REPORT No. 207

GEOLOGICAL SURVEY OF JAPAN

SUMMARY OF THE PALEOGENE MOLLUSCAN FAUNAS IN NORTH JAPAN

By

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Abstract

A brief summary is given in this paper upon the molluscan faunal development during Paleogene in north Japan and also some related stratigraphic problems.

Through the areas including the Ishikari, Rumoi, Kushiro and Joban coal fields, the Paleogene faunas are stratigraphically discriminated into four faunas, namely, lower Ishikarian fauna, middle Ishikarian fauna, upper Ishikarian fauna and Poronaian fauna. These faunas are respectively composed of both the marine and non-marine forms, showing a gradual chronological change of faunal constituent. The occurrence of fauna in each area is briefly accounted, together with its composition. The faunal development in a chronologic sense seems to owe in large parts to climatic elements, besides to a specific evolution in some taxon.

In comparing them with the simultaneous faunas in west Japan, which were clarified in the writer's preceding report, so striking differences in the constituents are recognized that the common species are hardly found in north Japan and west Japan. This fact makes the correct correlation between the both areas very difficult. From the similarity of a general feature of their chronologic developments, however, the following correlation is tentatively given.

	West Japan	North Japan
Oligocene	Nishisonogian	Poronaian fauna
	Mazean	Upper Ishikarian fauna
	Funazuan	Middle Ishikarian fauna
Eocene	Okinoshiman, Takashiman	Lower Ishikarian

I. Introduction

In north Japan, the Paleogene strata yielding molluscan fossils are distributed in the central and east Hokkaido and Joban areas. As a part of the writer's investigation to clarify the faunal development during Paleogene in the whole Japan, their molluscan faunas will be summarized here on the basis of previous many contributions and the writer's recent studies which will be published in detail in another papers.

The Paleogene faunal development in north Japan was so different from that in west Japan that the discussion of the former under the biochronologic division (Mizuno, 1962a,b;1964) based on the latter is made very difficult, according to the writer's study. Unfortunately, the faunal development has not yet been summarized, although faunal aspects of some formations, i.e. the Wakkanabe formation, Poronai group, Asagai formation etc. among many Paleogene strata in north Japan are now known well through the recent efforts of some authors.

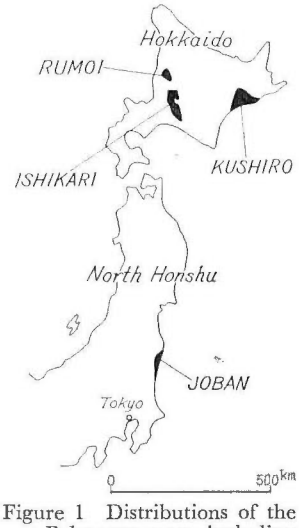

Figure 1 Distributions of the Paleogene strata including molluscan fossils in Japan

It has been well known that the Asagai formation in the Joban coal field yields many shallow marine molluscs called the "Asagaian fauna."

Its chronologic equivalent in the Ishikari coal field is the Poronai group of which abundant marine molluscan fossils comprised in siltstone were recently clarified taxonomically and bio-stratigraphically (Takeda, 1953; Teshima, 1955, 1958a), and there unconformably underlying Ishikari group intercalating many workable coal seams also comprises many fossils.

The stratigraphy and litho-facies of the whole Ishikari group were clarified in detail by Imai (1924~1925), Tashiro (1951) and Takao (1952)'s contributions. Nevertheless, there remain yet some problems as to the stratigraphic relation of its middle-upper part between the northeast Sorachi, northwest Sorachi and Yubari districts. The writer's view on the problem is expressed in table 1. The Ishikari group attains more than 3,000m in maximum thickness at the northeast

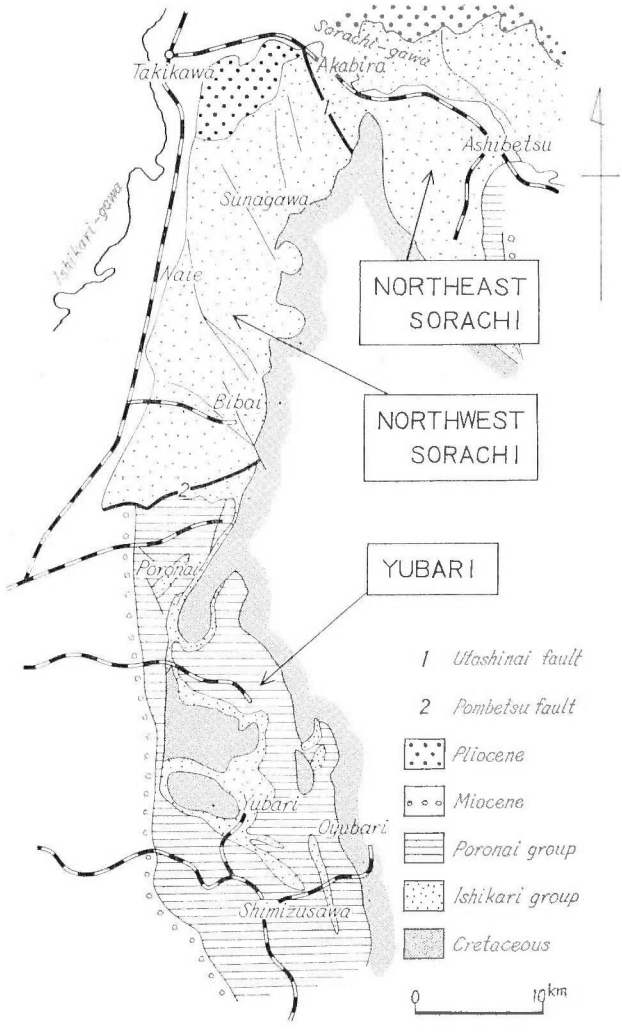

Figure 3 Three districts and rough geologic map of the Ishikari coal field

Table 1 Stratigraphic division and main litho-facies of the Ishikari group

Characteristics of litho-facies				formation	
Yubari district		Northwest Sorachi district	Northeast Sorachi district		
lack		lack	400 m in thickness. Sandstone, siltstone with many workable coal seams, with many plant fossil; fresh water and brackish shells are also much found; marine shells are included only at the upper part.	Ashibetsu	**
			450 m in max. thickness. Sandstone, and siltstone, with brackish and marine shells in middle and upper parts.	Hiragishi	**
		Not always able to be precisely defined from the below-lying formation, and upper limit being not able to be identified with the northeast Sorachi column. 400m in max. thickness. Mainly sandstone, with siltstone and many coal seams. The part have been hitherto identified to the Ashibetsu formation.	700 m in max. thickness. Alternation of sandstone and siltstone, with many thin coal seams; brackish and fresh water shells, and plant *Woodwardia* are rarely comprised.	Takane	***
Ikushumbetsu formation	Upper limit not able to be precisely identified to the northeast Sorachi column. 200 m in max. thickness. Sandstone and siltstone with many workable coal seams and plant fossils including *Woodwardia*.	600 m in max. thickness. Sandstone and siltstone with many coal seams especially at southern part. In the lower part, *Woodwardia* is yielded. Many marine and non-marine shells are found. The part have been hitherto identified with Akabira, Takane and Hiragishi formations	600 m in max. thickness. Sandstone and siltstone; fresh water and brackish shells are prevailing in lower and middle parts, and marine shells in middle.	Akabira	*
		200 m in max. thickness. Sandstone and siltstone, with workable coal seams; plant fossils are richly yielded, but brackish and fresh water shells are rarely found.		Bibai	***
Generally predominant in sandstone in upper part, but in siltstone in lower part; marine shells are richly found, but the non-marine type very rare. 200 m in max. thickness		Upper part is called Wakkanabe fossil-bearing member, composed of siltstone (prevailing)and sandstone; many marine and non-marine shells are found. Lower part is called Mojiri coal-bearing member, composed of siltstone and sandstone with many brackish and some marine shells.		Wakkanabe	*
300 m in max. thickness. Sandstone and siltstone, with workable coal seams; with many plant fossils and some fresh water shells.				ubari	***
Mainly siltstone, with intercalation of sandstone, with fresh water shells. 150 m in max. thickness.				Horokabetsu	***
800 m in max. thickness. Alternation of sandstone and siltstone, with workable coal seams and many plant fossils.				Noborikawa	***

* Mainly composed of brackish and marine facies.

** Mainly composed of non-marine facies, but marine facies being also considerably found

*** Wholly or mostly composed of non-marine facies.

part of the Ishikari coal field (northeast Sorachi district), and only there its whole stratigraphic column can be established, because of the lack of its upper part at the other areas of the field.

In the Uryu coal field the correlatives of the Poronai and Ishikari groups are known as the Tappu and Uryu groups, each of which comprises some molluscan fossils common to those of the Ishikari coal field.

Another Paleogene rocks can be found in the Kushiro coal field, where the Urahoro and Ombetsu groups, the both fossiliferous, are widely developed. Their stratigraphy was once summarized by Sasa (1953). The Urahoro group is generally composed of coarse-grained sediments with many coal seams, correlated with the upper part of the Ishikari group, while the Ombetsu is predominant in siltstone like the Poronai group which is the correlative of it.

The Paleogene molluscan faunas of these areas seem to be chronologically discriminated to four groups, mainly based on the occurrences of marine molluscs; here they will be tentatively called the **lower Ishikarian fauna, middle Ishikarian fauna, upper Ishikarian fauna** and **Poronaian fauna** for the convenience of discussion. Their upper and lower boundaries can not be clearly defined in the strata, because especially the Ishikari group and its correlatives don't always yield the available fossils in their all horisons; namely, the fossiliferous and non-fossiliferous rocks are in thick alternation. Moreover, the four faunas are vertically in gradually transitional relationships in their constituents.

Table 2 Characteristic molluscs of the Ishikari group

Specific name	Horokabetsu	Yubari	Wakkanabe		Bibai	Akabira	Takane	Hiragishi	Ashibetsu
			Sorachi d.*	Yubari d.					
GASTROPODA									
Bellamya mabutii (Suzuki)	·	·	×	·	·	·	(×)	×	·
Cipangopaludina sorachiensis Oyama	·	·	·	·	·	·	·	(?×)	·
C. ishikariensis Suzuki	×	·	(?×)	·	·	·	·	×	(×)
C. jimboi Suzuki	·	·	×	·	·	(×)	·	·	(×)
Semisulcospira fiscina (Yokoyama)	·	·	·	·	·	××	·	×	·
Melanoides otatumei Suzuki	·	·	·	·	·	·	·	×	·
Pyrazus miyajimai Mizuno (MS.)	·	·	×	·	·	·	·	·	·
Polinices nagahamai Mizuno (MS.)	·	·	×	·	·	?×	·	·	·
Calyptraea sorachiensis Oyama et Mizuno	·	·	×	×	·	·	·	·	·
"*Siphonalia*" *sakakurai* Mizuno	·	·	×	·	·	×	·	·	·
"*S.*" *ishikariana* Oyama et Mizuno	·	·	×	·	·	×	·	·	·
Nekewis sekii (Mizuno)	·	·	·	·	·	×	·	·	·
PELECYPODA									
Yoldia hokkaidoensis Oyama et Mizuno	·	·	·	·	·	××	·	·	·
Portlandia ogasawarai (Uozumi)	·	·	·	·	·	××	·	·	·
Acila shimoyamai Oyama et Mizuno	·	·	·	·	·	×	·	·	·
Brachidontes sakakurai Oyama et Mizuno (MS.)	·	·	××	·	?×	·	·	·	?×
B. ogasawarai Oyama et Mizuno (MS.)	·	·	××	·	·	××	·	·	·
Modiolus ishikariensis Mizuno (MS.)	·	·	·	·	·	××	·	·	·
Ostrea eorivularis Oyama et Mizuno	·	·	××	××	×	××	·	·	·
Margaritifera perdahurica (Yokoyama)	·	(×)	×	·	×	×	·	·	×
M. otatumei Suzuki	·	(?×)	×	·	·	·	·	·	·
Lanceolaria pisciformris (Yokoyama)	×	(×)	·	·	·	(×)	·	·	×

(*Continued*)

Specific name	Horokabetsu	Yubari	Wakkanabe		Bibai	Akabira	Takane	Hiragishi	Ashibetsu
			Sorachi d.*)	Yubari d.					
Unio uryuensis Suzuki	•	•	•	•	•	×	•	•	•
Hyriopsis mabutii Oyama	•	•	•	•	•	•	•	(×)	•
Anodonta subjapanensis Suzuki	•	•	•	•	•	××	•	•	•
A. subjapanensis yokoyamai Suzuki	•	•	•	•	•	(×)	•	×	•
Lepidodesma septemtrionale Suzuki	•	(×)	•	•	•	•	•	•	•
Crassatellites yessoensis Minato et Kumano	•	•	××	××	•	×	•	•	•
Venericardia otatsumei Uozumi	•	•	×	××	•	•	•	•	•
V. cfr. *yoshidai* Nagao	•	•	•	•	•	×	•	•	•
Geloina hokkaidoensis Nagao et Otatume	•	•	××	•	•	×	•	•	•
G. takaoi Nagao et Otatume	•	•	××	•	•	•	•	? ×	•
Cobicula tokudai (Yokoyama)	•	(? ×)	××	•	×	××	•	×	•
C. sitakaraensis Suzuki	•	•	•	•	•	•	•	××	•
C. sakakibarai (Otatume)	•	•	•	•	•	•	•	×	××
Thyasira bisecta omarui Oyama et Mizuno	•	•	•	•	•	×	•	•	•
Claibornites quinquangulus Uozumi	•	•	×	•	•	•	•	•	•
Pitar sorachiensis Oyama et Mizuno	•	•	×	××	•	•	•	•	•
P. ? *sannosawaensis* (Yokoyama)	•	•	××	•	•	•	•	•	•
Microcallista munroei (Yokoyama)	•	•	××	•	•	××	•	•	××
Cyclina shirokiana Yokoyama	•	•	×	•	•	•	•	•	•
Spisula sorachiensis Uozumi	•	•	××	××	•	•	•	•	•
Soletellina otatsumei Mizuno (MS.)	•	•	×	•	•	•	•	•	•
S. shimogawarai Mizuno (MS.)	•	•	×	•	•	•	•	•	•
Mya ezoensis Nagao et Inoue	•	•	××	××	•	×	•	•	•
M. ezoensis akabirensis Mizuno (MS.)	•	•	•	•	•	×	•	•	×
Thracia sekii Oyama et Mizuno (MS.)	•	•	•	•	•	×	•	•	•
Periploma teshimai Mizuno (MS.)	•	•	•	•	•	×	•	•	•

About 75 species of mollusca were discriminated by the writer, and of them about 45 are specifically determined, and 8 are new species or subspecies. (×) after previous works ×× especially abundant species

*) Including the fossils of the Shiroki formation of the Uryu coal field, as they are mostly conspecific to each other.

II. Lower Ishikarian Fauna

Molluscan fossils of the lower part of the Ishikari and Uryu groups including the Noborikawa, Horokabetsu, Yubari, Wakkanabe and Bibai formations of the former and Shiroki and Uryu formations of the latter are referred to the lower Ishikarian fauna. The marine molluscs are represented by those of the Wakkanabe and Shiroki and those of the other formations are mostly of non-marine.

The Wakkanabe formation includes many brackish and shallow marine molluscs, the former being represented by mytilids, ostreids, corbiculids, and the latter by crassatellitids, carditids, pitarinids, but the fresh water forms are rather few. They are evidently of warm water. Concerning the fauna comprizing about 45 species, it is very interesting from the paleoecologic viewpoint that the brackish molluscs are very predominant in the so-called Sorachi district and in the Shiroki formation of the Rumoi coal field, though the marine and fresh water forms, are

also found, while the marine molluscs are very predominant in the so-called Yubari district, where the non-marine is very rare and it is almost only represented by ostreid fossils at the basal or marginal facies. Analyzing carefully them in connection with stratigraphic situation and litho-facies, the writer considered that the former area was a wide estuary or enclosed shallow sea and the latter was an open sea, and tentatively called the former as the Paleo-Sorachi estuary and the latter as the Paleo-Yubari bay (Mizuno, 1961).

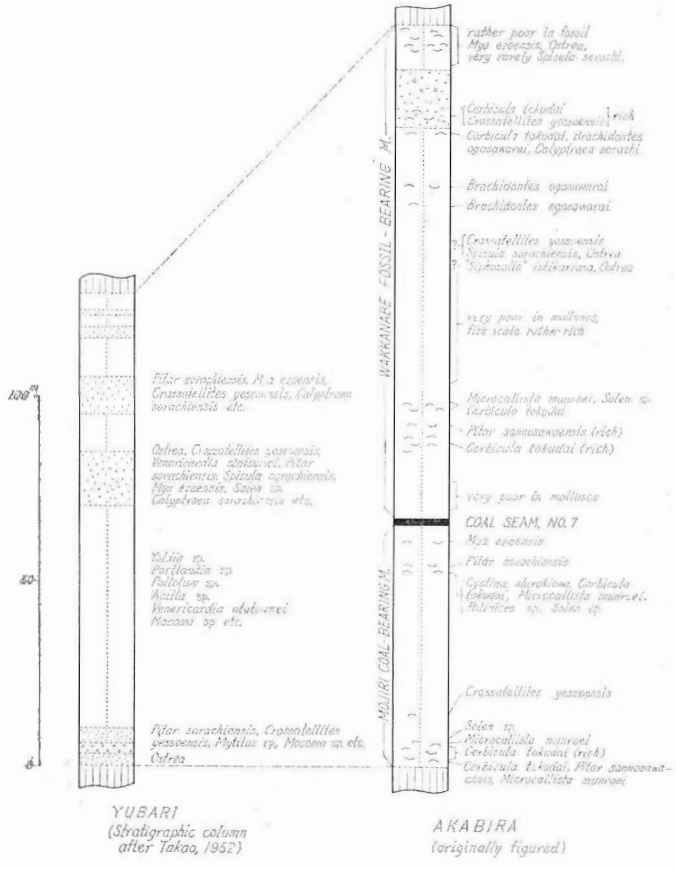

Figure 4 Representative columns of the Wakkanabe formation at the Sorachi and Yubari districts

In the Paleo-Sorachi estuary, the remarkable coal seams intercalated in the Mojiri coal-bearing member were formed in the early to middle stages of the Wakkanabe time, and sandy silt was deposited at its most parts, where many hypohaline brackish shells and some purely marine ones inhabited in calm bottom of very shallow sea much influenced by fresh water, sometimes intermitted by the abrupt deposition of marine medium- to coarse-grained sand in which *Crassatellites*, *Pitar sorachiensis*, etc. dwelled; while especially at its southern part where coal seam is not so developed coarse-grained sediments including sand and gravel were deposited through the time and *Ostrea*, *Brachidontes sakakurai*, *Pyrazus*, *Geloina* etc. were very prevailing at bottom. Thus the majority of environment in the estuary may be comparable with that of the Mangrove swamp existing in the southern and warm areas.

In the central large part of the Paleo-Yubari bay sandy silt was also deposited, but there was no brackish form, but were only neritic shells such as *Neilonella* sp., *Yoldia* sp., *Portlandia* sp., *Acila* sp., *Orectospira* sp. etc. which were very predominant genera at the deep bottom of the Poronai sea. At the later half time of Wakkanabe, marine sand in which *Crassatellites*, *Venericardia*, *Pitar* etc. dwelled was there deposited. Through the whole Wakkanabe time none of non-marine shells seems to have dwelled there, though *Ostrea* was in the nearly whole area of the bay in earliest time and marginal shoal areas.

III. Middle Ishikarian Fauna

Molluscan fossils of the Akabira formation are typically referable to the middle Ishikarian fauna. The Takane formation* doesn't bear marine molluscs, but bears many non-marine molluscs which are common to the other formations of Ishikari group.

There are some problems as to the stratigraphic relationship of Akabira formations of both the northeast and northwest Sorachi districts which are separated by the Utashinai fault near Utashinai, and the writer agrees, on the subject, with Ose and Ogasawara (1959)'s opinion (Mizuno, 1961). Moreover, in connection with the problem the writer has the view that the so-called Ikushumbetsu formation at the Yubari district is not referable to the Takane formation as has been generally considered, but to probably the Akabira formation in most parts.

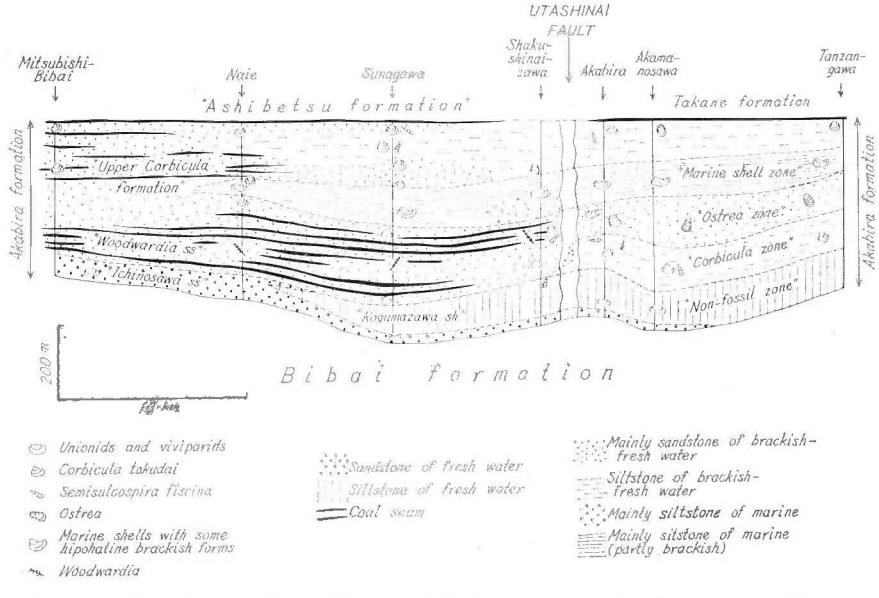

Figure 5 Idealized section of litho- and bio-facies of the Akabira formation in the Sorachi district

* Both the Takane and Raijo formations, the latter of which conformably covers the former have been recognized between the Akabira and Hiragishi formations (Shimizu et al. 1953; Kawano et al. 1956), but recently Matsui (1960) reported, owing to the result of survey by the Mitsui Mine, that the Raijo formation is identified to the Takane formation.

The Akabira formation comprises sandstone and siltstone formed in various environments, such as marine, brackish or fresh water and they exhibit so different stratigraphic columns in the northeast and northwests Sorachi district that the precise correlation of the both is very difficult. In the latter area litho-facies varies from north to south; many coal seams are included in the southern columns, but not in its northern columns. Moreover, bio-facies also varies; at the former non-marine molluscs are prevailing, but marine dwellers are richly found at the latter and the northeast columns of Sorachi district. As a whole, the formation exhibits a clear sedimentary cycle of non-marine—marine—non-marine at the northeast Sorachi district, and the same cycle is recognizable also at the northwest, though not so clear especially at its southern part.

The molluscs of the formation number more than 40 species in total. Some of them are conspecific with those of the Wakkanabe formation, but many different forms are found in them; these are represented by *Portlandia ogasawarai, Acila shimoyamai, Mya ezoensis akabirensis, Thyasira bisecta omarui, Yoldia hokkaidoensis* etc. Another character is shown by the disappearances or impoverishments of some Wakkanabean molluscs such as *Geloina, Brachidontes sakakurai, Pyrazus, Crassatellites, Pitar, Venericardia otatsumei, Spisula sorachiensis* etc. Corbiculids are nearly represented only by *Corbicula tokudai.*

Of the plant fossils, *Woodwardia* has been well known from the " Upper *Corbicula* formation " or " Ikushumbetsu formation " at the northwest Sorachi district and the Yubari which is now referred to the lower part of the Akabira formation and also from the Takane formation at the northeast Sorachi.

The Tachibetsu formation of the Uryu group in the Rumoi coal field is correlated to the Akabira formation. Its lower part bears *Corbicula* and unionid fossil, upper part bears *Corbicula, Ostrea, Solen* and " *Paphia,*" (Sogabe and Fujii, 1959) and the middle part comprises, according to M. Sogabe's oral communication, *Woodwardia.* Moreover, from the lower part of above-lying Migiomata formation *Woodwardia* is also found. Thus the biostratigraphic succession of Rumoi area seems roughly to correspond to that of Sorachi areas.

IV. Upper Ishikarian Fauna

Molluscan fossils of the Hiragishi and Ashibetsu formations of the Ishikari coal field and Shitakara formation of the Kushiro coal field are here in question.

The Hiragishi and Ashibetsu faunas are very poor in marine molluscs so far as the writer recognized in field, but rich in the non-marine. The both formations are distributed only at the northeast Sorachi district in the Ishikari coal field, but the correlative is also found in the Rumoi coal field, where it seems to be the Showa formation including few molluscs and mammalian *Amynodon watanabei* in its lower part (Takai, 1950). As unfortunately marine molluscs are few in both the Hiragishi and Ashibetsu, the comparison of the marine forms of the upper and middle Ishikarian faunas is not so significant, though the few shells are mostly conspecific with those of the middle Ishikarian; they are shown by "*Siphonalia,*" *Microcallista, Mya* etc. However, concerning the non-marine, according to the writer's view mainly brought from the study near Ashibetsu, there is a remarkable difference between the two faunas especially in corbiculids; namely the much occurrences of *Corbicula sitakaraensis* and *C. sakakibarai* instead of *C. tokudai* are the most characteristic feature of the upper Ishikarian. Moreover, it is clearly pointed out that *C. sitakaraensis* is rich in Hiragishi and *C. sakakibarai* is so in the Ashibetsu.

Table 3 Stratigraphic sequence of the Paleogene in the central part of the Kushiro coal field

			Thickness (m)	molluscan fossil
Ombetsu group	Nuibetsu formation		600+	wholly marine
	Charo formation	Charo siltstone	180~230	wholly marine
		Omagari sandstone	2~5**	mostly marine, partly brackish
conformable (unconformable at the western part of the coal field)				
Urahoro group	Shakubetsu formation		230~250	brackish in upper part, fresh water in middle part
	Shitakara formation	Ponshitakara sandstone	70~100	marine (rarely)
		Yukepira sandy siltstone	70~100	mostly marine, partly brackish
		Nishikizawa sandstone	20~ 50	mostly brackish, partly marine
	Teshibetsu formation	Chorobetsu subformation		
		Soun coal-bearing member	30~ 40	brackish
		Yubetsu coal-bearing member	150~170	fresh water (rarely)
		Shikaribetsu coal-bearing member*×	90~120	lack
		Perutsunai conglomerate*×	40~ 45	lack
		Kamibeppo subformation		
		Harutori coal-bearing member*	50~ 70	lack
		Beppo conglomerate*	40~ 60	lack

(after Mizuno and Hyakkoku, 1960)

* The four members are called the "Rushin formation" of 350 m in thickness in the lump at the western part of the coal field.

** The member attains about 70~80 m at the western part of coal field.

× The two members are called the "Tenneru formation" at the southeastern part of the coal field.

Table 4 Characteristic molluscs of the Urahoro group in the Kushiro coal field (1)

Teshibetsu formation

"Tenneru formation," at the Semposhi area of the eastern extremity of the coal field.

Cipangopaludina isikariensis (Suzuki) — *Chlamys mabuchii* Mizuno (MS.)

Bellamya mabutii (Suzuki) — *Ostrea eorivularis* Oyama et Mizuno

Margaritifera perdahurica (Yokoyama) — *Corbicula sitakaraensis* Suzuki

Unio uryuensis (Yokoyama) — *Nemocardium ezoense* Takeda

Anodonta subjapanensis yokoyamai Suzuki

Yubetsu coal-bearing member

Unio uryuensis (Yokoyama)
Margaritifera perdahurica (Yokoyama) } from the upper stream of Ombetsu-gawa.

Turritella sp.
Ostrea eorivularis Oyama et Mizuno
Mya kusiroensis Nagao et Inoue } from the Semposhi area.

Soun coal-bearing member, from the nearly whole coal field.

Semisulcospira fiscina yokoyamai (Suzuki) — **Ostrea eorivularis* Oyama et Mizuno

Cerithidea ishikariensis Yokoyama — **Corbicula sitakaraensis* Suzuki

Shakubetsu formation, at the Yubetsu and Akan areas

Margaritifera perdahurica (Yokoyama)
Cristaria sp. } from the lower part.

Mytilus mabuchii Oyama et Mizuno
Modiolus sp.
**Ostrea eorivularis* Oyama et Mizuno
**Corbicula sakakibarai* (Otatume) } from the upper part.

* especially abundant

The Urahoro group attaining about 1,000 m in thickness in the Kushiro coal field, is the correlative of the upper part of Ishikari group, though precisely unclear in detail owing to the striking differences of stratigraphy and litho-facies. It is lithologically divided into vertically serial three formations and exhibits a nearly perfect soul sedimentary cycle of non-marine—marine—non-marine (Mizuno and Hyakkoku, 1960).

Teshibetsu formation is poor in marine molluscs, which are rarely found in its Yubetsu and Tenneru members at the Kombumori area, eastern extremity of the coal field (Kawai, 1956); they are represented by *Turritella* sp. and *Mya kusiroensis* of the former and by *Chlamys mabuchii* and *Nemocardium ezoense* of the latter. Non-marine fossils are commonly found especially in the Soun member, and they are also rarely found in the above-cited two from which such common species with the Ishikari group as *Margaritifera, Unio, Cipangopaludina, Bellamya* and *Anodonta* are found. In the Soun member *Ostrea* and *Corbicula sitakaraensis* are very abundant.

In contrast to the formation, the Shitakara is very rich in marine molluscs. Although it is generally accepted through the coal field that its lower part consists of coarse-grained sediments with remarkable *Ostrea*-bed including also *Corbicula*, its middle of the fine-grained sediments

Table 5 Characteristic molluscs of the Urahoro group in the Kushiro coal field (2)

Shitakara formation

m	*Turritella* sp.	1,(m)	*Ostrea eorivularis* Oyama et Mizuno
m	*Ampullina asagaiensis* Makiyama	(m)	*Crassatellites yessoensis* Minato et Kumano
l	*Polinices nagahamai* Mizuno (MS.)	m	*Venericardia praetakedai* Mizuno (MS.)
m	*Ancistrolepis modestoideus* (Takeda)	m	*V.* spp.
m	*Neptunea shoroensis* Matsui	1,(m)	*Corbicula sitakaraensis* Suzuki
m	*Neptunea hurutatai* Matsui	m	*Thyasira bisecta* Conrad
(1,m)	*Buccinulum aokii* Mizuno (MS.)	(1)	*Papyridea harrimani* Dall
u	*Molopophorus shitakaraensis* Matsui	(1),m	*Nemocardium ezoense* Takeda
u	*M. kusiroensis* Takeda	(1)	*Pitar sorachiensis* Uozumi
1,m	*Dentalium* sp.	(1)	*Callista hanzawai* (Nagao)
m,u	*Yoldia laudabilis* Yokoyama	(1)	*Spisula sorachiensis* Uozumi
(m)	*Portlandia watasei* (Kanehara)	(m)	*Lutraria aokii* Mizuno (MS.)
(m)	*P. ovata* (Takeda)	m,u	*Macoma sejugata* (Yokoyama)
1,(m)	*Mytilus mabuchii* Oyama et Mizuno	m	*Mya grewingki* Makiyama
l	*Modiolus* sp.	m	*M. kusiroensis* Nagao et Inoue
(1),m	*Chlamys mabuchii* Mizuno (MS.)	(m)	*M. ezoensis akabirensis* Mizuno (MS.)
		(m)	*Periploma besshoense* (Yokoyama)

l.....Nishikizawa sandstone m.....Yukepira sandy siltstone
u.....Pon-shitakara sandstone ( )..... rather rare species

In the Shitakara formation the marine and non-marine molluscs are abundantly included. Throughout the coal field are roughly recognizable some following assemblages concerning the former, though often they occur in mix, owing to the current of depositional time.

I assemblage (sandy silt).....Characterized by *Periploma, Mya gnewingki,* buccinids etc. Subordinate forms are *Venericardia, Yoldia, Portlandia, Thyasira, Turritella.* This assemblage is found in the Yukepira sandy siltstone of central and eastern part of the coal field.

II assemblage (fine ~ very fine-grained sand) ..... Characterized by *Nemocardium, Mya kusiroensis Turritella, Dentalium, Macoma* etc. Subordinate forms are *Yoldia,* buccinids. This assemblage is found in the Yukepira sandy siltstone of the nearly whole coal field.

III assemblage (fine-grained sand).....Exclusively represented by *Yoldia* and *Molopophorus.* This is found only in the lower part of the Pon-shitakara formation, which is composed of laminated fine~very fine-grained sandstone.

IV assemblage (coarse~medium-grained sand).....Characterized by *Chlamys*, associated with *Mytilus, Modiolus, Corbicula, Pitar, Callista, Spisula, Calyptraea, Buccinulum, Nemocardium, Ostrea, Polinices* etc. This assemblage is found in the Nishikizawa sandstone of the central and eastern part of the coal field, and in the middle part of the formation, correlated with the Yukepira sandy siltstone, in the western marginal part of the coal field.

comprising many marine molluscs and its upper, of the coarse-grained ones again, the general litho-facies of the western marginal area of the basin is considerably different from that of the central areas, and bio-facies is also somewhat different, accompanied with the varying of litho-facies.

The Shakubetsu formation is poor in molluscan fossil. Its main part rarely yields fresh water molluscs and its uppermost part yields brackish molluscs. They are predominant in *Corbicula sitakaraensis*, *C. sakakibarai* and *Ostrea eorivularies*.

Comparing the fauna of Urahoro with the other fauna, the followings are pointed out. Amongst non-marine forms, *Corbicula tokudai* is almost absent so far as the writer examined, but *C. sitakaraensis* is very abundant in the Teshibetsu (in upper part) and Shitakara formation (in lower part) and *C. sakakibarai* is so in the upper Shakubetsu formation. Then, the faunal sequence is similar to that of the formerly discussed Hiragishi and Ashibetsu faunas so far as corbiculids are taken into consideration. Concerning marine forms especially richly included in the Shitakara formation, there are many common species to the Poronaian fauna to be next described; these are represented by *Yoldia*, *Periploma*, *Venericardia akagii*, *Thyasira bisecta*, *Mya grewingki*, *Portlandia* etc., but there are also many characteristic species to the Urahoro fauna or common species to the Ishikari group; they are buccinid and venerid shells, *Spisula*, *Mya akabirensis*, *M. kushiroensis*, *Crassatellites*, *Nemocardium*, *Chlamys* etc.

Thus, the writer has the opinion that the Urahoro fauna is almost synchronous with upper Ishikarian fauna from the above-discussed respects, in addition to that the Urahoro group exhibiting largely coal-bearing facies is covered by the Ombetsu group which has the similar fauna to the Poronai group, and that the plant *Woodwardia* found in Takane and Akabira formations is yielded in the Harutori member of Kushiro in which no mulluscan fossil is comprised.

Here the name of "upper Ishikarian fauna" is given to the both molluscan faunae of Ishikari and Kushiro.

V. Poronaian Fauna

Molluscan fossils of the Poronai group of Ishikari, Tappu group of Rumoi, Ombetsu group of Kushiro and Asagai formation of Joban are discussed here.

The Poronai group widely distributed in the Yubari district of Ishikari covers unconformably the Ishikari group and wholly consists of purely marine fine-grained sediments (sandy siltstone or siltstone), attaining more than 1,500 m in maximum thickness.

Yabe (1951) once suggested that the original relationship of both the groups was probably in interfingering laterally in part, and his view was positively supported by some authors mainly based on a foraminiferal viewpoint and partly on the miss-identification of some molluscs of the Ishikari group (Asano 1954; Saito, 1958). But the writer has the opinion that the Poronai group is possibly chronologically later than the Ishikari, from the reason of the probable synchroneity of the basal part of Poronai group at the Yubari and northeast Sorachi where the stratigraphic columns are considerably similar to each other, according to H. Shimogawara and J. Teshima's and O. Fukuta's oral communications, and at the latter the group unconformably covers the uppermost part of the Ishikari group (Shibata, 1957; Mori, 1958), and also from the reason that the corbiculid fossils of the upper Ishikari and Urahoro groups are very similar to each other as before said and the specific differences of common genus to the both Poronai and Ishikari such as *Venericardia*, *Portlandia*, *Yoldia*, *Thyasira*, *Periploma*, *Acila* etc. especially much found in the Akabira formation

in the Ishikari group are not able to be given an appropriate interpretation of differences of environmental factors in a same age.

The general aspect of its molluscan fauna was clarified by Takeda (1953) and Teshima (1955, 1958a). Teshima (1955) first elaborated its detailed subdivision, respecting succesively divergent mega-faunal assemblages at the Shimizusawa area, south of Yubari. It was clarified by the writer's field work in 1959～1960 that Teshima's result was reasonable also at the type Poronai area more than 20 km to the north of Shimizusawa. The molluscan fossils number more than fifty in species; and they are confined to some horizons in their maximum amounts. Among them, *Lima*, *Merisca*, *Nemocardium* etc. are remarkably restricted to the parts upper than E zonule in general, which are predominant in somewhat more coarse-grained material (sandy siltstone) than the lower, and in tuffaceous material and terrigenous various drifts.

More or less ubiquitous forms in the group are represented by *Portlandia watasei*, *Acila picturata*, *Yoldia nagaoi*, *Neilonella poronaica*, *Macoma poronaiensis*, *Periploma ezoense*, *Orectospira wadana*, *Turritella "poronaiensis,"* *Venericardia yokoyamai*, *V. akagii*, *V. tokudai* etc. *Palliolum*, *Periploma besshoense* and *Isognomon* are very abundant in the basal coarse-grained part (Ao zonule).

Table 6 Characteristic molluscs of the Poronai group

GASTROPODA
- *Orectospira wadana* (Yokoyama)
- *Turritella "poronaiensis* Takeda"
- *Fulgoraria antiguior* (Takeda)
- *Eocylichna multistriata* (Takeda)

SCAPHOPODA
- *Siphonodentalium* sp.
- *Dentalium nunomae* Takeda

PELECYPODA
- *Neilonella poronaica* (Yokoyama)
- *Yoldia saitoi* Uozumi
- *Y.* cfr. *akanensis* Uozumi
- *Y. sobrina* Takeda
- *Y. nagaoi* (Takeda)
- *Portlandia watasei* (Kanehara)
- *Nucula hokkaidoensis* Mizuno et Inoue (MS.)
- *Acila picturata* (Yokoyama)
- *Crenella nagahamai* Mizuno (MS.)
- *Isognomon murayamai* (Yokoyama)
- *Lima j-suzukii* Takeda
- *Palliolum ikushumbetsuensis* Utashiro
- *Ctenamusium kusiroense* (Takeda)
- *Venericardia yokoyamai* Oyama et Mizuno
- *V. akagii* Kanehara
- *V. tokudai* Takeda
- *V. satisparva* Mizuno et Inoue (MS.)
- *Crassatellites teshimai* Inoue et Mizuno (MS.)
- *Thyasira bisecta* Conrad
- *Nemocardium yokoyamai* Takeda
- *Hubertschenckia ezoensis* (Yokoyama)
- *Macoma poronaiensis* Inoue et Mizuno (MS.)
- *Merisca onishii* Inoue et Mizuno (MS.)
- *Periploma besshoense* (Yokoyama)
- *P. ezoense* Mizuno et Inoue (MS.)

The Tappu group shows somewhat similar litho- and bio-facies, unconformably upon the coal-bearing Uryu group in the Rumoi coal field, and is generally considered as the correlative of the Poronai group. Its lower half, Shimokine formation attaining about 500 m thick, mainly consists of medium- to fine-grained sandstone with thin coal seams at its upper part. The Tappu formation wholly consists of siltstone very similar to that of the Poronai; but the above-said division of the Poronai group can't be adopted there. The writer found some molluscan fossils in K. Kubo's collection near Tappu. Those of the Tappu formation closely resemble the Poronaian (especially its lower) molluscs, but those of the Shimokine are similar as a whole to the Asagaian or Omagarian molluscs to be next discussed. The differences probably owe to those of the bottom conditions, especially of bottom materials, coarse-or fine-grained.

Table 7 Division of the Poronai group and occurrences of main molluscan fossils

Division	Thickness (m)		Main molluscs *relatively abundant **relatively common ×relatively poor	Remarks
	Shimizu-sawa	Poronai		
I	100+	Lack	* *Neilonella, Venericardia* spp. ** *Acila, Portlandia, Thyasira, Crassatellites, Orectospira* × *Hubertschenckia, Lima*	Fossils abundant. (after Teshima, 1955)
H	300	Lack	* *Portlandia, Neilonella, Venericardia* spp. ** *Acila, Yoldia nagaoi, Periploma besshoense, Venericardia yokoyamai, Nemocardum, Crassatellites, Orectospira* × *Thyasira, Crenella?, Psephaea*	Fossils abundant; with thick tuffaceous sandstone bed in the middle; *Callianassa* and *Linthia* found. (after Teshima, 1955)
G	300	Lack?	** *Portlandia, Neilonella, Nemocardium, Crassatellites, Orectospira, Turritella* × *Acila, Yoldia nagaoi, "Propeamusium"* sp., *Tudicla japonica*	Fossils rather poor; *Linthia* included. (after Teshima, 1955)
F	80～130	200～300+	** *Portlandia, Neilonella, Merisca, Lima* × *Crassatellites, Crenella, Orectospira*	Fossils rather poor; tuffaceous, with glauconitic fine sandstone bed in the middle at the type Poronai area; *Callianassa, Bathyactis?* and *Linthia* found; characterized by *Lima*
E	30～77	130～300	* *Merisca, Periploma besshoense, Dentalium* ** *Portlandia, Neilonella, Orectospira, Venericardia yokoyamai* × *Lima, Acila, Saccella* sp., *Yoldia nagaoi, Crassatellites, Venericardia akagii*	Fossils rather abundant; tuffaceous; *Bathyactis?* found; characterized by *Merisca*
D	10～150	70～180	* *Portlandia, Neilonella* ** *Yoldia nagaoi, Venericardia yokoyama V. akagii, Dentalium, Orectospira* × *Macoma, Merisca, Periploma ezoense*	Fossils abundant; *Callianassa* found; characterized by *Portlandia*
C	20～150	100	* *Acila, Neilonella, Venericardia yokoyamai, Venericardia akagii, Orectospira* ** *Periploma besshoense, Portlandia* × *Dentalium*	Fossils abundant; characterized by *Callianassa* at Shimizusawa and Oyubari; *Acila* nearly exclusively restricted to the lower part.
B	100～145	200～450	* *Acila, Neilonella, Venericardia yokoyamai, Orectospira* ** *Venericardia akagii, V. tokudai, Siphonodentalium, Yoldia saitoi, Y. nagaoi, Macoma* × *Periploma ezoense, P. besshoense, Venericardia satisparva, Portlandia*	Fossils abundant; the upper part characterized by *Acila, Neilonella, Orectospira* and *Venericardia*, the lower part characterized by *Yoldia saitoi, Venericardia yokoyamai* and *Macoma.*
A	60～0	250～600	** *Yoldia sobrina, Macoma* × *Venericardia yokoyamai, Yoldia laudabilis, Riuguhdrillia rugosa, Siphonodentalium*	Fossils very poor; composed of hard fine-grained siltstone
Ao		70～35	* *Palliolum* ** *Periploma besshoense* × *Macoma, Neilonella, Siphonodentalium, Isognomon, Portlandia*	Fossils rather abundant; basal part composed of sandstone and conglomerate of about 1 m in thickness, the remaining composed of silty very fine-grained sandstone, reducing the grain size upwards to sandy siltstone, wholly with glauconitic grains.

Here are shown the compiled data of Teshima (1955) on the Shimizusawa area, the Oyubari mine of Mitsubishi Mining Company on the Oyubari area (unpublished) and Matsuno and the writer on the Type Poronai area.

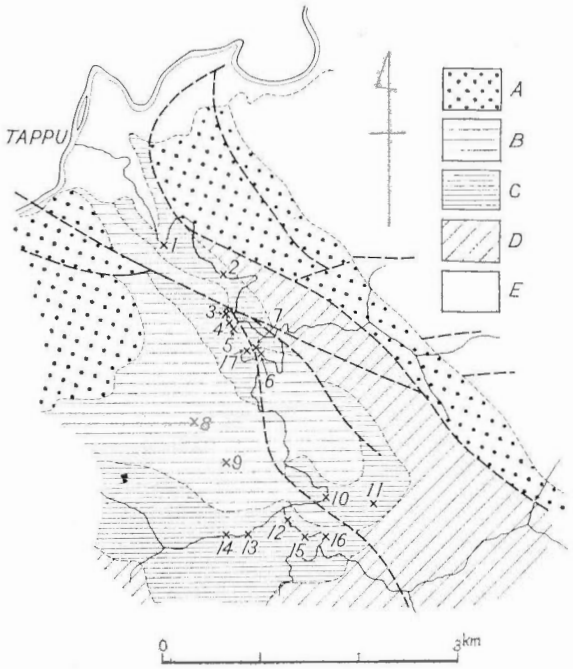

Figure 6 Geologic map near Tappu in the Rumoi coal field (after Tsushima et al. 1958), showing the fossil localities of the Tappu group
A. Neogene, B. Tappu formation, C. Shimokine formation, D. Uryu group, E. Cretaceous

Table 8 Molluscan fossils from the Tappu group

Specific name	Shimokine formation													Tappu formation			
	1	2	3	4	5	10	11	12	13	14	15	16	17	6	7	8	9
Turritella "*poronaiensis* Takeda"									×								
Crepidula matajiroi Makiyama				×							×						
Siphonodentalium sp.																×	
Neilonella poronaica (Yokoyama)														×			
Yoldia cfr. *sobrina* Takeda																×	
Yoldia cfr. *saitoi* Uozumi													×				
Portlandia ovata (Takeda)																	×
P. watasei (Kanehara)											×			×			×
Acila picturata (Yokoyama)																×	
Venericardia tokudai Takeda	×			×													×
V. cfr. *akagii* Kanehara																×	
V. yokoyamai Oyama et Mizuno	×										×	×	×				
Corbicula cfr. *sitakaraensis* Suzuki										×							
Thyasira bisecta Conrad								×					×				
Nemocardium cfr. *tristiculum* (Yokoyama)		×	×	×		×	×						×				
Pitar sp.										×							
Mya grewingki Makiyama				×				×		×		×					
Thracia sp.	×								×								
Periploma besshoense (Yokoyama)		?	×													×	

(coll. by K. Kubo)

In the Kushiro coal field, the fossiliferous Ombetsu group more than 1,000 m in maximum thickness rests upon the Urahoro group unconformably at its western marginal area and conformably at its central area. Molluscs numbering about 80 species were discriminated by the writer, collected from the stations over 200 throughout the coal field. Clear biostratigraphic division like in the Poronai is not recognizable there, but some divisions are obviously discriminated, though not always vertically.

The Ombetsu group wholly consists of marine sediment. Its lowest Omagari sandstone exhibits various litho-facies at each area and bio-facies also somewhat varies. The molluscs of Omagari consists mostly of sand dwellers. In the Charo siltstone, the writer discriminated two assemblages throughout the whole field; tentatively the one is called the " mollusca assemblage " and the other is called " the foraminifera—fish scale assemblage." Generally speaking, the former which is predominant in rather large molluscs is found in dark gray-coloured sandy siltstone in the lower several ten metres of the member, and the latter which is predominant in smaller foraminifers and small fish scales sometimes accompanied by small molluscs is found in light-coloured sandy siltstone in the middle to upper parts, though they are in alternation at some areas and are not always fixed in specific constituents.

The Nuibetsu formation consists of sandy tuffaceous siltstone and andesitic tuffaceous sandstone. Assemblages in the former are similar to those of Charo, but the division is more or less obscure and bio-facies frequently varies, sometimes showing the mixed feature. Comparing them with those of the Charo, it is remarkable that *Trominina, Bathybembix* are restricted to the Nuibetsu, and *Venericardia hobetsuensis*, which is found in the lower Neogene Momijiyama formation at the south Ishikari coal field together with *Trominina*, and *Venericardia* cfr. *orbica* of the Miocene Yunagaya group are also found, besides some molluscs of the Charo.

In comparison of the Ombetsu and Poronai faunas which are probably synchronous to each other, it is pointed out that nevertheless the similarity of the litho-facies predominant in sandy siltstone, so many common species are not found, but many are independently found in the both strata; *Crassatellites, Venericardia yokoyamai, Lima, Nemocardium, Turritella " poronaiensis "* and *Yoldia saitoi* are absent or very rare in Kushiro. Moreover, the similar fauna to that of the Nuibetsu formation is found in the Momijiyama formation which unconformably covers the Poronai group (see the later chapter), but the clear faunal boundary can not be recognized between both the formations or in the Nuibetsu formation. The facts seem to suggest the gradual faunal transition from Paleogene to Neogene in Kushiro and the writer tentatively regards Nuibetsu formation to be chronologically younger than the age shown by the " Poronaian fauna."

In the Joban coal field, the upper Paleogene Shiramizu group is developed. Its stratigraphy and structure were recently summarized by Sugai et al. (1957). According to them, it is divided into, Iwaki (coal-bearing), Asagai and Shirasaka formations in ascending order, and it exhibits largely the sequence from coal-bearing coarse-grained rocks to fine-grained rocks in ascending order. Especially, in the middle, Asagai formation, chiefly of fine-grained sandstone attaining about 100 m in thickness, includes many molluscan fossils called the Asagaian fauna and they were investigated taxonomically by Yokoyama (1924), Makiyama (1934), and Hirayama (1955). As the result of their contributions, about 77 species of shells are discriminated in the Asagai. Their representatives are *Turritella, Ampullina, Molopophorus*, buccinids, *Yoldia, Venericardia*, cardiids, *Macoma, Mya* etc. Hirayama (1955) gave the following paleoecologic conclusion, examining them. The conclusion seems to be appropriate in the light of the additional data on the shells.

Table 9 Characteristic molluscs of the Ombetsu group from the nearly whole Kushiro coal field

	Specific name	Omagari	Charo	Nuibetsu
	GASTROPODA			
(*)	*"Minolia" funiculata* Yokoyama		r	r
	Bathybembix sachalinensis (Takeda)			r
	Orectospira wadana (Yokoyama)		c	c
**	*Turritella "poronaiensis* Takeda"		a	r
	T. nuibetsuensis Kotaka et Mizuno (MS.)			r
*	*Acirsa* ? sp.		a	a
	Ampullina asagaiensis Makiyama	c		
	Crepidula matajiroi Makiyama	r		
	Trominina ishikariensis Hayasaka et Matsui			a
	T. umbelliformis Hayasaka and Matsui			r
	Ancistrolepis modestoideus (Takeda)			r
**	*Neptunea onbetsuensis* Matsui	c	c	
	N. ezoana Takeda	r		
(**)	*Riuguhdrillia rugosa* (Takeda)	r	r	
(*)	*Eocylichna multistriata* (Takeda)		r	r
	SCAPHOPODA			
	Dentalium sp.		c	c
	PELECYPODA			
	Neilonella poronaica (Yokoyama)		a	c
**	*Yoldia akanensis* Uozumi		c	r
	Y. laudabilis Yokoyama	a		
**	*Portlandia watasei* (Kanehara)	r	a	a
*	*P. ovata* (Takeda)		c	c
	Nucula hokkaidoensis Mizuno et Inoue (MS.)	r	r	r
	Acila picturata (Yokoyama)		c	
	Mytilus mabuchii Oyama et Mizuno	c		
*	*Crenella nagahamai* Mizuno (MS.)		c	c
*	*Lima j-suzukii* Takeda		r	
*	*Ctenamusium kusiroense* (Takeda)		a	
	Calyptogena kushiroensis E. Inoue et Mizuno (MS.)		r	
	Venericardia yokoyamai Oyama et Mizuno		r	
**	*V. akagii* Kanehara		r	r
**	*V. takedai* Mizuno (MS.)	r	c	
**	*V. kushiroensis* Mizuno (MS.)	r	a	
	V. tokudai Takeda	r		r
	V. hobetsuensis Hayasaka et Uozumi			c
	V. cfr. *orbica* Yokoyama			r
	Corbicula sitakaraensis Suzuki subsp.	a		
	Lucinona cfr. *hannibali* (Clark)			r
(**)	*Thyasira bisecta* Conrad	c	r	r
	Vasticardium sp.	a		
	Clinocardium kushiroense Kanno (MS.)	a		
*	*C.* cfr. *asagaiense* Makiyama		c	c
	Papyridea harrimani Dall	c	r	
	Hubertschenckia ezoensis (Yokoyama)	? r		
	Macoma sejugata (Yokoyama)	a	r	r
	M. subsejugata Mizuno (MS.)	a		
	Hiatella sachalinensis (Takeda)	r	r	
	Periploma besshoense (Yokoyama)	r	r	r
	P. ezoense Inoue et Mizuno (MS.)	r	a	c
	Cuspidaria interstitialis Takeda	r		
	Mya grewingki Makiyama	r		

*.....Very abundant species in the "foraminifer - fish scale assemblage" of Charo.
**.....Very abundant species in the "mollusca assemblage" of Charo.
( ).....Rather rare species, but exclusively included in the marked assemblage of Charo.

Table 10 Characteristic molluscan fossils of the Asagai formation

GASTROPODA
"Margarites" makiyamai Hatai et Nisiyama
Turritella tokunagai Yokoyama
T. importuna Yokoyama
Ampullina asagaiensis Makiyama
Calyptraea tokunagai Hatai et Nisiyama
C. aokii Hirayama
Crepidula matajiroi Makiyama
Colus fujimotoi Hirayama
C. asagaiensis Makiyama
Buccinum nakamurai Makiyama
Molopophorus watanabei Otuka
M. rarus Hirayama
Priscofusus ishijimai Hirayama
Cylichna stolida Hirayama
SCAPHOPODA
Dentalium yotsukurense Hirayama
PELECYPODA
Yoldia landabilis Yokoyama
Y. yabei (Yokoyama)
Portlandia watasei (Kanehara)
P. yotsukurensis Uozumi
Nucula yotsukurensis Hirayama
Acila oyamadensis Hirayama
Anomia asagaiensis Hirayama
Venericardia laxata Yokoyama
V. pacifera Yokoyama
V. tokunagai Yokoyama
Thyasira bisecta Conrad
Nemocardium iwakiense Makiyama
N. tristiculum (Yokoyama)
Clinocardium asagaiense (Makiyama)
Papyridea harrimani Dall
Cyclina asagaiensis Kawada
Liocyma furtiva (Yokoyama)
Macoma sejugata (Yokoyama)
Spisula nagakoensis Hatai et Nisiyama
Panope rhomboidea Hirayama
Mya grewingki Makiyama
Periploma besshoense (Yokoyama)
Cuspidaria makiyamai Kanehara

(mainly after Yokoyama, 1924; Makiyama, 1934; Hirayama, 1955; Hatai and Nisiyama, 1952)

"There are no tropical or subtropical genera or species, but there are many characteristic ones which are now living in the boreal regions. Further, noteworthy is that the fauna has yielded no brackish water species, and the shells of all of the species at hand consist of moderate to thick tests which are habitats in shallow water (neritic zone). From the various features of the formation and the fossils, the fauna may have flourished in an embayment or party enclosed sea, not far from shore and there is no evidence for its open sea nature, cliffed or being arranged with a rugged coast and the prevailing conditions were not quiet during deposition".

On the other hand, the molluscs are rather rare in the Iwaki formation composed mainly of coarse-grained sandstone with coal seams. Sometimes, some fossils are yielded in its upper part. The writer once discriminated some molluscs which are common to those of the Asagai. Besides them *Glycymeris nagakoensis*, *Modiolus yokoyamai*, *Callista misawaensis**, *Venericardia dodairensis*, *Serripes squalidus*, *Ostrea* sp.** etc. were reported from the Iwaki by Yokoyama (1924) and Hatai and Nisiyama (1952). Most of the shells are inhabitants evidently shallower than the Asagaian fauna.

The Shirasaka formation consisting mainly of siltstone is also poor in shell fossil. Mizuno (1954) and Eguchi and Shoji (1953) reported *Periploma besshoense*, *Turritella tokunagai*, *Clinocardium asagaiense*, *Yoldia laudabilis*, *Macoma asagaiensis* from its lower part near Isohara.

VI. Discussion

From the reason of the large differences in Paleogene stratigraphy and faunal constituent of the west and north Japan, the biochronologic division established at the former area cannot

* It is probably referred to *Callista hanzawai* from north Kyushu.
** It is probably referred to *Ostrea eoriwularis* of Hokkaido.

Table 11 Molluscan fossils of Shiramizu group found in the boring wells at Nakashio and Yotsunami near Taira city

Specific names	Nakashio																								Yotsunami													
	Asagai f.														Upper part of Iwaki f.										Asagai f.		Upper part of Iwaki f.											
	147.00	173.00	175.00	179.00	182.00	184.00	187.00	192.63	198.00	207.00	208.00	218.00	224.00	226.15	280.00	283.00	284.00	288.00	291.00	298.00	311.22	315.56	322.00	324.00	275.60	305.81	306.10	353.05	356.05	373.00	377.17	385.30	385.60	399.00	401.10	404.35	404.80	405.25
Ampullina asagaiensis Makiyama																			×																			
Turritella importuna Yokoyama								×	×		×																											
Turritella tokunagai Yokoyama				×	×							×										×												×				
Turritella sp.			×																																			
Turritella? sp.																																×						
Colus asagaiensis Makiyama									×																													
Nassarius? sp.		×							×								×				×																	
Molopophorus? sp.															×																							
Molopophorus watanabei Otuka													?										×															
Leucosyrinx sp.																×																						
Dentalium sp.															×																							
Dentalium yotsukurense Hirayama																											×		×									
Acila oyamadensis Hirayama									×	×	×	×			×																							
Yoldia laudabilis Yokoyama															×																							
Venericardia laxata Yokoyama									×			?																										
Venericardia sp.			×																																			
Venericardia tokunagai Yokoyama															?																							
Clinocardium asagaiense (Makiyama)									×				×		×			×			×							×					×			×	×	
Papyridea harrimani (Dall)			×				×		×	×		×													×													
Liocyma furtiva (Yokoyama)								×	×			×		×																								
Angulus (*Peronidia*) sp.			×										×		×	×	×		×	×	×			×						×				×	×			×
Macoma sejugata (Yokoyama)					×	×																																
Periploma besshoense (Yokoyama)						×			×				×																									
Callista sp.																										×					×						×	

after Asano, 1956 (partly modified)

be directly adapted to the latter area, and then the four faunas were here discriminated as to the Paleogene of the latter. They are summarized in table 12.

VI. 1 Remarks on some stratigraphic and correlative problems

For the foundation of discussion of faunal development, the stratigraphic relation of some strata, which has been given an attention by many authors are first summarized.

The Ishikari group is probably covered unconformably by the Poronai group throughout the Ishikari coal field, according to the writer's opinion.

The next important problem as to the former is whether its upper part in the northwest Sorachi district corresponds to the whole sequence of the Ishikari group in the northeast Sorachi district or not, and the writer has the opinion that only the strata below the Takane formation in the latter are presented in the former. Concerning the correlation between Ishikari and Kushiro, the Chorobetsu subformation, the lowest part of the Urahoro group in Kushiro, is probably correlated with the Takane or Akabira in Ishikari from the occurrence of *Woodwardia* and stratigraphic situation. The Charo formation of the Ombetsu group in Kushiro is surely correlated with the Poronai of Ishikari, and it is highly probable that the Nuibetsu lying above the Charo represents the horizon upper than the Poronai, filling the time-gap of sedimentation shown by the unconformity between the Poronai and Momijiyama, or it also represents the Momijiyama formation in Kushiro.

VI. 2 Characteristics of each fauna

The characteristics of each molluscan fauna is summarized as follows.

Lower Ishikarian fauna: This is found in the Ishikari and Rumoi coal fields, and is represented by the fossils of the Wakkanabe and Shiroki formations. The fauna is composed of about 30 species of pelecypoda and 10 species of gastropoda, each of which includes the marine, brackish water and fresh water forms. The distributions of genera and species in the Wakkanabe time were evidently regulated by various environmental factors including salinity, bottom material, physiography, and largely speaking by the two depositional basin, the Paleo-Sorachi estuary comparable to the recent mangrove swamp in the north and Paleo-Yubari bay rather of open sea in the south.

Thus, in the former, many brackish water forms including corbiculid, ostreid, cerithiid, mytilid, some of pitarinid etc., and some fresh water forms of viviparid and unionid are commonly found everywhere, together with some shallow marine forms which are conspecific with those of the Paleo-Yubari bay and suggests the occasional marine invasion from the bay to the present estuary; while in the latter, many marine forms are found, and non-marine forms are rarely found; there, the distributions of marine forms are clearly controlled by the factor of grain-size of bottom material, and then *Yoldia*, *Acila*, *Portlandia* etc. are included in sandy siltstone and *Pitar*, *Crassatellites*, *Spisula* etc. in sandstone.

Middle Ishikarian fauna: This is represented by the fauna of Akabira formation in the Ishikari coal field, and one of the Rumoi is poorly represented by some fossils. The fauna including molluscs of various habitats is composed of about 30 species of pelecypoda and 10 species of gastropoda. The fresh water molluscs are mostly conspecific with the lower Ishikarian forms, but concerning the marine and brackish water molluscs many newcomers are presented in the fauna and the replacements of genera and species are obvious. The distributions of the animals were also regulated by the environmental factors. The Akabira formation exhibits

Table 12 Main molluscs of each fauna at each area in north Japan

Molluscs of fresh water and a part of brackish water are excluded from this table.

Fauna	Ishikari	Rumoi	Kushiro	Joban	
			Bathybembix sachalinensis, Trominina ishikariensis, Neilonella poronaica, Portlandia watasei, Crenella nagahamai, Venericardia hobetsuensis, Periploma ezoense. (sandy siltstone and tuffaceous sandstone)		Saseboan
Poronaian	*Orectospira wadana, Neilonella poronaica, Yoldia saitoi, Y. nagaoi, Portlandia watasei, Acila picturata, Lima j-suzukii, Crassatellites teshimai, Venericardia akagii, V. tokudai, V. yokoyamai, Thyasira bisecta, Macoma poronaiensis, Merisca onishi, Periploma besshoense, P. ezoense* (sandy siltstone—siltstone) *Pallilum ikushumbetsuensis, Periploma besshoense* (fine—very fine sandstone)	*Neilonella poronaica, Portlandia watasei, Acila picturata, Venericardia tokudai, Periploma besshoense* (siltstone, rather poor in fossil) *Crepidula matajiroi, Venericardia, tokudai, V. yokoyamai, Thyasira bisecta, Nemocardium* cfr. *tristiculum, Mya grewingki* (sandstone, rather poor in fossil)	*Turritella "poronaiensis", Acirsa*? sp., *Neptunea onbetsuensis, Neilonella poronaica, Yoldia akanensis, Portlandia watasei, Acila picturata, Crenella nagahamai, Venericardia takedai, Periploma ezoense* (sandy siltstone): *Ampullina asagaiensis, Neptunea onbetsuensis, Yoldia laudabilis, Mytilus mabuchii, Corbicula sitakaraensis* subsp., *Thyasira bisecta, Macoma sejugata, M. subsejugata* (very fine—medium sandstone)	*Turritella tokunagai, Ampullina asagaiensis, Colus asagaiensis, Molopophorus watanabei, Yoldia laudabilis, Venericardia laxata, V. tokunagai, Thyasira bisecta, Nemocardium tristiculum, Clinocardium asagaiense, Papyridea harrimani, Mya grewingki, Periploma besshoense, Macoma sejugata* (mainly very fine—fine sandstone)	Nishisonogian
Upper Ishikarian	*Melanoides otatumei, Corbicula sitakaraensis, C. sakakibarai, Microcallista munroei, Mya ezoensis akabirensis* (sandstone and sandy siltstone, rather poor in fossil)	Almost unknown	*Ancistrolepis modestoideus, Neptunea shoroensis, Yoldia landabilis, Portlandia watasei, Mytilus mabuchii, Chlamys mabuchii, Venericardia praetakedai, Corbicula sitakaraensis, Ostrea eorivularis, Nemocardium ezoense, Periploma ezoense, Mya grewingki, M. kusiroensis, M. ezoensis akabirensis*	Lack	Mazean
Middle Ishikarian	*"Siphonalia" sakakurai, Yoldia hokkaidoensis, Portlandia ogasawarai, Acila shimoyamai, Brachidontes ogasawa ai, Ostrea eorivularis, Corbicula tokudai, Thyasira bisecta omarui, Microcallista munroei, Mya ezoensis, M. ezoensis akabirensis,* (sandstone and siltstone)	Almost unknown	Lack		Funazuan
Lower Ishikarian	*Pyrazus miyajimai, "Siphonalia" sakakurai, Brachidontes sakakurai, B. ogasawarai, Ostrea eorivularis, Crassatellites yessoensis, Venericardia otatsumei, Geloina hokkaidoensis, Corbicula tokudai, Claibornites quinquangulus, Pitar sorachiensis, P. sannosawaensis, Microcallista munroei, Cyclina shirokiana, Spisula sorachiensis, Mya ezoensis* (sandstone and siltstone)				Okinoshiman

vertically the nearly perfect soul sedimentary cycle, from the lower non-marine to the upper non-marine via the middle marine, and the fact controlled the vertical distributions of molluscs.

Upper Ishikarian fauna: This is mainly represented by the fauna of the Urahoro group of the Kushiro coal field and at the Ishikari and Rumoi coal fields it is only shown by some molluscs. Among about 60 species in total, only some including unionids, viviparids, corbiculids, a part of myids etc. are commonly found in both the Kushiro and Ishikari. The common species with the lower Ishikarian fauna is only poorly presented, and the large parts of the upper Ishikari are occupied by the newcomers, some of which range to the Poronaian fauna. The distributions of constituents of the upper Ishikarian fauna in Kushiro are regulated by the diversity of environmental conditions, owing to the soul sedimentary cycle recognized in the Urahoro group as well as that of the Akabira formation and to the difference of sedimentary environments every area in its each stage. Among the Urahoro group, its lowest, Kamibeppo subformation lacking in molluscan fossil is probably of a part of the age to which the middle Ishikarian fauna belongs, from the occurrence of a plant, *Woodwardia* and its stratigraphic situation.

Poronaian fauna: This is richly found in the Ishikari, Rumoi, Kushiro and Joban, and is composed of about 150 species in total (excluding the fossils of the Nuibetsu). Some of them are continued from the upper Ishikarian fauna especially in Kushiro, but their majority is occupied by newcommers.

The fauna mainly consists of marine molluscs, together with the brackish water form represented by *Corbicula* very poorly; the fresh water form is quite absent there. Rather many common species to certain two areas are found, but the common species to the four areas are only represented among the whole species of the fauna by *Periploma besshoense*, *Thyasira bisecta*, *Portlandia watasei* etc. In each area, the distribution of marine species is clearly controlled first by the bottom material of sandstone or siltstone, and also in some cases their assemblages are regulated by more detailed differences of various environmental factors.

The fauna of the Nuibetsu formation is roughly similar to the Poronaian fauna of the below-lying Charo formation. However, the appearances of some forms, *Trominina*, *Venericardia hobetsuensis* etc. suggest the faunal similarity to that of the Momijiyama formation unconformably covering the Poronai group at the Ishikari coal field.

VI. 3 Controlling factors of intra- and inter-areal appearances

From the above statements it is clear that the appearance of molluscan species of certain fauna in each area was regulated by various environmental factors related with a molluscan life. They include salinity, grain-size of bottom material, water temperature, dissolved amount of oxygen etc. and these factors which were largely influenced by the geologic phenomenon produced the diversified assemblages in each area, though their detailed relations are yet unknown in most parts.

It is the remarkable character that especially concerning the upper Ishikarian and Poronaian faunas the inter-areal common species are very few surprisingly. Concerning the upper Ishikarian, the non-marine forms are mostly conspecific in Ishikari and Kushiro. Although the marine forms cannot be taken into consideration as they are very poorly presented in Ishikari, *Microcallista* of Ishikari is quite absent in Kushiro, while *Mya ezoensis akabirensis* is found in the both, though very few, and the former fact is probably explained appropriately by the poorness of adaptability to the different environment as the result of its endemic develop-

ment in Ishikari through the long time. On the other hand, the absence of the majority of the marine forms of Kushiro in Ishikari will be able to be accounted by the poorness of marine condition profitable to the life of marine forms of Kushiro.

Concerning the Poronaian, the inter-areal diversity of constituents seems to largely owe to the more or less endemic character of the uncommon species, though partly owe to the other certain factors as represented by the followings : for example, *Clinocardium tristiculum* which is found in sand facies of Rumoi, Kushiro and Asagai is not found in Ishikari only for the reason that it didn't find the sand bottom profitable to its life, and *Crassatellites teshimai* is found only in the upper part of Poronai group for the reason of probable slightly higher water temperature than the other areas and also of its steno-thermal character.

VI. 4 Controlling factors of chronologic appearances

As formerly pointed out, there are the non-recurring replacements of constituents of each fauna. Concerning some of the brackish and fresh water molluscs having mostly rather wide stratigraphic ranges, *Geloina* of which recent form is restricted to the tropic and subtropic regions of the Indo-Pacific is much found in the lower Ishikarian, and its individuals are reduced upwards and are absent in the Poronaian. However, similarly southern form, *Cyrenobatissa* is found from the lower to the upper Ishikarian, and *Batissa* is found mostly in the upper Ishikarian. The most forms of unionid found from the lower to the upper Ishikarian also belong to the southern form, except *Margaritifera* which is the recent northern form.

Among the marine molluscs, *Microcallista munroei* which is exclusively found in the Ishikari and Uryu groups is one of the typical Eocene genera; according to Tremlett (1953), the genus is yielded in the lower to upper Eocene of the western Europe, and it is also found in the Eocene of Alabama (Stewart, 1930). *Claibornites* is the peculiar genus to the lower Ishikarian, found by Uozumi (1955), and its subgenus *Saxolucina* to which the lower Ishikarian species belongs is also of the middle to upper Eocene. *Venericardia otatsumei* of the abundant species of the lower Ishikarian belongs to *Venericardia* s. str. of warm form as well as *V. mandaica* and *V. yoshidai* of west Japan, but the nearly whole species of the genus of the upper Ishikarian and Poronaian belongs to *Cyclocardia* which lives in the temperate and cool zones in recent.

Concerning the nuculid and nuculanid fossils, *Truncacila* is found in the lower Ishikarian (*Acila* sp. of the Wakkanabe in the Paleo-Yubari bay) and much in the Poronaian (*A. picturata*), the latter of them being somewhat related with *A. gettysburgensis* Reagan of the Blakeley of the northwestern Washington. *Acila* s. str. is included in the middle Ishikarian (*A. shimoyamai* of the Akabira formation) and in the Poronaian (*A. kushiroensis* and *A. elongata*). *Acila* s. str. has been hitherto accepted as the subgenus after late Oligocene (Schenck, 1936), and its appearance in the Paleogene of west Japan almost coincides with the tendency as shown in the writer's preceding report. While, its appearance in north Japan is in contradiction to it, because the upper Poronaian fauna is of the late Oligocene, correlated with the Blakeley fauna and the middle Ishikarian is probably of the latest Eocene–earliest Oligocene. The fact seems to suggest that the birthplace of the subgenus was the north Japan area or around it of the middle Ishikarian time, though Schenck (1936) considered that it was possibly either the northwest coast of North America or the Japanese region. Another forms of the taxon in question are *Yoldia* and *Portlandia* which are the northern genera. The both are comprised in the whole fauna. In the lower Ishikarian, they are represented by the silt bottom dwellers in the Paleo-Yubari bay, *Yoldia* sp. and *Portlandia* sp. The middle Ishikarian species are represented by *Yoldia hokkaidoensis* and *Y.* sp., the both being miss-identified

as the Poronaian nuculanid (*Y. nagaoi*) by Ogasawara (1955), and also by *Portlandia watasei ogasawarai* which has the more inflated and smaller shell than *P. watasei* and is probably considered as the ancestral form of *P. watasei*. The upper Ishikarian form are represented by-*Portltandia waasei* and *Y. laudabilis* in Kushiro. The former is poorly presented, but the latter is abundantly comprised in the Shitakara formation. These species ranges to the Poronaian, and there they occupies the important part of the fauna. In the Poronaian, many species besides them appeared in the whole area.

Another northern form, buccinid, is represented by soul species of *Neptunea* sp. in the lower Ishikarian fauna, and is absent in the middle Ishikarian. While, it is represented abundantly by many genera and species in the upper Ishikarian and Poronaian. Moreover in the horizon upper than the latter, *Trominina* is found as a newcomer genus.

Summarizing the above discussions, it will be obvious that the controlling factors of chronologic appearance of fauna involve some elements. Among them the most important is considered the chronologic change of climate especially shown by water temperature. It is clearly indicated by the faunal change in the similar biotope, for example, brackish water environment, from the lower Ishikarian rich in the tropic or subtropic genera to the Poronaian poor in the forms, via the middle and upper in which the forms are moderately found. And in contrast to the facts, the cool water fauna is found abundantly in the upper Ishikarian and especially in the Poronaian, and it is only represented in the lower Ishikarian in the silt bottom of Paleo-Yubari bay*. The character of this temperature reducing roughly coincides with the result of Durham (1950) brought from the consideration on the Tertiary invertebrates of the Pacific Coast of North America. And the marine climatic change of north Japan probably introduced the immigrative and emigratives every time. Another important factor is shown by the endemic developments of some taxon, though they are unfortunately recognizable only in some in the present study.

VI. 5 Comparison with the faunal developments in west Japan

The Paleogene molluscs of north Japan number about two-hundred and some species in total. It is very remarkable that there are only found the common species or very similar forms with those of west Japan less than 5% of the total numbers of the both areas, and they are occupied nearly exclusively by the Poronaian species, represented by *Portlandia watasei, Yoldia laudabilis, Periploma besshoense* etc. The general feature is shown in summary as follows.

Among gastropods the turritellids are abundantly presented in each fauna of west Japan, but presented only in the upper Ishikarian and Poronaian fauna is in north Japan; the volutids abundantly represented by *Volutospina, Lyria* (lower than Mazean) and *Fulgoraria* (especially the Nishisonogian) in west Japan are shown only by the last genus of the Poronaian in north Japan; the viviparids are presented only by soul species of the Takashiman in west Japan, but by several species throughout the lower-upper Ishikarian in north Japan; the thiarids are mainly presented by *Faunus* of the Takashiman in west Japan, but by *Semisulcospira*, which is not comprised in the Paleogene of west Japan and is found in the middle and upper Ishikarian in north Japan; the potamidids are presented by *Vicarya* (the Takashiman) in west Japan, but by *Pyrazus* (the lower Ishikarian) in north Japan; *Ancistrolepis* and *Neptunea* are poorly presented by few species

* The appearing time of the "Poronaian fauna" has been sometimes discussed by some authors, in connection with the stratigraphic relation of the Poronai and Ishikari formations (Minato *et al.* 1952; Minato and Uozumi, 1957; Saito, 1958). It is the most appropriate that strictly speaking, the Poronaian species appeared in the time of upper Ishikarian, represented by the fossils of the Urahoro group, but some of the Poronaian genera has appeared already in the time of lower Ishikarian, ranging afterwards.

in west Japan, but their various species are abundantly found in north Japan (especially in the upper Ishikarian and Poronaian); *Mazzalina* and *Pseudoperissolax* are not presented in north Japan; *Molopophorus* is represented in both west and north Japan, but by soul species of the Nishisonogian in the former, and by some species of the upper Ishikarian and Poronaian in the latter.

Among pelecypods, *Yoldia* and *Portlandia* are very abundant in north Japan (especially in the middle Ishikarian–Poronaian), but they are poorly represented in west Japan, though in the Nishisonogian they are rather abundant; *Acila* s. str. is restricted to the Nishisonogian in west Japan, but is found in the middle Ishikarian–Poronaian in north Japan; in arcids, *Cucullaea* and *Noetia* are absent in north Japan; the unionids of west Japan are very few, but they are shown by many genera in north Japan; the crassatellitids are presented by 8 species throughout the Paleogene in west Japan, but only by 2 species in north Japan, the carditids are shown by many species in the both, but large venericards abundantly found in the former are quite absent in the latter, and *Venericardia* of the latter is represented by many species of *Cyclocardia* (upper Ishikarian–Poronaian), which is shown only by soul species of *V. harukii* (Nishisonogian) in Kyushu; the corbiculids are shown by many species of *Corbicula* s. str., *Geloina*, *Baticsa* and *Cyrenobatissa* in north Japan, but they are nearly represented only by a few species of *Cyrenobatissa* in west Japan; *Thyasira* and *Clinocardium* abundantly found in north Japan (especially in the Poronaian) are absent or very poorly presented in west Japan; the venerids are presented in west Japan by many species of *Pitar*. *Callista*, *Dosinia*, *Cyclina* and *Meretrix* throughout the whole Paleogene, but the genera are rather poorly presented in north Japan where *Microcallista* is abundant in the lower–upper Ishikarian faunae.

Such characters make the accurate correlation of the faunal sequence of west Japan to that of north Japan very difficult. Among the faunas in north Japan, those of the Wakkanabe formation, the Poronai group and the Asagai formation have been hitherto respected as a useful indicator of the correlation. Nagao (1933) considered the Wakkanabe formation the correlative of the Ashiya group (the writer's Nishisonogian stage). The view was followed by Otuka (1939), who established the "Ashiya-Ishikari age (Oligocene)" on the basis of the correlation and also the "Asagai–Poronai age (latest Oligocene or earliest Miocene)" in which the Sasebo group was kept. In the current studies, there seems to be two schools on the correlation (especially on the chronologic situation of the Poronai group), roughly speaking. The one is represented by the author of foraminiferal viewpoint (Saito, 1958) who correlates the Poronai and the Ombetsu with the "Nogata stage" of Kyushu and designates it as upper Eocene, and correlates the Asagai formation with the Kishima formation (the writer's Mazean). The other is represented by the authors of molluscan viewpoint (Takeda, 1953; Oyama *et al.* 1960), who consider the Ashiya, Asagai, Poronai and Ombetsu to be of the same age (upper Oligocene).

As formerly said, there are nearly no positive molluscan evidences concerning the correlation of both the districts. But summarizing the data of a few common species and similarity of faunal vicissitude, the Poronaian fauna is correlated with the Nishisonogian in having some common species and in showing the abrupt increasing the northern Pacific elements common or similar to the Pacific coast upper Oligocene fauna.

The middle and upper Ishikarian molluscan faunas exhibit nearly no faunal evidences on correlation. However, the lower Ishikarian is probably correlated with the Okinoshiman as later cited, and if the correlation is accepted, the stratigraphic situations of the two faunas enable the correlation of upper Ishikarian to Mazean and of middle Ishikarian to Funazuan.

comparing the Paleogene faunas of both the districts, it is pointed out that those of north Japan are more rich in the temperate–cool elements as a whole, and common genera to the Poronaian are more abundantly comprised in them.

The lower Ishikarian fauna represented by that of the Wakkanabe formation was once considered by the writer (Oyama *et al.*, 1960) " *Venericardia yoshidai* zone " including the Mazean and Funazuan stages here proposed, owing to the miss-identification of some species. But its faunal aspect suggests the designation of the fauna to the Okinoshiman as considered by Saito (1958), in having similar crassatellitid, *Venericardia* s. str., *Cyclina*, *Pitar* (*Pitar* of the Wakkanabe cited as *P.* cfr. *matsumotoi* by Uozumi, 1955 seems to be more related with *P. kyushuensis* than with *P. matsuraensis*) etc., and having some warm common forms to the Gulf Coast Eocene of America, though large *Venericardia* and *Volutospina* abundant in the Okinoshiman are quite absent in the lower Ishikarian. There is no faunal evidence on the correlation with the horizon lower than the Yubari formation of the Ishikari group, though Saito (1953) considered that the basal part of the Noborikawa formation is correlated with the Akazaki formation from the viewpoint of clay. The writer's view on correlation is shown in table 12.

From a paleobiogeographical viewpoint, it is very interesting that the Paleogene faunas of north Japan are rather similar to those of Kamchatka and Sakhalin than those of west Japan in their constituents and general aspect of chronologic development. This problem will be, however, discussed in another paper in detail.

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北日本地域における古第三紀貝類群の時代的変遷の総括

水野　篤行

要　旨

ここでいう北日本地域とは北海道および本州北部をさす。ここでは石狩炭田・釧路炭田・留萌炭田・常磐炭田などに含貝類化石古第三系が分布している。本論文では，これらにふくまれる貝類化石群を，とくにその時代的変遷という立場から総括した。その問題に関連していくつかの層序・対比に関する問題にも簡単にふれている。

北日本地域の古第三紀貝類群は，時代的にみて，下位から，下部石狩貝類群・中部石狩貝類群・上部石狩貝類群・幌内貝類群に識別できる。これらはそれぞれ海棲・非海棲貝類群からなり，また全体の構成のうえで漸次の変化をしめしている。各「貝類群」について，地域ごとにその産出状況をのべ，またそれぞれの「貝類群」の属種構成の特徴を要約した。その時代的変遷はおもに気候的変化によると考えられる。筆者が前に明らかにした，西日本地域の同時代の貝類群と比較すると，北・西日本両域の間に共通種がきわめて少ないことがわかる。しかし，全体の時代的変遷の状況からみると，おそらく次のような対比関係がなりたつであろう。

	西日本地域	北日本地域
漸新世	西彼杵期	幌内貝類群
	間瀬期	上部石狩貝類群
	船津期	中部石狩貝類群
始新世	沖ノ島期	下部石狩貝類群
	高島期	

カムチヤツカ・カラフト地域と，北日本地域との古第三紀貝類群の類似性とその古生物地理学的意義については興味深いものがあるが，この問題については別の機会にのべる。

地質調査所報告は1報文について報告1冊を原則とし，その分類の便宜のために，次のようにアルファベットによる略号を附ける。

A．地質およびその基礎科学に関するもの
- a．地　質
- b．岩石・鉱物
- c．古生物
- d．火山・温泉
- e．地球物理
- f．地球化学

B．応用地質に関するもの
- a．鉱　床
- b．石　炭
- c．石油・天然ガス
- d．地下水
- e．農林地質・土木地質
- f．物理探鉱・化学探鉱および試錐

C．そ の 他

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- b. Petrology and Mineralogy
- c. Paleontology
- d. Volcanology and Hot spring
- e. Geophysics
- f. Geochemistry

B. Applied geology
- a. Ore deposits
- b. Coal
- c. Petroleum and Natural gas
- d. Underground water
- e. Agricultural geology, Engineering geology
- f. Physical prospecting, Chemical prospecting & Boring

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Summary of the Paleogene molluscan faunas in north Japan

Atsuyuki Mizuno

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Through the areas including the Ishikari, Rumoi, Kushiro and Joban coal fields, the Paleogene faunas are stratigraphically discriminated into four faunas, namely, lower Ishikarian fauna, middle Ishikarian fauna, upper Ishikarian fauna and Poronaian fauna. The occurrence of fauna in each area is briefly accounted, together with its composition. The faunal development in a chronologic sense seems to owe in large parts to climatic elements, besides to a specific evolution in some taxon. The chronologic situation of them is also discussed.

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