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GEOLOGY OF THE IKUSHUNBETS COAL-MINING DISTRICT

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GEOLGICAL GUIDE TO THE EXCURSION TO THE IKUSHUNBETS COAL-MINING DISTRICT, ISHIKARI COAL-FIELD, HOKKAIDÔ

BY HISAKATSU YABE

CONTENTS

Introduction ............................................. 1
The Cretaceous Deposits of Hokkaidô .................. 4
The Palaeogene Coal-Bearing Group of the Ishikari Coal-Field—
   The Ishikari Series ................................... 14
The Neogene Deposits of the Ishikari Coal-Field ...... 18
The Geological Structure of the Ishikari Coal-Field ... 20
Itinerary .................................................. 21
References ............................................... 24

INTRODUCTION

An excursion to the coal mining district of Ikushunbets in the Ishikari coal-field, Hokkaidô, has been arranged for such specialists as may desire to understand the general aspect of the Cretaceous deposits and fauna, and the Palaeogene coal-bearing deposits and flora, predominant in the two islands of Saghalien and Hokkaidô. The district is within two and a half hours from Sapporo by railway.

The main island of Hokkaidô (sometimes called Hokushû or Yezo) is the second largest of the islands of Japan (78,000 sq. km.). It is rhombic in its general outline, with a peninsula of fish-tail shape, and embraces the large square Bay of Uchiura, sometimes called Volcano Bay, on the southwest. The main part of the island and the peninsula are separated by a broad meridional zone of depression extending from the Plain of Ishikari to that of Tomakomai-Yûfûts and deeply buried under alluvial materials. On the peninsular area, there are many volcanoes, of which Koma-ga-také (1,093 m.), Esan (620 m.), Makkari-nupuri (1,943 m.), Usu (595 m.) and Tarumae (1,016 m.) are well known: except for the younger effusive rocks, it
is composed mostly of Neogene and partly of Palaeozoic sediments and a few granites.

The backbone of the main part of the island passes through it in a SSE-NNW direction from Cape Erimo to Cape Sōya and is sometimes called the Yezo Mountain Range. It consists of two parallel chains, which are not, however, differentiated as independent in the southern part. The southern part, called the Hidaka Range, culminates in Pipairo (2,017) m. and consists of central granite intruding and metamorphosing the surrounding Palaeozoic sedimentaries of the Chichibu System. The middle part is occupied by many volcanic eminences (Nutapkaushibé 2,259 m., Oputateshiké 1,980 m., Tokachidaké 1,935 m., etc.) and one other of basic igneous rocks intruding the Palaeozoic rocks (Ishikari-daké 2,039 m.). Northwards, the eastern chain becomes lower, with several peaks but little higher than 1,000 m., and extends to the coast of Esashi, in the province of Kitami.

The western chain, which runs parallel to the eastern, is separated from it by the longitudinal valleys of the Teshio and Sorachigawa, and the two intermontane basins of Asahikawa and Furano. It is highest in its southern part, the Yabari Mountains (the highest point, Ashibets-nupuri 1,920 m.), and is composed of Palaeozoic and Cretaceous sedimentaries and basic igneous rocks. The middle part, elevated along the west side of the Asahikawa basin, is crossed by the transverse valley of the upper course of the Ishikari-gawa—the gorge of Kamuikotan. Besides the Palaeozoic sedimentaries, there are exposed crystalline schists resembling those of the Sambagawa and Mikabu Series. Farther north, the western chain is much reduced in elevation, and is composed of Cretaceous and Tertiary rocks.

The Chishima volcanic line passes from east to west through the main part of the island of Hokkaidō. The volcanic group of the middle part of the Yezo Range belongs to this line. East of the median range, the line bears several notable cones such as Meåkan (1,617 m.), Oåkan (1,614 m.), Atosa-nupuri (460 m.) and Rausu (1,573 m.).

Between these elevations and the seacoast, stretches a gently undulating hilly region through which flow many large rivers, such as the Ishikari-gawa, Teshio-gawa, Tokachi-gawa, etc. Fertile plains are found along these rivers. The coast is often marked by a number of terraces, the uppermost one being sometimes more than 60 m. high.
The Cretaceous rocks occupy numerous detached areas, which are more or less meridionally arranged in two parallel zones along the western chain of the Yezo Range. The western of these two zones extends from the middle course of the Niikappu, in the province of Hidaka, through the western side of Yūbari to near Utashinaï along the Sorachi-gawa, in the province of Ishikari. At one place interrupted by an extensive field of Tertiary sedimentsaries in the Rumoë-Uriu district, it reappears in the mountain ridge on the district-boundary between Uriu and Rumoë, and continues northwards as far as Cape Sōya. The eastern zone, which stretches along the eastern side of Yūbari and of the broad valley of the Uriu-gawa, extends southward to the coast of Urakawa, province of Hidaka, and northwards to the coast of Kitami.

Cretaceous sediments are little known from the extensive area lying east of the Yezo Range, though they are reported to occur in various parts of the provinces of Tokachi, Kushiro and Kitami. A part of the island of Shikotan, in the Kurile Group, is also composed of rocks of the same age.
While the Cretaceous of Hokkaido is essentially marine in origin, the Palaeogene formation is important in being productive of coal. The coal-bearing group closely follows the Cretaceous in distribution, lying between it and the overlying Neogene deposits, and is often structurally interwoven with them in a complicated manner. The important coal-fields are situated in a broad belt extending from Cape Soya to the coast of Hidaka and thence along the western chain of the Yezo Range. The one that is best known geologically and most productive is the Ishikari coal-field, which is situated to the east of the main course of the Ishikari-gawa, extending for 80 km. north to south, between the Sorachi-gawa and the Yubari-gawa, the two main tributaries of the Ishikari-gawa, and including the well-known collieries of Ashibets, Utashinai, Bibai, Pombets, Ikushunbets, Poronai, Miruto, Manji, Yubari, Oyubari, Kaede and Noborikawa.

East of the Yezo Range, productive coal-fields also occur in the province of Kushiro.

**CRETACEOUS DEPOSITS OF HOKKAIDO**

Being very rich in fossils and especially in Ammonites, the Cretaceous deposits of Hokkaido are the most distinguished of all the Mesozoic rocks in Japan. These are typically developed and better studied in the Ishikari coal-field than elsewhere in Hokkaido. The stratigraphy has been studied by Messrs. H. Imai and H. Yabe; the fauna by Messrs. M. Yokoyama, K. Jimbo, S. Yehara, S. Shimizu, T. Nagao, S. Hanzawa and H. Yabe; and the flora by Dr. M. C. Stopes, and Messrs. K. Fujii, Y. Suzuki, A. N. Kryshtofovich and S. Endo.

The Cretaceous deposits were for the first time subdivided by Yabe in 1903, the subdivisions then proposed being essentially followed even now. These subdivisions, however, need certain modifications in accordance with the knowledge more recently acquired; and a new revised system is introduced at this place.

I. The Lower Ammonites Beds. 900 m. or more.

This is the lowest division; a thick complex of shale and sandy shale of dark gray or black colour, sometimes with intercalations of thin layers of dark gray sandstone and marl; marl nodules of moderate size are common in the shale at different places. Along the lower course of the Sorachi-gawa, small lenses of limestone, gray to white in colour and containing abundant Orbitolina discoidea-conoidea var. ezoensis Yabe and Hanzawa, and
corals are intercalated in the shale; the shale underlying the limestone lenses contains another species of *Orbitolina, O. japonica* Yabe and Hanzawa. The limestone is also noteworthy as containing *Praecaprotina yaegashii* (Yehara). The uppermost part of the Lower Ammonites Beds is thin bedded shale and sandstone in alternation, and is distinguished as the Zone of *Lytoceras ezoense* Yabe. *Inflaticeras imaii* Yabe and Shimizu and *Oxytropidoceras* sp. are obtained in the Lower Ammonites Beds of the Ponhorokabets near the Yūbari colliery; the fossiliferous bed is believed also to belong to the *L. ezoense* Zone.

The type localities of the Lower Ammonites Beds are the Ikushunbets just above the first gorge, upstream from the colliery of the same name, and the lower course of the Sorachigawa, above the waterfall. On the fossil evidence, the Lower Ammonites Beds have been found to be Aptian-Albian (Gault) in age.

**List of Fossils from the Lower Ammonites Beds.**

° indicates the common fossils, and

* Ms. nom.

*Orbitolina*-Limestone.

° *Orbitolina discoidea-conoidea* var. *ezoensis* Yabe and Hanzawa

° *O. japonica* Yabe and Hanzawa

*Praecaprotina japonica* (Yehara)

*Lytoceras ezoense* Zone.

*Lytoceras ezoense* Yabe

*L. imperiale* Yabe

*Baculites gaudini* Pictet

*Turrilites cfr. bergeri* Brongn.

*Puzosia subcorbarica* Yabe*

*Inflaticeras imaii* Yabe and Shimizu

*Oxytropidoceras* sp.

II. The *Trigonia* Sandstone. 240–480 m. averaging 300 m.

The preceding complex is overlain by another thick series mostly composed of fine-grained sandstone of a light greenish gray colour in the fresh state, soon becoming yellowish by weathering. It intercalates conglomerate and shale at various horizons, and the sandstone becomes locally conglomeratic. Very
fossiliferous in certain zones; cephalopods rare; lamellibranchs and gastropods abundant. Especially rich in several species of *Trigonia, Pectunculus hokkaidoensis* Yabe and Nagao, and *Thetironia affinis* Whiteaves var. *japonica* Yabe and Nagao. On a former occasion, Yabe distinguished the three faunal zones of *Acanthoceras asiatica* (Jimbo) or *Trigonia longiloba* Jimbo, *Thetironia* (originally mentioned as *Thetis*), and *Pectunculus hokkaidoensis* Yabe and Nagao (originally mentioned simply as the *Pectunculus Zone*); but it is now considered better to withdraw these, until they are confirmed by later, more precise stratigraphical work. Ammonites found in the *Trigonia* Sandstone are *Acanthoceras asiatica* (*A. rhotomagense* var. *asiatica* Jimbo), *Turritites komotai* Yabe and *Desmoceras dawsoni* var. *japonica* Yabe, all of which indicate the Cenomanian age of the complex. The type locality of the *Trigonia* Sandstone is along the first gorge of the Ikushunbets just above the colliery of the same name.

List of Fossils from the *Trigonia* Sandstone.

○ indicates the common species.

*Pecten (Syncyclonema) cfr. obovatus* Stol.
*Nucula milnei* Yok.

○ *Pectunculus hokkaidoensis* Yabe and Nagao
*Trigonoarca cfr. tumida* Whiteaves
*Cucullaea ezoensis* Yabe and Nagao
*C. aff. truncata* Gabb
*Modiola ezoensis* Yabe and Nagao
*Astarte aff. striata* Sow.
*Inoceramus cfr. percostatus* Müller
*I. angulosus* Jimbo
*I. incertus* Jimbo

○ *Trigonia longiloba* Jimbo
○ *T. subovalis* Jimbo
○ *T. subovalis* Jimbo var. minor Yabe and Nagao
○ *T. hokkaidoana* Yehara
○ *T. brevicula* Yehara
*T. ainuana* Yabe and Nagao
○ *T. cfr. tryoniana* Gabb
Callista pseudoplana Yabe and Nagao

C. pseudoplana Yabe and Nagao var. alata Yabe and Nagao
C. var. elongata Yabe and Nagao

Spisula (Cymbophora?) subsulcata Yabe and Nagao

Thetironia affinis (Whiteaves) var. japonica Yabe and Nagao
Meekia cfr. sella Gabb
Voluitoderma (Rostellinda) bhiplicata Yabe and Nagao

Margarita funiculata Yok.

Cinulia sp.

Pugnellus sp.

Trochus vistulaeoides Yabe and Nagao

Tubulostium callosum Stol.

III. The Upper Ammonites Beds. 950 m.–1,550 m.

The Upper Ammonites Beds, which directly cover the Trigonites Sandstone, are again argillaceous, mostly composed of dark gray shale similar to, but in general of a lighter shade than, that of the Lower Ammonites Beds. Interbedded sandstone layers are not rare, being most frequent in the basal part. The shale is usually rich in marl nodules of various sizes and marine molluscan fossils, among which Ammonites and Inoceramus are dominant. The fossils are usually in an excellent state of preservation.

The Upper Ammonites Beds are subdivided into the following parts:

Mammites Zone (originally mentioned as the Upper Acanthoceras Zone)

Yezoites Beds (originally mentioned as the Scaphites Beds)

Parapachydiscus Beds (originally mentioned as the Pachydiscus Beds), comprising the Mesopachydiscus haradai (Jimbo) Zone and Neopachydiscus naumanni (Yokoyama) Zone.

The Mammites Zone is characterised by Mammites sp., the Yezoites Beds, by several species of Yezoites, Puzosia, Turritites and Hamites, and by Mortoniceras orientale Yabe, and the Parapachydiscus Beds, by numerous species of Parapachydiscus. While the Neopachydiscus naumanni Zone of the Parapachydiscus Beds is certainly Upper Senonian in age, being characterised by several species of Neopachydiscus, the Mesopachydiscus Zone is Lower Senonian, having Inoceramus schmidti Michael, Helcion gigantea Schmidt, Placenticeras subsulistriatum Jimbo, and several species
belonging to *Meso-, Epi-, Pseudo- and Anapachydiscus*. We are now of the belief that the *Yezoites* Beds and the lower part of the *Parapachydiscus* Beds intercalating the *Mesopachydiscus* Zone are almost contemporaneous, the two being in somewhat different facies. The marl nodules in the *Yezoites* Beds frequently include fragments of terrestrial plants, twigs and leaves, partly carbonised and partly calcified. The *Mammites* Zone is Turonian in age.

The type localities of the *Yezoites* Beds are along the upper course of the Yûbari-gawa above the junction of the Shi-yûbari and Pankemo-yûbari, and the upper course of the Opiraushibets in the province of Teshio, while those of the *Parapachydiscus* Beds are the Urakawa district in the province of Hidaka and the drainage area of the Abeshinai, a tributary of the Teshio-gawa. It is noteworthy that the *Parapachydiscus* Beds are almost entirely absent in the Ishikari coal-field, where the *Yezoites* Beds apparently replace the lower part of the complex, and the Hakobuchi Sandstone, the upper part.

The Hakobuchi Sandstone (the type locality being Hakobuchi, a sandstone gorge of the Yûbari-gawa, just above the Ô-yûbari colliery of the Mitsubishi Mining Company and below the junction of the Shi-yûbari and Pankemo-yûbari) is a thick complex composed of medium to fine-grained sandstone prevalently of a green colour, and intercalating conglomerate, sandy shale and shale beds at several horizons. Very characteristic of the complex are the beds of flinty shale and sandy shale, whitish in colour with a more or less bluish tint. Taken as a whole, this complex is liable to be easily confounded with the *Trigonia* Sandstone already mentioned above, owing not only to similarity in lithological character, both being arenaceous to rudaceous (in marked contradistinction to the Lower Ammonites Beds as well as the Upper Ammonites Beds in normal development), but also to the presence of *Trigonia subovalis* Jimbo var. *minor* Yabe and Nagao, which is a common species of the *Trigonia* Sandstone. On the other hand, the Hakobuchi Sandstone is likely to be mistaken for the coal-bearing Ishikari Series of Palaeogene age because of the intercalation of thin coal seams and thin plant beds at several horizons. It is one of the important contributions by Mr. H. Imai to the geology of the Ishikari coal-field,
that the Hakobuchi Sandstone is distinguished as an independent complex, overlying the Yezoites Beds and unconformably underlying the base of the Ishikari Series.

The plant beds in the Sandstone usually contain numerous *Nilssonia* leaves, together with those belonging to ferns, cycads, conifers and dicotyledons. Mr. S. Endo distinguished four species of ferns, seven of cycad-like plants, two of conifers and four of dicotyledons, as the following list shows:

*Pteris frigida* Hr.
*Asplenium dicksonianum* Hr. (?)
*Phyllites* sp. cfr. *Adiantum formosum* Hr.
*Pecopteris torellii* Hr. (?)
*Glossozamites* (?) *imaii* Endo
*Phyllites* sp. cfr. *Sphenozaamites rogersianus* Fontaine
*Cycadeoidea nipponica* Endo
*Nilssonia* cfr. *orientalis* Hr.
*N.* cfr. *johnstrupi* Hr.
*N.* *serotina* Hr.
*Libocedrus sabiniana* Hr.
*Sequoia heterophylla* Velenovsky
*Populus denticulata* Hr.
*P.* *arctica* Hr. (?)
*Rhamnites apiculatus* Lesq.
*Protophyllum obovatum* Newb.

Marine shells are but seldom found in other parts of the Sandstone; *Trigonia subovalis* var. *minor*, *Rhynchonella* sp. and *Cucullaea* sp., however, occur.

In the Ishikari coal-field, Mr. Imai estimated the thickness of the Hakobuchi Sandstone as 350 m. and that of the underlying Yezoites Beds as 600 m.—1,200 m.

List of Fossils from the Upper Ammonites Beds.
○ indicates common species and * MS. nom.

Mammites Beds.

*Acanthoceras (Kossmatia) pseudodeverianum* Jimbo
*A. (K’.) japonicum* Yabe*
*A. (K’.) yubarensce* Yabe*
*Mammites* sp.
Fagesia kotoi (Yabe)
F. ? unicum (Yabe)

Scaphites Beds and Parapachydiscus Beds

Pleosporites shiraianus Suzuki
Petrospora japonica Stopes and Fujii
Schizaeopteris mesozoica Stopes and Fujii
Fasciostereopteris tansleii Stopes and Fujii
Pteris frigida Heer
Asplenium dicksonianum Hr. (?)
Cfr. Adiantum formosum Hr.
Pecopteris torelii Hr. (?)
Glossozamites (?) imaiii Endo
Cfr. Sphenozamites rogersianus Fontaine
Cycadeoidea nipponica Endo
Nilsonia cfr. orientalis Hr.
N. cfr. johnstruppi Hr.
N. serotina Hr.
N. sp.
Nipponophyllum cordaitiforme Stopes and Fujii
Yezonia vulgaris Stopes and Fujii
Yezostrobus oliveri Stopes and Fujii
Araucarioxylon tankoense Stopes and Fujii
Cedroxyylon matsumurae Stopes and Fujii
C. yendoi Hr. Stopes and Fujii
Cunnighamiostrbus yubarensis Stopes and Fujii
Cryptomeriopsis antiqua Stopes and Fujii
C. mesozoica Suzuki

Abicaulis yezoensis Suzuki

Libocedrus sabiniana Hr.

Sequoia heterophylla Velenovsky

Saururopsis niponensis Stopes and Fujii
Jugloxylon hamaoanum Stopes and Fujii
Sabiocaulis sakuraii Stopes and Fujii
Populocaulis yezoensis Stopes and Fujii
Fagoxylon hokkaidense Stopes and Fujii
Cretovarrium japonicum Stopes and Fujii
Populus denticulata Hr.
P. arctica Hr. (?)
Rhamnites apiculatus Lesq.
Protothallus obovatum Newb.
Kingena sp.
Rhynchonella sp.
R. cfr. plicatiloides Stol.
Pecten sp.
P. cfr. gardanus Stol.
P. (Propeamuseum) cooperi Waring var. radiatus Yabe and Nagao
Cucullacea cfr. sachalinensis Schmidt
C. sp.
○ Inoceramus ezoensis Yok.
○ I. aff. lobatus Münster
○ I. schmidtii Mich.
Lucina cfr. fallax Forbes
Trigonia sawatai Yehara
T. subovalis Jimbo var. minor Yabe and Nagao
○ Helcion giganteus Schmidt
Capulus casidarius Yok.
Tessarolax japonicus Yabe and Nagao
○ Phylloceras ramosum Meek
○ P. ezoense Yok.
P. nera Forbes
○ Gaudryceras tenuiliratum Yabe
○ G. tenuiliratum Yabe var. ornatum Yabe
○ G. var. intermedium Yabe
G. var. infrequentis Yabe
G. crassicostatum Jimbo
G. striatum Jimbo
G. striatum Jimbo var. pictum Yabe
G. denseplicatum Jimbo
G. yamashitai Yabe
G. yokoyamai Yabe
G. limatum Yabe
G. limatum Yabe var. obscurum Yabe
○ Tetragonites glabrus Jimbo
T. crassus Jimbo
○ T. sphaeronotus Jimbo
○ T. popetensis Yabe
○ T. cfr. epigonus Kossmat
Baculites teres Forbes
Baculites asper Morton
B. aff. bohemicus Fritsch

○ Hamites (Polyptychoceras) pseudogaullinus Yok.
○ H. (P.) haradanus Yok.
○ H. (P.) subundulatus Yok.
○ H. (P.) yubarensis Yabe*
H. (P.) obstrictus Jimbo
○ H. (P.) cfr. vancouverensis Whiteaves
○ H. (Anisoceras) indicus Forbes
○ H. (A.) largesulcatus Forbes
H. (A.) notabilis Whiteaves
○ H. (A.) aff. subcompressus Forbes
○ H. (?) n. sp. (H. cfr. rugatus Yok.)
H. (Oxybeloceras?) quadrinodosus Jimbo
H. (O.) sanushibensis Yabe*

Bostrychoceras otsukai Yabe
B. cfr. indicum Stol.
B. otsukai Yabe var. multicostata Yabe
B. japonicum Yabe

Helicoceras? scalare Yabe
H. ? venustum Yabe
Heteroceras? orientale Yabe
Hyphantoceras oshimai Yabe
Nipponites mirabilis Yabe

○ Desmoceras (Kotoceras) damesi Jimbo
D. (K.) laeve Yabe*
D. (K.) semicostatum Yabe*
D. ? selwynianum Whiteaves
D. ? poronaicum Yabe*

Hauericeras angustum Yabe
H. gardeni Baily

Kossmaticeras kotoi (Jimbo)

K. pusillum (Yabe)*
K. iburiense (Yabe)*
○ K. ishikawai (Jimbo)
K. japonicum (Yabe)*
K. (Madrasites) pachystomum (Kossmat)
K. (M.) theobaldianum (Stol.)

Parapachydiscus (Pseudopachydiscus) kossmati (Yabe)
Parapachydiscus (Pseudopachydiscus) Jimboi (Kossmat)

- P. (Mesopachydiscus) haradae (Jimbo)
- P. (M.) teshioensis (Jimbo)
- P. (Neopachydiscus) naumannii (Yok.)
- P. (N.) ariyalurensis (Stol.)
- P. (N. ?) subtililobatus (Jimbo)
- P. (N.) sphaericus (Yabe P. naumannii Yok. pars.)
- P. (N. ?) kitamiensis (Yabe)*
- P. (N. ?) ezoensis (Yabe)*

P. (Epipachydiscus) mamiyai Yabe and Shimizu

P. (E. ?) abeshinaiensis (Yabe)

P. (Anapachydiscus) fascicostatus (Yabe)

P. (A. ?) koluturensis (Stol.)

P. (A. ?) sutneri (Yok.)

P. (Menuites) rotalinoides (Yabe)

Puzosia yubarensis (Jimbo)

- P. planulatiformis (Jimbo)

- P. indopacifica Kossmat

- P. alterna Yabe*

- P. ezoensis Yabe*

- P. elegans Yabe*

- P. japonica Yabe*

Prionotropis teshioensis Yabe and Shimizu

Prionocyclus aequicostatus Yabe and Shimizu

- Barroisiceras minimum Yabe

Mortoniceras orientale Yabe

M. namii Yabe and Shimizu

M. sanushubense Yabe and Shimizu

Gauthiericeras rarum Yabe

Peroniceras ninakawai Yabe and Shimizu

- Placenticeras subtilistriatum Jimbo

Neocriceras spinigerum Jimbo

Scaphites yokoyamai Jimbo

S. pseudoaequalitis Yabe

S. yonekurai Yabe

S. gracilis Yabe

- S. (Yezoites) planus Yabe

- S. (Y.) puerculus Jimbo

- S. (Y.) puerculus Jimbo var. teshioensis Yabe

- S. (Y.) perrini Anderson
Eucorystes japonicus Jimbo
Linuparus cfr. vancouverensis Whiteaves
Lamna appendiculata (Ag.)
Odontaspis cfr. complanata (Egerton)
Oxyrhina (Meristodon) sp.

Finally, it must be specially noticed that the Cretaceous deposits are always perfectly conformable to one another and evidently represent a continuous sedimentation, though the Trigonia Sandstone indicates a temporary rising of the sea bottom. As the Trigonia Sandstone and Lower Ammonites Beds are known to develop in Hokkaidō nowhere else than in the Ishikari coal-field and the Upper Ammonites Beds are extensively developed in and outside of it, the Senonian transgression, we believe, certainly took place also in Hokkaidō, just as in the more southern part of the Japanese Archipelago.

THE PALAEogene COAL-BEARING GROUP OF THE ISHIKARI COAL-FIELD
(THE ISHIKARI SERIES)

The Cretaceous deposits are unconformably overlain by a thick complex of Palaeogene deposits, called the Ishikari Series by Yabe some 25 years ago. Mr. H. Imai lately undertook a detailed stratigraphical study of the series and finally established the following subdivisions:

1. The Noborikawa Group.

This is the lowest coal-bearing member of the Ishikari Series; composed of thin-bedded sandstone, sandy shale and shale in alternation, and intercalating a number of coal seams which are usually thin and of inferior quality, but become thicker and better in the southern part of the Ishikari coal-field and especially in the Noborikawa Colliery; very variable in total thickness, measuring only 29 m. along the Yūbari-gawa below the junction of the Shi-yūbari and Pankemo-yūbari, but more than 150 m. at the Noborikawa Colliery. Plant remains not rare.

2. The Horokabets Shale.

A black shale bed about 60 m. thick, with interbedded thin marl layers; plant fossils are not rare, but usually so badly preserved as to be indeterminable. Glyptostrobus europens Hr., Salvinia sp., Taxus sp.
3. The Yūbari Group.

This is the lower coal-bearing member; sandstones alternating with many important coal seams; varying in thickness from 60 m. in the southern part to 600 m. in the northern. Plant remains not common; also fresh-water Mollusca such as *Vivipara* and *Unio*. According to the provisional determination of Mr. Endo, the plants belong to *Glyptostrobus ungeri* Hr., *Taxodium, Sequoia, Fraxinus macrophylla* Hr. ?, *Salix varians* Göpp., *Betula* sp., *Fagus castaneaefolia* Ung., *Populus arctica* Hr., *P. spp.*, *Viburnum cuneatum* Newb. (?), *Castanea ungeri* Hr., *Laurus* sp., *Pteris* sp., *Osmunda heerii* Gaudin.

4. The Wakkanappe Shale.

Marine shale of gray to dark gray colour, rarely with intercalations of thin sandstone bands and large marl nodules; 60 m. thick but often less. Remains of thin-shelled marine mollusca occur but rarely; also *Venericardia* sp.

5. The Wakkanappe Sandstone.

120 m. thick; composed of sandstone, sandy shale and shale. Sandstone usually gray to dark gray in colour, sometimes with bluish or greenish tint, fine-grained and fragile, sometimes coarse and containing quartz pebbles, often calcareous and full of sand pipes; shale gray to dark gray in colour, often thin-bedded and intercalated with sandstone. Marl nodules sometimes found in sandstone and shale. There are numerous *Ostrea* zones intercalated in this group; it also contains at places numerous marine Mollusca, especially bivalves. This molluscan fauna has not yet been worked over; but it is at least certain that a form of *Crassatellites* abounds which is almost indistinguishable from a species found in the Ashiya Group of Kyūshū.

6. The Bibai Group.

The middle coal-bearing member; composed of sandstone and shale in alternation and having several important coal seams. 150 m. thick. Plant remains common: *Sabal nipponica* Kryshtofovich, *Glyptostrobus, Sequoia, Taxodium, Nelumbium, Salvinia*, etc.

7. The Lower *Corbicula* Beds.

300-450 m. thick; complex of shale, sandy shale and sandstone, intercalating coal seams, thin marl layers and shell beds,
and sometimes containing huge marl nodules. Coal seams usually thin and worthless; but at places of workable quality and thickness. Ostrea and Corbicula abundant in shell beds; also a particular species of Modiola.

8. The Woodwardia Zone.

Ca. 60 m. thick; complex, characterised by a whitish or grayish sandstone or sandy shale, which is hard and compact, and often flinty; also thin platy sandstone, shale and thin coal seams. This zone contains a rich and characteristic flora, the prevailing types, according to Mr. Endo, being those given in the following list.

List of Plants from the Woodwardia Zone, following the Provisional Determination by Mr. S. Endo.

* indicates the common species.

*Aspidium oerstedii* Heer

Asplenium cfr. tenellum Knowlton

Osmunda affinis Lesquereux

O. sp.

Onoclea hebradica Gardner

Woodwardia latiloba Lesq.

* W. cfr. maxoni Knowlton

W. münsteriana (Sternb. & Presl)

Ginkgo cfr. adiantoides (Unger)

Glyptostrobus ungeri Hr.

Sequoia langsdorfii (Brongniart)

* Taxodium distichum miocenum Hr.

Alisma paucinervis Hr.

Iris latifolia Hr.

Musophyllum complicatum Lesq.

M. sp. (cfr. Musa basjoo Sieb.)

* Acer arcticum Hr.

*Alnus kefersteinii* (Göppert)

*Büttneria aequifolia* (Göppert)

Carya antiquorum Newbwrty

Castanea ungeri Hr.

Celastrus? borealis Hr.

Cinnamomum lanceolatum (Unger)

Corylus insignis Hr.
* Corylus macquarrii (Forbes)
* Ficus occidentalis Lesq.
* Grevia crenata (Unger)
  G. crenulata Hr.
* Hedera macclurii Hr.
* Juglans sp.
* Laurus schmidtiana Hr.
* Leguminosites sp.
* Nyssa arctica Hr.
* Paliurus colombi Hr.
* Platanus aceroides Göpp.
* P. cfr. guillelmae Göpp.
* Populus arctica Hr.
  P. cuneata Newberry
* P. latior A. Br.
* P. mutabilis Hr.
* P. speciosa Ward
* P. subrotundata Lesq.
* P. richardsonii Hr.
* P. zaddachi Hr.
* Prunus serrulata Hr.?
* Viburnum nordenskjoeldi Hr.
* Zizyphus cfr. falcatus Berry
* Z. meekii Lesq.
* Z. meigsii Berry


This is the upper coal-bearing member, consisting mostly of alternations of dark gray to gray sandstone and shale, which are somewhat different in aspect from those of the Woodwardia Zone: conglomerate rarely intercalated. There are more than 10 coal seams in the complex, of which 4 to 7 are workable, each measuring 1 to 2 meters or more. Plant remains are common, though less so than in the Woodwardia Zone, and specifically indistinguishable from those of the latter. The Ikushunbets Group and Woodwardia Zone are stratigraphically very intimate, and the former can be included in the latter as its uppermost part, being only 40-100 m. in thickness: only in the Ikushunbets district, does the Ikushunbets Group attain a considerable development, 300-360 m., and might better be regarded as a distinct complex.
10. The Upper Corbicula Beds.
Quite similar to the Lower Corbicula Beds in lithological, palaeontological and stratigraphical nature; varying in its total thickness from 60 m. to 300 m.

The uppermost coal-bearing member, very similar to the Woodwardia Zone and Ikushunbets Group in lithological nature, but characterised by its sandstone frequently being coarse- to medium-grained and sometimes tufaceous; 270-500 m. thick. Plant fossils common; also with fresh-water Mollusca like Vivi- para and Unio. Characteristic of this group are Liquidambar formosana Hance, Trapa borealis Hr., Comptoniphylum japonicum Nathorst, Nelumbium sp., Sequoia and Taxodium. This complex is especially well-developed in the Ashibets district, where it contains more than 10 coal seams of which 2 are workable.

None of these subdivisions of the Ishikari Series are constant in thickness, but vary in one direction or another as already stated. There is, however, no sign of any marked stratigraphical break in them.

The Ishikari Series is overlain in considerable unconformity by the Poronai Series, which is presumably Lower Neogene in age.

THE NEOGENE DEPOSITS OF THE ISHIKARI COAL-FIELD

Of the Neogene deposits of the Ishikari coal-field, the following two are important:
The Poronai Series.
The Kawabata Series.

1. The Poronai Series, a name proposed by Yabe in 1901 for a complex of dark gray shale intercalating thin marl layers and containing numerous marl nodules; glauconitic and sandy at the base. The basal sandy part varies greatly in thickness from place to place; the total thickness of the series is estimated by Mr. Imai to be 600-900 m. Characterised by the peculiar fauna listed below and by "Gennoishi," a calcite pseudomorph.

List of Fossils from the Poronai Series

Lagena gottschei Yok.
Anomalina floscularia Yok.
Rotalia lymani Yok.
Rotalia nitida Reuss
Pulvinulina (?) singularis Yok.
P. japonica Yok.
Bolivina cuplactela Yok.
Bullimina capitata Yok.
B. polymorphinoides Yok.
B. baccata Yok.
B. schwageri Yok.
B. ezoensis Yok.
B. sp.
Pleurostomella peregrina Yok.
Polymorphina seminulina Yok.
Frondicularia scolopendralia Yok.
Frondicularia sp.
Nucula poronaica Yok.
Nucula picturata Yok.
Venericardia compressa Yok.
Lucina poronaicensis Yok.
Thyasira bisecta Conrad
Tapes ezoensis Yok.
Turritella wadana Yok.

There are also a few species belonging to Yoldia, Pecten, Tellina, Neptunia, Buccinum, etc. Of these fossils, the most common are Venericardia compressa, Nucula picturata, N. poronaica, one or two species of Yoldia, Turritella wadana and Bullimina. In general, the fauna of the Poronai Shale is rich in number of individuals, but poor in species.

The Poronai Series is not limited in its distribution to the Ishikari coal-field, but extends to the provinces of Teshio, Kitami, Tokachi, Kushiro and Hidaka.

2. The Kawabata Series. The two series of Poronai and Kawabata are connected by a transition group, 60-90 m. thick; the Poronai shale is here interbedded with sandstone in thin layers. The typical Kawabata, more than 900 m. thick, consists of thin-bedded sandstone and shale in regular alternation; more or less thick-bedded near the base; also intercalating conglomerate with pebbles of Palaeozoic rocks, granite, diorite and augite andesite. Many fossil shells are enclosed in the shale and sandstone at various horizons; the molluscan fauna has a decidedly younger aspect than that of the Poronai Series.
THE GEOLOGICAL STRUCTURE OF THE ISHIKARI COAL-FIELD

Though the detailed geological structure of the Ishikari coal-field is certainly extremely complicated and there are many features still puzzling to us, yet its grand aspect is easy to grasp.

The river Ikushunbets, with its average E-W trend, divides the coal-field into two unequal portions. In the northern part there is Mt. Bibai extending from north to south and attaining 814 m.; geologically, this is an anticline, with the Lower Ammonites Beds at its core and successively overlain by the Trigonia Sandstone, the Upper Ammonites Beds, and the Ishikari and Poronai Series successively on both wings. The Tertiary rocks of the western wing are variously dislocated by folding and faulting, such as we are familiar with in mining districts between Utashinai in the north and Bibai in the south; whereas those of the eastern wing form a single syncline, which is bordered by a meridional fault, some 4 km. east of the valley of Ashibets. To the east of the dislocation line, there are again exposed the Cretaceous rocks of west dip, and from there on come into sight the Upper Ammonites Beds, Trigonia Sandstone and Lower Ammonites Beds with Orbitolina limestone in regular order from west to east.

The crest line of the Mt. Bibai anticline sinks northward; on the other hand, southward and near the Ikushunbets, it divides into two. While the western anticline, extending SSW beyond the river to the Horomui, is acute and asymmetrical, with its west wing vertical or inverted and the east wing rather gentle, the eastern anticline is rather broad and flat, having entirely lost its cover of Tertiary rocks. South of the Ikushunbets, the two anticlines embrace a rather broad syncline or synclinorium, opening to the south. This is composed of Tertiary rocks which show multiple series of folds and faults. The broad dome of the Cretaceous rocks lying west of the Manji Colliery and the narrow anticline of the same along the Ponhorokabets, a tributary of the Shiorokabets, in the Yūbari mining district, are the southern continuation of the western anticline, gradually becoming broader and at the same time much lower.

The synclinorium of Tertiary rocks in the southern Ishikari coal-field, alluded to above, is bordered on the east by the Cretaceous rocks along a line which extends from the lower course of the Penkehorokabets, a right tributary of the Shi-yūbari, due southward into the drainage area of the Mukawa, in the province of Iburi, for a distance
Geological Sketch Map of the Ishikari Coal-Field
1:500,000

- Palaeozoic
- Cretaceous
- Tertiary
- Gabbro
- Serpentine
- Basalt
of over 20 km. Along the geological-boundary line, both the Cretaceous and Tertiary rocks are inverted or upturned; downstream along the transverse valley of the Yūbari-gawa, there is a series of excellent exposures of the Ishikari and Poronai Series showing a number of recumbent folds and overthrusts, or, taken altogether an imbricate structure, of east dip. The most complicated structure in the entire Ishikari coal-field, is, however, developed along another line, marking the northeastern border of the synclinorium of the Tertiary rocks and extending from the lower course of the Penke-horokayūbari along the water-shed between the Horomui and Ikushunbets rivers to the upper valley of the Bannosawa, a left tributary of the Ikushunbets. In the drainage areas of the Penke- and Panke-horokayūbari, Messrs. Imai and Yabe found a flat sheet of Cretaceous rocks lying upon the much folded and faulted Ishikari and Poronai Series, a typical "Decke."

In the Ikushunbets mining district to be visited in the present excursion, the upturned Poronai shale is followed successively eastward by the Ikushunbets Group of the Ishikari Series, the Upper Ammonites Beds, *Trigonia* Sandstone and Lower Ammonites Beds, all in the same disposition. However, the two members of the Upper Ammonites Beds, the Hakobuchi Sandstone and *Yezoites* Beds are entirely squeezed out and not exposed along the Ikushunbets, while a part of the *Yezoites* Beds are found intact between the *Trigonia* Sandstone and the Ishikari Series at a short distance north and south of the river course. The Upper Ammonites Beds, on the other hand, are well developed on the eastern wing of the anticline.

**ITINERARY**

The following two routes have been selected to show the characteristic features of the different formations described above, with the exception of the Hakobuchi Sandstone and Kawabata Series, which are not exposed in this vicinity.

I. We follow the Ponbets first northwards from its junction with the Ikushunbets, and then eastwards. Exposed to the west, beyond the broad river terraces, is the dark gray shale of the Poronai Series with indistinct traces of stratification and containing numerous marl nodules. To the right are seen the sandstone and shale of the Ikushunbets Group of the Ishikari Series in upright position or in a very steep west dip. There are intercalated in the Group more than
20 coal seams, of which 10 are more than 1 m. thick and workable. Beneath it lies the Woodwardia Zone which is here much reduced in thickness, measuring some 10 m.; a black shale exposed along the left bank is rich in plant leaves. Upstream, the Ishikari Series is succeeded by a thick dark gray shale of the Upper Ammonites Beds with W 80° dip, about 120 m. thick; a thin greenish sandstone layer at the top of the shale encloses rarely Cucullaea sp. and is believed also to belong to the Cretaceous, while just at the boundary between it and the Woodwardia Zone it is covered with detritus. The shale of the Upper Ammonites Beds contains Inoceramus, a few ammonites and other fossils, and is conformably underlain by the Trigonia Sandstone, (about 440 m. thick) and the Lower Ammonites Beds successively. The details are given in the following columnar section.

**Columnar Section of the Trigonia Sandstone exposed along the Pombets-gawa, near the Pombets Colliery, Sorachi-gun. Scale 1:6000.**

<table>
<thead>
<tr>
<th>Formation name</th>
<th>Character of Rocks and Fossils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Ammonite Bed</td>
<td>Dark grey or black shale containing Inoceramus sp. Ammonite sp. and other fossils.</td>
</tr>
<tr>
<td>Trigonia Sandstone</td>
<td>Thin layer of conglomerate cont. Cardium sp. and other fossil shells. Ostrea sp. in thin layer of conglomerate. Grey or greenish grey sandstone. Trigonia Hokkaidoana Yehara in sandstone.</td>
</tr>
<tr>
<td>Total thickness, Ca. 14700</td>
<td>Grey or dark grey sandstone</td>
</tr>
<tr>
<td></td>
<td>Conglomerate ca. 200</td>
</tr>
<tr>
<td></td>
<td>Grey sandstone containing marly nodules.</td>
</tr>
<tr>
<td></td>
<td>Dark grey sandy shale. Grey platy sandstone.</td>
</tr>
<tr>
<td>Lower Ammonite Bed</td>
<td>Dark or black shales thinly intercalated by sandstone.</td>
</tr>
</tbody>
</table>

(After H. Imai 1924)
II. We follow the Ikushunbets southwestwards from the Ikushunbets Colliery. The Poronai Series, Ikushunbets Group, *Trigonia* Sandstone and Lower Ammonites Beds are well-exposed along the valley-walls, all inverted and inclining steeply eastwards. The Poronai Series is sandy and glauconitic near the base; the Ikushunbets Group apparently overlying the Poronai Series is some 550 m. thick at this place, intercalating more than 10 coal seams, of which 7 are thicker than 1 m. and workable. The next older *Woodwardia* Zone as well as the Upper Ammonites Beds, exposed along the Ponbets, are entirely excluded at this place, and the Ikushunbets Group is directly overlain by the *Trigonia* Sandstone. The river cuts a deep gorge through the sandstones of the two groups, which are quite intact; their precise boundary is hardly discernible.

*Columnar Section of the Trigonia Sandstone exposed along the Ikushunbets-gawa, near Ikushunbets Colliery.*

<table>
<thead>
<tr>
<th>Formation name</th>
<th>Column Section</th>
<th>Character of Rocks and Fossils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ikushunbets Coal-bearing Group (a part)</td>
<td></td>
<td>Sandstone and shale in alternation, intercalating many coal seams.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grey sandstone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thin Conglomerate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grey, dark grey and greenish grey sandstone, fine or coarse grained; often intercalated by bluish grey sandy shales.</td>
</tr>
<tr>
<td>Trigonia Sandstone. Total thickness about 1590'</td>
<td></td>
<td>Conglomerate containing <em>Ostrea</em> sp. 20'</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grey sandstone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thin Conglomerate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grey to dark grey sandstone, fine or coarse grained.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thin conglomerate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grey or greenish grey sandstone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Trigonia longicollis</em> Jimbo.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Margarites burrullensis</em> Y.B. in sandstone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thin conglomerate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Trigonia</em> sp. (T. subovalis Jimbo).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bluish grey sandstone containing marly nodules which inclose <em>Ammonite</em> sp. (Acanthoceras retomagenae var asiatica) Jimbo.</td>
</tr>
<tr>
<td>Lower Ammonite Bed.</td>
<td></td>
<td>Dark to black shale or sandy shale thinly intercalated by sandstone.</td>
</tr>
</tbody>
</table>

(After H. Imai 1924)
The *Trigonia* Sandstone is 450 m. thick and very rich in fossils in its lower part (stratigraphically), *Trigonia*, *Thetitonia* and *Pectunculus* being most common. Just above the gorge, it is apparently overlain by a complex of thin-bedded shale and sandstone in alternation,—the *Lytoceras ezoense* Zone of the Lower Ammonites Beds.

The Lower Ammonites Beds, which here constitute the core of a large recumbent anticline, continue to be exposed along the valley upstream for a distance of about 1.5 km.; whereas the second gorge of the river is occupied by the *Trigonia* Sandstone; the dip of the eastern wing is rather low, being 60°-30°. The Upper Ammonites Beds exposed upstream are very fossiliferous, and numerous marl nodules derived from the complex and containing beautifully preserved ammonites and other fossils are found as float on the river bed.

**POSTSCRIPT**

To Tokachi-dake on p. 2. A disastrous accident took place on the occasion of the eruption of Tokachi-dake on the evening of May 24, this year. The direct effect of the explosion was not of much significance; the west wall of the small central cone was destroyed, giving place to a new explosion craterlet, about 100 m. long and 50 m. wide; the waters of the crater lake, mingled with heated material from the destroyed crater wall, produced a mud flow which rushed down the steep western slope of the mountain into the narrow valley of the Furano-gawa. The mud flow was soon augmented by melting snow and swept everything before it soil, rock debris, trees, etc. After having run down over 20 km. in about half an hour, it reached the plain of Kami-Furano, covering it with debris, and annihilating the village of Kami-Furano. More than 150 persons were lost.

Mr. M. Watanabe, to whom I owe the above information, further reported that he saw a peculiar rock body with a very fresh appearance exposed at the bottom of the newly-formed craterlet, which is very likely the top of a lava plug in the initial stage of protrusion.
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Fig. 1. Late Cretaceous section the water-shed between the upper source of the Ichihara-gawa and the main course of the Arakita: showing the order of succession of the Iseki-eras and the Shizuoka formations; drawn somewhat diagrammatically. After 1924.

Fig. 2. Profile along the Valley of Ichibumato above the Ichibumato Cuttery. After 1924.

Fig. 3. Profile along the right bank of the Ichikawagawa from the so-called Kakebuchi Gorge near Oyukari to Shiminosema, showing the relation of the Iseki Series and the underlying formations. After 1924.

Legend:
- Lower Ammonite Lias
- Trigonias Sandstone
- Upper Ammonite Lias
- Kakebuchi Sandstone
- Iseki Series Sandstone and Lias
- Iseki Series Estuarine Formation
- Kakebuchi Gorge
- Ichibun Gorge
- Ichibumato Cretaceous and Sandstone
- Ichibumato Cretaceous Sandstone
- Mikawaya Cretaceous Sandstone
- Kakebuchi Gorge
- Continuens limestone mass
GEOLOGICAL MAP OF THE ENVIRONS OF IKUSHUNBETS,
THE ISHIKARI COAL FIELD, HOKKAIDO.

LEGEND.

Te  The Terrace Deposits.
La  The Lower-Ammonites Bed.
Tr  The Trigonia Sandstone.
Li  The Upper-Ammonites Bed.
Ww  The Woodwardia Zone.

Ce  The Ikushunbets Coal-Bearing Group.
Pn  The Poronai Series.

Cretaceous.
Older-Tertiary.
(The Ishikari-Series)
Younger-Tertiary.

--- Fault Line. --- Coal Seam.

SCALE 1:40,000.
CONTOUR INTERVAL 20 METERS.

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