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255. FORAMINIFERA FROM THE SUGOTA FORMATION, AKITA PREFECTURE, JAPAN.*

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秋田県須郷田層産の有孔虫化石群：本荘市と横手市の中間の出羽丘陵に分布する須郷田層に含まれる有孔虫化石群を研究し，その産出層準の古生態を論じた。須郷田有孔虫化石群は *Miogypsina*, *Operculina* に伴つて産出する小型有孔虫化石群に極めて類似しているが，アメリカ北西海岸地域の中新統の有孔虫化石群に近似した要素も多く含んでいる。本層から近年 *Desmostylus* が発見されたことにより，その時代は Luisian (Vindovonian) と考えられる。

須郷田有孔虫化石群からの7新種と，青森県西津軽郡大戸瀬村の田野沢からの1新種を記載した。

岩佐三郎・菊池良樹

Introduction

In this article the writers discuss and describe the foraminiferal fauna collected from the middle Miocene Sugota formation distributed in the Dewa Hills between Yokote and Honjô basins in Akita Prefecture.

The stratigraphy of the said area was first undertaken by K. MURAYAMA (1934), who treated all of the rocks below the siliceous or hard shales as the Takasegawa Green Tuff bed, thereby including several lithologic units into a single complex. Subsequently, Y. OTUKA (1936), who also studied the same area, recognized that the marine fossiliferous sediments coming conformably below the siliceous or hard shales and lying above a volcanic complex should be taken as a distinct stratigraphic unit, to which he proposed the name of Sugota formation. Recently, I. KATO (1949) and A. HATAKEYAMA (1954) published their results of geological survey in the same area, and the writers have undertaken field work from both stratigraphic and paleontological view to make clear the paleoecology and conditions under which the formation was deposited.

Before proceeding we wish to offer our appreciation to Professor Shôshirô HANZAWA and Professor Kiyoshi ASANO of the Institute of Geology and Paleontology, Tohoku University, for their continued encouragement and valuable suggestions. Acknowledgement is also due to Professor Kotora HATAI of the Department of Geology, College of Education, Tohoku University, for his opinion and discussions.

Stratigraphic Consideration

The Sugota formation is a sedimentary facies underlying the hard or siliceous shales equivalent to the Onnagawa formation of Oga Peninsula, Akita Prefecture, and is estimated to have a thickness of 200–150 meters.

The formation conformably overlies the volcanic complex of lava flows and agglomerates of hypersthene-andesite, and green colored tuffs.

* Read June 26, 1954; received July 24, 1954.

The lower half of the Sugota formation begins with boulder conglomerate at the base, succeeded upwards with cross-bedded agglomeratic sandstone interbedding several lenses of conglomerate and locally intercalating siltstone layers in which silicified drift woods, lignite seams and plant fossils are embedded. The fossil flora is characterized with *Liquidambar formosana* HANCE, *Ficus tiliaefolia* HEER and *Pterocarya denticulata* HEER.

The upper half of the Sugota consists chiefly of bluish gray colored medium to fine-grained sandstone locally intercalating conglomerate.

The middle part of this sandstone corresponds to the *Pecten-Terebratulina* bed of S. NOMURA and K. HATAI (1936), having as the name suggests, abundant remains of molluscs and brachiopods. From this horizon, S. NOMURA and K. HATAI (1936) reported; *Calyptraea tubura* OTUKA, *Cardita siogamaensis* (NOMURA), *Chlamys kaneharai* (YOKOYAMA), *Glycymeris vestitoides* NOMURA, *Phaxus izumoensis* (YOKOYAMA), *Dosinia kaneharai* YOKOYAMA, *Ostrea gravitesta* YOKOYAMA, *Patinopecten kimurai* (YOKOYAMA), *Placopecten akihoensis* (MATSUMOTO), *Shichiheia yokoyamai* (NOMURA and HATAI), *Terebratalia tenuis* (HAYASAKA), and *Turritella s-hataii* NOMURA. The sponge known as *Aphrocalistes* sp., also occurs in association with the *Pecten-Terebratulina* bed.

Foraminiferal fossils are seemingly restricted to a single horizon, being always found only in the upper part of the formation where megafossils do not occur. The only exception is in the Yazawagi area where the foraminifers occur in association with the molluscs.

The foraminifers collected from the Sugota formation are from the following localities;

Ak-15. Cliff 150 meters east of Agenosawa, Kamikawa-Ôuchi-mura, Yuri-gun.

Ak-16. Road side cutting 200 meters east of Kohabiro, ditto.

Ak-17. Cliff 300 meters northeast of Habiro, ditto.

Ak-18. Road side cutting 750 meters south of Habano, Tômae-mura, Yuri-gun.

Ak-19. Cliff 500 meters from south of valley southwest of Tashiro, ditto.

Ak-20. Road side cutting 750 meters west of Nashinoki-tôge, Tashiro-mura, Ogachi-gun.

Ak-21. Cliff 400 meters north of locality number Ak-20, ditto.

Ak-22. Cliff 500 meters south of Kinezaka, Yazawagi-mura, Hiraga-gun.
Pecten-Terebratulina bed.

Ak-23. Cliff 400 meters north of Takinoue, ditto. *Pecten-Terebratulina* bed.

Ak-24. Cliff 800 meters north of Takinoue, ditto. *Pecten-Terebratulina* bed.

Ak-25. Road side cutting 700 meters south of Kura, Shimogô-mura, Yuri-gun.

Ak-26. Cliff 500 meters east of Katsuradai, ditto.

Ak-27. Cliff 200 meters west of locality number Ak-26, ditto.

Ak-28. Southern cliff of the Ukibuta Primary School, Ukibuta, ditto.

Ak-29. Cliff 1500 meters northwest of the Primary School, Ukibuta, ditto.

Ak-30. Road side cutting 800 meters north of Uenosato, ditto.

Ak-31. Cliff 100 meters north of locality number Ak-30, ditto.

Faunal Characteristics and Paleoecology

The foraminiferal fauna of the Sugota formation consists of 149 species and subspecies (Table I) belonging to 57 genera and 14 families, excluding the pelagic forms. Of these species 7 are considered to be new.

The family Lagenidae is represented by the largest number of genera, species and individuals, occupying about one-third of the fauna. Of the other famil-

Table 1. Foraminifera from the Sugota Formation

Species \ Localites	Ak-15	Ak-16	Ak-17	Ak-18	Ak-19	Ak-20	Ak-21	Ak-25	Ak-26	Ak-27	Ak-28	Kk-29	Ak-30	Ak-31	Ak-22	Ak-23	Ak-24
															Pecten-Terebratulina Bed		
Gaudryina ishikiensis ASANO.	6	3	6			2	1					6			2		37
G. cf. *oga* ASANO																	5
Martinottiella communis (D'ORBIGNY)	5	1			2												
Textularia abbreviata D'ORBIGNY			1														
T. lythostrota SCHWAGER ...			1														
Siphotextularia cf. *miocenica* CUSHMAN & TODD	2		5			1			1	6	1	2		11			
Quinqueloculina sp.			6														
Miliolinella cf. *circularis* (BORNEMAN)	1																
Sigmoilina schlumbergeri SILVESTRI	2		1			1											
Triloculina tricarinata D'ORBIGNY			1														
T. trigonula (LAMARCK).....			1														
Robulus cf. *becki* RAU		2		2													
R. calcar (LINNAEUS)	4	32	3	1		1	5	2	1	11		49		1			
R. depressus ASANO			2			4				1							
R. etigoensis ASANO		1						2									
R. himiensis CHIJI & NAKASEKO			1			2								2			
R. iotus (CUSHMAN).....					2	2											
R. lucidus (CUSHMAN).....	8	2	5		20	17	20	6	2	2	1	3					
R. miyagiensis ASANO										5							
R. cf. *notoensis* ASANO.....										2							
R. pseudorotulatus ASANO.....								1		2				5			
R. sagamiensis ASANO							1	4						11			
R. sugotaensis IWASA & KIKUCHI, n. sp.					2							1					
Lenticulina huziokai IWASA & KIKUCHI, n. sp.....	2	1														2	
L. moniwaensis ASANO										1							
Planularia japonica ASANO...	1	1															
Marginulina aculeata NEUGEBOREN	8	4			6	2				1							
M. cf. *dubia* NEUGEBOREN...				1						1		4					
M. glabra D'ORBIGNY	3																
M. cf. *masudai* ASANO.....			1	1	4	1						5		1			
M. sendaiensis ASANO										4		1					
Dentalina communis D'ORBIGNY	1		1														

	15	16	17	18	19	20	21	25	26	27	28	29	30	31	22	23	24
D. emaciata REUSS		14	2		2	3											
D. insecta (SCHWAGER)		3	1														
D. subsoluta (CUSHMAN)		1				1	4										
D. tauricornis (SCHWAGER)						2											
Nodosaria deceptoria SCHWAGER														1			
N. longiscata D'ORBIGNY	1	6	4		12				5	3		2					
N. pyrula D'ORBIGNY						1											
N. raphanus (LINNAEUS)						1											
N. vertebralis (BATSCH)		3				1				1							
Lagenonodosaria fukushimaensis ASANO		4		1		1	7		1	1		58					2
L. holoserica (SCHWAGER)		1															1
L. scalaris (BATSCH)	4	1		2	10	1	3				1						
L. scalaris sagamiensis ASANO										1		10					
L. sp.					1								1		3		
Pseudoglandulina laevigata (D'ORBIGNY)	1		1					1		1			1				
P. sp.															1		
Saracenaria akitaensis IWASA & KIKUCHI, n. sp.			3			1	2										
S. latiforns (BRADY)										2		1					
Vaginulina yoshihamaensis INOUE & NAKASEKO			1	1						12		1					
Parafrondicularia cf. *japonica* ASANO		1															
Lagena acuticosta REUSS	1	11		2	18		7	1	1	9			1	4			1
L. elongata (EHRENBERG)												1					
L. laevis (MONTAGU)	1				2					1							
L. perlucida (MONTAGU)		2					1			1				1			
L. semistriata WILLIAMSON						1	2										
L. striata (D'ORBIGNY)	2	3				1	2			1				1			
L. striato-punctata PARKER & JACOB				1													
L. strumosa REUSS	1	1		1													
L. sulcata (WALKER & JACOB)				2													
Guttulina asanoi IWASA & KIKUCHI, n. sp.			1	1			2		1						2		
G. irregularis (D'ORBIGNY)		6	1	2	4	3						1		2			
G. lactea (WALKER & JACOB)							2			2				1			
G. sadoensis (CUSHMAN & OZAWA)					2											1	
G. yamazakii CUSHMAN & OZAWA																1	
Globulina minuta (ROEMER)	1																

	15	16	17	18	19	20	21	25	26	27	28	29	30	31	22	23	24
Pyrulina cylindroides (ROEMER)																	
Nonion cf. *akitaense* ASANO	1	1							1	1	1				10	14	
N. japonicum ASANO	2					5	9		4			1			5		
N. kidoharaense FUKUDA			6			4	1	17				15			2	3	8
N. nicobarense CUSHMAN							4		4	2	1		3	6			8
N. pompilioides (FICHTEL & MOLL)	2	12	5		20	6	3	1	4	7	8	1	21	1	5	14	5
N. scaphum (FICHTEL & MOLL)	6					11	3										4
Pseudononion japonicum ASANO															2	6	
Nonionella miocenica CUSHMAN	1					1									30	1	4
Astrononion aomoriense ASANO		1	2						1		10					4	1
A. stelligerum (D'ORBIGNY)			6	4		2									1	1	1
Elphidium cf. *fabum* (FICHTEL & MOLL)							1		1								
E. cf. *hughesi foraminosum* CUSHMAN						1											
E. cf. *ozawai* UCHIO																2	
E. cf. *subgranulosum* ASANO															2		
Cribroelphidium bartletti (CUSHMAN)																	1
C. imanishii ASANO																	11
Elphidiella momiyamansis UCHIO												1			14	4	
Plectofrondicularia japonica ASANO		1			2					1							
P. miocenica CUSHMAN					4	1											
P. miocenica directa CUSHMAN & LAIMING					6				3				1				
Bulimina cf. *inflata* SEGUENZA	5	3															
B. ovata D'ORBIGNY																	1
B. pupoides D'ORBIGNY						2											
Globobulimina cf. *pacifica* CUSHMAN	1	1			4								1				
Entosolenia catenulata WILLIAMSON	1															1	
E. cf. *fukamiensis* ASANO													1				
E. hexagona WILLIAMSON		1															
E. marginata (MONTAGU)		1					1				1						
E. orbignyana (SEGUENZA)	2			2						4	3		2	3			
Virgulina complanata EGGER						1											
V. schreibersiana CZIZEK	1					1	6					1	2				

	15	16	17	18	19	20	21	25	26	27	28	29	30	31	22	23	24
Bolivina advena striatella CUSHMAN					2									5			
B. marginata masudai ASANO	5			17	8	1	3	3					1	17			
B. cf. *robusta* BRADY	13	8	3	22	4	14	20	9	11	19	1		6	16	6	4	2
Loxostomum? sp.															1		
Reussella spinulosa (REUSS)			1													1	
Uvigerina multicosta LEROY															1		
U. proboscidea SCHWAGER	9	8	3	2	4	1	19		1				3	4	1	9	
U. sp.																2	
Hopkinsina hispida (SCHWAGER)	1					1									2		
H. sp.																1	
Angulogerina kokozuraensis ASANO	6	4	2	8		10	21	3	21	8				14	11	8	6
Ellipsonodosaria ketienjiensis ISHIZAKI	1	14	2	1				2	9	6	3			1		5	
E. lepidula (SCHWAGER)							1						2	21			
E. ugoensis IWASA & KIKUCHI, n. sp.			3	33		2		1		5				1			
Discorbis opercularis (D'ORBIGNY)																	1
Discopulvinulina cf. *bradyi* (CUSHMAN)				1													
D. cf. *isabelliana* (D'ORBIGNY)	2	1	1					5		3				1	1	1	1
Valvulineria araucana malagaensis KLEINPELL		2	1													1	
Gyroidina orbicularis D'ORBIGNY		1									1						
G. soldanii D'ORBIGNY			6			5	1	4		1							
Eponides frigidus (CUSHMAN)	2		8	15		3	13	3	6		9		1	6	21	22	4
E. frigidus calidus CUSHMAN & COLE																1	3
E. haidingeri (D'ORBIGNY)			4					2									
E. hatakeyamai IWASA & KIKUCHI, n. sp.			1						3	7							
E. umbonatus (REUSS)	1	2									22						
Rotalia cf. *beccarii* (LINNAEUS)			6					16		7		11				2	42
R. hatatatensis TAKAYANAGI	1					1					1						
R. sp.																1	
Cancris auricula (FICHTEL & MOLL)			12			1	3	1		1		15				1	13
Baggina notoensis ASANO	2	3	2			6				7		8			5	1	10
Epistominella japonica (ASANO)	3	4			35	3	9	11							1	12	

	15	16	17	18	19	20	21	25	26	27	28	29	30	31	22	23	24
E. cf. *smithi* (R.E. & K.C. STEWART)															2	2	
Cassidulina laevigata carinata CUSHMAN	15	8	32	13	16	1	7	57	1	8	22	1	106	51	5	4	
C. margareta KARRER	26	6	6	2		2	3	2	11	8	69		1		2	17	1
C. orientale CUSHMAN			1	1													
C. subglobosa BRADY															1		
Chilostomella czizeki REUSS	21					1											
Pullenia elegans CUSHMAN & TODD											2						
P. quinqueloba (REUSS)															2		
P. salisburyi R.E. & K.C. STEWART	1	1											3				
Anomalina cf. *glabrata* CUSHMAN	1																
Planulina nipponica ASANO	9	5	9	6	8	13	3	2				1				3	8
Hanzawaia nipponica ASANO	2		5	1				19	4	15	4					4	
H. tagaensis ASANO						1			1						2	2	
Cibicides lobatulus (WALKER & JACOB)	4	6	20	49	24	14	6		48	12	8	1	9	9	22	21	5
C. pseudoungerianus (CUSHMAN)	2	3					10		2	4	2		4	2			7
C. tani IWASA & KIKUCHI, n. sp.						1		7	41		43		8		29	19	7
C. sp.											1				6		
Dyocibicides biserialis CUSHMAN & VALENTINE			1					1		2							
D. perforata CUSHMAN & VALENTINE										1							
Total	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Globigerinidae	84	272	70	4	200	19	12	20	44	10	11	20	18	42	30	20	13

ies, those of the Nonionidae, Buliminidae, Rotaliidae and Anomalinidae are next in abundance and each family is represented by ten or more species.

From the fact that the fauna has yielded very few genera of the family Miliolidae and few species of the genera *Elphidium* and *Rotalia*, the upper part of the Sugota formation was not deposited in the littoral zone.

Furthermore, that the assemblage is characterized with a large number of species of *Robulus* and its allied genera indicates a neritic environment and probably its outer part.

The foraminifers found in association with mega-fossils in the Yazawagi area is characterized by the genera *Gaudryina*, *Nonion*, *Nonionella*, *Elphidiella*, *Eponides*, *Rotalia*, *Baggina* and *Cibicides*. The depth analysis of those genera reveals that the sediments entombing the fossils were deposited in depths corresponding to the inner to mid-neritic zone under the large bay environment.

From the Recent species contained in the fossil fauna it is evident that the Sugota fauna, as a whole, was influenced

by warm thermal conditions.

They are known from Tosa Bay of Shikoku and Sagaminada of Kanagawa and Shizuoka Prefectures along the Pacific side of southwest Japan, and from Wakasa Bay of Fukui Prefecture on the Japan Sea side of western Japan. Both areas are now under the influence of warm currents.

The lower part of the Sugota formation is thought that a near or deltaic environment prevailed, and the climatic condition was mild as can be judged from the fossil flora.

Correlation

The Sugota is correlated with the Nishikurosawa formation of Oga Peninsula, Akita Prefecture on the basis of *Aphrocallistes* sp., *Chlamys kaneharai* (YOKOYAMA), *Dosinia kaneharai* YOKOYAMA, *Placopecten akihoensis* (MATSUMOTO), and *Turritella s-hataii* NOMURA. The Nishikurosawa contains abundant specimens of *Operculina complanata japonica* HANZAWA, *Miogypsina kotoi* HANZAWA and *Amphistegina lessoni* D'ORBIGNY, although smaller foraminifera have not been reported from the formation.

By the above-listed larger foraminifers, the Nishikurosawa can be correlated with the Tanosawa formation of the Nishi-Tsugaru District in Aomori Prefecture, as already stated by S. HANZAWA (1935). The Tanosawa formation was found to contain a large number of smaller foraminifers, which are reported here for the first time. The distinct species are; *Robulus calcar* (LINNAEUS), *Nodosaria raphanus* (LINNAEUS), *Vaginulina yoshihamaensis* INOUE and NAKASEKO, *Nonion kidoharaense* FUKUDA, *N. japonicum* ASANO, *Eponides haidingeri* (D'ORBIGNY), *Rotalia* cf. *beccarii* (LINNAEUS), *R. tochigiensis* UCHIO, *R. tanosawaensis* n. sp., *Hanzawaia nipponica* ASANO.

The foraminiferal fauna of the Tanosawa formation is the same as that of the Sugota, although the former formation seems to have been deposited at a depth shallower (littoral to inner neritic) than the latter.

The Miocene Higashi-Innai formation (K. MASUDA, 1954) of Noto Peninsula in Ishikawa Prefecture possesses about 200 species of smaller foraminifera, the majority of which are common to the Sugota fauna. The Higashi-Innai has also yielded larger foraminifers as *Miogypsina kotoi* HANZAWA and *Operculina complanata japonica* HANZAWA. The foraminiferal fauna of the Higashi-Innai formation, according to K. ASANO (1943), is similar to the Miocene fauna of the Indo-Pacific region, which indicates an age corresponding to the Preangerian (Vindovonian).

The Sugota fauna is more similar to the Miocene fauna of the northwest coast of America than to the Indo-Pacific region, the following species in common with the former region but not known to occur in the latter, namely; *Nonionella miocenica* CUSHMAN, *Plectofrondicularia miocenica* CUSHMAN, *P. miocenica directa* CUSHMAN and LAIMING, *Valvulineria arucana malagaensis* KLEINPELL, *Cassidulina laevigata carinata* CUSHMAN, and *C. margareta* KARRER.

Previously S. NOMURA and K. HATAI (1936) from their study of the molluscs and brachiopods from the *Pecten-Terebratulina* bed of the Sugota formation, arrived to the conclusion that the age is Vindovonian.

Recently K. TAN (1951) reported on the discovery of a tooth of *Desmostylus japonicus* TOKUNAGA and IWASAKI found in association with molluscs and brachiopods which are common to the

Pecten-Terebratulina bed of S. NOMURA and K. HATAI. The geological age of *Desmostylus*, according to R. M. KLEINPELL (1938), on the west coast of North America, is Luisian. The Luisian is correlated with the Vindovonian by that author.

Accordingly, it seems that the Sugota formation and its correlatives mentioned in earlier lines may all belong to the Vindovonian age.

Description of Species

Genus *Robulus* MONTFORT, 1808

Robulus sugotaensis n. sp.

Text-figs. 1a-b.

Test large, elongate, compressed, periphery acute with narrow keel; 6-8 chambers in last whorl, not inflated, early part of chambers slightly evolute; sutures gently curved, very distinct, limbate, slightly raised except for latter one or two; wall smooth; apertural face slightly convex, aparture radiate with a short slit at the peripheral angle. Diameter up to 3 mm.

Holotype:—IGPS coll. cat. no. 65516; IGPS loc. no. Ak-25.

Occurrence:—Rare. Tashiro, Tômae-mura and Kura, Shimogô-mura, Yuri-gun.

Remarks:—This species resembles *Robulus asanoi* TAKAYANAGI, but differs by the absence of a broad keel, and the latter sutures are not raised.

Genus *Lenticulina* LAMARCK, 1804

Lenticulina huziokai IWASA and KIKUCHI, n. sp.

Text-figs. 2a-b.

Test large, subcircular, lenticular in side view, involute, periphery with narrow keel except for latter part; chambers 8-10 in last coil; sutures slightly curved, ornamented with a raised ridge, fusing at central part; wall smooth; aperture radiate at periphery angle. Diameter up to 3 mm.

Holotype:—IGPS coll. cat. no. 65517; IGPS loc. no. Ak-23.

Occurrence:—Rare. Agenosawa and Kohabiro, Kamikawa-Ôuchi-mura, Yuri-gun and *Pecten-Terebratulina* bed of Yazawagi-mura, Hiraga-gun.

Remarks:—This species stands close to *Lenticulina echinata* (D'ORBIGNY), but is distinguished by its continuous raised sutures and by the absence of spines at the periphery.

Genus *Saracenaria* DEFRANCE, 1824

Saracenaria akitaensis n. sp.

Text-figs. 3a-b.

Test free, elongate, roundly triangular in transverse section; chambers increasing gradually in size as added, early three or five closely coiled, later ones uncoiling; sutures distinct, not depressed but sometimes latter one or two slightly depressed, set oblique; wall smooth, finely perforate; aperture terminal, radiate, with a short slit. Length 1.5 mm.

Holotype:—IGPS coll. cat. no. 65518; IGPS loc. no. Ak-17.

Occurrence:—Rare. Habiro, Kamikawa-Ôuchi-mura, Yuri-gun, and Nashinoki-tôge, Tashiro-mura, Ogachi-gun.

Remarks:—The roundly triangular shape in transverse section, and the almost non-depressed sutures are the distinctive characters of this species.

By those features the present species is distinguished from the known species of the genus.

Genus *Guttulina* D'ORBIGNY, 1838

Guttulina asanoi n. sp.

Text-figs. 4a-b.

Guttulina sp. ASANO, 1953. Short Papers IGPS., no. 5, p. 18. pl. 3, figs. 9.

Text fusiform, generally twice as long

as broad, greatest breadth nearly at middle; chambers strongly inflated, embracing, arranged in a nearly quinqueloculine series; sutures distinct, depressed; wall smooth, with produced spine at base: aperture terminal, radiate. Length 1.1 mm.

Holotype:—IGPS coll. cat. no. 65519; IGPS loc. no. Ak-17.

Occurrence:—Rare. Found throughout the area of distribution of the Sugota formation.

Remarks:—This form resembles *Guttulina woodsi* CUSHMAN and OZAWA, but differs therefrom by having more strongly inflated chambers. *G. yabei* CUCHMAN and OZAWA which is similar to the present form in arrangement of chambers, is distinguished by the absence of the basal spine. *Guttulina* sp. of K. ASANO from the Miocene sediments of Noto Peninsula, *G. yabei ovale* listed by Y. TAKAYANAGI from the Miocene Hatatate formation of Miyagi Prefecture are very similar to this species.

Genus *Ellipsonodosaria* A. SILVERSTRI, 1900

Ellipsonodosaria ugoensis n. sp.

Text-figs. 5a-b.

Test small, slender, tapering, slightly curved, with round, initial end; 7-8 chambers in adult, very slightly inflated especially toward apertural end, early part generally broader than high, becoming higher than broad as added; sutures weakly limbate, nearly at right angles to axis of test; wall smooth; aperture at end of a produced neck, with a weak elliptical collar, and a tooth. Length 0.9 mm.

Holotype:—IGPS coll. cat. no. 65520; IGPS loc. no. Ak-17.

Occurrence:—This species is found throghout the area of distribution of the Sugota formation, and shows higher percentage of occurrence locally.

Remarks:—*Ellipsonodosaria fijiensis* (CUSHMAN) from the Miocene of the Fiji Islands resembles this form in the outline, but differs by having prominent perforations at surface. The smooth surface and rounded initial end of this species distinguish it from *Ellipsonodosaria hyugaensis* ISHIZAKI and *E. verneuili* (D'ORBIGNY).

Genus *Eponides* MONTFORT, 1808

Eponides hatakeyamai n. sp.

Text-figs. 6a-c.

Test biconvex, ventral side sometimes flat, periphery subacute with narrow keel, which never extends to latter one or two chambers, umbilical region filled with a raised and rounded mass of shell material; chambers distinct, 6-7 in last-formed coil; sutures distinct, limbate, oblique on dorsal side, slightly limbate and curved on ventral side; wall smooth; aperture ventral between umbilicus and periphery. Diameter 0.45 mm., thickness 0.09 mm.

Holotype:—IGPS coll. cat. no. 65521; IGPS loc. no. Ak-26.

Occurrence:—Few. Katsuradai, Shimogô-mura, Yuri-gun.

Remarks:—This species is distinguished from *Eponides carolinensis* CUSHMAN by having a umbilical raised mass, by the absence of raised sutures on the dorsal side, and the characters of the species serve to distinguish it from the previously described species of *Eponides*.

Genus *Rotalia* LAMARCK, 1804

Rotalia tanosawaensis n. sp.

Text-figs. 7a-c.

Test small, biconvex, more convex on ventral side, periphery subacute, composed of about 3 whorls; chambers 8-9

in last whorl; sutures slightly oblique, thickened on dorsal side, radial and depressed on ventral side; umbilicus raised, with a rounded plug of shell material; aperture at ventral border of last chamber. Diameter 0.51 mm., thickness 0.17 mm.

Holotype:—IGPS coll. cat. no. 65522; IGPS loc. no. Ao-14., Road side cutting 1000 meters southwest of Tanosawa, Odose-mura, Nishi-Tsugaru-gun, Aomori Prefecture.

Occurrence:—Rare. Occurring only at the type locality.

Remarks:—The dorsal characters of *Rotalia papillosa* BRADY and *R. stachi* ASANO resemble this form, but the absence of a plug on the ventral side distinguishes it therefrom. The ventral plug is found in such as *Rotalia nipponica* ASANO and *R. tochigiensis* UCHIO, however, both differ from this species by lacking the thickened sutures of the dorsal side. *Rotalia* sp. B. of LEROY Miocene of Sumatra is closely related to this species, but differs in having a more lobulate periphery.

Genus *Cibicides* MONTFORT, 1808

Cibicides tani, n. sp.

Text-figs. 8a-c.

Test plano-convex, ventral side flat or slightly convex, thickest at umbilical area, periphery subacute, slightly lobulate in the latter; chambers 8-10 in last-formed coil, latter one or two sometimes weakly expanded; sutures very obscure in earlier half or more, latter two slightly depressed; wall coarsely perforate; aperture narrow, at peripheral margin, a rounded arch at base of chamber, extending over to dorsal side and running along periphery. Diameter 0.6 mm., thickness 0.1 mm.

Holotype:—IGPS coll. cat. no. 65523; IGPS loc. no. Ak-28.

Occurrence:—Common, found from many localities of the Sugota formation.

Remarks:—This species resembles *Cibicides altamiraensis* KLEINPEL from the Miocene of California, but differs in the less lobulate periphery and more obscured sutures.

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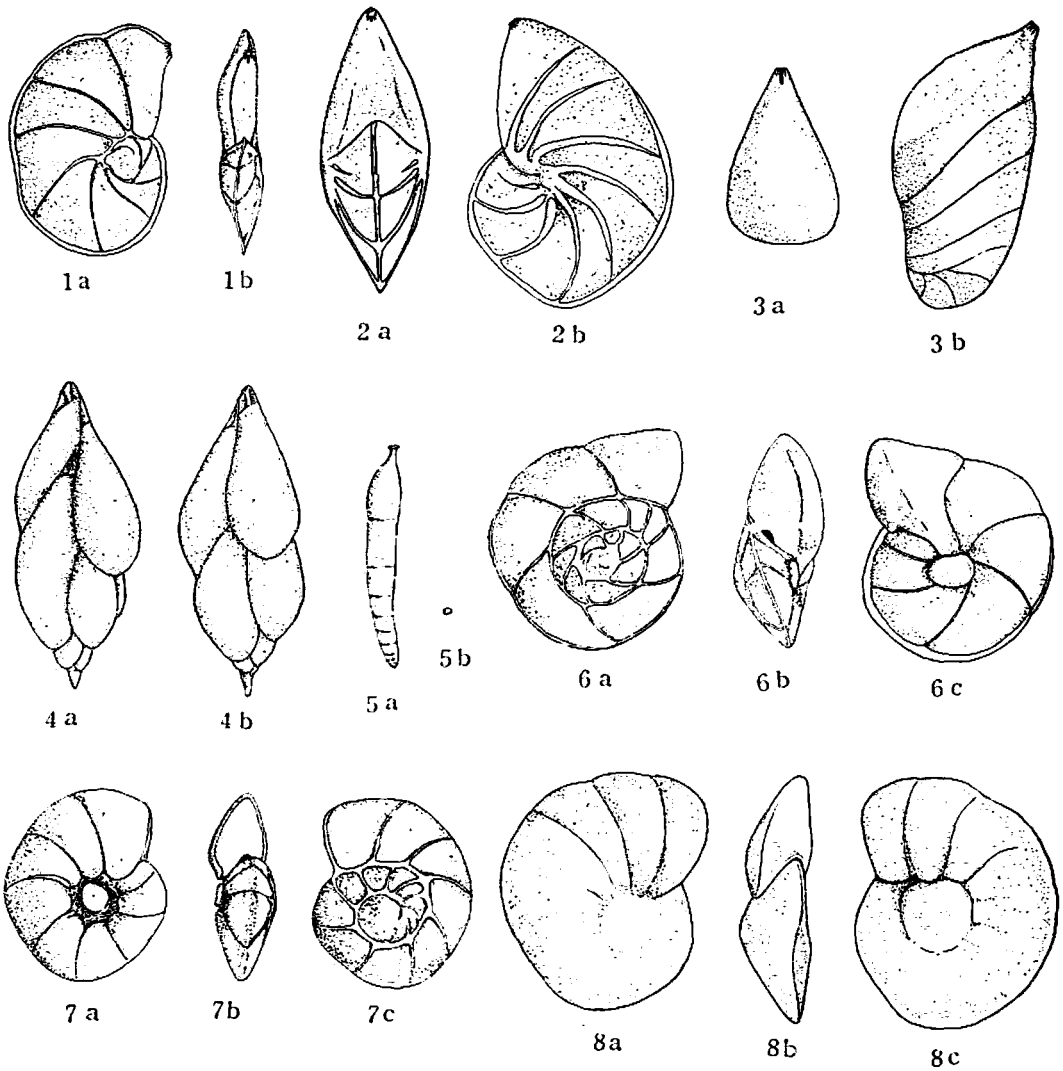

Explanation of Text-figures

Figs. 1a-b. *Robulus sugotaensis* IWASA and KIKUCHI, n. sp. ×8
Figs. 2a-b. *Lenticulina huziokai* IWASA and KIKUCHI, n. sp. ×13
Figs. 3a-b. *Saracenaria akitaensis* IWASA and KIKUCHI, n. sp. ×24
Figs. 4a-b. *Guttulina asanoi* IWASA and KIKUCHI, n. sp. 36
Figs. 5a-b. *Ellipsonodosaria ugoensis* IWASA and KIKUCHI, n. sp. ×36
Figs. 6a-c. *Eponides hatakeyamai* IWASA and KIKUCHI, n. sp. ×72
Figs. 7a-c. *Rotalia tanosawaensis* IWASA and KIKUCHI, n. sp. ×52
Figs. 8a-c. *Cibicides tani* IWASA and KIKUCHI, n. sp. ×55

Trans. Proc. Palaeont. Soc. Japan. N.S., No. 15, pp. 195—200, Pl. 25. Dec. 15, 1954

256. NOTES ON SOME TERTIARY PLANTS FROM TYÔSEN (KOREA). IV*

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朝鮮産第三紀植物化石 IV. 本篇では Fagaceae のうち *Quercus* 4 種, *Cyclobalanopsis* 4 種を記載した。 藤岡一男

Contents

Of the fifteen species of the genus *Quercus* now to be found on the Korean peninsula the following species are the most flourishing and are of general distribution as to be found on almost the entire peninsula: *Quercus aliena* BLUME, *Q. dentata* THUNB., *Q. mongolica* FISH., and *Q. serrata* THUNB. By comparison, the closely related genus *Cyclobalanopsis* is now restricted in its distribution to the southern part of the peninsula and contiguous islands.

The known species of *Quercus* and *Cyclobalanopsis* from the Tertiary of Korea are comparatively abundant as shown in the following list:

Quercus aliena BLUME: Kantindo formation of N. Kankyo-Do (ENDO, 1938, name only).

Q. crispula BLUME: Kantindo formation of N. Kankyo-Do (ENDO, 1938, name only); Enniti group of N. Keisyo-Do (KANEHARA, 1936, name only).

Q. furcinervis ROSSM.: *Engelhardtia* Bed of N. Kankyo-Do (ENDO, 1938, name only).

Q. intermedia FRIEDRICH: *Engelhardtia* Bed of N. Kankyo-Do (ENDO, 1938, name only).

Q. Johnstrupi HEER?: *Engelhardtia* Bed of N. Kankyo-Do (ENDO, 1938, name only).

Q. koraica TANAI: Enniti group of N. Keisyo-Do (TANAI, 1953, p. 5, Pl. 1, figs. 11, 12).

Q. cfr. *pseudo-castanea* GOEPPERT: Kantindo formation of N. Kankyo-Do (TATEIWA, 1925, name only).

Q. simulata KNOWLTON?: *Engelhardtia* Bed of N. Kankyo-Do (ENDO, 1938, name only).

Q. spp.: Agoti coal-bearing bed (ENDO, 1938) and Kantindo formation (TATEIWA, 1925 and ENDO, 1938), N. Kankyo-Do.

Cyclobalanopsis glauca THUNB.: Enniti group of N. Keisyo-Do (KANEHARA, 1936 and TANAI, 1953, name only).

C. Huziokai TANAI: Enniti group of N. Keisyo-Do (TANAI, 1953, p. 4, Pl. 1, fig. 10).

C. Mandraliscae (GAUDIN) TANAI: Enniti group of N. Keisyo-Do (TANAI, 1953, p. 3, Pl. 1, figs. 6, 9).

At the writer's disposal were manifold types of fossil *Quercus* and *Cyclobalanopsis* from Korea which were examined in the course of these studies. From this material three are considered distinct and valid species, while the others could not be assigned to any species with any certainty due to the

* Read May 13, 1954; received Oct. 11, 1954.

fragmentary nature of the specimens.

The species determined by the writer were *Quercus Kodairae*, sp. nov., *Q. miocrispula*, sp. nov., Cfr. *Q. dentata* THUNB., *Q.* sp., Cfr. *Q. serrata* THUNB., *Cyclobalanopsis Mandraliscae* (GAUDIN) TANAI, *C.* sp. a, *C.* sp. b, and Cfr. *C. gilva* OERSTED.

Description of Species

Genus *Quercus* L.

Quercus Kodairae, sp. nov.

Plate 25, Figures 7-10

Description:—Leaf generally small, 5-7 cm (rarely 9 cm) long and 3-5 cm (rarely 8 cm) broad, oval, ovate-elliptic or elliptic in outline. Apex like a marginal dent, acutely pointed, base broadly cuneate or truncate. Margin dentate or lobulatodentate; each dent triangular in shape, pointed at the top. Midvein rather thin, straight or slightly zigzag to the apex. Lateral veins 7-8 pairs in number, regularly arranged, straight or slightly up-curved to the marginal dents, diverging from the midvein at angles of 40-70°; some lower pairs occasionally decurrent below at their bases. Tertiary veins obscure in impression, frequently branched from the lateral veins; finer veins forming polygonal meshes. Petiole very short. Texture apparently thin.

Comparison and remarks:—The present specimens are comparable with leaves of *Lepidobalanus* ENDL. of the genus *Quercus*, but there is no exact equivalent in the living species. Among the known fossil species, *Quercus Johnstrupi* HEER (1883, p. 24, Pl. 56, figs. 7-12) and *Q. sessiliflora* SALISBURY *fossilis* MAEDLER (1939, p. 78, Pl. 7, figs. 17, 18) are somewhat similar to our leaves.

Occurrence:—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Quercus miocrispula, sp. nov.

Plate 25, Figure 3

Description:—Leaf large, obovate-elliptic in outline. Apex acute like a marginal tooth, base narrowed and slightly auriculate. Margin coarsely and deeply dentate; teeth large, acutely pointed, slightly up-curved at the apices. Midvein stout. Lateral veins 15-17 pairs, diverging from the midvein at angles of 30-50°, almost straight to the marginal teeth. Petiole thick, very short for the size of lamina. Texture apparently thick. Dimension of the figured specimen: about 18 cm long and 9 cm broad.

Comparison and remarks:—The specimens are clearly similar to *Quercus crispula* BLUME which is widely distributed in Saghalin, South Kurile islands, Japanese Islands and Korea. In Korea it grows on mountains (400m-1950m) of N. Keisyo-Do and the Island of Saisyu. Fossils of *Q. crispula* have been found in Japan as old as the Younger Neogene Tertiary.

Quercus pseudo-castanea GOEPPERT (1852, p. 274, Pl. 35, figs. 1, 2) apparently resembles *Q. crispula* and *Q. miocrispula* in having the large marginal dents, but differs from them in the narrow lamina and the long petiole.

Occurrence:—Kissyu-town, Kissyu-gun, N. Kankyo-Do; White Shale of the Kissyu formation (Miocene); Coll. OISHI.

Kinkodo, Usen-men, Geizitu-gun, N. Keisyo-Do; Changi group (Miocene); Colls. KODAIRA and UOTANI.

Kantiondo, Meisen-gun, N. Kankyo-Do; Kantindo formation (Miocene); Coll. OISHI.

Quercus sp.

Plate 25, Figure 11

Description:—Leaf large, general outline unknown. Apex unknown. Base truncate, somewhat inequilateral. Margin coarsely and deeply lobulatodentate. Midvein rigid, somewhat zigzag; lateral veins coarsely arranged, straight to the marginal dents, diverging from the midvein at angles of 90° at the basal part of lamina and angle gradually decreasing upwardly; finer veins coarsely percurrent. Petiole thick, about 1.5 cm long.

Comparison and remarks:—Though all specimens which the writer has studied are fragmental and the full characters of leaf are unknown, the foliar type is quite distinct from the known species both of the fossil and the existing *Quercus*.

The present leaf is distinguished from *Quercus Kodairae* from the same locality by its larger size, the inequilateral base and the longer petiole. *Q. columbiana* CHANEY (1920, p. 170, Pl. 13, figs. 1, 2) and *Q. Bretzi* CHANEY (1920, p. 171, Pl. 12, fig. 4; Pl. 13, fig. 3) from the Eagle Creek of Oregon somewhat resemble our leaf in the marginal dentation.

Occurrence:—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Cfr. *Quercus dentata* THUNB.

Some fragmental specimens which are closely comparable with *Quercus dentata* THUNB. were found in the collections from Kissyu and Ryuhokudo.

Q. dentata is now widely distributing in Northeastern Asia as a common forest tree of the temperate zone. Fossils of this species have been reported by KON'NO (1931, Pl. 4, figs. 4, 5; Pl. 11, figs. 2, 3) and KRYSHTOFOVICH (1930, p. 27, Pl. 4, fig. 39) from the Miocene floras of Nagano prefecture.

Occurrence:—Kissyu-town, Kissyu-gun, N. Kankyo-Do; White Shale of the Kissyu formation (Miocene); Coll. OISHI.

Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Genus *Cyclobalanopsis* OERSTED

Cyclobalanopsis Mandraliscae (GAUDIN) TANAI

Plate 26, Figures 1 and 2.

1953. *Cyclobalanopsis Mandraliscae* TANAI: p. 3, Pl. 1, figs. 6-9.

Quite recently, TANAI (1953) described this species from the Enniti group of southern Korea. Our leaves, when compared with his specimens, are larger and possess a long petiole. In the essential characters our leaves are quite similar to *C. Mandraliscae*, and in a wide sense also to *Quercus Drymeja* UNGER (1847, p. 113, Pl. 32, figs. 1-4).

HEER (1878, p. 8, Pl. 4, fig. 4) reported *Q. Drymeja* from the Miocene beds of North Saghalin, but it is very doubtful to identify if his specimen can be identified as, or assigned to *Q. Drymeja* UNGER.

Occurrence:—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Cfr. *Cyclobalanopsis gilva* OERSTED

Plate 25, Figure 5.

As shown in Pl. 26, fig. 5, a specimen

from Ryuhokudo, which shows only the lower part of a leaf, is closely comparable with the living *Cyclobalanopsis gilva* OERSTED. *C. gilva* is now widely distributed in the warmer regions of Japan and Formosa.

Occurrence:—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do, *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Cyclobalanopsis sp. a

Plate 25, Figure 4.

Description:—Whole outline of leaf unknown, but may be linear lanceolate, longer than 8 cm and about 2.5 cm wide. Apex unknown, base narrowly cuneate. Margin dentate, teeth seemingly obtuse or rounded at the top. Midvein rigid and straight. Lateral veins more than 14 pairs in number, almost equidistantly arranged, straight to the tip of the marginal teeth and incurved there, leaving the midvein at an acute angle (about 30°) in the lower part of lamina and at an angles of generally 45° in the middle part. Petiole unknown.

Comparison and remarks:—This specimen may be referable to the genus *Cyclobalanopsis*, but is quite different from all living species of the genus.

In having the conspicuous marginal teeth the present leaf is comparable with *Fagus castanaefolia* UNGER (1847, p. 104, Pl. 28, fig. 1) and *Castanea Ungeri* HEER (1869, p. 470, Pl. 45, figs. 1–3; Pl. 46, fig. 1), both of which has been considered to be conspecific and named *Castanea castanaefolia* (UNGER) KNOWLTON (1898). The type specimen of *Fagus castanaefolia* UNGER is oblong-lanceolate in shape bearing mucronate-serrate margin, while HEER's *Castanea Ungeri* is ovate-lanceolate in outline and markedly dentate at the upper three-fourths of the leaf. In comparing these two forms our leaf is similar to HEER's type rather than to UNGER's. However, this Korean leaf may be distinct from *Castanea castanaefolia* in the linear lanceolate shape and the cuneate base.

A fragmental leaf reported by TANAI (1953, p. 5, Pl. 1, fig. 13) under the name of *Castanea castanaefolia* from the Enniti group of N. Keisyo-Do may be conspecific with our leaf.

Occurrence:—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

Cyclobalanopsis sp. b

Plate 25, Figure 6.

Description:—Whole outline of leaf unknown, lacking the apical part. Leaf probably linear lanceolate or somewhat spatulate, and may be 10 cm in length, 1.5–2.0 cm broad at the middle part. Apex unknown, base tapered and acutely pointed. Margin quite entire, at least at the lower half of leaf, and slightly back-rolled. Midvein thick, grooved at the upper surface. Lateral veins more than 8 pairs in number, rather coarsely and irregularly arranged, leaving the midvein at angles of about 60° at the basal part and about 40° at the middle part of leaf, gently curved upwards and ascending along the margin. Finer veins obscure. Petiole thick, about 1.5 cm long. Texture apparently thick.

Comparison and remarks:—The present leaf, which lacks its apical part, is provisionally referred to the genus *Cyclobalanopsis*. It is uncertain that the leaf is quite entire at the whole margin or serrate at the apical part only.

Similar fossils are *Quercus simulata*

KNOWLTON (1898, p. 728, Pl. 101, figs. 3, 4; Pl. 102, figs. 1, 2) of the American Miocene floras and *Quercus neriifolia* AL. BRAUN (HEER, 1856, p. 45, Pl. 1, fig. 3; Pl. 2. fig. 12; Pl. 74, figs. 1–7; Pl. 75, fig. 1) and *Quercus apocynophyllum* ETTINGSHAUSEN (1869–70, p. 34, Pl. 2. fig. 15) of the European Miocene floras.

Occurrence:—Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (Miocene); Colls. KODAIRA and UOTANI.

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See Art. 243 of this Journal No. 13 for KANEHARA, K, (1936), KON'NO, E. (1931). and TATEIWA, I. (1925).

Localities of the described species

Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do; *Engelhardtia* Bed (咸鏡北道. 古乾原炭鉱, 龍北洞; *Engelhardtia* 層) *Salvinia pseudoformosa* OISHI et HUZIOKA, Cfr. *Platanus Guillelmae* GOEPPERT, *Fagus koraica* HUZIOKA, *F. protolongipetiolata* HUZIOKA, *F. Uotanii* HUZIOKA, *Zelkowa Tibae* OISHI et HUZIOKA, *Carpinus Kodairae-bracteata* HUZIOKA, *Quercus Kodairae* HUZIOKA, *Q.* sp., *Cyclobalanopsis Mandraliscae* (GAUDIN) TANAI, Cfr. *C. gilva* OERSTED, *C.* sp. (a), and *C.* sp. (b).

Kantindo, Meisen-gun, N. Kankyo-Do; Kantindo formation (咸鏡北道, 明川郡, 咸錦洞; 咸錦洞層).

Acer subpictum SAPORTA, *A. ezoanum* OISHI et HUZIOKA, *A. trilobatum* (STERNB.) var. *productum* AL. BRAUN, *A. japonicum* THUNBERG. *A.* (samarae) spp., *Fagus protolongipetiolata* HUZIOKA, *Ulmus carpinoides* GOEPPERT, *Zelkowa Ungeri* (ETT.) KOVATS, *Carpinus carpinoides* MAKINO, *C. crosa* BLUME *ellipticibracteata* HUZIOKA, and *Quercus miocrispula* HUZIOKA.

Yutendo, Meisen-gun, N. Kankyo-Do; Ryudo formation (咸鏡北道, 明川郡, 熊店洞; 龍洞層).

Tilia distans NATHORST, *T. japonica* SIMONKAI, *T. meisenensis* HUZIOKA, *T. subnobilis* HUZIOKA, *Acer rotundatum* HUZIOKA, *A. subpictum* SAPORTA, *A.* sp., *A.* (samarae) spp., *Zelkowa Ungeri* (ETT.) KOVATS, *Betula myongchonensis* HUZIOKA, and *Ostrya shiragiana* HUZIOKA.

Kissyu-town, Kissyu-gun, N. Kankyo-Do; White Shale of Kissyu formation (咸鏡北道, 吉州郡, 吉州邑; 吉州層白色頁岩.

Tilia distans NATHORST, *Acer subpictum* SAPORTA, *Ulmus shiragica* HUZIOKA, *Zelkowa Ungeri* (ETT.) KOVATS, and Cfr. *Quercus dentata* THUNBERG.

Kinkodo, Usen-men, Geizitu-gun, N. Keisyo-Do; Changi group (慶尙北道, 迎日郡, 鳥川面, 金光洞; 長鬐層群).

Tilia remotiserrata OISHI et HUZIOKA, *Acer rotundatum* HUZIOKA, *A. subpictum* SAPORTA, *A. fatsiaefolia* HUZIOKA, *A. ornatum* CARR., *Ulmus shiragica* HUZIOKA, *Zelkowa Ungeri* (ETT.) KOVATS, *Betula shiragica* HUZIOKA, *Carpinus carpinoides* MAKINO, *C. miocordata* HU et CHANEY, *C. simplicibracteata* HUZIOKA, *Ostrya shiragiana* HUZIOKA, and *Quercus miocrispula* HUZIOKA.

Explanation of the Plate 25

(The figures are of natural size otherwise stated)

The specimens are stored in the Institute of Geology and Mineralogy, Faculty of Science, Hokkaido University, Sapporo.

Figs. 1-2. *Cyclobalanopsis Mandraliscae* (GAUDIN) TANAI Loc. Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do, *Engelhardtia* Bed.

Fig. 3. *Quercus miocrispula*, sp. nov. (×2/3) Loc. Kinkodo, Usen-men, Geizitu-gun, N. Keisyo-Do, Changi group.

Fig. 4. *Cyclobalanopsis* sp. a Loc. Ryuhokudo, Kokangen coal-mine, N. Kankyo-Do, *Engelhardtia* Bed.

Fig. 5. Cfr. *Cyclobalanopsis gilva* OERSTED Loc. Ditto.

Fig. 6. *Cyclobalanopsis* sp. b Loc. Ditto.

Figs. 7-10. *Quercus Kodairae*, sp. nov. Loc. Ditto.

Fig. 11. *Quercus* sp. Loc. Ditto.

T. Takayasu photo.

Trans. Proc. Palaeont. Soc. Japan. N.S., No. 16, pp. 201—211, Pl. 26, 1 text-fig., Dec. 15, 1954

257. A *SINOSPIRIFER*-FAUNULE FROM THE ABUKUMA PLATEAU, NORTHEAST JAPAN, IN COMPARISON WITH THE SO-CALLED UPPER DEVONIAN BRACHIOPOD FAUNULE OF THE KITAKAMI MOUNTAINS*

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相馬中村の西方上栃窪附近合ノ沢層中に産した，変形した腕足類の内型中に *Sinospirifer sinensis australis* MAXWELL (1951), *Cyrtospirifer*, *Chonetes*, *Camarotoechia* 等が認められ，恐らくはデヴォン紀後期を示すもののようである。最初のものは北上山地の鳶ケ森層（＝中倉層）中にも，*Cyrtospirifer* cf. *kindlei* STAINBROOK 並びに最後の2種と共に産する（"*Sp. verneuili*" は認められず)。かくて中倉層も上部デヴォン系であることが認められると共に，この時代の地層が北上から阿武隈の地方にまで拡がつていることがわかつた。将来は更に拡張される希望がある。　早坂一郎・湊　正雄

The Abukuma plateau is one of the regions of Japan which had not been intensely studied from the side of stratigraphy and paleontology, except for the coal-bearing southern parts, until about the close of the World War II, when a group of geologists started to engage themselves in the field works along various untrodden lines of research.

The writers of this note happend to have the pleasure of examining a faunule consisting of a small number of species of brachiopods collected by Toshio SATO, a post-graduate student in the Tôkyô University of Education, who had devoted himself in the stratigraphical research in a region west of the maritime city Nakamura, Fukushima Prefecture, in the northernmost part of the Abukuma plateau.

The fossils are preserved in a hard, silicified shale, containing abundant plant fragments, dark gray in color, but by no means in a favorable state of fossilization to retain the details of the structures inside, except for a few specimens of spiriferids. Most of them are more or less deformed, owing to the crustal disturbance, and many are mere external molds impressed on the surface of the shale. In the few relatively well preserved specimens of spiriferids some features of the beak region are observed: by means of these features identification of the spiriferids is ventured in this note.

It is of interest and of some importance, however, that the Abukuma faunule at disposal consists of forms comparable to and roughly identifiable with those that were reported by H. YABE and M. NODA[1] from the region of Nakakura in the southern part of the Kitakami mountains in the north beyond the Bay of Sendai. In their note the pictures of what they identified with *Spirifer verneuili* MURCHISON were given, and, as associate fossils "*Chonetes hardrensis* PHIL." and "*Rhynchonella pleurodon* PHIL." as well as a pelecypod looking like an *Aviculopecten* were put on record. In a later note NODA enlarged

* Read Oct. 9, 1954; received Aug. 21, 1954.

the list of the fossils as follows: *Spirifer (Trigonotreta) verneuili* MURCHISON, *Rhynchonella pleurodon* (PHIL.), *Chonetes hardrensis* PHIL., *Aviculopecten* cf. *losseni* (KOENEN), *Murchisonia*? sp. indet., and *Fenestella* sp. beside indeterminable tetracorals and crinoid fragments.[2]

The comparison between the corresponding component species of the two faunules is tried in the following pages.

As will be seen in the descriptions of the species to follow, the Abukuma and the Kitakami faunules are not identical in a strict sense, but it is quite evident that they are very much alike as a whole.

As to the geological age of the Kitakami faunule YABE and NODA laid stress on the occurrence of what they regarded *Spirifer verneuili* on account only of the surface sculpture of the steinkern specimens. The two other associate species, provided that identification was unanimous, are forms known to occur both in the lower Carboniferous and in the upper Devonian in Europe.

This seems to show why YABE and NODA remarked about the age of their *Spirifer verneuili* faunule that "the geological age of the fossiliferous bed is either the upper Devonian or the lowest Carboniferous....."

In the meantime, a discovery of the fossiliferous Devonian and Gotlandian formations was reported by H. YABE and T. SUGIYAMA[3] in the area north of Sakari, recently a part of the city of Ôfunato, about 35 km to the east of Nakakura. In the succession of strata ranging from Gotlandian upwards in this locality, the upper Devonian is characterized by the occurrence of a horizon with *Leptaena*[4]; the fossilferous horizon is described to be rich in the remains of brachiopods, trilobites, cephalopods, tetracorals and fenestellid bryozoans, all of the upper Devonian appearance.

Unfortunately, however, no further accounts of these fossils have been published since.

However, according to more recent and detailed stratigraphical and paleontological studies carried out chiefly by the junior writer[5] of this paper, this so-called horizon with *Leptaena* includes species yielded from different stratigraphical units that are Carboniferous. What concerns us with respect to the problem embodied in this study is what is called the Tobigamori formation in the present usage.[6] The Tobigamori formation, in this sense, is the equivalent of the Nakakura formation of TACHIBANA[7], which is characterized by the frequent occurrence of *Cyrtospirifer*.

In a paper presented to the 6th Pacific Science Congress, 1936. YABE[8] stated that the Nakakura beds, at least its fossiliferous parts, are either younger-Devonian or basal Eo-Carboniferous in age, as before, but the list of fossils was a little enlarged, by adding *Murchisonia*?, fenestellids, tetracorals and crinoid stems.

Examining the fossils from the Abukuma plateau as carefully as possible, the writers are convinced that the spiriferids in their material are not strictly identifiable with *Sp. verneuili*. The latter species was once considered to have a wide range in the form of the shell. But in regard to the morphological features retained in some of the specimens examined it is ascertained that the Abukuma spiriferids contain *Sinospirifer sinensis* var. *australis* MAXWELL, 1951 and a *Cyrtospirifer* sp.

The Tobigamori (Nakakura) faunule of Kitakami at disposal also has been examined at the same time. In it the writers have been able to distinguish three

species of *Cyrtospirifer*, one of which closely resembles *C. kindlei* STAINBROOK, and the other two specifically indeterminable.

In neither of the faunules in the collection forms identifiable with *Sp. verneuili* s.s. have been recognized.

Concerning the chonetid, the writers cannot say anything more than that *Ch. hardrensis* PHIL. is one of the known species that appear to be more or less closely allied to the one from Japan dealt with in this note.

As to the rhynchonelid, the writers have been able to find that there are several species both of the Devonian and the Carboniferous ages that resemble the fossils from the Abukuma and the Kitakami regions, as far as the characters retained by them are concerned. Of several genera or subgenera collectively called the rhynchonellids, it is suggested that it is *Camarotoechia* that the Japanese fossils should be considered to belong to.

However, whether the Japanese species is really *C. pleurodon* PHIL. or not, it is beyond the writers' power to decide with such a scanty material like this.

According to the cursory observation by the junior writer in the region in the Abukuma plateau where the fossils were collected by SATO, it seems there are five fossiliferous zones in the Palaeozoic sequence ranging from the bed with *Yabeina* above, followed by those of *Lyttonia*, *Pseudoschwagerina*?, and *Lithostrotion*, and that of *Cyrtospirifer* below. It is not known at the present moment whether there are other horizons corresponding to the stratigraphical units recognized in the southern Kitakami region. It is so far certain, however, that the zone with *Cyrtospirifer* occupies the lowest of the fossiliferous horizons, and also that the zone with the corals like *Lithostrotion* roughly corresponds to the Onimaru series of the Kitakami mountains.

In both regions the zones with *Cyrtospirifer* are formed of very similar rocks, chiefly being silicified shales, and characteristically rich in fragmentary plant remains: the fossiliferous horizon is underlain by beds of schalstein, reddish purple in color, equally in both the regions. The fact that the *Cyrtospirifer* zone is exposed close in contact with the *Lithostrotion* zone in the Abukuma plateau is conjectured to correspond to the erosion unconformity ascertained in the profiles of certain parts of the Kitakami mountains.[9]

In conclusion, in north-eastern Honshyu there is a horizon in the Paleozoic sequence which is characterized by *Cyrtospirifer* and a few other brachiopods. The horizon can not have its age exactly decided with these fossils alone.

However, the fact that the Hikoroichi series in the Kitakami Mountains unconformably overlying the Tobigamori formation with *Cyrtospirifer* is lower Carboniferous, seems to point to the view that the *Cyrtospirifer* fauna is rather younger Devonian than older Carboniferous in age in north Japan.

The writers like to express their cordial thanks to Messrs. K. TASHIRO and T. SHIBAZAKI for their kind companionship in the field, and to Mr. Toshio SATO for his generosity to entrust them his valuable material for investigation.

Description of Species

Sinospirifer sinensis GRABAU em. TIEN (1938)

var. *australis* MAXWELL, 1951

Pl. 26, Figs. 1—6

1951. *Sinosp. sinensis* var. *australis*, MAXWELL:—Upper Devonian and Middle Carboniferous Brachiopods of Queensland. *Univ. Queensland Papers, vol. 3*, no. 14, p. 6, pl. I, figs. 1-16; pl. II, figs. 1-3.

Shell spiriferoid, sub-equally convex, wider than long: hinge-line as long as the greatest width of the shell: cardinal extremities acute: sinus rather prominent, sinal plications simple as far as visible. Ventral beak small, pointed, slightly incurved over area which is relatively high and slightly concave.

Internally, diverging strong but relatively short delthyrial-supporting plates embrace oval-shaped muscualr impression which is longitudinally striated: between delthyrial-supporting plates is a low but long median septum which divides the muscular scar into two parts. Transverse delthyrial plate is incompletely preserved in certain specimens.

Laterals covered by simple plications and very faint, thread-like concentric markings: plicae in alternation with much narrower interspaces: plicae tend to be obscure anteriorly.

Sinus divided by two, long and strong primary plicae starting immediately below beak into three sub-equal area: these plicae accompany one or two others on either side. Following sinal formulae recognized in some specimens:

1+I+1+1+I+1
2+I+1+1+I+2

Remarks:—The material at hand is, as stated above, by no means in a very favorable state of preservation, but we have been able to recognize the presence of a transverse delthyrial plate. Thus, it is highly probable that the species under consideration belongs to either *Cyrtospirifer* or *Sinospirifer*, as is evident from the observed characteristics described above.

The Abukuma specimens, as a whole, are relatively small in size, and the delthyrial-supporting plates are rather short and fairly curved. These fossils, therefore, are much more likely to be ascribed to the genus *Sinospirifer* rather than to *Cyrtospirifer*.

Meanwhile, among the Chinese species of *Sinospirifer* as defined either by GRABAU or TIEN, there is none with which the Abukuma form can be identified. As far as is known to the writers, an Australian variety of the popular Chinese species *Sinospirifer sinensis*, recently reported by MAXWELL[10] from the upper Devonian formation, namely, *Sinosp. sinensis* var. *australis*, appears to be most closely related to the Abukuma form, especially in point of size, form, inner structure and sinal formula.

The so-called *Spirifer* (*Trigonotreta*) *verneuili* of YABE and NODA, referred to elsewhere, from the Tobigamori formation of the Kitakami mountain region resembles the Abukuma species in general features. According to the writers observations on the material from the very locality where YABE and NODA's specimens were yielded, it is certain that the specimens vary in form probably due to subsequent deformation. It is not easy to decide the species, consequently. In reality, there are individuals of the type of *Sp. verneuili* among the specimens, but as the description and illustration of YABE and NODA's fossils are not enough to give the details of the specimens, it is quite uncertain whether or not the specimens in the collection and those of YABE and NODA are identical. However, as some of them show to possess straight and long delthyrial-supporting plates within, the probability is great that they belong to *Cyrtospirifer* rather than to *Sinospirifer*.

Hor.: Tobigamori series, Ainosawa formation.

Loc.: Ainosawa, Kamitochikubo, Uagaya-mura, Sôma-gun, Fukushima Prefecture.§

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Cyrtospirifer cfr. *kindlei* STAINBROOK

Pl. 26, Figs. 7-9

1900. *Spirifer whitneyi*, KINDLE (non HALL, 1858): The Devonian fauna of the Ouray Limestone *Bull. U.S.G.S. 391*, p. 24, Pl. 8, figs. 2-5a.

1947. *Cyrtospirifer kindlei*, STAINBROOK: Brachiopoda of the Percha shale of New Mexico and Arizona. *Jour. Palaeont. vol. 21*, p. 318, pl. 44, figs. 1-2, 7-12.

Numerous specimens are at disposal for study, but all of them are strongly deformed; furthermore, they are only ventral valves preserved as internal and external casts. Neither the features of the beak nor the cardinal area are observable, unfortunately.

Accordingly, it is quite difficult to compare them with the known species. Notwithstanding, judged from the shell form, and the nature of the shell, it is beyond doubt, that these specimens belong to the genus *Cyrtospirifer*. Description follows.

Shell large, strongly convex, culminating almost in the center, subquadrate or subpentagonal in outline, far wider than long, the greatest width equaling the hinge-line, cardinal extremities slightly produced and auriculate, sometimes slightly flattened against the visceral part of the shell; lateral margins nearly straight, and anterior commissure strongly sulcate, with antero-lateral angles bluntly pointed a little.

Umbonal region looks strongly protruded over hinge-line because of deformation, suggesting its being strongly convex; beak not observed, but possibly a little incurved over the hinge-line. Area high? and slightly incurved: delthyrium rather narrow.

Sinus begins immediately below the beak as a narrow and shallow depression, but becomes broader and deeper anteriorly, and separated from the lateral slopes by two relatively strong ribs. The sinal plications conform with the typical triplicate formulae:

$$\begin{array}{c} \underline{\text{Ix}} \\ 2+\text{Ix}+1+1+\underline{\text{I}}+\text{Ix}+2 \\ 2+\text{I}+1\text{x}+\text{y}+1\text{x}+\text{I}+2 \\ 1+1\text{x}+\text{I}+1\text{x}+\text{y}+1\text{x}+\text{I}+1\text{x}\ 1 \end{array}$$

Internaly, provided with long and straight delthyrial-supporting plates, which only slightly diverge anteriorly; median septum lacking.

Laterals are covered by as many as more than 30 simple, radiating plicae which are flat especially in the anterior part, separated by narrow interspaces: toward cardinal margin they become finer and indistinct.

Remarks:—The Kitakami specimens can by no means be specifically identified with either the Devonian species of *Sinospirifer* described by GRABAU[11] and TIEN[12] or those of the *Cyrtospirifer* of Europe. Judging from size, nature of ribs, shell configuration and internal structures, the present species rather strongly resembles the American or Australian species hitherto described, especially *Cyrtospirifer kindlei*, described by STAINBROOK from the Percha formation, the lowest member of the Mississippian. According to STAINBROOK,[13] the

§ 福島県相馬郡上野村上栃窪合ノ沢

plications either on lateral slopes or in the sinus, appear to be more numerous in his species than in the Kitakami-specimens. However, we have to keep in mind that the specimens at hand are all in an unfavorable state of preservation, so that the plications are mostly worn out especially around the cardinal extremities, and are hardly to be counted.

The internal structures of the Kitakami specimens and of STAINBROOK's species look almost identical: in both of them delthyrial-supporting plates (STAINBROOK's dental plates) are long and straight, curving only slightly toward the anterior margin of the shell, and without a median septum between them.

Such being the case, the writers are disposed to believe that the Kitakami fossils and STAINBROOK's species are very intimately related, if not identical.

In the general outline of the shell and the internal structure, as well as in the convexity of the ventral valve, the Kitakami specimens more or less resemble the species described by MAXWELL[14] as *Cyrtospirifer reidi* from the Mount Morgan district, Australia, but they are not to be specifically identified, as the latter is generally larger in size and its sinal formulae are more complicated.

Spirifer whitneyi HALL also more or less resembles the Kitakami species. However, the former is not only relatively smaller in size, but also its plicae show an aspect different from those of the latter. As already pointed out by STAINBROOK the plicae of *Spirifer whitneyi* are broadly convex and separated by wider and deeper interspaces; those in both the Kitakami specimens and STAINBROOK's *Cyrtospirifer kindlei* (non HALL) are much flatter and the interspaces much narrower. Furthermore, *Spirifer whitneyi* is less convex than either of the latter. On the other hand, *Spirifer whitheyi*[15] was regarded by GRABAU to be a *Sinospirifer*, but not a *Cyrtospirifer*, the internal structure probably being different from that of the Kitakami specimens.

Hor.:—Tobigamori series, Tobigamori formation.

Loc.:—Nakakura, Nagasaka-mura, Higashi-Iwai-gun, Iwate Prefecture.§

Coll.: M. MINATO.

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Cyrtospirifer sp. indet. a

Pl. 26, Fig. 10; Text-fig. 1

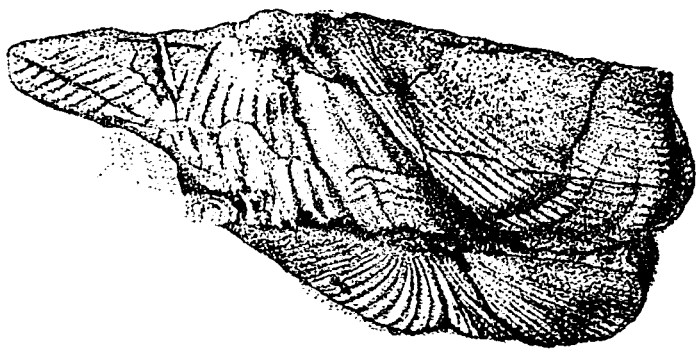
1953. *Spirifer* (*Trigonotreta*) *verneuili*, YABE and NODA (non MURCHISON): Discovery of *Spirifer verneuili* MURCHISON. *Proc. Imp. Acad., Tokyo, vol. 9*, p. 521, figs. 1-4, 6, 5?

Shell spiriferoid in outline, medium to large in size, subequally biconvex, transverse, much wider than long; hinge-line straight, representing the greatest width of shell; cardinal extremities slightly constricto-produced, apparently acute, in deformed individuals.

Internally, ventral valve is provided with rather a short but straight pair of delthyrial-supporting plates, diverging anteriorly, without median septum. Sinus shallow and narrow in umbonal region, and strongly widening anteriorly. Sinal plications quite simple; the sinal formula in one of the young specimens being

2+I+1+1+I+2.

§ 岩手県東磐井郡長坂村中倉



Text-fig. 1: *Cyrtospirifer* sp. indet. a (×2.0)
Tobigamori formation, Kitakami mountains.

Dorsal valves show all the characteristic features recognized in the specimens figured by YABE and NODA, especially the specimens, figs. 1, 2, 3, and 4 in their above-quoted paper. Fold is distinct from the lateral slopes.

Whole shell surface is covered by numerous simple plicae, furrows, and less numerous concentric striae. Plicae are simple, radiating, broadly convex or nearly flat on top, alternating with rather narrow and deep furrows, both becoming fainter towards the cardinal extremities.

A typical specimen measures ca. 44 mm and ca. 21 mm in width and length, respectively.

Remarks:—This species is easily distinguishable from the preceding by its much more transverse form. It is quite certain that this is synonymous with YABE and NODA's species. However, it is difficult to decide whether this is really *Spirifer verneuili* or not. As far as the specimens examined by the writers are concerned, they show divergence in the shell outline and other features, from the original materials illustrated by MURCHISON.

Hor.:—Tobigamori series, Tobigamori formation.

Loc.:—Nakakura, Nagasaka-mura, Higashi-Iwai-gun, Iwate Prefecture.

Coll.: M. MINATO.

Reg. No.:—15947, Department of Geol. Min., Fac. Sci., Hokkaido Univ.

Cyrtospirifer sp. indet. b

Pl. 26, Fig. 11

Several specimens as internal casts of ventral valves and external casts of the ventral and the dorsal at hand, all being strongly deformed.

Shell small, inequally biconvex, the ventral far more strongly convex than the dorsal; spiriferoid in outline, hinge-line equaling the greatest width of shell, with acute and sometimes mucronate cardinal extremities. Dimensions are difficult to measure precisely because of deformation, but one specimen measured gives the rough idea of size, namely, 13 mm, 10 mm and 8 mm in width, length and thickness, respectively.

Ventral valve strongly convex, highest behind the middle; umbo rather narrow,

sloping down from the umbonal region rather abruptly toward cardinal extremities, and more gently toward antero-lateral margins.

Sinus originating at beak, narrow but rather deep in front. Umbo elevated, beak pointed, slightly incurved. Cardinal area quite high, almost flat, divided by high and rather broad delthyrium.

Delthyrial-supporting plates rather long and straight and only slightly diverge anteriorly, with an obsolete median septum. Umbo narrow, beak small and obtuse. Cardinal area extremely narrow. Internal structure unknown, median septum probably lacking.

Shell plicated, plicae numerous, seven? being on fold and six in sinus, surface impunctate; sinal formula is as follows:

1+I+1+1+I+1

Remarks:—The present fossils are characterized by relatively smaller size, high cardinal area, and simple sinal plications representing the triplicate type.

Some species of *Tenticospirifer* appear to be closely allied to the present specimens in point of relatively smaller size and high cardinal area. The specimens described by MANSUY[16] from Yunnan under the name of *Spirifer tenticulum*, together with specimens described by GRABAU from South China as its variety, *quardrangularis* GRABAU and the forms called by TIEN *Spirifer* (*Tenticospirifer*) *tenticulum* are all considered as synonymous and especially closely resemble the Kitakami specimens. However, the latter lack the median septum of whatever kind in the dorsal valve: consequently, they are considered generically distinct from *Tenticosospirifer*, in spite of strongly similar appearance.

In the external appearance only, the Kitakami specimens show some likeness to certain of the specimens of *Spirifer verneuili* MURCHISON in DAVIDSON (plate V, fig. 7 and pl. XXXVI, fig. 11): both of them are very small in size, and have mucronate cardinal extremities. However, they may also be specifically different from the Kitakami specimens in having a low cardinal area.

The Kitakami specimens can not be congeneric with *Tenticospirifer*, because they lack median septum in the dorsal valve, as stated above. They decidedly belong to the genus *Cyrtospirifer*, because they are provided with relatively long and rather straight delthyrial-supporting plates, and a quite high but flat cardinal area.

Among the known species of *Cyrtospirifer*, *Cyrtospirifer brevipostícus*, described and figured by STAINBROOK from the Percha formation of North America, may be most nearly related to the present Kitakami species, as far as the present writers can judge. Yet the American species may be specifically different from the latter, in having a hinge-line slightly shorter than the greatest width of the shell, and less strong plications.

Hor.:—Tobigamori series, Tobigamori formation.

Loc.:—Nakakura, Nagasaka-mura, Higashi-Iwai-gun, Iwate Prefecture.

Coll.:—M. MINATO.

Reg. nos.:—17828, 17829, 17830, Department of Geol. Min., Fac. Sci., Hokkaido Univ.

Cyrtospirifer sp. indet. c

There are many more specimens of spiriferids at disposal that came from both the Ainosawa formation of the Abukuma plateau and the Tobigamori

formation of the Kitakami mountains: they belong doubtlessly to the genus *Cyrtospirifer*. They are all in a very unfavorable state of preservation for study, and do not allow identification. However, as far as has been observed it seems quite certain that these specimens as a whole are specifically different from either of the two described above.

Camarotoechia sp.
and
on Rhynchonellid and Chonetid.

Pl. 26, Fig. 12

In the collection at hand there are a number of fragmentary and deformed specimens of a rhynchonellid species, and much less of similarly preserved chonetids, in association with those of *Spirifer* (*Cyrtospirifer*). Most of these fossils are molds of valves impressed on the surface of the slabs of hardened shale, and nothing of the inner structures is to be observed. It is almost impossible to decide their species without knowing the inner characters.

On the other hand there is a small lot of brachiopods from the Kitakami mountains in our collection. They were collected in the locality from where YABE and NODA once reported the occurence of their *Spirifer verneuili*, *Rhynchonella pleurodon* and *Chonetes hardrensis*, referred to elsewhere. In the present collection there are very poorly fossilized specimens that correspond in appearance to those mentioned by the latter authors.

There is hardly any doubt that the present specimens of rhynchonellid and chonetid are identical with those of YABE and NODA, respectively.

Although it is extremely difficult to specifically identify them, it is important that nobody can disregard a very close affinity between the rhynchonellid and chonetid from the Abukuma plateau and those from the Kitakami mountain just referred to. It is on account of this that such imperfect and deformed fossils deserve consideration.

Of the chonetids (Pl. 26, fig. 12), however, the specimens are rather scanty in the present collection, and the details of sculpture are not very well recognized; but the outline of the small valves is transverse, and almost semicircular in appearance, and looks really quite like *Chonetes hardrensis* which ranges from Devonian to Carboniferous, but identification is by no means possible.

The rhynchonellids are also of rather a small size, and are in somewhat better state of preservation, retaining impressions of very acute radial plications that can be traced back to the beak which is sharply pointed. The plicae are simple, that is, they do not seem to divide: 3-4 of them are counted in the shallow median depression of the ventral valve, while there are 5, 6 or possibly more on the flanks or laterals. In these features that are shown in the rhynchonellids from both the Abukuma plateau and the Kitakami mountains the writers are lead to the recognition of their very close resemblance to *Rhynchonella pleurodon*, as YABE and NODA were sometime ago. The external characters observed in the specimens at hand alone can not be regarded as decisive of the species of the fossils, however, because there are more than one species of the Paleozoic brachiopods that have been characterized by the similar features. Mention of a few examples may be usueful in regard to this point. A form from Turkestan, *Rh. turanica* ROMANOWSKI,[17] which occured abundantly in Chimkend district, in association with *Spirifer disjunctus*, has

the similar features. This is of special interest because it is an Asiatic occurence, and in association with *Spirifer disjunctus* which is, if not identical, very closely allied to the form quite popular in the upper Devonian formation of Eastern Asia. Another example from Central Asia is *Rh. hofmanni* KROT. as was reported by VADASZ[18]: this is an Anthracolithic form, occuring in association with many other species including *Rh. (Uncinulus) timorensis* BEYR.

Among North American species *Rh. harsfordi* HALL may be a representative: a picture of the ventral view of a specimen is given in the paleontological studies of the Eureka district by WALCOTT.[19]

Now, if the fossils at hand are really identical with what was called *Rhynchonella pleurodon*, then they must be *Camarotoechia pleurodon* according to the more recent taxonomic investigations. Al though it is almost impossible to either prove or disprove with such a poor material the existence of the divided hinge-plates in the dorsal valve and a dental plate in the ventral, characteristic of the genus *Camarotoechia*, there are in literature species of the latter genus that have the similar features as those of the Japanese specimens here under discussion.

Nobody will fail to recognize the external likeness between the latter and *Camarotoechia sobrina* STAINBROOK from the Percha shale of southern United States, the brachiopod fauna being regarded as early Mississippian in age. In this species three or sometimes more of the 16 angular radial plicae are found in the median depression. An upper Devonian species from Iowa, described by the same author, *C. cedarensis*,[20] also is similar externally, though less so than the last one.

Resemblance of external features of this degree is found in many more of the known species, reference to which may not be necessary any more.

It is important to see that the Abukuma and the Kitakami specimens of the rhynchonellid belong to the genus *Camarotoechia*, the specific affinity of which is either with the Devonian or equally with the lower Carboniferous species hitherto on record.

Hor.:—Tobigamori series, Ainosawa formation and Tobigamori formation.
Loc.:—Nagasaka, Iwate Prefecture.
Coll.:—M. MINATO.
Reg. no.:—15956, 17837.

Loc.:—Ainosawa, Fukushima Prefecture.
Coll.:—T. SATO.
Reg. no.:—17836.

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Explanation of Plate 26

(All figures in natural size, unless otherwise stated)

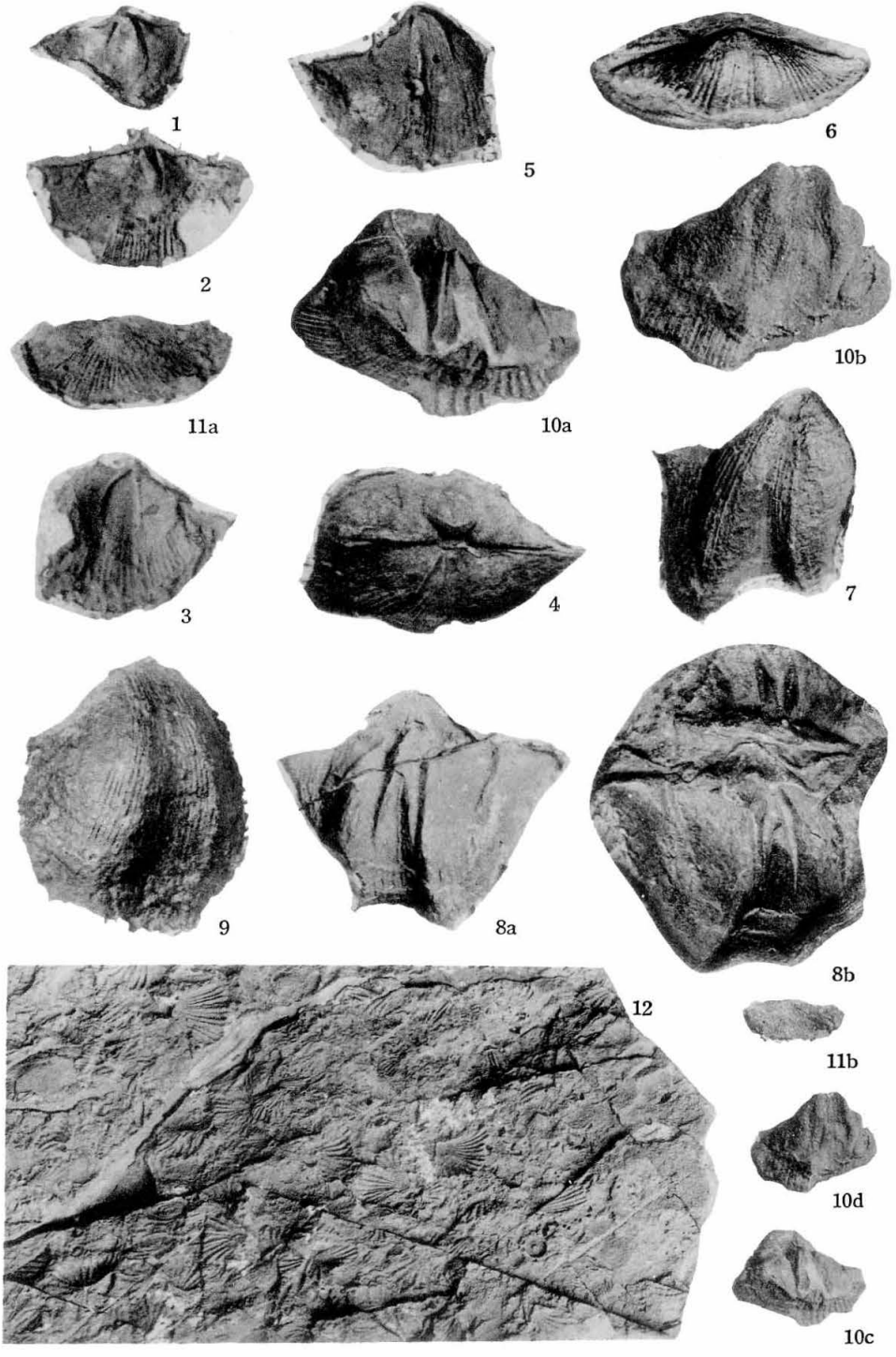
Figs. 1-6. *Sinospirifer sinensis* GRABAU em. TIEN var. *australis* MAXWELL. Ainosawa formation, Abukuma plateau.

Figs. 7-9. *Cyrtospirifer* cfr. *kindlei* STAINBROOK. Tobigamori formation, Kitakami mountains.

Fig. 10. *Cyrtospirifer* sp. indet. b. Fig. 10b, ×2. Tobigamori formation, Kitakami mountains.

Fig. 11. *Chonetes* sp. indet. Fig. 11a. ×2. Tobigamori formation, Kitakami mountains.

Fig. 12. *Camarotoechia*? sp. indet. Ainosawa formation, Abukuma plateau.



S. KUMANO photo.

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

「日本古生物学会第59回例会」昭和29年10月9日金沢大学理学部地質学教室に於て開催す（参会者31名）。講演者並に講演題目次の如し。

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新潟県村上鼠ケ関附近の中新世植物群 ...藤岡一男

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(The heading in Japanese commemorates the handwriting of Prof. M. YOKOYAMA, father of Japanese Palaeontology, who was Professor of Stratigraphy and Palaeontology at the Geological Institute, Imperial University of Tokyo.)

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CONSTITUTION
of the
PALAEONTOLOGICAL SOCIETY OF JAPAN

ARTICLE 1. Name

The Society shall be known as the Palaeontological Society of Japan. The Society is a section of the Geological Society of Japan.

ARTICLE 2. Object

The object of the Society shall be to promote the study of palaeontology and related sciences.

ARTICLE 3. Achievement

The Society in order to execute Article 2 shall (a) issue the Society journal and other publications, (b) hold or sponsor scientific lectures and meetings, and (c) sponsor collecting or field trips, and lectures.

ARTICLE 4. Membership

The Society shall be composed of persons who are active of interested in palaeontology or related sciences, and shall be known as regular members, honorary members, and patrons.

ARTICLE 5. The members of the Society shall be obliged to pay annual dues to the Society, for which they shall enjoy the privilege of receiving the Society's journal and of submitting papers which have been read and discussed at the meetings for publication in the Society's journal.

ARTICLE 6. Administration

The Society shall have the following organizations for its administration.

(a) General meeting. The general meeting shall be composed of the Society members. More than one tenth of regular members shall be present to hold general meetings. Administrative affairs shall be decided during the general meeting.

(b) President. The president shall be elected from among the regular members. The president shall represent the Society and supervise its business matters.

(c) Council. The council shall be composed of councillors who are elected from among the regular members. The council shall discuss administrative affairs.

(d) Business council. The business councillors shall be elected from among the council members, and shall administer business affairs.

(e) Officers shall be elected by vote of returned mail ballots, as a general rule.

ARTICLE 7. Amendments to the constitution shall be by decision of the general meeting.

By-Laws and Administration

ARTICLE 8. The Society's journal shall be issued quarterly.

ARTICLE 9. Regular members shall be persons who have knowledge, experience, or interest in palaeontology or related sciences.

ARTICLE 10. Patrons shall be selected individuals or organizations who give special support to the objectives of the Society.

ARTICLE 11. Honorary members shall be persons of distinguished achievement in palaeontology. The council shall nominate honorary members for decision by the general meeting.

ARTICLE 12. Applicants for membership to the Society shall submit their full name, mailing address, date of birth, occupation, and name of school from which they graduated.

Dues

ARTICLE 13. Rates for annual dues of the Society shall be decided during the general meeting. Annual dues for regular members are Yen 600.00 (domestic members) and U.S. $3.00 (foreign members). Patrons are individuals or organizations donating more than Yen 15,000.00 annually. Honorary members are free from obligations.

ARTICLE 14. The Society income shall be from membership dues and bestowals.

ARTICLE 15. The Society shall have one chairman, fifteen councillors, and several business councillors, whose term of office shall be two years. They may be re-elected.

Addendum

ARTICLE 1. There shall be four business councillors for the present.