Endothyroid Foraminifera, *Endothyranopsis* from Japan

By

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with 2 Text-figures and 1 Plate

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ABSTRACT. Four species of *Endothyranopsis* are described and illustrated from the *Pseudoendothyra spiroides* zone of the Akiyoshi Limestone group, Akiyoshi plateau, Southwest Japan, and No. 17 horizon of the Onimaru formation, Kitakami massif, Northeast Japan. They are *Endothyranopsi hirosei* sp. nov., *E. compressa* (RAUSER-CHERNOUSSOVA and REITLINGER), *E*? sp. A, and *E*? sp. B. The foraminiferal assemblage in association with *Endothyranopsis* strongly suggests that the *Pseudoendothyra spiroides* zone of the Akiyoshi Limestone group is equivalent in age to the Onimaru formation (upper Viséan).

CONTENTS

I. INTRODUCTION

The genus *Endothyranopsis*, an endothyroid Foraminifera characterized by a planispiral and involute test with slight axial rotation and a peculiar wall structure, was erected by CUMMINGS in 1955 as one of the results of revision of the Carboniferous and Permian foraminifers of Brady Collection. CUMMINGS designated *Involutina crassa* BRADY as the type-species. He clarified that this genus is common in the upper part of the British Lower Carboniferous, and that *Endothyranopsis crassus* (BRADY) is confined to the lower part of the Lower Limestone Group in the Scotish Lower Carboniferous. At that time the following three forms were also referred to *Endothyranopsis*: *Endothyra conspicua* HOWCHIN (1888) from the "J" Limestone of the Tipalt district, Northern England, and *Endothyra crassa compressa* RAUSER-CHERNOUSSOVA and REITLINGER (1936), and *E. crassa sphaerica* RAUSER-CHERNOUSSOVA and REITLINGER (1936), both from the upper Viséan of the Pechora region of Northern Ural, USSR. Recently ROSOVSKAYA (1963) emended specific diagnoses of *Endothyra umbonata* GANELINA (1956)

and *E. crassa pechorica* Rauser-Chernoussova (1948) from the Viséan sediments of the northwest region of the Moscow Basin, and assigned them to the same genus.

The stratigraphical occurrence of the above species and subspecies mostly confined to the *Dibunophyllum* Zone of the British Avonian and its facies units in USSR. Furthermore, as Cummings (1955) inferred, morphologically the simplest and stratigraphically the oldest *Endothyranopsis* may be ancestral to such endothyroids as *Bradyina* Möller and *Cribrospira* Möller. His inference has been generally supported by Reitlinger (1958) and Rosovskaya (1963) through the phylogenetic study of the Endothyridae. Thus, so far as has been known, the genus may probably be regarded as an important index of the upper Viséan age.

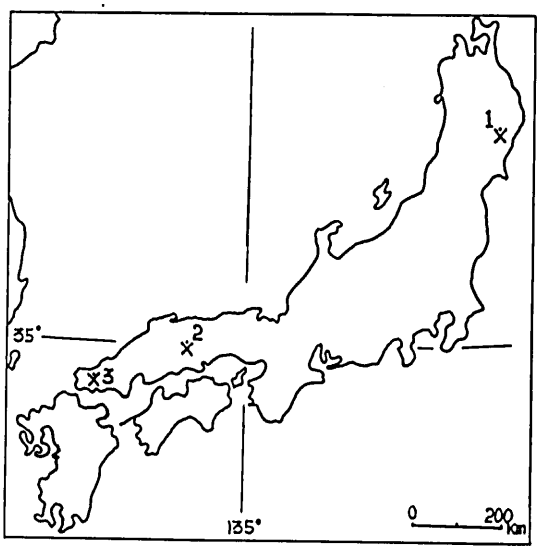

Fig. 1. Index map showing location of the Kitakami, Atetsu, and Akiyoshi district.

The writer found four species of *Endothyranopsis* in the course of his research on smaller foraminifers from the Lower Carboniferous of several selected areas in the Japanese Islands, especially from the Onimaru formation of the Kitakami massif, Northern Honshu and the *Pseudoendothyra spiroides* zone (Okimura, 1963) of the Akiyoshi Limestone group, Western Honshu. They are *Endothyranopsis hirosei* sp. nov., *E. compressa* (Rauser-Chernoussova and Reitlinger), *E*? sp. A and *E*? sp. B. The first and the second species are safely referable to this genus from their plectogyroid coiling and agglutinate wall of the test, but the last two are not typical for the genus in the wall structure, being therefore assigned to it with a query. In this paper the descriptions of the species mentioned above are given with some discussions on their geological age.

Repository. All specimens described and figured in this paper are kept in the

Institute of Geology and Mineralogy, Hiroshima University, Japan. Their register-numbers are indicated in the plate explanation.

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II. FAUNAL AFFINITY AND CORRELATION

In the Inner Zone of Southwest Japan, especially in the Chugoku district, there develop large masses of limestones ranging from the Carboniferous to the Permian. The well-known examples are those of Akiyoshi and Atetsu (see text-fig. 1), which display almost complete succession of calcareous facies of the Upper Carboniferous and Permian in Japan. It has, however, long been a focus of dispute whether these limestones range further down to lower horizons, the Lower Carboniferous.

Mostly on the basis of corals MINATO and his collaborators (MINATO, 1951, 1955, 1960; MINATO and KATO, 1957 a, b, 1963) have insisted for many years that the lowest part of the Akiyoshi Limestone (i. e. the *Nagatophyllum satoi* zone below and the *Stylidophyllum* sp. zone above of MINATO et al.) may be almost synchronous with the Sabukura stage, the lower half of the Bashkirian Nagaiwa formation of the Kitakami massif, Northeast Japan. Their view also includes that no fossiliferous Lower Carboniferous deposits are developed in the Chugoku area in contrast to extensive distribution of the Upper Carboniferous and Permian. Regarding this matter the readers can refer MINATO's paper (1960, pp. 652–654, 660, and fig. 3) in which he abstracted different opinions and set forth his view in detail. However, he overlooked the results of the writer's biostratigraphical study of the Atetsu Limestone (OKIMURA, 1958; Carboniferous Research Committee, Ed. FUJIMOTO, 1960).

The writer (1958) divided the lower part of the Atetsu Limestone (the Nagoé formation) into five zones, each of which is defined by a characteristic assemblage of endothyroid foraminifers. He compared them tentatively with the Mississippian foraminiferal zones in the Cordilleran region, U. S. A. (ZELLER, 1957), and (1963) concluded the lower three zones can be referable to the upper part of the Lower Carboniferous.

In connection with the geological age of the *Pseudoendothyra spiroides* zone (revised name of the *Endothyra spiroides* zone) of the Atetsu Limestone, YAMAGIWA (1962) considered corals from the zone as being of the lower Upper Carboniferous or the lowermost Upper Carboniferous and the uppermost Upper Viséan in age. He compare them with those of the C_1 zone (*Millerella* zone) of the Omi district, Central Japan. From the C_1 zone, however, the Lower Carboniferous bryozoans were very recently reported (SAKAGAMI, 1963) and *Pseudoendothyra spiroides*, *Endostaffella parva*, *Endothyra* ex gr. *bradyi*, and *Endothyranopsis*? sp. were also found (after writer's examination of Prof. IMAMURA's collection).

A conclusion analogous to the writer's opinion in 1958 has been drawn by MURATA (1961) from the study of the Akiyoshi Limestone. According to MURATA, the lowest part of this limestone (*Endothyra* zone) is characterized by a particular assemblage of smaller foraminifers and corals without accompanying such fusulinaceans as *Millerella* and advanced forms of *Eostaffella*, being correlated with the lower Viséan. YANAGIDA and OTA also offered a similar view on the basis of corals and brachiopods from the same beds[1] (YANAGIDA, 1962). On the other hand, HASEGAWA (1963), and MINATO and KATO (1963) asserted again that the age of the lowest part of the Akiyoshi Limestone can not be viewed to be as old as the upper Viséan. Their age determination was also based on bryozoans, coelenterates and brachiopods such as *Pleurodictyum dechenianum* KAYSER, *Cyathaxonia* sp., *Fenestella* sp., *Schuchertella* sp. a, *S.* sp. b, *Chonetes* sp., *Waagenoconcha* sp., *Neophricodothyris*? sp., *Nebenothyris hasegawai* MINATO and KATO, *Pterinopecten*? sp.

In 1963, the present writer published his biostratigraphical study on the Carboniferous of Akiyoshi, with some revisions of the zonation and correlation of the Nagoé formation of Atetsu. In the lower part of the Akiyoshi Limestone he discriminated three zones of *Millerella* sp. A, *Pseudoendothyra spiroides* and *Endothyra* sp. A in descending order, of which the first is roughly equivalent to the lower half of the *Stylidophyllum* sp. zone of MINATO and KATO (1957).

Species of *Endothyranopsis* described in this paper were discovered from the middle and upper parts of the *Pseudoendothyra spiroides* zone at several localities of the southeastern slope of the Akiyoshi Limestone plateau. The associated foraminiferal species are as follows; *Tuberitina* sp. of *minima* group, *Eostaffella* spp., *Endothyra* sp. of *bradyi* group, *E.* sp. of *spinosa* group, *E.* spp., *Mikhailovella* spp., *Bradyina* sp., *Cribrospira* spp., *Pseudoendothyra spiroides*, *P.* spp., *Palaeotextularia* sp. aff. *P. consobrina*, *P.* sp. cf. *P. vulgaris*, *Climacammina* sp. aff. *volgensis*, *C.* sp. cf. *C. antiqua*, *Cribrostomum* sp., *Deckerellina* sp., *Deckerella* sp., *Tetrataxis* spp., *Archaediscus* sp. of *karreri* group, *Endostaffella* spp., and some indetermined forms. The *Millerella* sp. A zone which overlies disconformably the *Pseudoendothyra spiroides* zone is characterized by species of *Millerella*, *Globivalvulina*, *Glomospira* etc., and differs

1) Read at the 71st annual meeting of the Geological Society of Japan, April, 1964.

remarkably in the contained assemblage of species from the underlying ones.

Endothyranopsis was found also from the Onimaru formation of the Kitakami massif which has been regarded as the standard section for the upper Lower Carboniferous of Japan. The material came from the horizon No. 17 of the A section (ONUKI and YAMADA, 1956) in the type area of the formation. The associated species are *Endostaffella parva*, *Endothyra* spp., *Pseudoendothyra struvei*, *Tuberitina* sp. of minima group, *Loebrichia* sp., *Forschia* sp., *Haplophragmina* sp., *Bradyina* sp., *Mikhailovella* spp., *Palaeotextularia* sp. of *longiseptata* group, *P.* sp. of *angusta* group, *Stacheia* sp., *Archaediscus* sp. of *karreri* group, *Chernyshinella*? sp., *Climacammina*? sp., and some others. Underlying this horizon there is a thick series of limestone containing some species of *Millerella* at many horizons. It is the main part of the Onimaru formation, and the above-listed foraminifers except *Endothyranopsis* are common throughout the formation in the A section.

Among the hitherto known species of *Endothyranopsis*, *E. crassus* (BRADY) and *E. conspicua* (HOWCHIN) were reported from the upper Lower Carboniferous of England, Scotland and Belgium, in association with *Saccamminopsis carteri*, *Climacammina antiqua*, *Palaeotextularia davisella*, *Cribrostomum eximium*, *Stacheoides polytremoides*, *Stacheia conquesta*, *Endothyra bowmani*, *E. globulus*, *E. radiata*, *E. ornata*, *E. ornata tenuis*, and a few others. *Endothyranopsis compressa* (RAUSER-CHERNOUSSOVA and REITLINGER) and *E. sphaerica* (RAUSER-CHERNOUSSOVA and REITLINGER) were originally described from the upper Lower Carboniferous of the Pechora region of the Northern Ural, USSR and were subsequently reported from the upper Viséan (V_1^va-d) of the following areas of European Russia and Central Asia: the Kolva-Visherka area in the east-central European Russia, by CROZDILOVA and LEBEDEVA, 1954; the Kuznetz basin of USSR, by LEBEDEVA, 1954; the Donetz basin, by AIZENBERG and BRAZNIKOVA, 1956; the Pripyat Arch district in White Russia, by GOLUBTZOV, 1957 and GOLUBTZOV and KEDO, 1958; the Timan-Pechora province by DURKINA, 1959; Southwestern part of the Moskow basin by FOMINA, 1958; Beograd-Oboyansk of Yugoslavia by GUREVITCH, 1959; Turkestan by BOGUSH and YUPHEREV, 1962. According to the above micropaleontologists and stratigraphers of USSR, the following foraminifers are associated with *Endothyranopsis*; *Saccamminopsis carteri*, *Endothyra* spp. of *bradyi* group, *E.* spp. of *omphalota* group, *E.* spp. of *spinosa* group, *Archaediscus* spp. of *karreri* group, *Ammodiscus incertus*, *Samarina operculata*, *Tetrataxis* spp. of *minima* group, *Palaeotextularia* spp. of *angusta* group, *P.* spp. of *longiseptata* group, *Forschia mikhailovi*, *Archaesphaera minima*, *Loeblichia miranda*, *Monotaxis gibba*, *Pseudoendothyra* spp., *Cribrostomum eximium*, *Mikhailovella* spp., *Climacammina* spp. etc.

From the microfaunal comparison among West Europe, USSR, and Japan, especially from the occurrence of *Endothyranopsis*, it is concluded that the Onimaru formation of the Kitakami massif is correlative with the upper Viséan as has been insisted by MINATO et al., and that the *Pseudoendothyra spiroides* zone of the Akiyoshi plateau as well as the Nagoé formation of the Atetsu is equivalent in

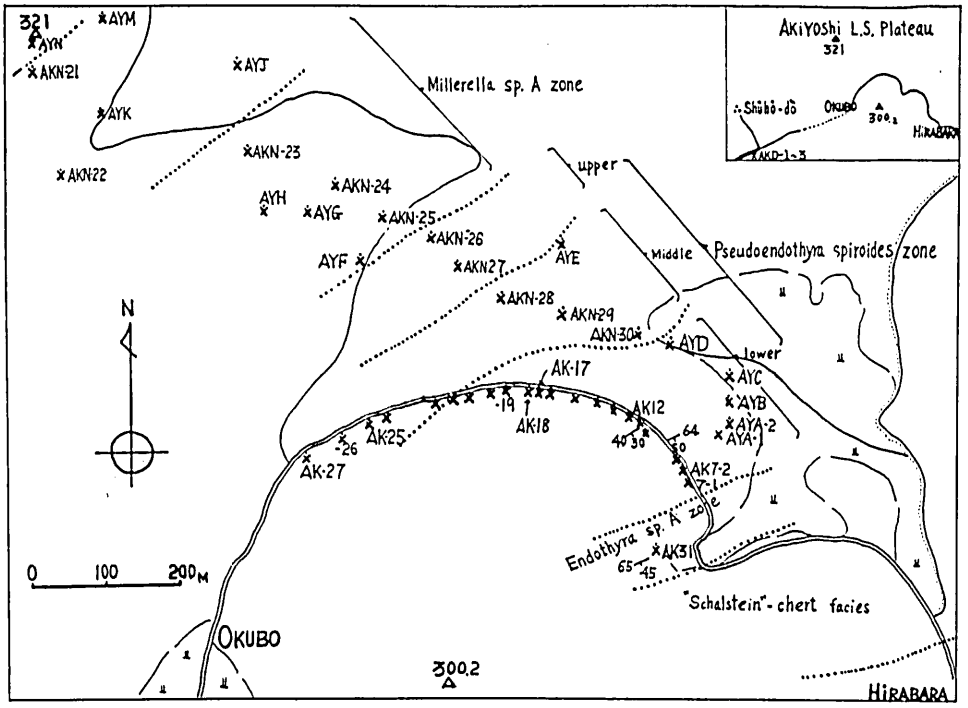

Fig. 2. Map of the southeastern slope of the Akiyoshi Limestone plateau, showing collecting localities.

age to the Onimaru formation.[1)]

III. Description of Species

Family Endothyridae Brady, 1884
Subfamily Endothyranopsinae Reitlinger, 1959
Genus *Endothyranopsis* Cummings, 1955

Type-species.—*Involutina crassa* Brady, 1869
Synonymy.—*Involutina* (pars) Brady, 1869
Endothyra (pars) Brady, 1873 and 1876

1) With regard to the problems of the Upper Carboniferous-Lower Carboniferous boundary in Japan, the microfaunal zonation in Shikhoté Alin serves as a good reference. Sosnina (1960, p. 66) correlated the *Millerella* zone defined by Toriyama (1958) in the Akiyoshi and by Igo (1957) in the Hida massif with the *Ozawainella aurora-Pseudostaffella antiqua* zone of the Bashkirian in Shikhoté Alin. If this correlation is acceptable, it may be suggested that the *Pseudoendothyra spiroides* zone which underlies the *Millerella* sp. A zone (almost the same as *Millerella* sp. α zone of Toriyama, and the lower *M. kanmerai* subzone of Igo) is assigned to the upper Lower Carboniferous. Furthermore the assemblage of foraminiferal species from the lowest part of the *Millerella-Eostaffella-Endothyra globulus* zone (upper Viséan) of the Shikhoté Alin is very similar to that from the *Millerella* sp. A zone of the Akiyoshi.

Diagnosis.—Test relatively large, subglobular, coiled with a slight rotation of axis in the early stage of ontogeny, almost or entirely involute with a short axis of coiling in the mature stage. Sutures slightly depressed, but inconspicuous. Wall thick, consistion of granules of calcite bound by calcareous cement with a small but varying proportion of adventitious material. Aperture low, opening at the base of apertural face. Septa relatively long and thick.

Remarks.—The genus *Endothyranopsis* differs from *Rhenothyra* BECKMAN, the other genus of the Endothyranopsinae (REITLINGER, 1959), in that the latter has a completely evolute and discoidal test. This genus is distinguished from other members of Endothyridae by the thick agglutinating wall and the slight rotation of the axis of coiling.

Geological age.—The upper Lower Carboniferous: This genus has been recorded from the Viséan formations of the England, Scotland, Belgium, Central Asia and European Russia.

Endothyranopsis hirosei, sp. nov.
Pl. XXI, figs. 1-4

Material.—Holotype, YOAK 26-1 (Pl. XXI, fig. 1) from the AK route on the southeastern slope of the Akiyoshi Limestone plateau. Paratypes, YOAK 17-2 (Pl. XXI, fig. 3) from the same route, and YON 17-3 (Pl. XXI, fig. 2) from the horizon No. 17 of the Onimaru formation of the Katakami massif. In addition to the holotype and paratypes, a number of incomplete sectioned specimens have been examined.

Description.—Test rather small for the genus, subglobular, slightly asymmetrical, shallowly umbilicate on one side and involute on the other; coiling plectogyroid in the early stage, and axial rotation rather small in the later stage. Three whorls present, increasing moderately in height as the shell grows. Proloculus minute, ranging from 0.02 to 0.04 mm in diameter. There are about nine chambers in the last volution; each of them scarcely inflated between the sutures. Septa relatively long, sturdy, but varying in width; their distal ends slightly tapering and curving forward. Wall fairly thick, consisting of granules of calcite bound by calcareous cement with a varying amount of adventitious material, perforated irregularly. Secondary deposits absent or a little. Aperture low, opening at the base of apertural face.

Dimensions.—Holotype (YOAK 26-1), maximum diameter 0.704 mm and minimum diameter 0.561 mm in the horizontal axial section. One of the paratypes (YOAK 17-2), maximum diameter 0.51 mm and minimum diameter 0.462 mm in the vertical axial section.

Remarks.—This species differs from the type-species of *Endothyranopsis*, including its subspecies *sphaerica*, in its smaller size and larger total angular distortion. The present species resembles *Endothyranopsis compressa* (RAUSER-CHERNOUSSOVA and REITLINGER) in the size of the shell, but differs in having the more loosely

coiled shell, the higher chambers in the last volution and the thicker wall. *Endothyranopsis conspicua* (HOWCHIN) is much larger in size.

Horizon and localities.—The present species is common in collections from the horizon No. 17 of the A section (ONUKI and YAMADA, 1956) in the type area of the Onimaru formation, and in those from the *Pseudoendothyra spiroides* zone of the Akiyoshi Limestone at localities AK-17, -19 and -26 on the southeastern slope of the Akiyoshi plateau.

Endothyranopsis compressa (RAUSER-CHERNOUSSOVA and REITLINGER)
Pl. XXI, figs. 5-7

1936, *Endothyra crassa compressa* RAUSER-CHERNOUSSOVA and REITLINGER, *Akad. Nauk S. S. S. R., Polionaia Kosissia, Trudy Fasc.* 28, pl. 6, figs. 1 and 2
1948, *Endothyra crassa compressa* RAUSER-CHERNOUSSOVA, *Trudy IGN AH S. S. S. R., Geol. Ser.* No. 19, pl. 4, figs. 5-7
1954, *Endothyra compressa* LEVEDEVA, *Mikrofauna S. S. S. R.*, Vol. 7, pl. 6, fig. 4
1957, *Endothyra crassa compressa* GOLUBTZOV, *Akad. Nauk B. S. S. R., Inst Geol. Nauk*, Vol. 2, pl. 2, figs. 23-25
1959, *Endothyra compressa*, DURKINA, *Mikrofauna S. S. S. R.*, Vol. 10, pl. 14, figs. 2 and 3
1963, *Endothyranopsis compressa*, ROSOVSKAYA, *Trudy Palaeont. Inst. Izd. Akad. Nauk S. S. S. R.*, Tom 97, pl. 10, figs. 3-9; pl. 11, figs. 1 and 2

Types.—By original designation (RAUSER-CHERNOUSSOVA and REITLINGER, 1936): Holotype (Vertical axial section), specimen of fig. 1 of pl. 6 and paratype (slightly oblique median section), specimen of fig. 2 of the same plate; came from the Viséan formation of the Petchora region, Northern Ural, USSR.

Material.—Two horizontal axial sections, YOAKD 1-1 (Pl. XXI, fig. 5) and YOAK 27-2 (Pl. XXI, fig. 7), a vertical axial section, YOAK 18-1 (Pl. XXI, fig. 6), and a number of oblique sections have been examined.

Description.—Test small, thick discoidal with a broadly rounded periphery and a depressed axial area, slightly asymmetrical, coiled with small total angular distortion in the young stage, and almost planispiral in the later stage. Septal furrows shallow; slight umbilical depression on one side. Adult specimens have three volutions which increase gradually in height with growth; the last volution has ten fairly inflated chambers. Proloculus minute. Septa relatively long, almost plane. Wall relatively thin, consisting of granular calcite and small adventitious material bound by calcareous cement. Secondary deposits slightly cover the interior surface of several chamber. Aperture low, opening at the base of apertural face.

Dimensions.—YOAK 27-2, maximum diameter 0.781 mm and minimum diameter 0.594 mm in the horizontal axial section. YOAK 18-1, maximum diameter 0.610 mm and minimum diameter 0.338 mm in the vertical axial section.

Remarks.—This species most closely resembles *Endothyranopsis hirosei*, but is distinguished in its slower increasing of whorls and more inflated chambers. It also differs from other species of *Endothyranopsis* in its smaller size, thinner wall and more slightly umbilicate test.

Horizon and localities.—The present species was obtained from the *Pseudoendothyra spiroides* zone of the Akiyoshi Limestone at the localities AKD-3, -1, AK-14, -18 and -27. No specimens referable to this species were found from the Onimaru formation.

Endothyranopsis? sp. A
Pl. XXI, figs. 8 and 9

Material.—Seven sectioned specimens are assigned to this species, of which two are illustrated (YON 17-8, Pl. XXI, fig. 8 and YON 17-6, Pl. XXI, fig. 9). No complete vertical axial section has been obtained, so the following description is entirely based on the horizontal axial sections.

Description.—Test rather small for the genus, probably subglobular, coiled with a slight rotation of the axis in the juvenile, but almost planispiral in the later stage. Chambers in the last volution 13-16 in number; height of chambers increases moderately and regularly as the shell grows, but the width is variable. Wall relatively thick, showing the agglutinate nature with adventitious material in varying amount. Septa identical in structure as the wall, long, nearly plane, slightly bending towards the anterior. Proloculus minute. Secondary deposits lacking. Aperture very low, opening at the base of apertural face.

Dimensions.—One of the figured specimens (Pl. XXI, fig. 9), maximum diameter 0.66 mm and minimum diameter 0.385 mm in the horizontal axial section. In another nearly vertical axial section, maximum diameter 0.77 mm and minimum diameter 0.374 mm.

Remarks.—Due to the insufficiency of the material the precise generic and specific assignment of this form is impossible, but the wall structure shows that it may probably be referable to *Endothyranopsis*. In the horizontal axial section the present specimen somewhat resembles species of the genus *Loebrichia* CUMMINGS in the arrangement of chambers, but differs in the agglutinate character of the wall.

Horizon and localities.—The specimens of the present species were obtained only from the horizon No. 17 in the A section of the Onimaru formation, Kitakami massif. It has not yet been found from the Akiyoshi Limestone.

Endothyranopsis? sp. B
Pl. XXI, figs. 10-12

Material.—Fifteen thin sectioned specimens were examined, and three of them (YOAKD 3-1, YOAK 25-1 and YOAK 27-3a) are illustrated. No complete

vertical exial section has been obtained.

Description.—Test small, subglobular with a broadly rounded periphery, almost symmetrical and planispiral, very shallowly umbilicate on one side and completely involute on the other. Three whorls present; chambers of the outermost volution nine to ten in number, increasing regularly in size with growth. Proloculus minute. Septa long, almost plane and sturdy, bending towards the anterior at the distal ends. Wall thick, composed of microglanular calcite and a small amount of adventitious material bound by calcareous cement. Secondary deposits slightly developed on the floors of the first and second whorls. Aperture low, opening at the base of apertural face.

Dimensions.—A figured specimen (Pl. XXI, fig. 10) of three whorls, maximum diameter 0.583 mm and minimum diameter 0.463 mm in the horizontal axial section. Another figured specimen (Pl. XXI, fig. 11) of three whorls, maximum diameter 0.567 mm and minimum diameter 0.41 mm in the nearly vertical axial section.

Remarks.—The present species is somewhat similar to Rhenothyra in the arrangement of chambers, but it may probably be referable to *Endothyranopsis* by the agglutinate wall structure and the slender ploughshare-like outline of septa.

Horizon and localities.—This species was rarely found only from the *Pseudoendothyra spiroides* zone of the Akiyoshi Limestone group. It came from the localities AKD-3, AK-16, -25 and -27.

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Explanation of Plate XXI

Endothyranopsis hirosei, sp. nov.

Fig. 1. Holotype (YOAK 26-1), horizontal axial section from loc. AK-26, Akiyoshi. ×80

Fig. 2. Paratype (YON 17-3), horizontal axial section from the horizon No. 17 of the Onimaru formation. ×80

Fig. 3. Paratype (YOAK 17-2), Vertical axial section from loc. AK-17, Akiyoshi. ×90

Fig. 4. Horizontal axial section of an immature specimen (YOAK 26-2) from loc. AK-26, Akiyoshi. ×50

Endothyranopsis compressa (Rauser-Chernoussova and Reitlinger)

Fig. 5. Horizontal axial section (YOAKD 1-1) from loc. AKD-1, Akiyoshi. ×50

Fig. 6. Nearly vertical axial section (YOAK 18-1) from loc. AK-18, Akiyoshi. ×50

Fig. 7. Horizontal axial section (YOAK 27-2) from loc. AK-27, Akiyoshi. ×50

Endothyranopsis? sp. A

Figs. 8 and 9. Horizontal axial sections (YON 17-8 and YON 17-6) from the horizon No. 17 of the Onimaru formation. ×80

Endothyranopsis? sp. B

Fig. 10. Horizontal axial section (YOAKD 3-1) from loc. AKD-3, Akiyoshi. ×50

Fig. 11. Nearly vertical axial section (YOAK 27-3a) from loc. AK-27, Akiyoshi. ×50

Fig. 12. Horizontal axial section (YOAK25-1) from loc. AK-25, Akiyoshi. ×50

Rhenothyra? sp.

Fig. 13. Horizontal axial section (YOAK 19-1) from loc. AK-19, Akiyoshi. ×50

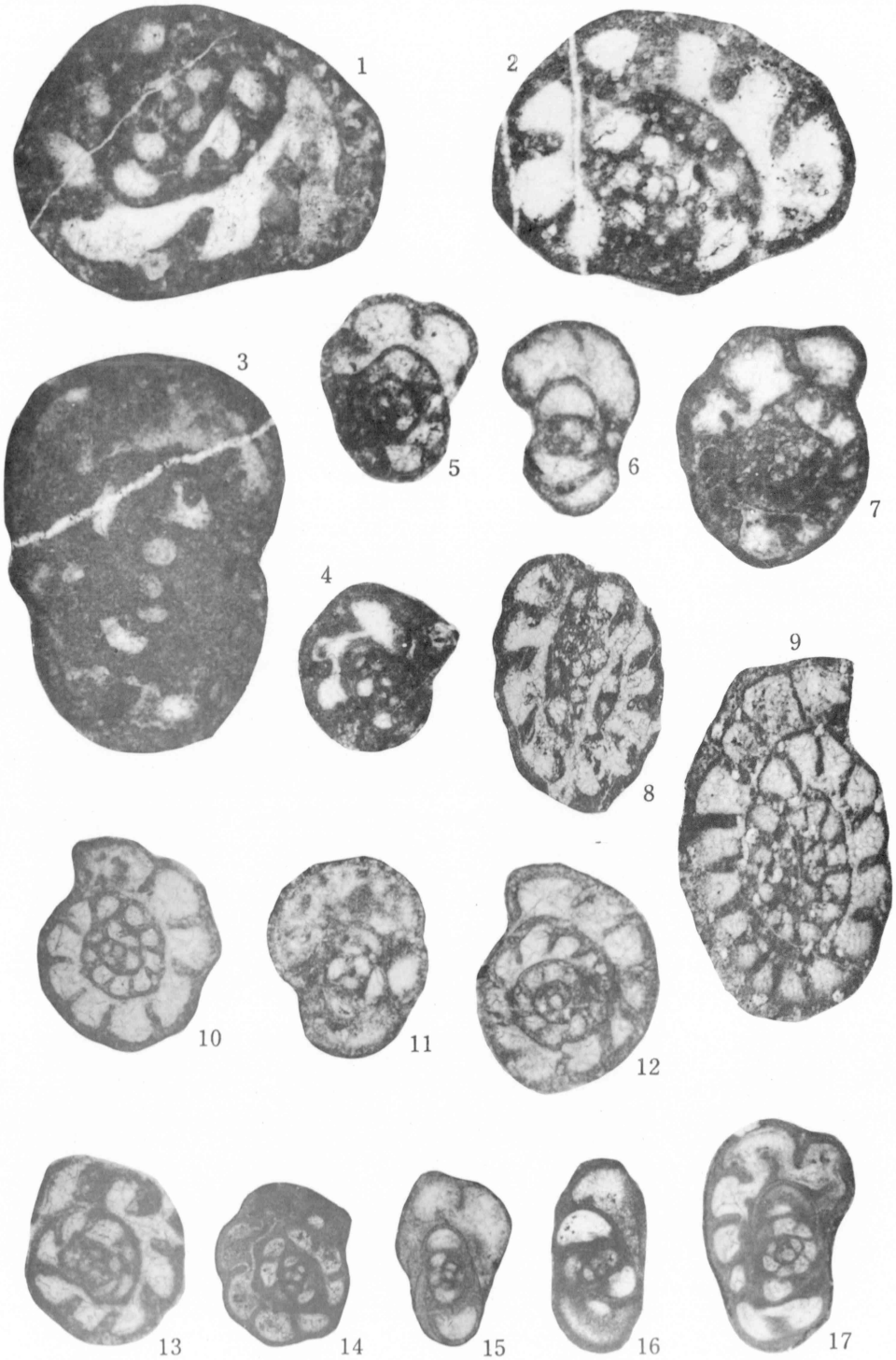
Some species of *Endothyra* associated:

Fig. 14. *Endothyra* ex gr. *bradyi* Mikhailov. Horizontal axial section (YOAK 16-2) from loc. AK-16, Akiyoshi. ×50

Fig. 15. *Endothyra* sp. cf. *E. pauciseptata* Rauser-Chernoussova. Nearly vertical axial section (YOAK 27-3b) from loc. AK-27, Akiyoshi. ×50

Fig. 16. *Endothyra* sp. Vertical axial section (YOAK 24-1) from loc. AK-24, Akiyoshi. ×50

Fig. 17. *Endothyra* sp. Nearly horizontal axial section (YOAK 16-3) from loc. AK-16, Akiyoshi. ×50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