日本古生物學會報告

(Transactions of the Palaeontological Society of Japan)

7. *Nagatoella*, A New Genus of Permian Fusulinids.

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[Received February 3rd, 1936; read February 29th, 1936]

In 1925 OZAWA (8)¹⁾, describing for the first time the extremely rich fusulinid fauna of the Permian of Nagato (southern Japan), coined the term *orientis* for a form which he regarded a new variety of *Triticites ellipsoidalis* (STAFF)—he illustrated three specimens of this form, all from different localities. *Triticites ellipsoidalis* (STAFF) [= *Fusulina ellipsoidalis* STAFF (11) and *Schellwienia ellipsoidalis* OZAWA (8)] was originally described from the Upper Pennsylvanian of Iowa. During my studies of Iowa fusulinids I have studied for comparison the descriptions of all known closely similar forms, but I was not able to determine definitely the generic affinities of OZAWA's types of *T. ellipsoidalis orientis*. Through the courtesy of the Geological Institute of the Imperial University of Tokyo, and particularly through the kindness of Dr. T. KATO and Dr. T. KOBAYASHI, I have had the opportunity to study the illustrated sections on which OZAWA based his original description. These specimens have proved to be of more than ordinary interest in regard to the classification of the fusulinids and my restudy of them in the light of our present detailed knowledge of the fusulinids has yielded certain information which I believe is worthy of publication. It seems to me that these specimens represent two species rather than one

1) Numbers refer to bibliography at end of paper.

variety, and they are apparently not referable to any previously described genus. I am, therefore, proposing the new generic name *Nagatoella* for them with *Nagatoella orientis* (OZAWA), s. s., as the genotype. Also, I am proposing below the new specific name *Nagatoella kobayashii* for part of OZAWA's original types.

Recent studies of Permian fusulinids have gone to show that unusually rapid evolutionary changes took place within this family during the upper portion of Lower Permian and the lower portion of Middle Permian times. In the upper portion of the Upper Pennsylvanian, or Upper Carboniferous, only one genus of fusulinids, namely *Triticites*, occurs abundantly and only two or possibly three other genera are known to be present in these strata. In contrast to this small variety of generic types in the Upper Pennsylvanian, twenty-six genera have been recognized in the Permian. Both of the known representatives of the new genus *Nagatoella* are associated with the genus *Doliolina* SCHELLWIEN (9, 10), and one of them, *N. kobayashii*, n. sp., is also associated with the genera *Neofusulinella* DEPRAT (3), *Parafusulina* DUNBAR and SKINNER (5), and *Ozawainella* THOMPSON? (12)—these four associated generic types indicate Middle Permian age.

Systematic Descriptions

Genus **Nagatoella** THOMPSON, n. gen.

The only species which I can refer definitely to this genus are *N. orientis* (OZAWA), the genotype, and *N. kobayashii*, n. sp. described below. The form which DEPRAT (4) described as *Fusulina lepida* in 1914 from Cammon and which OZAWA (8) described as *Schellwienia lepida* in 1925 from Nagato may represent this genus, but from a study of the published illustrations and descriptions, I am inclined to doubt that it is congeneric with *N. orientis*, though it may be regarded by some as a primitive representative of this genus.

From a study of the holotype of the genotype and the types of the only other known congeneric form, I have drawn up the following generic diagnosis of *Nagatoella*.

Diagnosis of Nagatoella.—Shell large, ellipsoidal. Axis of coiling essentially straight. Poles blunt and broadly rounded. Mature shells contain at least thir-

teen volutions and are 6 to 7mm. in length and 3.5 to 4.5mm. in width. Form ratio 1:1.2 to 1:1.7. The innermost volution is very broadly ellipsoidal, but the next other four to five volutions become rather elongate, and the form ratio of the remaining outer volutions becomes slightly larger. The septa are numerous. They are composed of the downward deflection of the tectum of the spirotheca and a lighter less dense layer on the posterior side which may be the downward extension of a portion of the keriotheca of the spirotheca. The septa are very heavily coated by layers of dense calcite which are not developed in the outermost volutions, but which essentially fill the chambers in the polar regions of the inner volutions. These deposits of dense calcite increase in thickness toward the poles and they extend from the septa onto the upper and lower surfaces of the spirotheca. The extreme basal portions of the septa are acutely fluted at rather broadly spaced intervals and the forward fold of one septum joins the backward fold of the following septum so as to form a very low opening from the base of the following chamber. These openings are later closed, after the tunnel is developed, by the dense calcite layers which cover the septa. The fluting increases in intensity only slightly poleward from the tunnel. The proloculum is essentially spherical and it is of moderate size. The shell is essentially symmetrical throughout growth, and the rate of increases of the chambers is very uniform. The spirotheca is composed of a tectum and a coarsely alveoli keriotheca. In the innermost volution of the genotype the spirotheca is very thin and measures only about 5 microns, but in the outer volutions it becomes as thick as 100 microns. The tunnel is well developed and it is very low and wide. Chomata are developed in the inner four to five volutions and there they are very low and are essentially symmetrical. In the outer volutions the chomata are not developed.

The genus *Nagatoella* appears to be a direct descendent of the genus *Triticites* GIRTY (7). *Nagatoella* seems to have developed from typical *Triticites* by changes which included a reduction of the chomata, a more uniform and different development of the septal fluting, a more gradual increase in the thickness of the spirotheca with growth of the individual, the development of the dense calcite deposits on the septa and spirotheca, and the change of the general development of the shape of the shell. *Triticites ordinatus* CHEN (2) of the Swine limestone, which is probably upper Lower Permian or possibly lower Middle Permian in age, of southern China represents the group of highly developed *Triticites* from which *Nagatoella* was probably developed.

Typical representatives of *Nagatoella* may be distinguished from typical representatives of *Pseudofusulina* DUNBAR and SKINNER (5) by their more nearly uniform and lower septal fluting, the dense calcite deposits on their septa and spirotheca, the marked difference in the shape of their shell, and their more rapidly

thickening spirotheca. The type of *Nagatoella* is similar in many respects to the type of *Leeina* GALLOWAY (6), *L. fusiformis* (SCHELLWIEN), but it differs from that genotype especially in that the dense calcite deposits extend on its septa and spirotheca throughout the shell, its septa are more weakly and uniformly fluted, its shell has a different shape and rate of development, and its chomata are better developed. The thick spirotheca, the rather well developed chomata, the low broad septal fluting, the heavy deposits of dense calcite on the septa and spirotheca throughout the length of the shell, and the general shape of the shell of *Nagatoella* serve to distinguish representatives of this genus from those of *Palaeofusulina* DEPRAT (3), "*Gallowaiina*" CHEN¹⁾ (1), and *Quasifusulina* CHEN (2).

As was pointed out by OZAWA (8) in his original description of the genotype, the sagittal section of *Nagatoella* resembles sagittal sections of *Doliolina* SCHELLWIEN. Also, the shape of the shell of *Nagatoella* resembles that of *Doliolina*. However, the similarity of these two genera is entirely superficial for, in contrast to *Doliolina*, *Nagatoella* possesses a tunnel bordered by chomata, its septa are fluted, it has dense calcite deposits on the septa and spirotheca, and it does not possess parachomata.

Nagatoella orientis (OZAWA)

Plate II, figures 1, 2

Schellwienia ellipsoidalis orientis OZAWA [part], 1925, Imp. Univ. Tokyo, Jour. Coll. Sci., vol. 45, art. 6, pp. 22-23, pl. 8, fig. 3 [not pl. 6, fig. 1a; pl. 8, fig. 5].

OZAWA described this species as a new variety in 1925 and illustrated three specimens, all from different localities in Nagato. I have studied all three of these specimens in great detail and I have reached the conclusion that, although they are closely related, in the light of our present detailed knowledge of the fusulinids they should be regarded as representing two rather than one species. I am, accordingly, preserving OZAWA's name for one of these specimens (see Pl. II, figs. 1, 2) and I am here designating

1) The generic name *Gallowaiina* CHEN, 1934, is apparently to be considered a homonym of *Gallowayina* ELLIS, 1932 (proposed for an orbitoid in *Am. Mus. Novitates*, no. 568)

it as the holotype of *N. orientis* (OZAWA). I am referring the remaining two specimens, originally illustrated by OZAWA as *N. orientis*, to the new species described below as *Nagatoella kobayashii*. The normal procedure would perhaps be to regard OZAWA's two illustrated conspecific types as representing *N. orientis* and make the third specimen the type of a distinct species. However, I wish to base the new genus *Nagatoella* on the specimen illustrated as figures 1 and 2 on plate II and I prefer to preserve OZAWA's name for the genotype.

Since a part of OZAWA's original description of this species was based on specimens which I am now referring to a distinct species, I am redescribing *N. orientis* based solely on the holotype as follows:

Shell large, ellipsoidal. Axis of coiling essentially straight. Lateral slopes low and convex. Poles very blunt and broadly rounded. The innermost volution is subspherical, the second volution has a form ratio of about 1:1.6, and the remaining outer volutions have a form ratio of about 1:2.0. The holotype consists of ten volutions and it measures about 3.3mm. in width and 6.6mm. in length.

The spirotheca is very thin in the inner volutions, but it becomes rather thick in the outer volutions. It is composed of a tectum and a keriotheca, and deposits of dense calcite cover its surfaces in all volutions except the outer one. The alveoli of the outer volutions are very coarse. The thickness of the spirotheca in the center of the first to the ninth volution measures 5.0, 8.0, 10.5, 12.3, 17.5, 40.0, 52.5, 61.5, and 87.5 microns, respectively.

The proloculum is essentially spherical and its inside diameter measures about 140 microns. The rate of expansion of the shell is rather uniform and the total widths of the first to the ninth volutions measure 310, 425, 565, 750, 960, 1275, 1625, 2050, and 2550 microns, respectively.

The septa are thick. They are composed of a tectum and a lighter thicker layer on the posterior side which is apparently a continuation of the keriotheca. Either side of the septa is coated with rather dense thick deposits of calcite which essentially fill the chambers in the polar regions. These deposits extend onto the lower and upper surfaces of the spirotheca. The extreme lower portions of the septa are rather acutely fluted at regular intervals and the forward fold of one septum joins the backward fold of the following septum so as to form small openings from the base of one chamber to the base of the following chamber. The middle and upper portions of the septa are essentially unfluted. The openings at the base of the septa are closed in the inner volutions by the dense calcite deposits on the septa. However, the closing of these openings is slightly behind the development of the tunnel.

The tunnel is very low and broad. It is only about one-third as high as the chambers and the tunnel angle is slightly larger than 26 degrees in the ninth volution. In the inner four to five volutions the tunnel is bordered by low es-

essentially symmetrical chomata, but in the outer volutions the chomata are apparently undeveloped.

Nagatoella orientis may be distinguished from *N. kobayashii* n. sp., by its lower and more weakly developed septal fluting, its heavier deposits of dense calcite on the septa and spirotheca and by its slightly more rapidly expanding shell. *N. orientis* resembles in general appearance *Triticites ordinatus* CHEN (2) of the Swine limestone of southern China, and it seems probable that *Nagatoella* developed from this type of highly developed *Triticites*. However, in *T. ordinatus* there are well developed heavy chomata throughout the shell and the septa and spirotheca do not contain the heavy deposits of dense calcite found in *N. orientis*.

Occurrence.—This species occurs in the Permian limestone, probably Middle Permian, of Kaerimizu, Akiyoshi-Dai, Nagato, where it is associated with *Doliolina claudiae* DEPRAT (see Pl. II, fig. 3).

Type.—The holotype is in the palaeontological collection of the Imperial University of Tokyo.

***Nagatoella Kobayashii* THOMPSON, n. sp.**

Plate II, figures 4—6

Schellwienia ellipsoidalis orientis OZAWA [part], 1925, Imp. Univ. Tokyo, Jour. Coll. Sci., vol. 45, art. 6, pp. 22-23, pl. 6, fig. 1a; pl. 8, fig. 5 (not pl. 8, fig. 3).

Shell large, ellipsoidal. Axis of coiling essentially straight throughout the length of the shell. The inner four to six volutions are elongate ellipsoidal and the outer volutions become relatively shorter and the form ratio becomes larger. The illustrated axial section of one of the cotypes of thirteen volutions measures 4.3mm. in width and 7.1mm. in length. The form ratio is about 1:2.8 for the fourth volution and 1:1.7 for the thirteenth volution. The external furrows are very shallow. The poles are very blunt and are broadly rounded.

The spirotheca is rather thick. It is composed of a tectum and a keriotheca. In the inner five to six volutions the spirotheca is very thin and the structure of the keriotheca can not be clearly seen, but in the outer volutions the keriotheca is thick and the alveoli are very coarse. The thickness of the spirotheca in the center of the first to the eleventh volution of the figured sagittal section measures 5.3, 5.3, 10.5, 10.5, 15.8, 22.8, 35.0, 35.0, 52.5, 79.0, and 87.5 microns, respectively; and the thickness of the spirotheca of the sixth to the twelfth volution of the figured axial section measures 17.5, 22.8, 33.3, 35.0, 70.0, 96.5, and 105.0 microns, respectively. Rather dense calcite extends with increasing thickness on the upper side of the spirotheca from the tunnel to the poles. In the inner volutions this dense calcite extends with decreasing thickness up the septa and spreads onto the lower surface of the spirotheca.

The proloculum of the illustrated sagittal section is apparently distorted and

its maximum and minimum diameters measure about 156 and 100 microns, respectively. The rate of expansion of the shell is rather uniform and the total widths of the first to the eleventh volutions of the illustrated sagittal section measure 196, 282, 394, 535, 760, 1030, 1355, 1695, 2090, 2740, and 3050 microns. The total widths of the second to the thirteenth volution of the illustrated axial section measure 283, 425, 595, 775, 1020, 1300, 1640, 2065, 2620, 3055, 3680, and 4275 microns.

The septa are thick and numerous. The septal count for the first to the tenth volution of the illustrated sagittal section is as follows: 10, 13, 16, 16, 16, 20, 27, 28, 27, and 30. The septa are composed of the downward deflection of the tectum of the spirotheca and a lighter thicker layer on the posterior side which appears to be the downward deflection of the keriotheca of the spirotheca. There is a suggestion, however, that there is a definite line of separation between this lighter layer of the septa and the keriotheca. Either side of the septa is coated by dense calcite which increases in thickness poleward from the center of the shell and essentially fills the chambers in the extreme polar regions of the inner nine to ten volutions. This dense material spreads onto the upper and lower surfaces of the spirotheca. The septal fluting of this species is rather typical of the genus, but the fluting extends higher up the septa than in the genotype. The small openings at the base of the septa became closed by the dense calcite deposits of the septa and spirotheca as the tunnel was formed to furnish communication between the chambers. These openings at the base of the septa remain open only between the chambers of the outer one or two volutions.

The tunnel is low and wide. It is about one-third to one-half the height of the chambers. In the ninth volution the tunnel angle is slightly less than 22 degrees. In the inner six volutions the tunnel is bordered by very low essentially symmetrical chomata, but in the remaining outer volutions the chomata are apparently not developed. The tunnel is not developed in the outer part of the last volution.

Nagatoella kobayashii can be distinguished from the only other known representative of this genus, *N. orientis* (OZAWA), by its slightly higher and narrower septal fluting, its lighter deposits of dense calcite on the septa and spirotheca, and its slightly more slowly expanding shell.

Occurrence.—This species has been found in the Permian limestone, probably Middle Permian, at two localities in Nagato, north end of Ofuku-Dai and Nakamura of Ominemura, and it is known from six specimens. However, at one locality, Ofuku-Dai, it is known only from an axial section (Pl. II, fig. 6); whereas, at the other locality, Nakamura, it is known from a centered sagittal section, a parallel sagittal section (Pl. II, figs. 4 and 5), and three random oblique sections. It is, therefore, possible that these two sets of specimens are not conspecific, but, in regard to the septal fluting, dense calcite deposits and all measurable data,

they seem to be identical. At Ofuku-Dai this species is associated with *Parafusulina* ? *edoensis* (OZAWA) and at Nakamura it is associated with *Neofusulinella simplex* (LANGE)?, *Doliolina* sp., and *Ozawainella* ? sp.

Types.—The cotypes of this species are in the paleontological collection of the Geological Institute of the Imperial University of Tokyo.

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二疊紀紡錘蟲新屬 *Nagatoella* (摘要)

M. L. THOMPSON

長門産 *Schellwienia ellipsoidalis orientis* OZAWA のタイプ標本再研究の結果、之が 1 變種に非ずして、2 の獨立せる種なる事、又此の種は既に記載されたる如何な屬にも所屬せざることを知れり。依つて茲に此の種の爲に新屬 *Nagatoella* を樹立し、*N. orientis* (OZAWA) を以つて基本種とす。此の新屬を精細に記載し、其の系統を論じ、*N. orientis* (OZAWA) 及び *N. kobayashii* の記載と圖を附す。(小林譯)

Explanation of Plate II

- All illustrations on this plate are unretouched photographs.
- Figs. 1, 2—*Nagatoella orientis* (OZAWA). 1, Enlarged portion of the holotype, $\times 20$; and 2, axial section of the holotype, $\times 10$.
- 3—*Doliolina claudiae* DEPRAT. Portion of an axial section in the same slide with the holotype of *Nagatoella orientis*, $\times 10$.
- 4-6—*Nagatoella kobayashii* THOMPSON, n. sp. 4, Sagittal section, $\times 20$; 5, parallel sagittal section, $\times 20$; and 6, axial section tangential to the second volution, $\times 10$.

日本古生物學會記事

Proceeding of the Palaeontological Society of Japan.

昭和 11 年 2 月 29 日 日本古生物學會第 2 回講演會を仙臺市東北帝國大學理學部地質古生物學教室に開く (參加者, 37 名)。講演者並に題目次の如し。

1. <i>Nagatoella</i> , a New Genus of Permian <i>Fusulinids</i> . (代讀)	M. L. THOMPSON.
2. Studies on the Fossil <i>Foraminifera</i> from the Neogene of Japan: <i>Foraminifera</i> from Muraoka-mura, Kamakura-gôri, Kanagawa-pref.	K. ASANO
3. <i>Pseudononon</i> , a New Genus of <i>Foraminifera</i> found in Muraoka-mura, Kamakura-gôri, Kanagawa-pref.	K. ASANO
4. 四射珊瑚類の成長率より推定されたる泥盆紀の赤道	馬 延 英
5. 日本産珊瑚化石 <i>Astrocaenia japonica</i> EGUCHI に就いて	江 口 元 起
6. A Note on a New Species of <i>Sismondia</i> E. DESOR. from the Oligocene Deposits of Titizima.	P. NISIYAMA
7. <i>Microporina</i> 屬 (蘚苔蟲) の二三の化石 (代讀)	坂 倉 勝 彦