; paratype, IGPS coll. cat. no. 75143 from sample Im-12454.

Remarks:—The new subspecies is distinguished from the typical one in having a comparatively larger test, more chambers in the final whorl, and a broad umbilicus. The subspecific name is from Yezo, an old name for Hokkaido.

Occurrence:—Rare but found in both the units Ma and Mc of the Middle Yezo group.

Hedbergella washitensis (CARSEY), 1926

Pl. 28, figures 13a-14c.

Globigerina washitensis CARSEY, 1926, p. 44, pl. 7, fig. 10, pl. 8, fig. 2; PLUMMER, 1931, p. 193, 194, pl. 13, fig. 12; TAPPAN, 1940, p. 122, 123, pl. 19, figs. 13a-c; TAPPAN, 1943, p. 513, pl. 83, figs. 1a-c; LOEBLICH and TAPPAN, 1949, p. 265, pl. 51, figs. 4a, b; FRIZZELL, 1954, p. 127, pl. 20, figs. 9a-c; BOLIN, 1956, p. 293, 294, pl. 39, figs. 2a-3c, text-fig. 5 (11a, b); BOLLI, 1959, p. 271, pl. 23, figs. 6a-7b; TAKAYANAGI, 1960, p. 138, 139, pl. 10, figs. 10a-c.

Hedbergella washitensis (CARSEY). LOEBLICH and TAPPAN, 1961, p. 278, pl. 4, figs. 9-11c.

Hypotypes:—Figs. 13a-c, IGPS coll. cat. no. 75133; figs. 14a-c, IGPS coll. cat. no. 75134, both from sample Im-12403.

Size ranges from 0.37 to 0.48 mm. in maximum diameter.

Remarks:—Although this species is distinct from any other species in having coarse reticulations on the surface, the Ikushumbetsu specimens are somewhat different from the typical one in the feature of the last chamber. Juvenile specimens as shown in figs. 13a-c are quite similar to the previously described ones. But the adult specimens, though often crushed, show an abnormally reduced final chamber with smooth surface (figs. 14a-c). The position of this chamber is rather constant, being located near a deep umbilicus on the umbilical side, and protruding somewhat from the surface of the previous chambers. Similar features are often found in the bulla structure of the Tertiary and Recent globigerinids. However it is difficult to assume this chamber as a kind of bulla, because the chamber does not cover the umbilicus. On the other hand, the tendency of the final chamber to become reduced seems to be not limited to the present specimens, but is also seen in the fine illustrations by LOEBLICH and TAPPAN (1961, *op. cit.*). Judging from their illustrations, this tendency appears in the adult form of the closely related *H. hiltermanni* LOEBLICH and TAPPAN as well as *H. washitensis*. Moreover, in *H. hiltermanni*, the cancellate surface ornamentation appears to be not so distinct on the final chamber as compared with those of the previous ones. It is inferred from these phenomena that such a tendency does not offer any criteria for distinguishing the present form the typical but may be an essential character to this species and its related forms.

This species has long been treated as a *Globigerina*. According to LOEBLICH and TAPPAN (1961, *op. cit.*), the apertural character of this species is occasionally almost umbilical, but all gradations are found to the characteristic umbilical-extraumbilical aperture. For that reason they referred the species to *Hedbergella*.

So far as the Ikushumbetsu materials are concerned, their apertural position is almost umbilical rather than umbilical-extraumbilical. In addition, most of the illustrations previously so referred show also umbilical apertures. So placing the present species in the genus *Hedbergella* will leave some doubt.

Occurrence:—Not common, but found in both the units Ma and Mc of the Middle Yezo group.

List of Localities of Samples

Im-12222:—A cliff of a southern tributary of the Ikushumbetsu River, about 2550 m. S 40.5° E of the Ikushumbetsu Station, and about 8250 m. N 87° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12252:—A cliff of a southern small tributary of the Ikushumbetsu River, about 1625 m. S 35° E of the Ikushumbetsu Station, and about 7250 m. N 84° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Ma).

Im-12317:—A cliff of a southern tributary of the Ikushumbetsu River, about 3000m. S 1° E of the Ikushumbetsu Station, and about 6425 m. S 82° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12322:—A cliff of a southern tributary of the Ikushumbetsu River, about 3200 m. S 1.5° E of the Ikushumbetsu Station, and about 6425 m. S 82° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12342:—A cliff of a southern tributary of the Ikushumbetsu River, about 2625 m. S 13° W of the Ikushumbetsu Station, and about 5750 m. S 85° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Ma).

Im-12354:—A cliff of a southern tributary of the Ikushumbetsu River, about 4120 m. S 24.5° W of the Ikushumbetsu Station, and about 4900 m. S 70° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Ma).

Im-12355:—A cliff of a southern tributary of the Ikushumbetsu River, about 4120 m. S 24° W of the Ikushumbetsu Station, and about 4950 m. S 7° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Ma).

Im-12393:—A cliff of a southern tributary of the Ikushumbetsu River, about 4100 m. S 8.5° W of the Ikushumbetsu Station, and about 6000 m. S 75° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12403:—A cliff of a southern tributary of the Ikushumbetsu River, about 3825 m. S 19° W of the Ikushumbetsu Station, and about 5275 m. S 73.5° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Ma).

Im-12406:—A cliff of a southern tributary of the Ikushumbetsu River, about 3700 m. S 22° W of the Ikushumbetsu Station, and about 5075 m. S 70.5° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Ma).

Im-12453:—A cliff of a southern tributary of the Ikushumbetsu River, about 6150m. S 15.5° W of the Ikushumbetsu Station, and about 6000 m. S 50.5° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12454:—A cliff of a southern tributary of the Ikushumbetsu River, about 6175m. S 15.5° W of the Ikushumbetsu Station, and about 5075 m. S 70.5° E of the Mikasa Station of the Poronai Railway Line, Mikasa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12476:—A cliff of the Shikoro-zawa, a southern tributary of the Horomui River,

about 5420 m. S 40° W of the Manji Station, and about 6200 m. S 17.5° E of the Miruto Station of the Manji Railway Line, Kurisawa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12478:—A cliff of the Sikoro-zawa, a southern tributary of the Horomui River, about 5450 m. S 39° W of the Manji Station, and about 6450 m. S 18.5° E of the Miruto Station of the Manji Railway Line, Kurisawa-cho, Sorachi-gun, Ishikari Province. (Mc).

Im-12546:—A cliff of a northern tributary of the Horomui River, about 9650 m. S 13° W of the Ikushumbetsu Station, and about 8350 m. S 29.5° E of the Mikasa Station of the Poronai Railway Line, Iwamizawa City, Ishikari Province. (Mc).

Im-12584:—A cliff of a northern tributary of the Horomui River, about 8280 m. S 8.5° E of the Ikushumbetsu Station, and about 7880 m. S 70° E of the Mikasa Station of the Poronai Railway Line, Iwamizawa City, Ishikari Province. (Mc).

Im-12585:—A cliff of a northern tributary of the Horomui River, about 8250 m. S 8.7° E of the Ikushumbetsu Station, and about 7830 m. S 70° E of the Mikasa Station of the Poronai Railway Line, Iwamizawa City, Ishikari Province. (Mc).

Im-12611:—A cliff of an eastern branch of the Sekiyu-zawa, a northern tributary of the Horomui River, about 8050 m. S 20° W of the Ikushumbetsu Station, and about 6470 m. S 33° E of the Mikasa Station of the Poronai Railway Line, Iwamizawa City, Ishikari Province. (Ma).

Im-12614:—A cliff of an eastern branch of the Sekiyu-zawa, a northern tributary of the Horomui River, about 8000 m. S 19° W of the Ikushumbetsu Station and about 6530 m. S 34° E of the Mikasa Station of the Poronai Railway Line, Iwamizawa City, Ishikari Province. (Ma).

Im-12632:—A cliff of an eastern branch of the Sekiyu-zawa, a northern tributary of the Horomui River, about 7630 m. S 12.5° W of the Ikushumbetsu Station, and about 7070 m. S 40° E of the Mikasa Station of the Poronai Railway Line, Iwamizawa City, Ishikari Province. (Mc).

Im-12654:—A cliff of an eastern branch of the northern tributary of the Anoro River, about 1200 m. S 74.5° E of Hatonosu-yama, and about 5530 m. N 39.5° E of the Shinfutamata Station of the Yubari Railway Line, Hinode, Yubari, City, Ishikari Province. (Ma).

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Explanation of Plate 28

(a.-spiral view; b.-umbilical view; c.-side view)

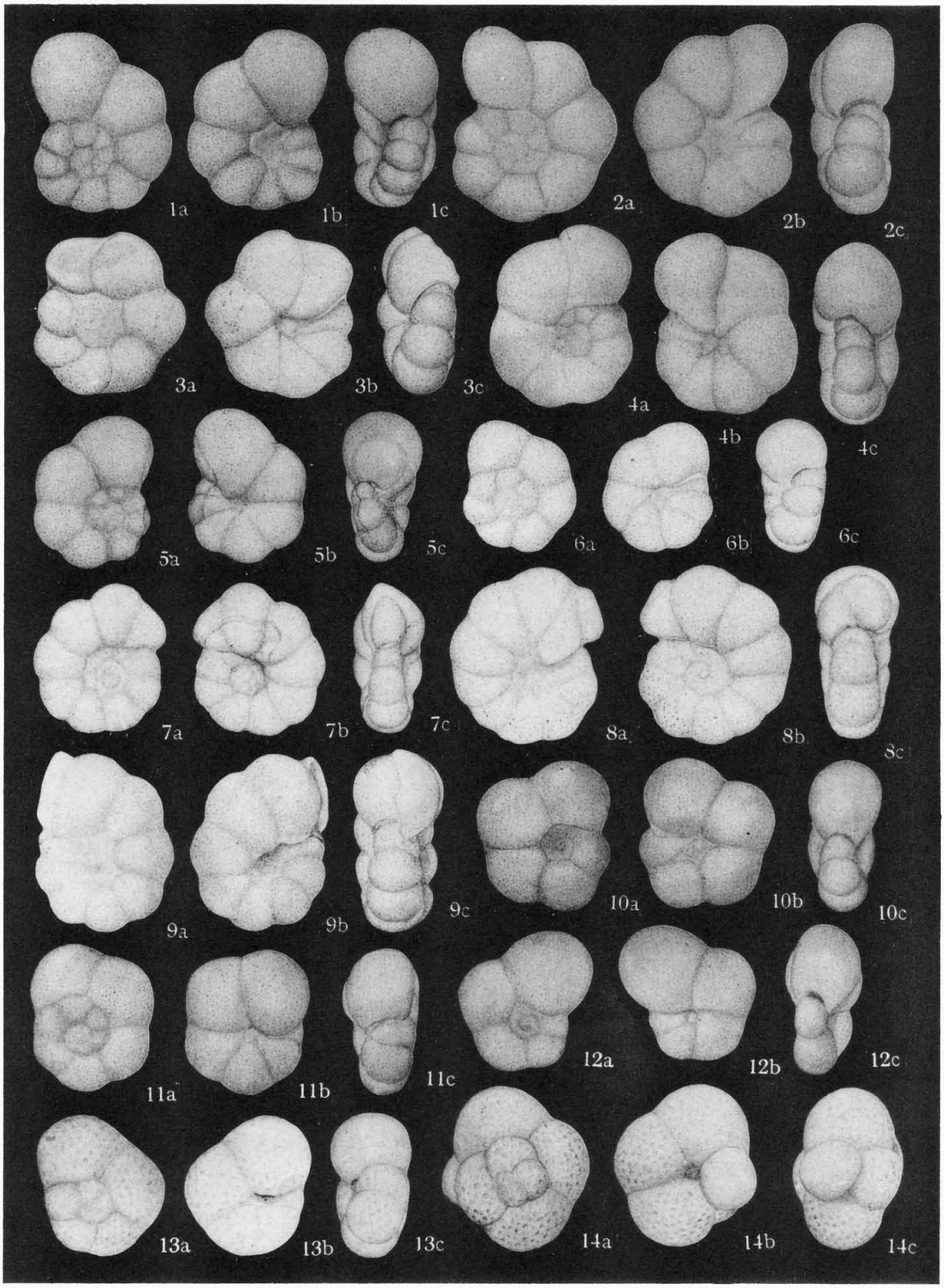
Figs. 1a-2c. *Hedbergella trocoidea* (GANDOLFI) *yezoana* TAKAYANAGI and IWAMOTO, n. subsp.
1. Paratype, IGPS coll. cat. no. 75143 from sample Im-12454 (Mc). ×97.
2. Holotype, IGPS coll. cat. no. 75142 from sample Im-12632 (Mc). ×85.

Figs. 3a-6c. *Hedbergella trocoidea* (GANDOLFI)
3. IGPS coll. cat. no. 75135 from sample Im-12454 (Mc). ×91.
4. IGPS coll. cat. no. 75136 from sample Im-12454 (Mc). ×89.
5. IGPS coll. cat. no. 75137 from sample Im-12584 (Mc). ×93.
6. IGPS coll. cat. no. 75138 from sample Im-12454 (Mc). ×100.

Figs. 7a-9c. *Biticinella ? breggiensis* (GANDOLFI)
7. IGPS coll. cat. no. 75130 from sample Im-12584 (Mc). ×57.
8. IGPS coll. cat. no. 75131 from sample Im-12584 (Mc). ×61.
9. IGPS coll. cat. no. 75132 from sample Im-12453 (Mc). ×85.

Figs. 10a-12c. *Hedbergella delrioensis* (CARSEY)
10. IGPS coll. cat. no. 75139 from sample Im-12476 (Mc). ×100.
11. IGPS coll. cat. no. 75140 from sample Im-12403 (Ma). ×88.
12. IGPS coll. cat. no. 75141 from sample Im-12403 (Ma). ×94.

Figs. 13a-14c. *Hedbergella washitensis* (CARSEY)
13. IGPS coll. cat. no. 75133 from sample Im-12403 (Ma). ×63.
14. IGPS coll. cat. no. 75134 from sample Im-12403 (Ma). ×60.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423. DISCOVERY OF THE FOSSIL GIANT SALAMANDER (*MEGALOBATRACHUS*) IN JAPAN*

TOKIO SHIKAMA and YOSHIKAZU HASEGAWA

Geological Institute, Yokohama National University

日本における化石ハンザキの発見：　愛媛県喜多郡肱川村敷水の石灰岩採石場にある裂罅堆積物たる敷水層より産した大サンショウオは，日本現世種に同定される。時代は上部鮮生層と同じく，更新世後期である。　　鹿間時夫・長谷川善和

Introduction

In the spring of 1958, Prof. K. NAGAI of the Geological Institute of the University of Ehime sent the writers numerous fossil bones and teeth collected at a limestone quarry of Shikimizu, Hijikawa-mura, Kita-gun, Ehime Prefecture (132° 43′E, 33°28′N). Among them they found a dental bone of a giant salamander. Further, in the summer of the same year, in a field survey jointly held by the Geological Institute of Yokohama National University and the Geological Institute of Ehime University, supported by the Caving Club of Shikoku, Ehime News Press Co., the authorities of the Hijikawa-mura, several specimens of the similar species were gained from the same quarry. The writers could obtain valuable help and assistance from Prof. K. NAGAI and the members of his Institute, Prof. K. YAMAGUCHI and the other members of the Caving Club of Shikoku, Messrs. M. NOGUCHI, H. OCHI and the other gentlemen of Ehime News Press Co., Mr. M. IKEDA and the other gentlemen of Hijikawa-mura, and wish to extend their cordial thanks to them. The junior writer could observe some comparative specimens by the courtesy of Drs. S. UENO, H. OZAKI and Y. IMAIZUMI. He also could gain valuable advice and help for his research from Drs. Y. OKADA, K. KOBA, H. TAKASHIMA, M. SHIMIZU, T. MIYAO, Y. IKOMA and I. UCHIDA. The writers also express their hearty thanks to these gentlemen.

The fissure deposits at the quarry of Shikimizu, the Shikimizu bed of the writers, are mainly composed of brown brecciated clay of 14 m thick, underlain by layers of black sand, yellow clay and gravel, also overlain by red clay and black humus. From the bed are found the following species.

Cervus (*Depéretia*) *praenipponicus* SHIKAMA
Sinomegaceroides yabei (SHIKAMA)
Capricornis crispus (TEM.)
Cervus (*Sika*) *nippon* TEM.
Macaca fuscata (BLYTH)
Meles leucurus kuzuüensis SHIKAMA
Ursus japonicus SCH.
Martes ten SHIKAMA
Mustela itatsi TEM.
Lepus brachyurus TEM. & SCH.
Sciurus sp.
Clethrionomys sp.

* Received Oct. 6, 1961, read Jan. 15, 1961.

Apodemus sp.
Sorex shinto THOMAS
Crocidura dsinezumi (TEM. & SCH.)
Mogera sp.
Rhinolophus sp.
Pipistrellus sp.
Phasianus sp.
Aves, gen. & sp. indet.
Ophidia, gen. & sp. indet.
Lacertilia, gen. & sp. indet.
Bufo sp.
Rana sp.
Pisces, gen. & sp. indet.

Beside vertebrates tolerable numbers of Decapoda, Myliapoda and Mollusca were found. The fauna above mentioned is correlated with that of the Upper Kuzuü formation and regarded to Late Pleistocene in age. Hitherto no fossil giant salamander were found in Japan, so the discovery of it from the Pleistocene formation in Shikoku is very significant from the palaeogeographical point of view.

Description

Megalobatrachus japonicus (TEMMINCK)

Plate 29, figures 1-8

Specimens:—A right parietal, a right parasphenoid, three right dentary and three vertebrae, stored in the Geological Institute, Yokohama National University.

Locality:—Shikimizu limestone quarry, Karaiwadani, Hijikawa-mura, Kita-gun, Ehime Prefecture.

Horizon:—Late Pleistocene; Shikimizu bed composed of yellowish brown brecciated clay (fissure deposits).

Description:—Right parietal (figs. 1a, 1b).

Bone rather complete in preservation but marginal part a little broken. Jointing borders with left parietal, right frontal and with right orbitosphenoid have some simple parallel shallow grooves. Bone becomes thinner from posterio-inner to anterio-outer sides. Length and width as preserved 28.5 and 15.6 mm respectively, thickness 4.7 mm.

Right parasphenoid (figs. 2a, 2b).

A fragmental bone of anterior part of parasphenoid thin, flat, smooth and broken in marginal part. Ventral and dorsal surface of anterior part marked with shallow grooves running in radial direction. Maximum length, width and thickness are 27.8, 9.8 and 2.2 mm respectively.

Right dentary no. 1 (figs. 3a-3d).

Bone good in preservation although tips of anterior- and posterior parts slightly broken. Length as preserved +8.7 mm, height and length of dental arch 54.5 and 4.7 mm; height and thickness at anterior end 9.4 and 5.6 mm respectively. Fossa for angular large, long and concave in buccal side. Pleurodont teeth sit at ridge of bone; teeth crown lost. Root undeveloped, but tubes of dental pulp of thirty three in numbers, developed at dental arch. A cross section of tube oval shaped, 1.5 mm in long diameter and 0.7-1.0 mm in short diameter. Height of tube +4 mm in median part; interval between tubes 1-2 mm. The osseus tissue of tubes the same as that of dentary. Attached area of the tubes to the wall of dental arch becomes narrower upwardly.

Right dentary no. 2 (figs. 4a, 4b).

A fragment of posterior part preserved. Bone as large as no. 1; height and thickness at end of dental arch 14.3 and 5.4 mm respectively; length as preserved +50 mm and length of dental arch +33.4 mm. Dental pulp tubes all lost; shallow fossae and low ridges run in alternation on dentary.

Right dentary no. 3 (figs. 5a, 5b).

A small fragment of dentary preserved at the area of maxillary foramen. Bone considerably worn.

Three vertebrae preserved of presacral and post third vertebra.

Vertebra no. 1 (figs. 6a-6d).

Bone lustred, considerably large and thicker than the following two bones; ossification developed; ventral side thicker than dorsal side. Centrum amphicoelous, longer than high and hand-drum formed in general outline with median constriction. Centrum 18.8 mm long along median ventral line; anterior glenoid cavity 11.5mm wide and 12.0mm high, while posterior glenoid cavity 12.2 mm wide and 11.2 mm high. Glenoid cavity oval, deep, unpierced and with median foramen lying dorsally; ventral surface of glenoid cavity larger than dorsal one; anterior median foramen almost touches posterior one. Some nervous foramen opened on ventral surface of mid centrum. Right prezygapophysis and right transverse process broken off; base of left transverse process preserved. Right half of neural broken. Prezygapophysis stout and large. Zygapophysial ridge well developed, concave in dorsal view, particularly at its posterior part. Articulating surface of prezygapophysis elongate oval in shape, longer than wide, -7×6 mm and directed anterio-lateralward.

Vertebra no. 2 (figs. 7a-7e).

Bone slightly smaller than no. 1 and ossification insufficient. Distance from tip of left prezygapophysis to tip of left postzygapophysis 16 mm. Anterior glenoid cavity higher than wide, 6.7 mm wide and 6.9 mm high; posterior glenoid cavity wider than high, 7.4 mm wide and 6.6 mm high. Centrum 12.2mm long, neural canal 3.7 mm wide and 2.2 mm high. Neural arch at the narrowest portion of zygapophysial ridges slightly wider than centrum. Anterior neural canal crescent, convex upward, while posterior canal more circular than anterior. Articulating surface of prezygapophysis elongate oval, much longer than wide and relatively longer than that of no. 1. Articulating surface of postzygapophysis ovate. Zygapophysial ridge well developed and slightly concave in dorsal view. Right pre- and postzygapophysis broken off. Neural arch provided with an elevated ridge-like median keel; neural spine absent.

Vertebra no. 3 (figs. 8a-8e).

Bone like no. 2. Transverse process, right prezygapophysis, left postzygapophysis and upper part of posterior glenoid cavity broken off. Length of centrum 12.0 mm; distance between tip of left prezygapophysis and tip of right postzygapophysis 18.8mm; width of posterior glenoid cavity +7 mm. A foramen at the posterior margin of neural arch fairly deep and triangular with longest ventral margin.

Remarks:—The individual numbers of the giant salamander in question seem to be four in total; at least one is smaller sized and at least three are larger sized. The specimen stored in the Ueno National Science Museum is 1170 mm in total length and that of Ueno's collection is 380 mm in ditto: assuming from these specimens, the smaller one seems to be about 500 mm long and larger ones about 900 mm long. This species has relatively longer vertebrae than the recent species (figs. 9a-9d), and no other clear distinction can be noticed between the two species. Thus the writers put this species to a recent one. As the existence of fossil species is established in Shikoku, it may also be possible to discover a recent species in Shikoku, the writers think.

Distribution of Megalobatrachus:—

After I. SATO the recent species is known from Middle Honsyu and North Kyusyu; the Kirigamine, Suwa-gun, Nagano Prefecture (northern limit of distribution), the Nagara River and the Upper Hida River, Gihu Pref., the Nabari River, Mie- and Nara Pref., the Upper Asahi- and the Takahashi Rivers, Okayama Pref., the Upper Yura River, Kyoto Pref., the Upper Ôta River, Hiroshima Pref., the Toyooka River, Hyogo Pref., the Tenjin- and Hino Rivers, Tottori Pref., the Eno River, Shimane Pref., the Nishiki River, Yamaguchi Pref. and the Yakukan River, Ôita Pref. etc. Some questionable samples, known from the suburbs of Matsuyama city and Kagawa Pref. (ISHIKAWA, 1935), may be supported by the fossil species. Cryptobranchidae is distributed in the world as follows; recent species is in Eastern Asia including Japan, Lower Pliocene one in Nebraska, North America and Miocene-Upper Oligocene one in Europe. It may be said that Cryptobranchidae migrated in geological ages from Europe to Eastern Asia.

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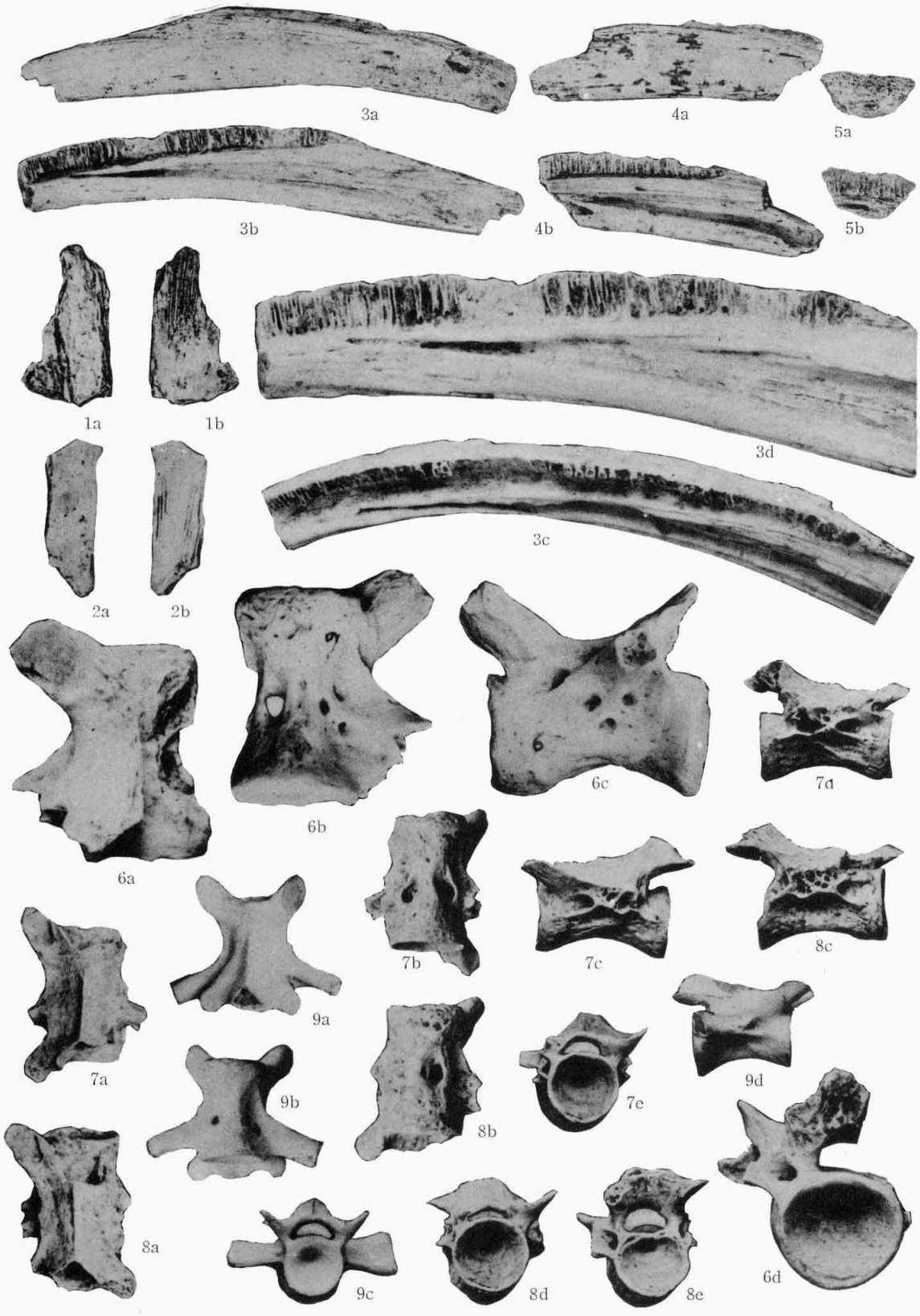
Explanation of Plate 29

Megalobatrachus japonicus (TEM.)

Fig. 1. A part of right parietal. ×1. a, ventral side; b, dorsal side.
Fig. 2. A part of right parasphenoid, ×1. a, ventral side; b, dorsal side.
Fig. 3. Right dentary. a, buccal side, ×1; b, lingual side, ×1; c, upper side, ×1.95; d, lingual side, ×1.95.
Fig. 4. A part of right dentary, ×1. a, buccal side; b, lingual side.
Fig. 5. A part of right dentary, ×1. a, buccal side; b, lingual side.
Fig. 6. Vertebra no. 1, ×1.9. a, dorsal side; b, ventral side; c, left side d, posterior side.
Fig. 7. Vertebra no. 2, ×2. a, dorsal side; b, ventral side; c, left side; d, right side; e, anterior side.
Fig. 8. Vertebra no. 3, ×2. a, dorsal side; b, ventral side; c, right side; d, anterior side; e, posterior side.
Fig. 9. Twentieth vertebra of recent specimen (Ueno's coll.), ×1.7. a, dorsal side; b, ventral side; c, anterior side; d, right side.



TAKAGI and HASEGAWA photo.

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424. *DASYBATUS* FROM THE JAPANESE MIOCENE*

KOTORA HATAI and TAMIO KOTAKA

Institute of Geology and Paleontology, Faculty of Science,
Tohoku University, Sendai Japan

中新世鱏二新種：増田孝一郎及び田村美乃によって，それぞれ門ノ沢層および山内層より発見された鱏化石を現生種と比較検討し，*Dasybatus masudae* ならびに *Dasybatus nipponensis* と命名して報告する。　畑井小虎・小高民夫

Introduction and Acknowledgements

Two small, gradually tapering shafts with minute and curved denticle on both lateral sides, and from different localities, were offered to the writers for study. One of the two specimens was obtained by Mr. Yoshiharu TAMURA, a graduate of the Institute of Geology and Paleontology, Tohoku University, during his field work in the classical area of Mizunami in Gifu Prefecture, and the other which is the smaller, by Dr. Koichiro MASUDA of the Department of Geology, College of Education, Tohoku University from the well known area of Ninohe in Iwate Prefecture. The former was dug out from a tuffaceous sandstone situated at about seven to eight meters above the base of the lower part of the marine Yamanouchi formation in the Karimabora valley at Togari in Mizunami City, Gifu Prefecture and the latter from the marine Shiratori member of the Kadonosawa formation in the valley at Nisatai, Fukuoka-machi, Ninohe-gun, Iwate Prefecture.

The larger specimen was compared with the Recent *Dasybatus akajei* (MÜLLER and HENLE) from the shallow sea off Miyagi Prefecture and found to be very similar in the preserved features of the shaft. The smaller one which was collected by Dr. MASUDA was compared with both the Gifu specimen and Recent ones and found to be somewhat different, thus its generic position is doubtful. However, since this may be the first record to fossil *Dasybatus* from the Cenozoic deposits of Japan, it is thought worthy to describe and illustrate them.

Here the writers thank Dr. Koichiro MASUDA and Mr. Yoshiharu TAMURA for kindly offering the specimens to the writer's study. Particular thanks are due to Professor Kei-ichi OMORI of the Institute of Economic Geology, Petrology and Mineralogy of the Tohoku University for kindly identifying the material from which the shafts are made.

* Received on Sept. 29, 1961, read at 79th meeting of the Society at Kanazawa, Sept. 23, 1961.

Description of *Dasybatus* Specimens

Dasybatus nipponensis HATAI and KOTAKA, n. sp.

Plate 30, Figures 5, 8, 10.

Description:—Shaft slender, gradually tapering, measuring 92 mm in length

plus 14 mm of impression, about 9 mm at preserved broadest anterior part and about 2 mm at preserved narrowest posterior part and about 5 mm in thickness. Shaft nearly straight, flattened anteriorly and posteriorly, more or less by subsequent pressure, with deep and narrow grooves and rounded narrow ridges longitudinally arranged on external surface, the number decreasing posteriorly. Sides of shaft with numerous anteriorly directed denticles numbering about five per five millimeters distance. Each denticle conical, polished, well rounded, sharply pointed at apex, broadening basally, broader than their interspaces, all directed anteriorly. Extending outwards from basal part almost perpendiculary although somewhat obtusely, then becoming more or less parallel with the lateral sides of shaft. All denticles pointed apically, their respective interspaces and thickness may vary somewhat and some appear to be equal to their interspaces in breadth although of the same shape. Dorsal and ventral sides of shaft apparently with sharply elevated central ridge developed posteriorly but not anteriorly where it grades into more or less uniformly rounded shaft but a little flattened so far as preserved parts show.

Locality:—From a tuffaceous sandstone situated at about seven to eight meters from base of lower part of Yamanouchi formation in the Karimabora valley at Togari, Mizunami City, Gifu Prefecture. Early Miocene.

Remarks:—Compared with the shaft of the Recent *Dasybatus akajei* (MÜLLER and HENLE), (Figs. 3, 4, 6, 7, 9) a living species of Japan, the fossil form is almost indistinguishable except for the more robust shaft, apparently stronger ridges on its anterior dorsal portion, sharper angled dorsal and ventral ridges at the posterior part, more number of denticles per ten millimeters distance, there being only about eight to nine in the living species at the posterior part and about 12 near the middle part, which is more than in the fossil specimen measured at the nearly same positions. However, both are similar to one another in the general shape, possession of grooves and ridges on the dorsal surface at the anterior half of the shaft, sharply pointed conical denticles all directed anteriorly and in their being closely arranged. The denticles of both fossil and living specimens are similar in extending outwards, first rather perpendicularly then abruptly or gradually becoming nearly parallel with the contour of the shaft itself.

Because of the differences above stated of the fossil specimen and the Recent one, the former is considered to represent a new species, for which the name of *nipponensis* is here proposed.

Shafts are developed in *Myliobatus tobijei* BLEEKER, *Pteroplatea japonica* TEMMINCK and SCHLEGEL, *Dasybatus Zugei* (MÜLLER and HENLE), *Uroloplus fuscus* GARMAN, besides *Dasybatus akajei* (MÜLLER and HENLE), among which only the last mentioned is in the present collection. The shafts of the other mentioned species were examined from illustrations. All of the mentioned species are known from the seas of the Japanese Islands being more common in the southern part but individually abundant in northern Japan (*Dasybatus akajei*). *Raja Kenojei* MÜLLER and *Naske japonica* (TEMMINCK and SCHLEGEL) belong to the same group, but are not known to have double-saw-teeth-like shafts.

It is very difficult to obtain Recent specimens particulary because the tails are nearly always removed immediately after their capature by chopping or cutting since they may cause severe injury. For this reason it is thought worth while

to describe the Recent specimens at hand and also because very little is known of the characteristic feature. The descriptions will be given of the tails of *Dasybatus akajei* (MÜLLER and HENLE) which were collected from the shallow sea off Miyagi Prefecture and submitted to the writer for study by Dr. Senji TANITA of the Tohoku Regional Fisheries Research Laboratory at Shiogama, Miyagi Prefecture, to whom the writer's deep appreciation is due.

The shafts, (Figs. 3, 4, 7, 9) appear to be outgrowths from the cartilage tail and thus only the shafts would be preserved as fossil, whereas the cartilage skeleton and tail would decompose. These shafts are situated generally on the dorsal central surface (Figs. 7, 9) of the tail occupying only the anterior half. The posteriormost shaft is the largest and best developed whereas those situated more anteriorly are smaller, taper more rapidly, thinner, with only weak development of grooves and ridges at their basal parts, usually extending outwards at a higher angle, and have along their lateral sides small denticles. Underneath the shafts are found conical swellings (Figs. 6, 7, 9) apparently in contact with the shafts, and these apparently disappear with the growth of the shafts. The largest shaft has no such swelling below it whereas the smaller the shaft the more developed is the swelling. This suggests that the shaft-bone developes by excretion of apatite from the mentioned conical swelling referred to above. The process in excretion of the apatite crystalized from collophane of a cartilage tail and the true nature of the mentioned swellings underneath the shafts and in contact with them is unknown to writers.

A *Dasybatus akajei* tail measuring about 51 cm in length has one very large and three small shafts, two pre-mature ones between the first and second, and one minute one anterior to the first small shaft. The distance from the tip of the first small shaft to that of the second is about 40 mm, from the second to third about 35 mm, and from the tip of the third to the tip of the largest and fourth about 125 mm. The largest shaft measuring 102 mm in length from base to tip attains about nine mm in its broadest part which is near the basal part. The apical part is smooth for about seven mm whereas anteriorly or basally the denticles gradually become well developed but are not developed at the 32 mm distance from base apically. Grooves and ridges extend apically for only about 70 mm length from basal part apically, thereon apically the shaft is smooth. The denticles are closely spaced, all directed anteriorly and show very slight variation in their spacing, strength and development. The three smaller shafts show similar features as the largest one, but the development of the denticles is premature. The largest shaft is flatly rounded transversally oval in its anterior part (which is also basal) but apically the shaft develops sharply elevated mesial portion both dorsally and ventrally. Although the basal part of the largest shaft narrows, those of the smaller three broaden and under the obliquely projecting shafts are found the conical extensions of the tail-skin.

Another tail of the same species (living) of about similar length has four small shafts and one large one, all of which are smaller than those described. All other features are the same as described above.

This may show that the lengths of the shafts and number of secondary shafts are not related with the length of the tail, although the actual size of the ray-body may have some relationship

therewith, but this could not be determined.

The shafts, both large and small, are a means for injuring the enemy by injecting them into the body. Since the tail is very flexible and easily moved in any direction, they are always removed immediately after catching.

A shaft called *Trygon* or *Myliobatis* was reported by LADD (1934, p. 244, pl. 42, fig. 9, pl. 43, fig. 5) from the Suva formation at an abandoned quarry on the south side of Walu Bay, near the entrance, a few feet above sea-level. This unnamed species resembles *Dasybatus nipponensis* HATAI and KOTAKA, n. sp. in general features, but is distinguishable by the number of denticles per one centimeter distance, shape of them and in the surface sculpture and dorso-ventral ridges.

Dasybatus (?) *masudae* HATAI and KOTAKA, n. sp.

Plate 30, Figures 1, 2.

Description:—Shaft short, measuring nearly 30 mm in preserved length, 4.5 mm in breadth anteriorly and 3.5 mm in breadth posteriorly and about 1 mm in thickness. Sides gradually tapering posteriorly, flatly oval in sectionan teriorly, more rounded posteriorly. Posteriorly shaft with sharply elevated central longitudinal ridge which dies out anteriorly. Anterior part of dorsal surface with three rough ridges and grooves, ventral surface concave, mesial grooves developed probably due to compression, posterior ventral surface with several rough grooves and ridges anteriorly merging into concave mesial groove. Posterior half of shaft with small denticles on lateral sides, all directed anteriorly. Denticles small, short, about 12 within a distance of 10 mm, low, rather widely spaced (from tip to tip), their basal parts very broad, the whole a low broad triangle inclined anteriorly. Denticles stronger posteriorly than anteriorly where they gradually decrease in size to nearly vanish near middle of preseved length of shaft.

Locality:—From the Shiratori member of the Kadonosawa formation in the val-

Explanation of Plate 30

Figs. 1, 2. *Dasybatus* (?) *masudae* HATAI and KOTAKA, n. sp.
Fig. 1-ventral surface showing median ridge, surface ornamentation and denticles. Fig. 2-dorsal surface of same specimen showing longitudinal ridges and grooves and the denticles. ×5. Locality-Nisatai, Fukuoka-machi, Ninohe-gun, Iwate Prefecture.

Figs. 3, 4, 6, 7, 9. *Dasybatus akajei* (MÜLLER and HENLE).
Figs. 3, 4-ventral and dorsal surfaces of shaft showing median ridge, surface ornamentation and development of denticles. Fig. 6-cross-section of tubercle developed on back (nat. size). Figs. 7, 9. Showing positions of shaft on median portion of tail, the sculpture and denticles. Figs. 3, 4-×4. Fig. 6-nat. size. Figs. 7, 9-slightly less than nat. size. Recent. Locality-off Miyagi Prefecture in shallow water.

Figs. 5, 8, 10. *Dasybatus nipponensis* HATAI and KOTAKA, n. sp.
Fig. 5-enlarged view (×2) showing the development of denticles, rounded dorsal surface and longitudinal sculpture. Fig. 8-same specimen in natural size. Fig. 10-enlarged portion showing development of denticles and their detail shapes and spacing. (×2). Locality-Karimabora valley, Togari Mizunami City, Gifu Prefecture.


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ley at Nisatai, Fukuoka-machi, Ninohe-gun, Iwate Prefecture. Early Miocene.

Remarks:—This species is easily distinguishable from *Dasybatus nipponensis* by the narrower shaft, smaller denticles of different shape, and in the shaft having a concave mesial groove anteriorly on the ventral surface and by the sharply elevated portion at the posterior part being developed better on the dorsal surface. The specific name is named after the collector, Dr. Koichiro MASUDA in recognition of his works on the paleontology of the Tertiary Pectinidae.

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Trans. Proc. Palaeont. Soc. Japan, N. S., No. 45. pp. 206–208, pl. 31, April 10, 1962

425. ON THE EOCENE PLANTS FROM THE WOODWARDIA FORMATION OF THE ISHIKARI GROUP*

SEIDO ENDO

石狩層群「ウットワルヂア」層産始新世化石植物。北海道石狩層群は今井氏によって層序は大体確立されたが，其中の「ウットワルヂア」（羊歯）層は多数の化石植物が出るので石狩層群の層序をしらべるのに重要な指準となって居る。其化石植物をしらべたが重要な化石「ウットワルヂア」属についてのべる。是は現在九州附近に繁茂して居る「オホカグマ」によく似て居る。併し「オホカグマ」は1米以上にもなる大きなものであるが，多量の材料を見た結果化石の材料はみなそれよりはるかに小さく且つ其他多少の相違がわかったので此化石を其変種として命名した。是は「ウットワルヂア」属の中で最も原始的なものである。

遠藤誠道

Introduction

Many years ago, Dr. H. IMAI undertook a detailed stratigraphical study of the Paleogene coal bearing group of the Ishikari coal fields and finally established the following subdivisions in Yubari district: (ascending order)

1. The Hakobuchi formation
   —unconformity—
2. The Noborikawa coal bearing formation
3. The Horokabets formation
4. The Yubari coal bearing formation
5. The Wakkanappe formation
6. The Woodwardia formation
   —unconformity—
7. The Poronai formation

Afterwards, it was restudied by the writer and many other geologists, and the subdivisions were, on the whole, recognized by the many geologists.

Among above formations of the Ishikari group, the Woodwardia formation contains abundant fossil plants. The fossil plants are now investigating by the writer, and the genus *Woodwardia* is one of the most important and characteristic plants at the fields. Therefore, it will be the first, carried on the genus *Woodwardia*.

The writer wishes to acknowledge his great indebtedness to Prof. R. W. CHANEY for kindly offering funds for the present work.

Description

Woodwardia japonica SW. var. *eocenica* ENDO (var. nov)

Pl. 31, figs. 1-3, 5.

Woodwardia Endoana OISHI et HUZIOKA: (Studies on the Cenozoic Plants of Hokkaido and Karafuto, I. Ferns from the Woodwardia Sandstone of Hokkaido by Saburo OISHI and Kazuo HUZIOKA) *Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. IV, Vol. VI, No. 2*, p. 187, pl. XLI (III) figs. 5, 6; pl. XLII (IV) figs. 1, 2, 2a, 3, 3a, 5. 6; 1941.

Woodwardia decurrens OISHI et HUZIOKA, *Op. cit.*, p. 189, pl. XLII (IV) figs. 4, 4a; pl. XLIII (V), figs. 1-3, 3a, 4, 5; 1941.

* Received Sept. 5, 1961; read Sept. 23, 1961.

Description:—Frond bipinnate, more than 30 cm. long; rachis 5 mm± across measured on the compressed surface in the material; pinnae alternate, linear, long and narrowing gradually towards the apex and attached to the rachis at an angle of about 40± degrees; pinna axis bears a single series of long and low areoles on each side; pinnules triangular in shape with acuminate apex, slightly falcate; midnerve distinct, with a series of low areoles generally 6-7 in number or less on each side; secondary nerves which are given off from the areoles, thin and generally indistinct, simple or once forking; margin finely serrate-toothed or almost entire; sori 5-7 in number on each side of the midnerve, as in the existing species, linear and oblong, one to each areole; indusium attached by its outer margin to the sorus-bearing areole; sporangia are quite similar to the existing species.

Remarks:—The present material is quite identical with the existing *Woodwardia japonica* Sw., which is now growing in the Islands of Kyushu etc., Southern Japan. In the present material, the secondary nerves of the pinnule are simple or once forking, but in the existing species, it occurs, rarely, areoles, except simple or once forking secondary nerves. In the nervations of the seedling of *Woodwardia orientalis* are, always, simple or once forking, except a series of sori producing areoles on each side of the midnerve, while in the adult ones, there are always, network nervation.

The nervation of the seedling of *Woodwardia orientalis* (Pl. 31, fig. 4) is quite similar to the nervation of *Woodwardia japonica*. The nervation of *Woodwardia japonica* is a primitive type than the nervation of *Woodwardia orientalis*. The geological occurrences of *Woodwardia* cfr. *orientalis* type are from the younger Shirakawa formation near Kobe (SHIKAMA) probably the Miocene in age, than the *Woodwardia japonica* type, that occurs from the Eocene Woodwardia formation in Hokkaido.

The genus *Woodwardia* was classified in three types, by H. CHRIST; namely, *Woodwardia virginica* type (I) Pl. 31, fig. 6, *Woodwardia radicans* type (II) Pl. 31, fig. 2, and *Woodwardia areolata* type (III) Pl. 31, fig. 7; and the present material and *Woodwardia japonica* belong to the *Woodwardia virginica* type (I), and *Woodwardia orientalis* belongs to the *Woodwardia radicans* type (II).

Next, the distinctive characters of *Woodwardia endoana* and *Woodwardia decurrens* were precisely detected by the writer, the former two species belong to *W. virginica* type (see *op. cit.*, p. 189, Pl. V, fig. 5) and unlike to *W. orientalis* (*W. radicans* type).

It seems to the writer that these are same species with present species.

Another allied one is *Woodwardia Maxoni*, which was described by F.H. KNOWLTON from the Paleocene formation of Wyoming, but it is incomplete material for identify to our present material.

It is, however, *Woodwardia virginica* type and the most allied one to the present material.

Another allied species, *Woodwardia latiloba serrata* KNOWLTON, was described from the Paleocene of the Middle Park, Colorado. This is probably the oldest known species of the genus *Woodwardia* in the geological age. The material is, however, too incomplete to the identification, but it is also *Woodwardia virginica* type of CHRIST. The generic term *Woodwardites*, which suggests affinity with the recent genus *Woodwardia*, has been used for Rhaetic plants belonging to the Dipteridinae (?). On this fern, HARRIS says, "There are profound differences

between the present fern and *Woodwardia* both in venation and sorus and it was only mistakenly regarded as the oldest member of the polypodiaceae."

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Explanation of Plate 31

Fig. 1. *Woodwardia japonica* var. *eocenica* ENDO, ×2. Loc. Shimizusawa, Yubari City, Hokkaido.
Fig. 2. *Woodwardia radicans* SM. CHRIST, H. Die Farnkräuter der Erde. p. 186, fig. 570, 1895.
Fig. 3. *Woodwardia japonica* var. *eocenica* ENDO, ×5. Loc. Shimizusawa, Yubari City, Hokkaido.
Fig. 4. *Woodwardia orientalis* SM. ×3. Seedling, (Kumamoto)
Fig. 5. *Woodwarqia japonica* var. *eocenica* ENDO, ×2. Loc. The river bank of the river Yubari, Shimizugawa, Yubari City; Hokkaido.
Fig. 6. *Woodwardia virginica* SM. CHRIST, H. *op. cit.*, p. 186, fig. 569, 1898.
Fig. 7. *Woodwardia areolata* MOORE. CHRIST, H. *op. cit.*, p. 187, fig. 571, 1898.
Fig. 8. *Woodwardia japonica* SW. The existing material, for comparison. Loc. Kumamoto.
Fig. 9. *Woodwardia orientalis* SM. The existing material, for comparison.

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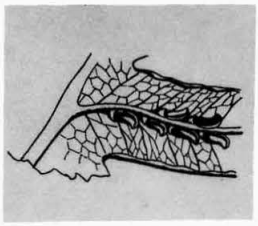

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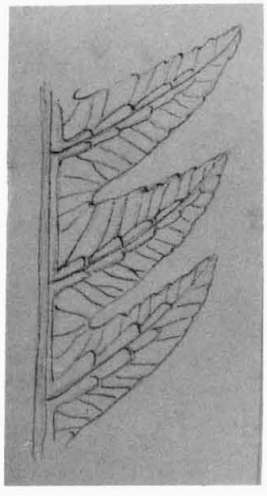

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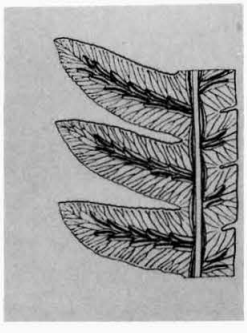

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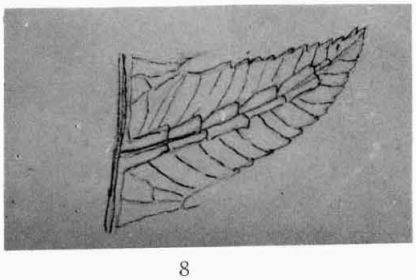

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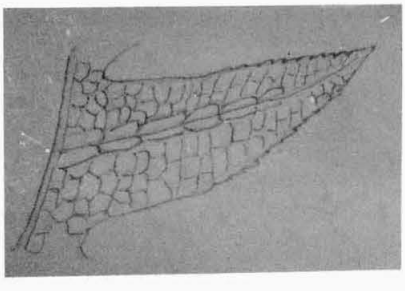

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Trans. Proc. Palaeont. Soc. Japan, N. S., No. 45, pp. 209-225, pls. 32-34, April 10, 1962

426. EOCENE PLANKTONIC FORAMINIFERA FROM HAHAJIMA (HILLSBOROUGH ISLAND)*

TSUNEMASA SAITO

Institute of Geology and Paleontology, Tohoku University

母島産始新世浮游性有孔虫：小笠原群島母島に分布する始新統は，大型のヌンムライト (*Nummulites boninensis* HANZAWA)，およびその他の豊富な大型有孔虫化石を産することで，古くから多くの研究がなされているが，これらの始新統はまた，保存のよい浮遊性有孔虫化石を含んでいる。母島の浮遊性有孔虫化石群から *Hantkenina dumblei* 等の 18 種が識別記載され，一部の属・種の検討が行なわれている。これらの化石群は，Trinidad の Navet 層等から報告された fauna に酷似し中部始新世 (Lutetian) を代表する。この時代論は大型有孔虫により得られた結果と全く一致する。

斎　藤　常　正

The Tertiary deposits of Haha-jima (Hillsborough Island) are well known for their yield of large *Nummulites* and other Foraminifera since the early part of this century. Although the stratigraphy of this island is not yet established, there are many paleontological contributions by various workers, especially of the larger Foraminifera.

Among them, HANZAWA made a geological survey of Haha-jima in 1925 and collected numerous foraminferous rocks. The results of his stratigraphical and subsequent paleontological studies were published in 1947 and 1950, when he described the large *Nummulites* as *Nummulites boninensis* and several others besides the stratigraphic succession of the Eocene rocks in the island. He concluded that Haha-jima was formed of Eocene rocks and that the foraminiferal fauna were largely of Lutetian in age.

Recent progress in the study of planktonic Foraminifera now enables extensive zonal correlation of the Eocene rocks. In this concern, Dr. HANZAWA suggested the study of smaller Foraminifera which are associated with the Eocene larger Foraminifera and the foraminiferous rocks collected by him were forwarded to the writer for examination. This paper is devoted to the description of the planktonic Foraminifera, a discussion on their geological age and correlation of the Eocene rocks in Haha-jima with other areas.

The writer thanks Dr. Shoshiro HANZAWA, Professor emeritus of the Tohoku University, for suggesting this study and for his advices on the stratigraphy and paleontology of Haha-jima. Thanks are also due to Professors Kiyoshi ASANO, Kotora HATAI and Dr. Yokichi TAKAYANAGI of the Institute of Geology and Paleontology, Tohoku University for their valuable suggestions and encouragements.

Geologic Setting

Haha-jima is a small, long and narrow island in the Ogasawara (Bonin) group, located approximately at latitude 26°40′ N., longitude 138°10′E. No geologic map of this island has been published. Ac-

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cording to (HANZAWA 1947), however, the stratigraphic section of the about 200 meters thick Eocene beds in Haha-jima is as follows in descending order (quoted):

Meters

"11 *Biplanispira* limestone: white, compact and cavernous, containing *Biplanispira absurda* (UMBGROVE), *Pellatispira* sp., *Acervulina* n. sp. Sekimon-yama and Onion Beach 100

10 *Discocyclina* limestone: pink or white, indurated, with abundant *Discocyclina* (s. l.) and pelagic and benthonic Foraminifera. The top of Akaiwa, Nishiura 10

9 *Globigerina* tuff: reddish-brown and greenish-gray, abundant pelagic and benthonic Foraminifera, and *Discocyclina* (s. l.). Onion Beach, Oki-mura 3-5

8 *Discocyclina-Alveolina* tuff: buff-colored, with abundant *Discocyclina* (*Actinocyclina*) *colcanapi* and *Alveolina javanus* var. Nishi-ura 25

7 *Eorupertia-Alveolina* tuff: buff-colored, with abundant *Eorupertia boninensis*, *Alveolina javanus* var., *Lithothamnium*, corals, echinoids and mollusks. Nishiura and 100 meters north of Nishiura-bashi 15

6 Tuff: dark green, Shizukazawa.... several meters ..... ?

5 *Nummulites-Discocyclina* tuff and agglomerate: buff-colored, with *Nummulites boninensis* and *Discocyclina* (*Actinocyclina*) *colcanapi*. Cocoanut Beach, Nanking Beach 20

4 Tuff: white 7

3 *Nummulites* tuff: Buff-colored, with abundant *Nummulites boninensis*, *Alveolina javanus* var., and *Eorupertia boninensis*. Nanking Beach, Cocoanut Beach, Shizukazawa, Yumemizaka, Rosudani, Funaki-yama, Nenbutsu Pass, Sakai-dake 16
(Rosu-ishi, the *Globigerina* limestone may be referred to a deeper facies of this tuff, which has been suggested as a shallow-water deposit of less than 200 meters depth, in Yabe's study of some arenaceous Foraminifera encrusting the surface of *Nummulites* tests.)

2 Tuff: white 7

1 Andesite basement rock"

Concerning these Eocene rocks HANZAWA (*loc. cit.*) added that: "The Eocene beds are locally intercalated with some andesite lava in several horizons, except the uppermost *Biplanispira*-limestone which is destitute of pyroclastic material. This fact suggests that the volcanic activity that took place in the Lutetian age, during which the *Nummulites*-bearing beds were deposited, ceased before the Priabonian age, in which the *Biplanispira*-limestone was formed."

Among the rock samples collected from the 11 beds described by HANZAWA, four were washed for the present study, namely *Nummulites* tuff, Rosu-ishi (a local name of the *Globigerina* limestone quarried for building stone), *Discocyclina-Alveolina* tuff, and *Globigerina* tuff. And except for the *Discocyclina-Alveolina* tuff, the other three yielded smaller Foraminifera. The localities and some remarks on the lithology of the three samples which yielded the foraminiferal fauna studied are briefly summarized as follows.

Nummulites tuff:—Shizukazawa, Oki-mura, Haha-jima (Hillsborough Island). Light brown, tuffaceous fine grained sandstone with abundant tests of *Nummulites boninensis* HANZAWA (330 specimens in 100 g. rock sample).

Rosu-ishi:—A quarry at the entrance of Rosu-dani (Rosu-valley), northeast of Oki-mura, Haha-jima. Hard compact white limestone made up largely of foraminiferal tests. Stratigraphically, it is supposed to be a deeper water facies of the *Nummulites* tuff above mentioned.

Globigerina tuff:—The sea cliff of Onion Beach, at the east side of the small

embayment of Oki-mura, Haha-jima. Light greenish gray tuffaceous compact medium to fine grained sandstone.

Age, Correlation and Planktonic Foraminifera

After treatment by the hard-rock maceration method using GLAUBER's salt, a rich planktonic fauna was extracted from the residue on the screen with about 100 microns opening. All planktonic forms and their frequency are shown in Table

Table 1. Distribution of Foraminifera from Haha-jima (L: left direction, R: right direction).

	Nummulites Tuff		Rosu-ishi		*Globigerina* Tuff	
SPECIES \ COILNG OF TEST	L.	R.	L.	R.	L.	R.
Hantkenina dumblei WEINZIERL and APPLIN					3	
Globorotalia centralis CUSHMAN and BERMUDEZ					52	7
G. crassata crassata (CUSHMANN)	1	16	39	55	145	10
G. crassata densa (CUSHMANN)	4	5	22	20	81	
G. lehneri CUSHMANN and JARVIS			3	2	31	19
G. spinulosa CUSHMANN			9	14	31	17
Truncorotaloides topilensis (CUSHMANN)	1	1			19	
Globigerina collactea (FINLAY)	2	3		1	1	
G. linaperta FINLAY					1	2
G. yeguaensis WIENZIERL and APPLIN					7	14
G. yaguaensis WEINZIERL and APPLIN var.	1	4			8	12
Globoquadrina venezuelana (HEDBERG)			2	1	6	9
"*Globigerinoides*" *higginsi* BOLLI		1				4
Sphaeroidinellopsis senni (BECKMANN)	1	1	61	47	116	115
Globigerapsis mexicana (CUSHMANN)			11		78	
G. index (FINLAY)	1	4		2	2	16
Porticulasphaera beckmanni SAITO, n. sp.					4	
Globigerinatheka barri BRONNIMANN					118	
Catapsydrax echinatus BOLLI					5	
Planktonic miscellanea (sp. indet.)	4		20		350	
Total	50		309		1283	
Weight of Sample (in Gram)	100		1		0.5	

1 with the weight of each rock sample treated. Except for the *Nummulites*-tuff, the planktonic forms predominate over the benthonic ones in all of the samples. The planktonic fauna from Haha-jima consists of 18 species of which one is new and they are described in the systematic part. Nearly all of them are familiar Eocene planktons and their geologic ranges and geographical distribution are fairly well known by the studies of previous authors.

By the extensive works on the planktonic Foraminifera from the Eocene Navet and San Fernando formations in Trinidad, BOLLI (1957*c*) established biostratigraphic zonation of the Eocene formations. The zonation of BOLLI has been currently used in the Eocene biostratigraphy as a tool for interregional correlation. In the middle to upper Eocene, seven zones were recognized in ascending order, namely *Hantkenina aragonensis*, *Globigerapsis kugleri*, *Globorotalia lehneri*, *Porticulasphaera mexicana*, *Truncorotaloides rohri*, *Globigerapsis semiinvoluta*, and *Globorotalia cocoaensis* Zone. As discussed later in the systematic part, however, some changes are made on the species *Porticulasphaera mexicana* (CUSHMAN) of BOLLI *et al.* (1957) and *Globigerapsis kugleri* BOLLI, LOEBLICH and TAPPAN. *Globigerapsis kugleri* of BOLLI *et al.* is considered to be a junior synonym of *Globigerina mexicana* CUSHMAN and therefore the hypotypes referred to CUSHMAN's *mexicana* by them are an undescribed form to which the new name *Porticulasphaera beckmanni* is here proposed. Accordingly it seems that the zone names of *Globigerapsis kugleri* and *Porticulasphaera mexicana* of BOLLI (*loc. cit.*) should be emended hereafter for the newly designated name of the species which represents the types of BOLLI *et al.*, namely *Globigerapsis mexicana* for *Globigerapsis kugleri* and *Porticulasphaera beckmanni* for *Porticulasphaera mexicana*.

As already stated, the *Nummulites*-bearing rocks in Haha-jima were considered to be Lutetian (Middle Eocene) in age except for the *Biplanispira* limestone which is Priabonian (Upper Eocene) based upon the larger Foraminifera (HANZAWA, *loc. cit.*) and which yielded no smaller Foraminifera. The planktonic fauna from the lower three beds, however, is difficult to subdivide and it should be considered as comprising a single unit. In the *Nummulites* tuff, the planktonic assemblage is very poor in number and kind of species, probably due to some ecological conditions during deposition of that bed.

Considering the geologic ranges of each species and the present faunal assemblage, this fauna is evidently correlative with the "*Porticulasphaera mexicana*" (=*P. beckmanni*) Zone of Trinidad (BOLLI, *loc. cit.*). This zone is defined by the first appearance of *Globoquadrina venezuelana* (HEDBERG), the extinction of *Globorotalia spinulosa* CUSHMAN and *Truncorotaloides topilensis* (CUSHMAN) at the top, and by the restriction of *Porticulasphaera beckmanni*, n. sp. (=*P. mexicana* BOLLI, *et al.*) to it. The *P. beckmanni* Zone is now considered to represent a part of the middle Eocene (Lutetian) in age. The Lutetian age of the present fauna coincides with that indicated by the larger Foraminifera and upheld by the occurrence of *Hantkenina dumblei* which is a characteristic middle Eocene species (THALMANN, 1942*b*; BRONNIMANN, 1950). Thus the fauna from the Eocene rocks in Haha-jima is closely related with that of the Navet formation in Trinidad.

In the northern hemisphere of the Pacific province, the genus *Hantkenina* which was believed to be restristed to the Atlantic prior to 1932, has been re-

corded from islands of Rota (HANZAWA, 1957), Saipan, Mariana Islands (TODD, 1957), Mid-Pacific seamounts (HAMILTON, 1953), Eniwetok Atoll (TODD and LOW, 1960) and East Borneo (THALMANN, 1942*a*). Either *Hantkenina alabamensis* or the species supposed to be an upper Eocene form have been described from all except the last mentioned island. The present discovery of *Hantkenina dumblei*, a middle Eocene form in Haha-jima added a new locality of the species in the northern Pacific province.

All the types here described are desposited in the Institute of Geology and Paleontology, Tohoku University. The prefix IGPS to the catalogue numbers is an abbreviation for Institute of Geology and Paleontology, Sendai.

Systematic Descriptions

Family Hantkeninidae

Genus *Hantkenina* CUSHMAN, 1924

Hantkenina dumblei WEINZIERL and APPLIN, 1929

Plate 32, figures 5-7

Hantkenina dumblei WEINZIERL and APPLIN, 1929, p. 402, pl. 43, figs. 5a, b (*fide* ELLIS and MESSINA, 1940 *et seq.*); SHOKHINA, 1937, p. 437, pl. 2, figs. 12, 13 (reproduced from WEINZIERL and APPLIN); REY, 1939, p. 324, pl. 22, figs. 10-12, p. 329, text-figs. c, d; THALMANN, 1942*a*, (no figures); BOLLI, LOEBLICH and TAPPAN, 1957, p. 26-28, pl. 2, figs. 5a-6 (lectotype designated).

Hantkenina cf. *dumblei* WEINZIERL and APPLIN, CUSHMAN and SIEGFUS, 1939, p. 32, pl. 7, fig. 2.

Hantkenina (*Applinella*) *dumblei* WEINZIERL and APPLIN, THALMANN, 1942*b*, p. 812, 814, pl. 1, figs. 2a, b (reproduced from WEINZIERL and APPLIN); BRONNIMANN, 1950, p. 408-410, pl. 55, figs. 17, 18, 22-24, pl. 56, fig. 5.

Hantkenina (*Applinella*) cf. *dumblei* WEINZIERL and APPLIN, CRESPIN, 1958, p. 317-319, text-figs. 1-4.

Remarks:—This characteristic middle Eocene form is easily distinguished by having the five to six chambers longer than broad, a triangular shape with a long, slightly curved frontal line; the spines placed at the anterior angles of the chambers, just below the sutures; sutures radial, slightly depressed and either straight or sigmoidally curved. This species was originally described from the middle Eocene Yegua formation of Texas. Since then, it has been recorded from many remote localities, namely Trinidad, Morocco, North Caucasus, East Borneo, western Australia, California *etc*. The present occurrence in the northwestern Pacific region is very interesting in considering the Eocene paleogeography and the distribution of this species. Only from the *Globigerina* tuff, fragile but fairly well preserved specimens are rarely found. The size ranges from 0.45 to 0.83 mm. in maximum diameter without spines.

Hypotypes:—IGPS coll. cat. no. 79000a-c from the *Globigerina* tuff.

Family Globorotaliidae

Genus *Globorotalia* CUSHMAN, 1927

Globorotalia centralis CUSHMAN and BERMUDEZ, 1937

Plate 33, figures 1a-2

Globorotalia centralis CUSHMAN and BERMUDEZ, 1937, p. 26, pl. 2, figs. 62-65; HOWE, 1939, p. 84, pl. 12, figs. 4-6; BERGQUIST, 1942, p. 97, pl. 9, figs. 34, 36, 37; STAINFORTH, 1948, p. 118, pl. 26, figs. 27-29; HAMILTON, 1953, p. 229, pl. 32, fig. 8; BECKMANN, 1954, p. 396, pl. 26, figs. 8, 9, text-fig. 21; TODD, 1957, p. 268 (table), pl. 71, figs. 1a-c, 3a-c; BOLLI, LOEBLICH and TAPPAN, 1957, p. 41, pl. 10, figs. 4a-c (re-

production of holotype); BOLLI, 1957*c*, p. 169, pl. 39, figs. 1a-4; TODD and LOW, 1960 (part), p. 850, pl. 259, figs. 10a-11c (not figs. 12a-c); SOURDILLON, 1960, pl. 2, figs. 29-31.

Globorotalia (*Turborotalia*) *centralis* CUSHMAN and BERMUDEZ. CUSHMAN and BERMUDEZ, 1949, p. 44, 45, pl. 8, figs. 19-21.

Remarks:—The large specimens of this species frequently occcur in the present material. As stated by BOLLI (*loc. cit.*), this species shows considerable variation in the number, shape and spiral arrangement of the chambers. High spired forms are rather rare. The coiling of the test is a strong preference to the left direction. The size ranges from 0.36 to 0.63 mm. in maximum diameter.

Hypotypes:—IGPS coll. cat. no. 79001a, b from the *Globigerina* tuff.

Globorotalia crassata crassata (CUSHMAN), 1925

Plate 33, figures 3a-4c

Pulvinulina crassata CUSHMAN, 1925*b*, p. 300, 301, pl. 7, fig. 4.

Globorotalia crassata (CUSHMAN). COLE, 1927, p. 34, pl. 1, figs. 7, 8; CUSHMAN and BARKSDALE, 1930, p. 67, 68, pl. 12, figs. 7a, b; HOWE, 1939, p. 84, pl. 12, figs. 7-9; CUSHMAN, 1939, p. 74, pl. 12, fig. 19; CUSHMAN and APPLIN, 1943, p. 44, pl. 8, figs. 10a, b; CUSHMAN and RENZ, 1948, p. 40, pl. 8, figs. 5, 6; HAMILTON, 1953, p. 229, pl. 31, figs. 17, 18, pl. 32, figs. 1-3; BECKMANN, 1954, p. 396, 397, pl. 26, figs. 10, 11, text-fig. 22.

Globorotalia (*Truncorotalia*) *crassata* (CUSHMAN). CUSHMAN and BERMUDEZ, 1949, p. 37, pl. 7, figs. 4-6.

Globorotalia bullbrooki BOLLI, 1957*c*, p. 167, pl. 38, figs. 4a-5c.

Globorotalia densa (CUSHMAN). PESSAGNO, 1961, p. 356, pl. 1, figs. 1-3.

Remarks:—When CUSHMAN (*loc. cit.*) proposed this species, he figured only a single spiral view. The present specimens are identified with this species. In 1925, CUSHMAN divided *Pulvinulina crassata* into two species, namely *Pulvinulina crassata* (*s. s.*) and *P. crassata* var. *densa*. *Pulvinulina crassata* (*s. s.*) is herein treated as *Globorotalia crassata crassata* and it differs from *G. crassata densa* in having more rhomboidal equatorial profile and more numerous chambers visible on the spiral side. Considerable variations are found in this species with respect to the angle of periphery which is very thin almost keel-like to sub-rounded, and the rate of increase of the chambers. This species occurs in abundance in Haha-jima and shows the tendency of the coiling of tests which become strongly to the left in the younger deposits. The size ranges from 0.22 to 0.43 mm. in maximum diameter.

Hypotypes:—IGPS coll. cat. no. 79002a, b from the *Nummulites* tuff.

Globorotalia crassata densa (CUSHMAN), 1925

Plate 33, figures 5a-6b, 10a-11c

Pulvinulina crassata CUSHMAN var. *densa* CUSHMAN, 1925*b*, p. 301 (no figures given).

Globorotalia crassata (CUSHMAN) var. *densa* (CUSHMAN). COLE, 1927, p. 34, (listed only); CUSHMAN and BARKSDALE, 1930, p. 68, pl. 12, figs. 8a, b; CUSHMAN, 1939, p. 74, 75, pl. 12, figs. 20a, b.

Globorotalia (*Truncorotalia*) *crassata* (CUSHMAN) var. *densa* (CUSHMAN). CUSHMAN and BERMUDEZ, 1949, p. 38, pl. 7, figs. 10, 12, 11 (?).

Globorotalia crassata densa (CUSHMAN). HAMILTON, 1953, p. 230, pl. 32, fig. 4.

Globorotalia crassula CUSHMAN and STEWART. BECKMANN, 1954, p. 397, pl. 26, fig. 12 (not of CUSHMAN and STEWART).

Globorotalia crassata var. *densa* (CUSHMAN). TODD and LOW, 1960, p. 850, pl. 259, figs. 13a-c.

Remarks:—This subspecies differs from

the typical one in having more compact form, usually four chambers in the last whorl, sub-rectangular equatorial profile, and the more rounded periphery. It occurs as commonly as the typical one in the present materials and also has the tendency to left coiling in the younger horizons. The size ranges from 0.24 to 0.34 mm. in maximum diameter.

Hypotypes:—IGPS coll. cat. no. 79003a-d from the *Globigerina* tuff.

Globorotalia lehneri CUSHMAN and JARVIS, 1929

Plate 32, figures 11a-c

Globorotalia lehneri CUSHMAN and JARVIS, 1929, p. 17, pl. 3, figs. 16a-c; CUSHMAN and RENZ, 1948, p. 40, pl. 8, figs. 3, 4; CUSHMAN and BERMUDEZ, 1949, p. 32, pl. 6, figs. 7-9; BOLLI, 1957*c*, p. 168, pl. 38, figs. 9a-13.

Remarks:—The forms transitional between this species and *Globorotalia spinulosa* are also found in the present materials as in the Navet formation (BOLLI, *loc. cit.*). The test of this species, in general, is more compressed, nearly equally biconvex, and with weaker keeled periphery than *G. spinulosa*. The coiling of the tests shows slight preference to the left. The size ranges from 0.27 to 0.48 mm. in maximum diameter.

Hypotype:—IGPS coll. cat. no. 79004 from the *Globigerina* tuff.

Globorotalia spinulosa CUSHMAN, 1927

Plate 33, figures 9a-c.

Globorotalia spinulosa CUSHMAN, 1927*a*, p. 114, pl. 23, figs. 4a-c; COLE, 1927, p. 34, pl. 2, fig. 9; HOWE, 1939, p. 85, pl. 12, figs. 10-12; CUSHMAN, 1939, p. 75, pl. 12, figs. 21a-c; FRANKLIN, 1944, p. 318, pl. 48, fig. 8; BECKMANN, 1954, p. 397, 398, pl. 26, fig. 13, text-fig. 23; TODD, 1957, p. 268 (table), pl. 71, figs. 2a-c; BOLLI, 1957*c*, p. 168, pl. 38, figs. 6a-7c.

Globorotalia (*Truncorotalia*) *spinulosa* CUSHMAN, CUSHMAN and BERMUDEZ, 1949, p. 40, 41, pl. 8, figs. 1-3.

Remarks:—This species differs from *G. lehneri* in having an umbilicoconvex test, instead of a nearly equally biconvex one as in the latter. Usually this species shows a dense and more spinose thickened keel than *G. lehneri*. The coiling of the tests show a preference to the left. The size ranges from 0.20 to 0.53 mm. in maximum diameter.

Hypotype:—IGPS coll. cat. no. 79005 from the *Globigerina* tuff.

Genus *Truncorotaloides* BRONNIMANN and BERMUDEZ, 1953

Truncorotaloides topilensis (CUSHMAN), 1925

Plate 33, figures 8a-c

Globigerina topilensis CUSHMAN, 1925*a*, p. 7, pl. 1, figs. 9a-c; HOWE, 1939, p. 84, pl. 12, figs. 1-3; WEISS, 1955, p. 309, 310, pl. 2, figs. 16, 17; HAMILTON and REX, 1959, p. 792, pl. 252, figs. 17, 21.

Truncorotaloides topilensis (CUSHMAN), BOLLI, 1957*c*, p. 170, pl. 39, figs. 13-16b.

Remarks:—The Haha-jima specimens referable to this species are closely related to the hypotypes of BOLLI (*loc. cit.*) which was compared by him with the holotype. This species is characterized by having a rather lobulate periphery owing to the greater separation of the individual chambers, the coarsely hispid test surface and some sutural supplementary apertures on the spiral side. This feature of sutural supplementary apertures is an important criterion which distinguishes this species from previously known related forms in general appearance of the adult. In juvenile specimens, however, sometimes these supple-

mentary apertures are not clearly observed. The coiling of the test is a strong preference to the left. The size ranges from 0.32 to 0.51 mm. in maximum diameter.

Hypotype:—IGPS coll. cat. no. 79006 from the *Globigerina* tuff.

Family Globigerinidae

Genus *Globigerina* D'ORBIGNY, 1826

Globigerina collactea (FINLAY), 1939

Plate 32, figures 12a-c

Globorotalia collactea FINLAY, 1939*b*, p. 327, pl. 29, figs. 164, 165.

Globigerina collactea (FINLAY). BRONNIMANN, 1952*b*, p. 13, 14, pl. 1, figs. 13-15; BOLLI, 1957*a*, p. 72, pl. 15, figs. 21-23; BOLLI, 1957*c*, p. 162, pl. 35, figs. 18a, b.

Remarks:—This species was originally described as a *Globorotalia*. As noted by BRONNIMANN, it has an umbilical aperture which is a character of the genus *Globigerina*. This species is characterized by having the last whorl consisting of four to five chambers which increase gradually in size, but the last one sometimes is equal to or even smaller than the penultimate; and a fairly wide open umbilicus is usual. FINLAY described this species from the Bortonian stage of New Zealand. According to HORNIBROOK (1958), the Bortonian stage is correlative with the upper Middle Eocene. The present stratigraphic occurrence in Haha-jima coincides with that of this species in New Zealand, but in the Caribbean region the range of this species is restricted to the Lower Eocene. The coiling shows a supposedly left direction. The size ranges from 0.24 to 0.33 mm. in maximum diameter.

Hypotype:—IGPS coll. cat. no. 79007 from the *Nummulites* tuff.

Globigerina linaperta FINLAY, 1939

Plate 32, figures 4a-c

Globigerina linaperta FINLAY, 1939*a*, p. 125, pl. 13, figs. 54-57; BRONNIMANN, 1952*b*, p. 16, pl. 2, figs. 7-9; HAMILTON, 1953, p. 222, pl. 32, figs. 5, 6; BOLLI, 1957*a*, p. 70, pl. 15, figs. 15-17; BOLLI, 1957*c*, p. 163, pl. 36, figs. 5a, b; HORNIBROOK, 1958, p. 33, 34, pl. 1, figs. 19-21 (reproduction of holotype); SAID and KENAWY, 1956, p. 157, pl. 7, figs. 7a, b.

Remarks:—The specimens referable to this species occur rarely in Haha-jima. The coiling of the tests is uncertain because of the few specimens. The size ranges from 0.29 to 0.46 mm. in maximum diameter.

Hypotype:—IGPS coll. cat. no. 79008 from the *Globigerina* tuff.

Globigerina yeguaensis WEINZIERL and APPLIN, 1929

Plate 32, figures 1a-3

Globigerina yeguaensis WEINZIERL and APPLIN, 1929, p. 408, pl. 43, figs. 1a, b. (*fide* ELLIS and MESSINA, 1940. *et seq.*); BOLLI, 1957*c*, p. 163, pl. 35, figs. 14a-15c.

Globigerina bulloides D'ORBIGNY (?). CUSHMAN and BARKSDALE, 1930, p. 67, pl. 12, figs. 6a, b.

Globigerina pera TODD, 1957, p. 301, pl. 70, figs. 10a-11c.

Catapsydrax unicavus BOLLI, LOEBLICH and TAPPAN. BOLLI, 1957*c*, pl. 37, figs. 7a, b (not of BOLLI, LOEBLICH and TAPPAN).

Catapsydrax cf. *dissimilis* (CUSHMAN and BERMUDEZ). BOLLI, 1957*c*, pl. 37, figs. 6a, b.

Remarks:—This species is characterized by the well lobated periphery, rather open umbilicus in which a narrow and low arched aperture with a fragile but distinct lip opens, and the inflated and well separated subglobular chambers. In addition to this typical form some variants with an aberrant chamber are found

in association. These forms are found to be very similar to either of *G. pera* TODD or to the two "*Catapsydrax*" species of BOLLI (*loc. cit.*). There is considerable variation in the mode of development of the aberrant chamber. In some specimens this covers entirely the umbilicus as in the case of BOLLI's "*Catapsydrax* cf. *dissimilis*", but in some other specimens one slit-like aperture is present at the inner edge of the supplementary chamber as shown in pl. 32, fig. 3. *Globigerina pera* of TODD (*loc. cit.*) and "*Catapsydrax unicavus*" of BOLLI (*loc. cit.*). And in some extreme cases this aberrant chamber covers only less than half of the umbilicus. The general characters of the test when this aberrant chamber was removed, however, do not differ from the typical *Globigerina yeguaensis* as shown in pl. 32, fig. 2. Even in some distinct Eocene species as *Globigerapsis index* and *Globorotalia crassata densa*, such aberrant chambers are also observed. Further cases and the meaning of the aberrant chamber were discussed in detail elsewhere (TAKAYANAGI and SAITO, 1962). The stratigraphic occurrence of these Eocene "*Catapsydrax*"-like forms seems to coincide well with the range of *Globigerina yeguaensis*. Consequently the writer considered a part of these Eocene "*Catapsydrax*"-types with an aberrant chamber to be a variant of *G. yeguaensis*. In this point of view, further investigations seem to be necessary on the genus *Catapsydrax*. In this article the forms with an aberrant chamber are distinguished from the typical only in the distribution chart as a variety of this species without taxonomic status. This species shows a slight preference to right coiling. The size ranges from 0.31 to 0.54 mm. in maximum diameter.

Hypotypes:—IGPS coll. cat. no. 79009, 79010a, b from the *Globigerina* tuff.

Genus *Globoquadrina* FINLAY, 1947

Globoquadrina venezuelana (HEDBERG), 1937

Plate 34, figures 9a-10

Globigerina venezuelana HEDBERG, 1937, p. 681, pl. 92, figs. 7a, b; CUSHMAN and STAINFORTH, 1945, p. 67, pl. 12, figs. 13a, b; HAMILTON, 1953, p. 223, 224, pl. 30, fig. 3; WEISS, 1955, p. 310, pl. 2, figs. 18-20; BOLLI, 1957*b*, p. 110, pl. 23, figs. 6a-8b; BOLLI, 1957*c*, p. 164, pl. 35, figs. 16a-17; HAMILTON and REX, 1959, p. 792, pl. 253, figs. 15, 16.

Globigerina conglomerata SCHWAGER, BECKMANN, 1954, p. 391, pl. 25, figs. 6-9, text-fig. 15 (not of SCHWAGER).

Globoquadrina venezuelana (HEDBERG), BLOW, 1959, p. 186, pl. 11, figs. 58a-c, 59.

Remarks:—This species was referred to the genus *Globoquadrina* FINLAY at the time of its proposal. BOLLI (*loc. cit.*) and BLOW (*loc. cit.*) discussed some variations of this species and BLOW upheld the view of FINLAY. In some Eocene forms a pointed umbilical tooth is found at the base of the final chamber (pl. 34, fig. 10). In Haha-jima, rather large forms occur fairly commonly in association with *Hantkenina dumblei*. The coiling of the tests is random. The size ranges from 0.26 to 0.63 mm. in maximum diameter.

Hypotypes:—IGPS coll. cat. no. 790011a, b from the *Globigerina* tuff.

Genus *Globigerinoides* CUSHMAN, 1927

"*Globigerinoides*" *higginsi* BOLLI, 1957

Plate 34, figures 8a, b

"*Globigerinoides*" *higginsi* BOLLI, 1957*c*, p. 164, 165, pl. 36, figs. 11a-13b; PESSAGNO, 1961, p. 356, pl. 2, fig. 14.

Remarks:—The rare but well preserved specimens in the present materials are identified with the species of BOLLI. This species is distinguished by the very

high spiral arrangement of its chambers and some supplementary sutural apertures on the spiral side. But in the earlier whorls the supplementary apertures are very obscure or not observed. Because of its small size and the rare occurrence, further study is reserved for future opportunity concerning the generic position of this high spired species. All the specimens show right coiling. The size ranges from 0.24 to 0.31 mm. in maximum diameter.

Hypotypes:—IGPS coll. cat. no. 79012 from the *Globigerina* tuff.

Genus *Sphaeroidinellopsis* BANNER and BLOW, 1959

Sphaeroidinellopsis seni (BECKMANN), 1954

Plate 34, figures 3a-5b

Sphaeroidinella seni BECKMANN, 1954, p. 394, 395, pl. 26, figs. 2-4, text-fig. 20.

Globigerina seni (BECKMANN). BOLLI, 1957*c*, p. 163, pl. 35, figs. 10a-12.

Sphaeroidina gredalensis COOK (*sic*=*Sphaeroidina gredalensis* MALLORY). MALLORY, 1959, p. 248, pl. 22, figs. 10a, b, pl. 34, figs. 4a, b.

Remarks:—This species was originally described as a *Sphaeroidinella*. But BOLLI transferred it to the genus *Globigerina*, laying stress on the absence of sutural supplementary apertures and chamber flange in this species. The absence or presence of supplementary sutural apertures, however, seems not to be a consistent character of *Sphaeroidinella*. In the works of BOLLI *et al.* (1957) and BOLLI (1957*b*), such forms without these accessory apertures as *S. seminulina* and *S. rutschi* were included in the same genus *Sphaeroidinella*, though these species were later referred to the new genus *Sphaeroidinellopsis* by and of BANNER and BLOW (1959). In *Sphaeroidinella dehiscens*, the type species of the genus, fairly wide variations in the development of supplementary sutural apertures are observed. In the populational study of *Sphaeroidinella dehiscens* from the *Globigerina* ooze (collected at the Lat. 2°50'5" N., Long. 133°54' E. by the S. S. Manshu in 1925), it was found that the specimens less than 0.42 mm. in maximum diameter had no supplementary aperture other than the primary. On the other hand, the well developed crenulate flanges with the apertural margins are observed in the present specimens as well as in the type figures of BECKMANN (*loc. cit.*) and of BOLLI (1957*c*, pl. 35, fig. 10a). Concerning this apertural ornamentation, BECKMANN stated: "Mündung im Umbilicus, durch höckerige Auswüchse der ventralen Kammerränder verdeckt". Such "tentacular"-like flange bordering an apertural opening along its margin is not observed in any species of *Globigerina*. In some specimens the exterior surface of the later chambers is smooth and somewhat glassy in appearance. From the foregoing features the writer considered this species to belong to the genus *Sphaeroidinellopsis* because of the absence of supplementary sutural aperture in the adult. This species occurs in abundance in the present materials and shows nearly random coiling. The size ranges from 0.22 to 0.48 mm. in maximum diameter.

Hypotypes:—IGPS coll. cat. no. 79013a-c from the *Globigerina* tuff.

Genus *Globigerapsis* BOLLI, LOEBLICH and TAPPAN, 1957 emended

Type species here designated: *Globigerapsis mexicana* (CUSHMAN) [=*Globigerina mexicana* CUSHMAN, 1925*a* (here emended)]=*Globigerapsis kugleri* BOLLI, LOEBLICH and TAPPAN, 1957 (Type species by original designation).

Test subglobular; early portion trochospiral with subglobular chambers, final chamber embracing and covering the umbilical region of the preceding coil, less than a half of the surface of the test in extent; primary aperture covered in adult by an enveloping final chamber, which possesses two or more arched openings at lower margin of final chamber, at intersections with sutures of earlier whorl.

Remarks:—*Globigerapsis kugleri* BOLLI, LOEBLICH and TAPPAN, the type species of their new genus *Globigerapsis* is undoubtedly a junior synonym of *Globigerina mexicana* CUSHMAN 1925 as discussed below. Accordingly, the type species of the genus *Globigerapsis* is here substituted and emended as *Globigerapsis mexicana* (CUSHMAN).

This genus differs from *Porticulasphaera* in not having the inflated strongly enveloping last chamber larger in size than the entire previous portion of test and the multiple sutural apertures around the lower margin of the final chamber, at the contact with the sutures of the earlier whorl. This genus does not show the multiple apertures on earlier chambers as noted in *Globigerinoides* and *Porticulasphaera*.

Globigerapsis mexicana (CUSHMAN), 1925 emended

Plate 34, figures 6a–7c

Globigerina mexicana CUSHMAN, 1925*a*, p. 6, 7, pl. 1, figs. 8a, b; CUSHMAN, 1927*b*, p. 168, pl. 26, figs. 16, 17; COLE, 1928, p. 218, pl. 2, fig. 11; STAINFORTH, 1953, p. 23–25, text-figs. 1–3; WEISS, 1955, p. 309, pl. 2, fig. 15; MALLORY, 1959, p. 249, pl. 22, figs. 9a-c; TODD and LOW, 1960, p. 848, pl. 259, figs. 6, 7.

Globigerinatheka barri BRONNIMANN, 1952*a* (part), p. 27, 28, text-figs. 3d-f (not figs. 3a-c, g, h).

Globigerinoides mexicana (CUSHMAN), HAMILTON, 1953, p. 224, pl. 32, fig. 27; BECKMANN, 1954 (part), p. 393, 394, pl. 25, figs. 15, 17 (not figs. 16, 18, 19.)

Globigerapsis kugleri BOLLI, LOEBLICH and TAPPAN, 1957, p. 34, pl. 6, figs. 6a-c; BOLLI, 1957*c*, p. 165, pl. 36, figs. 21a, b.

Test subglobular, early portion trochospiral, final chamber considerably larger and somewhat embracing, covering umbilical region of early coil, but less than a half of surface of test in extent; about four chambers in each whorl but usually three equally sized chambers in last whorl; sutures deeply depressed, incised, radial to curved; wall calcareous, coarsely perforate, finely spinose, but usually surface spines broken into rough surface; primary aperture covered in adult by final somewhat enveloping chamber which has two or more arched sutural supplementary apertures, each bordered by a slight lip, in earlier whorl secondary apertures obscured or absent.

Maximum diameter of figured hypotypes 0.34 and 0.53 mm. Other specimens range from 0.22 to 0.55 mm. in maximum diameter.

Remarks:—In 1957, BOLLI, LOEBLICH and TAPPAN proposed a new genus *Porticulasphaera* with *Globigerina mexicana* CUSHMAN as the type species, based on the forms with the final chamber which entirely covered more than a half of the test and with multiple sutural supplementary apertures around the lower margin of the final chamber, at the contact with the sutures of the earlier whorl (BOLLI *et al.*, *loc. cit.*). However, although *Porticulasphaera* of BOLLI *et al.* is based upon CUSHMAN's original *mexicana*, the characters are different from their generic diagnosis. From the original figures of CUSHMAN as well as the subsequent good figures of his topotype or paratype specimens from the type locality (CUSH-

MAN, 1927*b*) and also of STAINFORTH (*loc. cit.*) it is evident that the forms of CUSHMAN's *mexicana* do not have the chamber covering the earlier chambers in areal (larger in size than the entire previous portion of the test) and the multiple sutural supplementary aperture around the lower margin of the final chamber. From these features, the type species of *Porticulasphaera* of BOLLI *et al.* should be given a new name, since it represents a new species for which the name of *Porticulasphaera beckmanni* is here proposed. On the other hand, the type species of *Globigerapsis* BOLLI, LOEBLICH and TAPPAN, is conspecific with CUSHMAN's original *mexicana* and is therefore a junior synonym and the type species of that genus becomes CUSHMAN's original *mexicana*. From the viewpoint of Zoological Nomenclature the newly proposed generic name of BOLLI *et al.*, *Porticulasphaera*, was based upon an undescribed species but the genus now actually includes several other species. For this reason, choice should be made between selection of the second named species of the genus as the type species or of the new name given to replace the type species of BOLLI *et al.*, or a new generic name should be established to include species agreeing with the generic diagnosis. Since *Porticulasphaera* was not based upon syntype or cotype materials, no lectotype can be designated, and selection of the second named species is impossible, and therefore a new generic name should be proposed into which the newly named specific name for the type species of BOLLI *et al.* is to be included. To avoid confusion and to abide with the laws of International Zoological Nomenclature, the species *Porticulasphaera beckmanni* is here designated as the type species of *Porticulasphaera*, of which description is given under the genus *Porticulasphaera*.

Types:—Holotype (CUSHMAN coll. 4334) from the upper Eocene Tantoyuca formation, Vera Cruz, Mexico. Herein figured hypotypes (IGPS coll. cat. no. 79014a, b) from the *Globigerina* tuff, Onion Beach, Okimura, Haha-jima.

Globigerapsis index (FINLAY), 1939

Plate 32, figures 9-10c

Explanation of Plate 32

(All figures ×68: a, umbilical view; b, spiral view; c, side view)

Figs. 1a-3. *Globigerina yeguaensis* WEINZIERL and APPLIN. 1, hypotype (IGPS 79009). 2, umbilical view of hypotype showing the form removed of a bulla-like aberrant chamber (IGPS 79010a). 3, umbilical view of hypotype with an aberrant umbilical chamber (IGPS 79010b).

Figs. 4a-c. *Globigerina linaperta* FINLAY. Hypotype (IGPS 79008).

Figs. 5-7. *Hantkenina dumblei* WEINZIERL and APPLIN. 5, side view of hypotype (IGPS 79000a). 6, side view of hypotype (IGPS 79000b). 7, side view of hypotype (IGPS 79000c).

Figs. 8a, b. *Globigerinatheka barri* BRONNIMANN. 8a, umbilical side showing supplementary bulla (IGPS 79015a). 8b, spiral view.

Figs. 9-10c. *Globigerapsis index* FINLAY. 9, umbilical view of hypotype with a supplementary bulla covering an apertural opening (IGPS 79015a). 10, hypotype (IGPS 79015b).

Figs. 11a-c. *Globorotalia lehneri* CUSHMAN and JARVIS. Hypotype (IGPS 79004).

Figs. 12a-c. *Globigerina collactea* FINLAY. Hypotype (IGPS 79007).


1a
1b
1c
5
2
3
6
7
4a
4b
4c
9
10c
8a
8b
10a
10b
12b
12a
11a
11b
11c
12c

Globigerinoides index FINLAY, 1939*a*, p. 125, pl. 14, figs. 85-88; BECKMANN, 1954, p. 392, pl. 25, fig. 14; TODD, 1957, p. 268 (table), pl. 70, figs. 5-7; HORNIBROOK, 1958, p. 34, pl. 1, figs. 11-14 (reproduction of holotype).
Globigerapsis index (FINLAY). BOLLI, 1957*c*, p. 165, pl. 36, figs. 14a-18b; SOURDILLON, 1960, pl. 2, figs. 30-41; PESSAGNO, 1961, p. 356, pl. 2, figs. 15-17.

Remarks:—This chracteristic species occurs rarely in the present materials. It is distinguished by its globular test in the adult stage and supplementary sutural aperture on the spiral side, usually three fairly large chambers consist of the bulk of the entire test in the mature stage, and in three chambered forms a larger main aperture is placed symmetrically with respect to the intercameral suture between the penultimate and antepenultimate chambers. Coiling of the test is a slight preference to the right. Some forms with an umbilical bullae are found rather rarely and one of them is figured in pl. 32, fig. 9.

Hypotypes:—IGPS coll. cat. no. 79015a, b from the *Globigerina* tuff.

Genus *Porticulasphaera* BOLLI, LOEBLICH and TAPPAN, 1957 emended

Type species here designated: *Porticulasphaera beckmanni* SAITO, new species.

Test subglobular, early portion trochospiral, final chamber inflated to almost spherical, and strongly enveloping, more in extent than the entire previous portion of the test, covering the umbilical region of the early coil; sutures depressed, radial to curved; primary aperture in the early portion interiomarginal umbilical, covered in the adult by a large enveloping final chamber, around the lower margin of the final chamber multiple sutural supplementary apertures developed, secondary sutural apertures also visible on the spiral side of the early coils as in *Globigerinoides*.

Porticulasphaera beckmanni SAITO, n. sp.

Plate 34, figures 1a-2

Globigerinoides mexicana CUSHMAN. BECKMANN, 1954 (part), p. 393, 394, pl. 25, figs. 18, 19 (not figs. 15-17).
Porticulasphaera mexicana (CUSHMAN). BOLLI, LOEBLICH and TAPPAN, 1957, p. 35, pl. 6, figs. 8-9b; BOLLI, 1957*c*, p. 165, pl. 37, figs. 1a, b.

Test free, subglobular, early portion low trochospiral, with five to six chambers per whorl, last chamber subglobular, inflated and strongly embracing and enveloping umbilical region of early coil, more in extent than a half of entire test; sutures usually distinct, depressed and somewhat incised; wall calcareous, comparatively thick, coarsely perforate; primary aperture in early portion interiomarginal, umbilical which is covered by last enveloping chamber with smaller multiple secondary apertures around its lower margin, secondary sutural apertures also visible on spiral side of early portion as in *Globigerinoides*. Maximum diameter of holotype 0.60 mm., paratype 0.54 mm. Other specimens range from 0.44 to 0.62 mm. in maximum diameter.

Remarks:—As noted under *Globigerapsis mexicana*, this species was described from the Oceanic formation of Barbados as *Globigerinoides mexicana* (CUSHMAN) by BECKMANN and as *Porticulasphaera mexicana* (CUSHMAN) by BOLLI *et al.* and BOLLI from the Eocene Navet formation, Trinidad. But the characters are different from CUSHMAN's original *mexicana* and this new name which represents the hypotypes of BOLLI *et al.* and of BECKMANN is here proposed. *P. beckmanni* SAITO, n. sp. differs from *Globigerapsis*

mexicana (CUSHMAN) in having the inflated hemispherical last chamber enveloping the umbilical region of the early coil, larger in size than the entire previous portion of the test, and the multiple sutural supplementary apertures around the lower margin of the last chamber, at the contact with the sutures of earlier coils. It is also distinguished by the secondary sutural apertures on the spiral side as in *Globigerinoides*.

According to BOLLI (*loc. cit.*), this species seems to have its range comparable with his *Porticulasphaera mexicana* Zone (herein treated as *Porticulasphaera beckmanni* Zone) This species is named after Dr. J. P. BECKMANN who first recognized this species and in honor of his contributions to micropaleontology.

Types:—Holotype, IGPS coll. cat. no. 79016; paratype, IGPS coll. cat. no. 79017 both from the *Globigerina* tuff, Onion Beach, Haha-jima.

Genus *Globigerinatheka*
BRONNIMANN, 1952

Globigerinatheka barri
BRONNIMANN, 1952

Plate 32, figures 8a, b

Globigerinatheka barri BRONNIMANN, 1952*a* (part), p. 27, 28, text-figs. 3a-c, g, h (not figs. 3d-f); BOLLI, LOEBLICH and TAPPAN, 1957, p. 38, pl. 7, figs. 12a-c; BOLLI, 1957*c*, p. 166, pl. 37, figs. 8, 9; SOURDILLON, 1960, pl. 2, fig. 35.

Globigerina mexicana CUSHMAN. HOWE, 1939, p. 83, pl. 12, fig. 13 (not of CUSHMAN).

Globigerinoides mexicana (CUSHMAN). BECKMANN, 1954 (part), p. 393, 394, pl. 25, fig. 16 (not figs. 15, 17-19).

Remarks:—This species occur commonly in the present material. It possesses a globular test, in which the early chambers are trochospiral and the later a large enveloping final chamber covering the previous umbilical side. The multiple secondary sutural apertures which are covered by small bulla are visible on the spiral side. Each of this bullae has one or more small arched openings at the intersections with the sutures. In general characters, the forms removed of these bulla closely resemble *Globigerapsis mexicana* (CUSHMAN). However, they seem to have different stratigraphic ranges as noted in the Eocene Navet and San Fernando formations of Trinidad. Accordingly, this species may be distinct stratigraphically. But further morphological and stratigraphical studies on these two species seem to be necessary for the reason that the bullae may

Explanation of Plate 33

(Figures 8a-c × 60; all others ×68; a, umbilical view; b, spiral view; c, side view)

Figs. 1a-2. *Globorotalia centralis* CUSHMAN and BERMUDEZ. 1, hypotype (IGPS 79001a). 2, umbilical view of hypotype (IGPS 79001b).

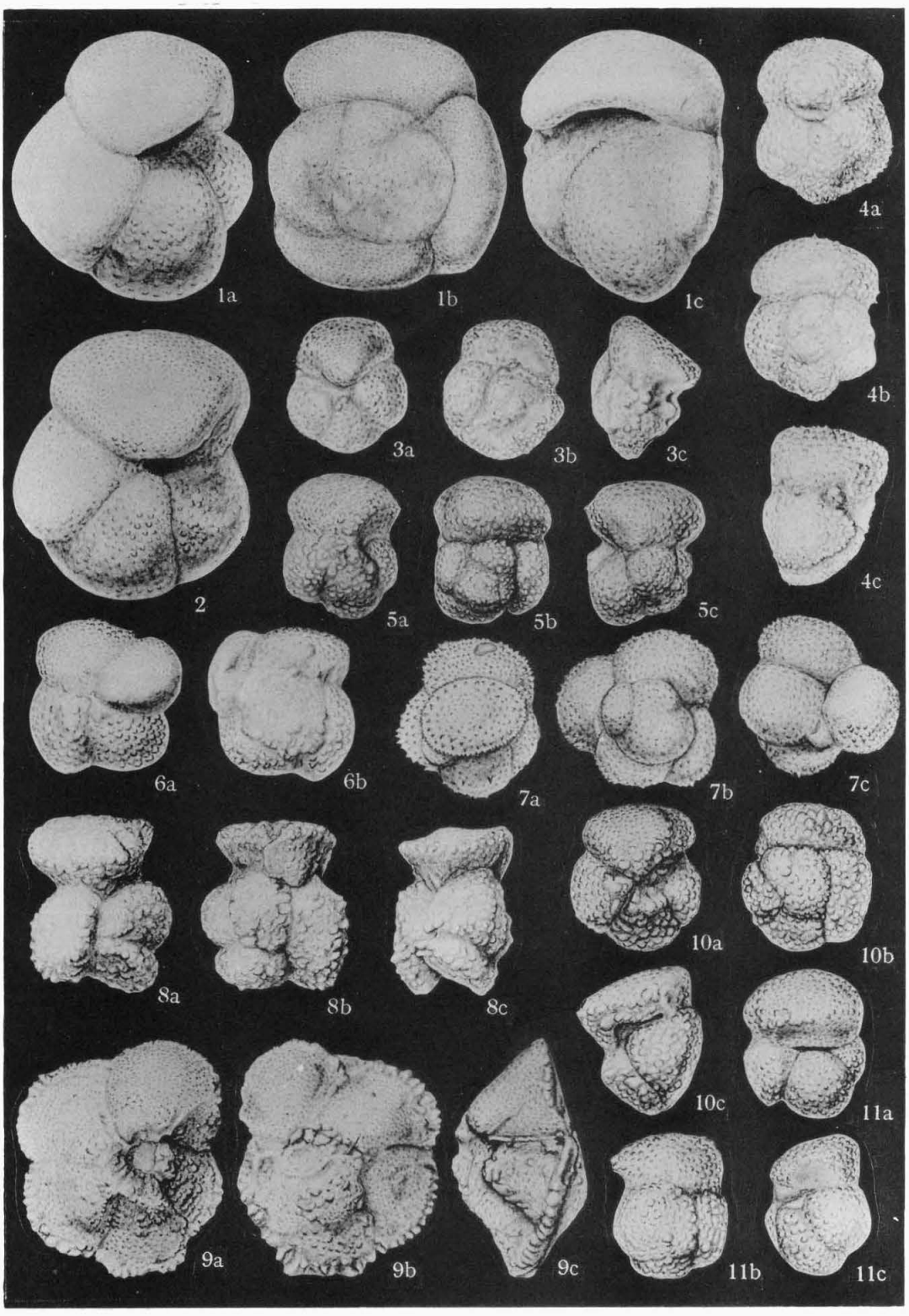
Figs. 3a-4c. *Globorotalia crassata crassata* (CUSHMAN). 3, hypotype (IGPS 79002a). 4, hypotype (IGPS 79002b).

Figs. 5a-6b, 10a-11c. *Globorotalia crassata densa* (CUSHMAN). 5, hypotype (IGPS 79003a). 6, hypotype with an aberrant umbilical chamber (IGPS 79003b). 10, hypotype (IGPS 79003c). 11, hypotype (IGPS 79003d).

Figs. 7a-c. *Catapsydrax echinatus* BOLLI. Hypotype (IGPS 79019).

Figs. 8a-c. *Truncorotaloides topilensis* (CUSHMAN). Hypotype (IGPS 79006).

Figs. 9a-c. *Globorotalia spinulosa* CUSHMAN. Hypotype (IGPS 79005).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11b
11c

be an unreliable criterion in taxonomy as discussed elsewhere. The size ranges from 0.24 to 0.64 mm. in maximum diameter.

Hypotype:—IGPS coll. cat. no. 79018 from the *Globigerina* tuff.

Genus *Catapsydrax* BOLLI, LOEBLICH and TAPPAN, 1957

Catapsydrax echinatus BOLLI, 1958

Plate 33, figures 7a-c

Catapsydrax echinatus BOLLI, 1957*c*, p. 165, 166, pl. 37, figs. 2a-5b.

Remarks:—Although rare, the specimens are found to be identical with this species. It is characterized by having the chambers slightly compressed with a distinctly spinose surface. Concerning the generic position of this species, however, it seems that some considerations are needed as in the case of other Eocene "*Catapsydrax*" species discussed elsewhere. But it will be reserved for another occasion because of the few specimens. All the specimens in the present materials show left coiling. The size ranges from 0.27 to 0.37 mm. in maximum diameter.

Hypotype:—IGPS coll. cat. no. 79019 from the *Globigerina* tuff.

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Explanation of Plate 34

(Figures 8a, b ×75; all others ×68: a, umbilical view; b, spiral view; c, side view, unless otherwise noted)

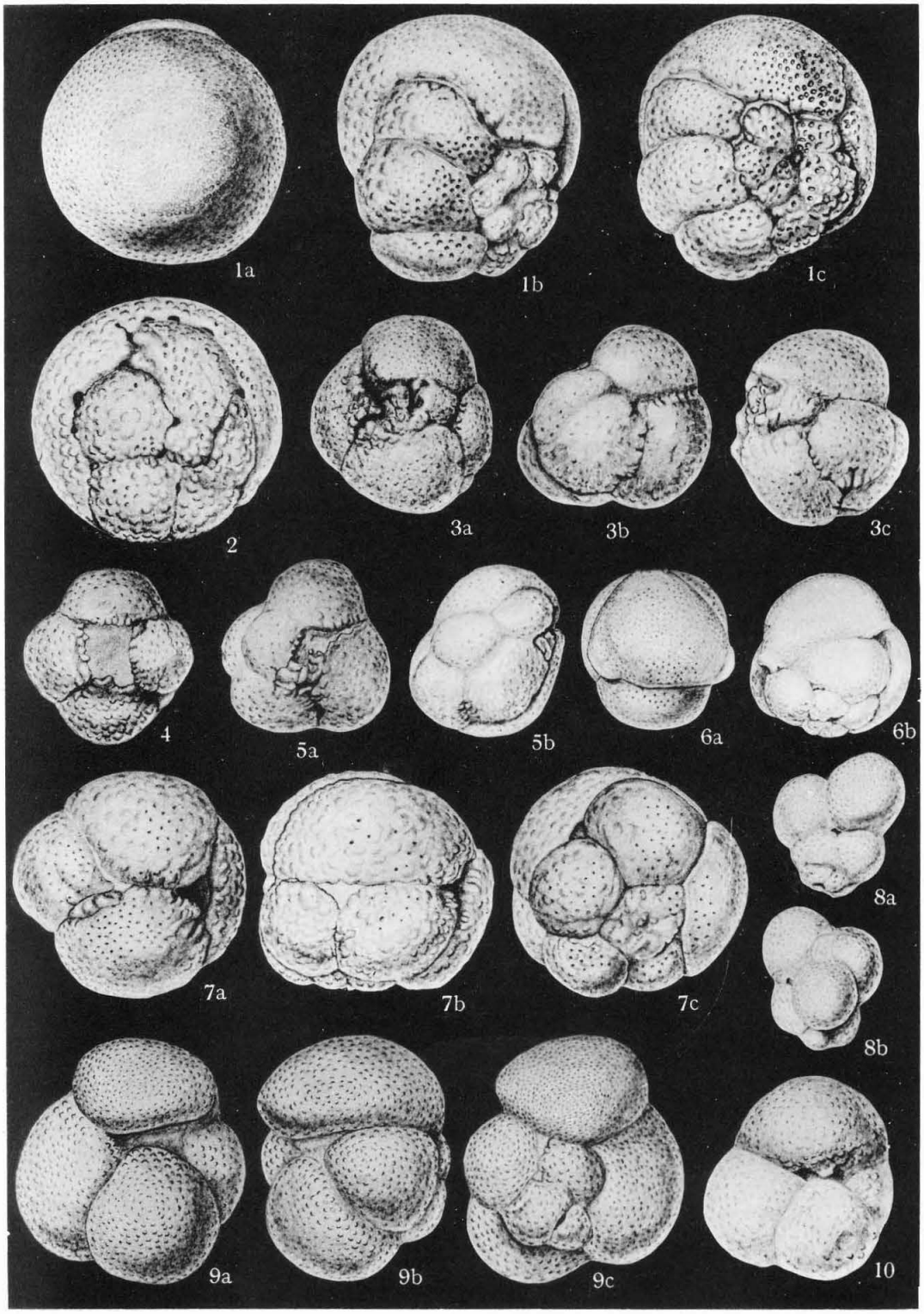
Figs. 1a–2. *Porticulasphaera beckmanni* SAITO, new species. 1a, umbilical side of holotype, showing inflated and strongly enveloping final chamber (IGPS 79016). 1b, side view. 1c, spiral view. 2, spiral view of paratype (IGPS 79017).

Figs. 3a–5b. *Sphaeroidinellopsis senni* (BECKMANN). 3, hypotype (IGPS 79013a). 4, hypotype (IGPS 79013b). 5, hypotype (IGPS 79013c).

Figs. 6a–7c. *Globigerapsis mexicana* (CUSHMAN) 6a, umbilical side of small hypotype (IGPS 79014a). 6b, side view. 7a, side view of small hypotype (IGPS 79014). 7b, side view. 7c, spiral view.

Figs. 8a, b. "*Globigerinoides*" *higginsi* BOLLI. 8, hypotype (IGPS 79012).

Figs. 9a–10. *Globoquadrina venezuelana* (HEDBERG). 9, hypotype (IGPS 79011a). 10, hypotype with umbilical tooth at the lower end of the final chamber (IGPS 79011b).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PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

日本古生物学会昭和36年度年会は，1962年1月20日東北大学理学部地質学古生物学教室において開催された(参加者37名)。年会における講演者並びに講演題目は次の通りである。

特　別　講　演

Some species of Equisetaceae and Podozamitacea in Japan and Korea....Enzo KONNO

イスラエルにおけるネアンデルタール型人類の発掘 .....高井冬二

第7回欧州微古生物学コロキアムに出席して ...
..... 浅野　清

学　術　講　演

On the genus *Carpinus* with descriptions of two species.....Seido ENDO

Neogene Pelagic foraminifera from the southern Kanto region...Yoshiki KIKUCHI

Age, distribution and morphology of *Globigerina nepenthes* Todd (Planktonic Foraminifera). .....Tsunemasa SAITO

Some Jurassic Trigoniids from the Tetori group in the Kuzuryu district, Central Japan. (代読) .....Shiro MAEDA

Upper Triassic (Carnic) Ammonoids from Malaya. .....Tadashi SATO

A Note on *Didymoceras awajiense* (YABE)..
..... Tatsuro MATSUMOTO and Mitsuo NAKANO

北海道岩見沢市朝日炭鉱付近の第三系産貝化石群について (代読)....菅野三郎・買手屋　仁

Remarks on Some Fossil *Dosinia* of Japan.
..... Kôichirô MASUDA

Influence of Environment on the Variation of *Batillaria multiformis* (LISCHKE) (ウミニナの変異に及ぼす環境の影響)..永沢譲次

日本産上部古生代三葉虫について .....
..... 遠藤隆次・松本英二

Mursia takaihashii について .....今泉力蔵

Dasycladaceae について .....遠藤隆次

Polyphyletic Derivation of Angiosperms inferred by Leaf-form Evolution...浅間一男

News

◎ 国際地学連合 (IUGS) は1961年9月にICSUに加盟した。そして，本年5-6月に執行委員会を開いて将来の活動，万国地質学会議 (IGC) の associations や committees，ICSU，UNESCO との関係等を議することになっている。この会議には小林会長が出席することになっている。

◎ 古生物学研究連絡委員会は1962年1月19日仙台で総会を開き古生物学界に関する諸問題を議した。第1回国際花粉学会議には徳永重元君を代表として推薦することになった。

◎ ベルリン工業大学の K. J. MÜLLER 氏は日本各地でコノドントに関する講義を行うため本年4月来日される予定である。

◎ XVI回国際動物学会議 (International Congress of Zoology) は1963年アメリカ合衆国ワシントンに於て8月21日より27日まで7日間にわたり開催される。この会議の Sponsoring Society 中には，古生物学関係では Society of Economic Paleontologists and Mineralogists; Society of the Study of Evolution; The Paleontological Society 等が見られる。
会議に関する問合せ先きは下記の通りである。

Dr. Gairdner B. MOMENT
Secretary General, XVI International Congress of Zoology.
2101 Constitution Avenue, Washington 25, D. C., U. S. A.

例　会　通　知

	開　催　地	開　催　日	講演申込締切日
第 81 回 例 会	熊 本 大 学	1962 年 6 月 2 日	1962 年 5 月 5 日
第 82 回 例 会	東京教育大学	1962 年 9 月 29・30 日	1962 年 8 月末日

学　会　記　事

◎ 本会特別出版物第 7 号として会員坂上澄夫君の Japanese Permian Bryozoa が出版された。定価一部 1200 円である。

◎ 本年 9 月 29・30 日 の両日にわたり東京教育大学で開催される本会第 82 回例会には「日本中新世の下限について」のシンポジウムが予定されている。

◎ 本会誌の出版は一部文部省研究成果刊行費補助金による。

会　則　変　更

1962 年 1 月 20 日東北大学で開かれた日本古生物学会総会で次の如く会則第 12 条が変更された。

普通会員会費年 600 円が 800 円に
特別会員会費年 1,000 円が 1,300 円に
在外会員会費年 $3 が $5 にそれぞれ変更された。

Change in Constitution

On the Occasion of the Annual Meeting of the Palaeontological Society of Japan, held on January 20, 1962, it was decided upon to revise Article 12 as indicated (in italic) below.

Article 12. Rates for annual dues are: Regular Members, Yen 800, Fellows, Yen 1,300, and Foreign Members, $5.00

会　員　消　息

◎ 会員浅野清君は欧米視察旅行を終えて昨年 11 月下旬帰国した。

◎ 会員猪郷久義君はイリノイ州立地質調査所へ招聘され昨年 12 月下旬渡米した。

1961 年 4 月 4 日より 1962 年 1 月 19 日までの会員移動は次の通りである。

入会者	池谷　仙之	植松　健児	大脇　康孝	岡崎　由夫	小川　久	買手屋　仁
	小池　敏夫	佐野　誠	関戸　信次	高橋由美子	高山　俊昭	田中　収
	恒石　幸正	長瀬　和雄	中世古幸次郎	名取　博夫	西田　民雄	沼野恭一郎
	原　卓郎	松本　英二	的場　保望	三上　貴彦	満岡　孝	三谷　勝利
	森　啓	山崎　裕	David von Denburg Le Mone			
退会者	佐藤　良昭	滝　庸(死亡)	藤田　至則	三木　一成		

購読御希望の方は本会宛御申込下さい

1962 年 4 月 1 日　印　刷
1962 年 4 月 10 日　発　行

日本古生物学会報告・紀事
新　篇　第 45 号
350 円

東京大学理学部地質学教室内
日本古生物学会
編　集　者　高　井　冬　二
発　行　者　市　川　健　雄
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学術図書印刷株式会社　富　田　元

日本古生物学会会則　(1962, 1, 20)

第 1 条　本会は日本古生物学会という。

第 2 条　本会は古生物学およびこれに関係ある諸学科の進歩および普及を計るのを目的とする。

第 3 条　本会は第 2 条の目的を達するため次の事業を行う。

1. 会誌そのほかの出版物の発行。 2. 学術講演会の開催。
3. 普及のための採集会・講演会そのほかの開催。
4. 研究の援助・奨励および研究業績ならびに会務に対する功労の表彰その他第 2 条の目的達成に資すること。

第 4 条　本会の目的を達するため総会の議を経て本会に各種の研究委員会を置くことができる。

第 5 条　本会は古生物学およびこれに関係ある諸学科に興味を持つ会員で組織する。

第 6 条　会員を分けて普通会員・特別会員・賛助会員および名誉会員とする。

第 7 条　普通会員は所定の入会申込書を提出した者につき評議員会の議によって定める。

第 8 条　特別会員は本会に 10 年以上会員であり古生物学について業績のあるもので，特別会員 5 名の推薦のあったものにつき評議員会の議によって定める。

第 9 条　賛助会員は第 2 条の目的を賛助する法人で評議員会の推薦による。

第 10 条　名誉会員は古生物学について顕著な功績のある者につき評議員会が推薦し，総会の決議によって定める。

第 11 条　会員は第 12 条に定められた会費を納めなければならない。会員は会誌の配布を受け第 3 条に規定した事業に参加することができる。

第 12 条　会費の金額は総会に計って定める。会費は普通会員年 800 円，特別会員年 1,300 円，賛助会員年 10,000 円以上とする。名誉会員は会費納入の義務がない。在外の会員は年 5 弗とし会誌および特別出版物の配布を受ける。

第 13 条　本会の経費は会費・寄付金・補助金などによる。

第 14 条　会費を 1 ケ年以上滞納した者および本会の名誉を汚す行為のあった者は，評議員会の議を経て除名することができる。

第 15 条　本会の役員は会長 1 名，評議員 15 名とし，うち若干名を常務委員とする。任期は総て 2 年とし再選を妨げない。

会長の委嘱により本会に幹事および書記若干名を置くことができる。

常務委員は評議員会において互選される。評議員は特別会員の中から会員の通信選挙によって選出される。

第 16 条　会長は特別会員の中から評議員会において選出され，本会を代表し会務を管理する。

会長に事故ある場合は会長が臨時に代理を委嘱する。

第 17 条　本会には名誉会長を置くことができる。名誉会長は評議員会が推薦し総会の決議によって定める。名誉会長は評議委員会に参加することができる。

第 18 条　本会は毎年一回定例総会を開く。その議長には会長が当り本会運営の基本方針を決定する。

総会の議案は評議員会が決定する。

会長は必要があると認める時は臨時総会を召集する。総会は会員の十分の一以上の出席をもつて成立する。

会長は会員の三の分一以上の者が会議の目的たる事項および召集の理由を記載した書面をもつて総会召集の請求を受けた場合は臨時総会を召集する。

第 19 条　総会に出席しない会員は他の出席会員にその議決権の行使を委任することができる。但し，欠席会員の議決権の代行は 1 人 1 名に限る。

第 20 条　総会の議決は多数決により，可否同数の時は議長がこれを決める。

第 21 条　会長および評議員は評議員会を組織し，総会の決議による基本方針に従い運営要項を審議決定する。

第 22 条　常務委員は常務委員会を組織し評議員会の決議に基づいて会務を執行する。

第 23 条　本会の会計年度は毎年 1 月 1 日に始まり 12 月 31 日に終る。

第 24 条　本会会則を変更するには総会に付議し，その出席会員の三分の二以上の同意を得なければならない。

付　則　1) 評議員会の議決は総て無記名投票による。