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206. FOSSIL DIATOMS FOUND IN THE KAYAMA CLAY-SHALE ON THE OUTSKIRTS OF KANAZAWA CITY[1]

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金沢市效外茅山の粘土質頁岩中から発見された化石珪藻65種を記載し，これら化石を含む堆積物は，礫層を主とする卯辰山層の一部であり，しかも化石珪藻の大部分が淡水中から知られているものであるから，卯辰山層の一部は，淡水堆積物である．

卯辰山層の時代は鮮新世か，それとも更新世か，その帰属はまだ明かにされていないが，ここでは下位にあると考へられる海成の大桑砂層とは全く別なものである．市川　渡．

INTRODUCTION

In the present article, the writer has attempted to give close attention to details concerning the assemblage of the fossil diatoms in the Kayama clay-shale.

The Kayama clay-shale is one facies of what was called by Prof. K. MOCHIZUKI the Utatsuyama bed. Its geological age has not yet exactly been determined. But it is a certain fact that the bed belongs to the early Pleistocene or the late Pliocene.

The exposure of this clay-shale is limited to a small cliff which is about 6 m in height and 5 m in width. (See Text-Fig.) The sample used for my experiment had been selected from the central portion of that cliff. Its colour is grayish white. As the sample is comparatively homogeneous, the method of its chemical treatment is simple as follows:—

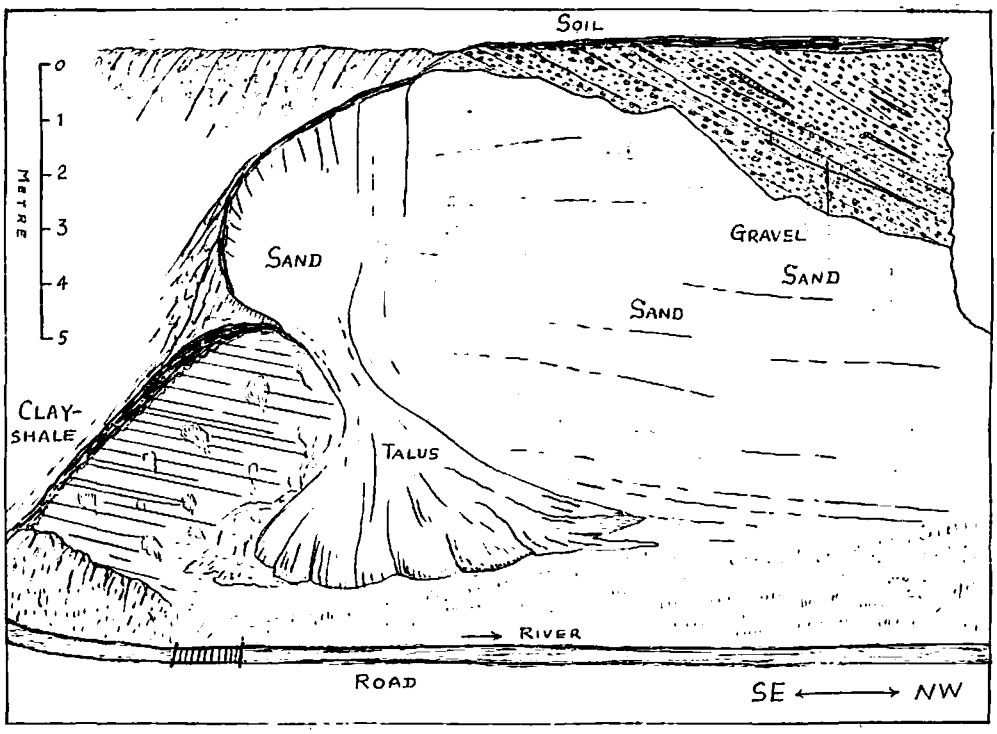
First, some of the material is loosened in one test-tube by some distilled water. After that, concentric sulphuric acid twice or thrice as much as the used material is poured into it, and the test-tube is left as it stands for three or four hours. After having been sufficiently washed by distilled water, the material must be taken out from that test-tube, and it is dried in the constant temperature furnace until it becomes white powder. Its dried powder is useful for the microscopical test of fossil diatoms.

The writer wish to record here my indebtedness to Proc. Dr. I. HAYASAKA of our University and Prof. Dr. KOBAYASHI of the Tokyo University who so kindly made helpful suggestions in connection with the present study.

Some geo-ecological Problems of the Utatsuyama Bed

The Utatsuyama bed is composed of gravel, sand, mud and clay-shale. It lies unconformably on the Onma bed of the Onma series which belongs to the Pliocene age. The area in the surrounding of Kanazawa City where the Utatsuyama bed is now exposed, is comparatively wide.

1) Read March, 24, 1951; received June 18, 1951



Text-Figure The Kayama clay-shale exposed by weathering.

Little is known, however, of the sediments and microfossils of the clay-shales found in the Utatsuyama bed, and it is the chief aim of this study to elucidate these aspects.

The Onma bed is composed of sand, mud, tuff and shale etc. The geological relation between the Utatsuyama and the Onma bed has been pointed out by a few geologists. According to their data, the latter is of marine origin in view of its fossil remains. The former, however, remains unexplained.

The upper part of the Utatsuyama bed is characterized by gravels. But it also contains sand, mud and clay-shale here and there. The fact means that the geological structure of the bed is complicated.

The mudstone of the Onma bed contains many fossil diatoms which were carried by a sea-current, or deposited with other livings near the coast. For example, the Mitsukoji mudstone of the Onma bed found at the eastern outskirt of Kanazawa City contains many marine diatoms together with sponge spicules, Radiolaria and Silicoflagellata.

Although the exposure of the Kayama clay-shale is limited to a small area, it contains many fossil diatoms deposited with other Algae and Fishes. Most of them belong to the fresh-water forms. The sediment, therefore, is of fresh-water origin.

The Kayama clay-shale is unconformably covered by sand, and this sand again by gravel in the same way. Each boundary of these layers is complicated. Such clay-shale, mud and sand have been found at a few places in the exposed part of the Utatsuyama bed. The Kayama clay-shale is only one instance of them.

The most of the fossil diatoms which the writer found in the Kayama clay-shale belong to the recent fresh-water forms. From this fact, it is concluded that the Kayama clay-shale was the sediment of a pond or a swamp or a small lake in the past. From this reason, it may be stated that some part of the Utatsuyama bed is of the freshwater deposit.

Fossil Diatoms in the Kayama Clay-shale

A list of diatoms showing the relative frequency of each species in the assemblage, provides a basis for determining such ecological conditions during deposition as fresh water, lacustrine, brackish estuary, shallow water marine, open sea, etc.

According to my microscopical examination, it is found that the sample collected from the Kayama clay-shale, contains the following sixty-five species of diatoms:—

TABLE I
List of Diatoms and their Habitats.

Specific Name	Habitat	D. C. R.	No. on Plate
Achnanthes aueri KRAS.	Fresh water	Rare	1
Achnanthes brevipes AG.	Marine and brackish water	〃	2
Achnanthes Hauckiana GRUN. var. *densistriata* HOR. et OKU.	Fresh water	〃	3
Achnanthes lanceolata (BRÉB.) GRUN.	〃	〃	4
Amphora ovalis KTZ.	〃	〃	5
Caloneis silicula (EHR.) CL.	〃	〃	6
Campylodiscus cribrosus W. SM.	Marine and brackish water	〃	7
Cocconeis placentula EHR. var. *klinoraphis* GEIT.	Fresh water	〃	8
Cocconeis placentula EHR. var. *lineatus* (EHR.) CL.	〃	〃	9
Cocconema cistula HEMPR.	〃	〃	47
Cocconema cymbiforme EHR.	Fresh water	〃	10
Coscinodiscus eccentricus EHR.	Brackish	〃	11
Cymbella affinis KTZ.	Fresh water	〃	12
Cymbella gracilliam HUST.	〃	〃	13
Cymbella prostrata (BERK.) CL.	〃	〃	14
Denticula obtusa KTZ.	〃	〃	15
Epithemia argus W. SM	〃	Common	16
Epithemia Hyndmanii W. SM.	〃	〃	17
Epithemia longicornis EHR.	〃	〃	18
Epithemia musculus KTZ.	Brackish	〃	19
Epithemia sorex KTZ.	Fresh and brackish water	〃	20
Epithemia turgida W. SM.	Fresh water	Rare	21
Epithemia zebra (EHR.) var. *porcellus* (KTZ.) GRUN.	〃	Common	22

Gomphonema acuminatum EHR.	Oligohalob.	28
Gomphonema augur EHR.	〃	29
Gomphonema gracile EHR.	〃	31
Gomphonema lanceolatum EHR. var.	〃	32
insignis (GREG.) CL.	〃	32
Hantzschia amphioxys (EHR.) GRUN. var. *xerophia* GRUN.	〃	65
Melosira granulata RALFS.	〃	38
Nitzschia sigmoidea (EHR.) W. SM.	〃	41
Pinnularia gentilies (DONKIN.) CL.	〃	46
Pinnularia virdis W. SM.	〃	52
Rhoicosphenia curvata (KTZ.) GRUN.	Oligohalob und Euryhalin.	54
Rhopalodia gibba (EHR.) O. MÜLL.	Indifferent und Euryhalin.	55
Stauroneis phoenicenteron EHR.	Oligohalob	58
Synedra rumpens KTZ. var. *fragilarioides* GRUN.	〃	61
Synedra ulna EHR.	Indifferent und Euryhalin.	62

Description of Species

Family DIATOMACEAE

Section A. *Centricae*

Sub-family I. *Discoideae*

Tribe 1. *Coscinodisceae*

Sub-tribe a. *Melosirinae*

Genus *Melosira* AG., 1824.

Melosira granulata (EHR.) RALFS.

Text-fig. 33, a, b.

OKUNO (1943): *Japan. Diat. Dept., Bot. Mag. Tokyo, Vol. 57, No. 683-4*, p. 366, Pl. I, fig. e.

Valve long and narrow. Striae distinctly striate and punctate (a); Striae somewhat spiral and punctate, one extremity broadened in comparison with the other (b).

Found in the diatomite of Yatsuka (Okayama), Kanou and Kawabe (Nagano), Hirazawa (Miyagi), Nakaterao (Yamanashi), and in the mudstone of Mitsuwa (Nagano).

Orthosira orichalcea W. SM.

Text-fig. 43, a. b.

SMITH (1856): *Brit. Diat., Vol. II*, p. 61, Pl. LIII, fig. 337.

Valve punctate; line of junction with somewhat distinct and subdistant denticulations. This species has arisen much confusion in the synonymy, hence here referred to the above-mentioned name. According to RABENHORST, it is identical with *Melosira orichalcea* (MERTENS) KTZ.

Sub-tribe d. *Coscinodiscinae*

Genus *Coscinodiscus* EHR., 1838.

Coscinodiscus eccentricus EHR.

Text-fig. 11.

SMITH (1853): *Brit. Diat., Vol. I*, p. 23, Pl. III, fig. 38.

Valve circular, spots arranged in eccentric lines. Found in the clay of Kahoku lagoon (Ishikawa).

Genus *Stephanodiscus* EHR., 1845.

Stephanodiscus aegyptiacus EHR.

Text-fig. 59, a, b, c.

EHRENBERG (1854): *Mikrogeol.*, T. XXXIV, fig. 16, a.

Frustule undulate with spines on the margin. Valve circular covered with radiating rows of spots, but rows are distinct as striae near the margin.

Stephanodiscus Bramaputrae EHR.

Text-fig. 60.

EHRENBERG (1854): *Mikrogeol.*, T. XXXVA, IX, fig. 9.

Valve plane or somewhat curved, rows of spots delicately radiate from the center, many large spots found at interval near the marginal part.

Section B. *Pennatae*

Sub-family V. *Fragilarioideae*

Tribe 10. *Fragilalieae*

Sub-tribe a. *Fragilariinae*

Genus *Fragilaria* LYNGB., 1819.

Fragilaria diophthalma EHR.

Text-fig. 25.

EHRENBERG (1854): *Mikrogeol.*, T. XII, fig. 2, a–h.

Valve linear, cuneate at the subacute extremities. It is identical with *F. cupucina* DESMAZ.

Fragilaria inflata (HEIDEN.) HUST.

Text-fig. 26.

OKUNO (1940): *Diat. Japan.*, *I*, *Jour. Sci. Hiroshima, Ser. B, Div. 2, Vol. 4*, p. 40, fig. 4.

Valve lanceolate, both extremities rostrate and middle part inflated. Striae slightly radiate.

Found in the muddy substrata at Genbu-do (Hyogo).

Genus Synedra EHR., 1830.

Synedra rumpens KTZ. var. *fragilarioides* GRUN.

Text-fig. 61.

OKUNO (1940): *Diat. Japan.*, *I*; *Jour. Sci. Hiroshima, Ser. B, Div. 2, Vol. 4*, p. 43, fig. 9.

Valve narrow, lanceolate, both extremities round, in the middle part, somewhat broadened. Striae parallel, pseudoraphe linear.

Found in the diatomite of Hirazawa (Miyagi), and in the mudstone of Nakamura-Irizawa (Yamanashi).

Synedra ulna EHR.

Text-fig. 62, a, b.

SMITH (1853): *Brit. Diat.*, *Vol. I*, p. 71, Pl. XI, fig. 90.

Valve lanceolate-acute, with parallel margins and rostrate extremities.

Found in the diatomite of Ooike (Nagano), and in the mudstone of Mitsuwa (Nagano), Nakamura-Irizawa (Yamanashi).

Sub-tribe b. *Diatominae*

Genus *Odontidium* KG., 1844.

Odentidium mutabile W. SM.

Text-fig. 42.

SMITH (1856): *Brit. Diat.*, *Vol. II*, p. 17, Pl. XXIV, fig. 290.

Valve oval, elliptical or linear-acuminate; costae marginal distinct. Exceedingly variable in size and outline of valve. This species is identical with *Fragilaria mutabilis* (W. SM.) GRUN.

Found in the diatomite of Kanou and Kawabe (Nagana), Ureshino (Saga), and in the mudstone of Nakamura-Irizawa (Yamanashi), Mitsuwa (Nagano).

Sub-family VI. *Heteroideae*

Tribe 12. *Achnantheae*

Sub-tribe a. *Achnanthinae*

Genus *Achnanthes* BORY, 1822.

Achnanthes aueri KRAS.

Text-fig. 1, a, b.

KRASSKE (1949): *Diat. Patagoniens und Feuerlands., Ser. A, IV. 14*, p. 79, fig. 3.

Valve lanceolate, with rostrate extremities, inflated in the middle part. Upper valve with narrow lanceolate pseudoraphe. Central part with horse shoe-shaped hyaline space. Lower valve with narrow axial area. Striae slightly radiate.

Achnanthes brevipes AG.

Text-fig. 2, a, b.

SMITH (1856): *Brit. Diat., Vol. II*, pp. 27-28, Pl. XXXVII, fig. 301.

Valve linear-oval, with a slight central constriction. Spotted striae parallel.

Achnanthes Hauckiana GRUN. var. *densistriata* HOR. et. OKU.

Text-fig. 3.

OKUNO (1940): *Diat. Japan., I, Jour. Sci. Hiroshima, Ser. B, Div. 2, Vol. 4*, p. 52, fig. 20.

Valve elliptic-lanceolate, with slightly rostrate extremities. Striae somewhat radiate.

Found in the muddy substratum at Genbu-do (Hyogo).

Achnanthes lanceolata (BREB.) GRUN.

Text-fig. 4.

OKUNO (1940): *Diat. Japan., I, Jour. Sci. Hiroshima, Ser. B, Div. 2, Vol. 4*, p. 53, fig. 21.

Valve elliptic-lanceolate, with broad rounded extremities. Upper valve with narrow pseudoraphe, and on one side a horse shoe-shaped hyaline space. Lower valve with narrow axial area. Striae slightly radiate.

Found in the muddy substrata at Genbu-do (Hyogo).

Genus *Rhoicosphenia* GRUN., 1860.

Rhoicosphenia curvata (KTZ.) GRUN.

Text-fig. 54.

MUROBUSE (1936): *Diat. Ashi, Suisankenkyushi, Vol. 31*, p. 3, Pl. I, fig. 14.

Front of valve elliptical, and it curves toward epitica.

Genus *Cocconeis* EHR., 1835.

Cocconeis placentula EHR. var. *klinoraphis* GEIT.

Text-fig. 8.

KOBAYASHI (1950): *Diat. Desm. Ueno., Japan. Jour. Limn., Vol. 14*, No. 4, p. 195, Pl. I, fig. 8.

Valve elliptical, striae delicately radiated.

Found in the Paddy-fields at Ueno City (Mie).

Cocconeis placentula EHR. var. *lineatus* (EHR.) CL.

Text-fig. 9, a, b.

OKUNO (1940): *Diat. Japan., I, Jour. Sci. Hiroshima, Ser. B, Div. 2, Vol. 4*, p 55, fig. 25.

Upper valve with narrow pseudoraphe.

Central area absent (a). Lower valve with raphe (b). Striae very fine, irregularily pointed.

Found in the diatomite of Tochibori (Nigata), Ureshino (Saga), Hirazawa (Miyagi), Kanou and Ooike (Nagano), and in the mudstone of Nakamura-Irizawa (Yamanashi), Kawabe (Nagano).

Sub-family VII. *Naviculoideae*

Tribe 13. *Naviculeae*

Sub-tribe a. *Naviculinae*

Genus *Navicula* BORY, 1822.

(*Pinnularia* EHR., 1840; *Caloneis* CL., 1891; *Neidium* PFITZ., 1871.)

Navicula cortanensis KRAS.

Text-fig. 34.

KRASSKE (1949): *Diat. Trop. Moosrasen. BD. 42, H. 4*, pp. 443, T. II, fig. 3.

Valve linear lanceolate with three strong lines on both sides from the center. Striae radial, but indistinct.

Navicula didyma KTZ.

Text-fig. 35.

SMITH (1853): *Brit. Diat., Vol. I*, Pl. XVII, fig. 154.

Valve elliptical, deeply constricted in the center; striae interrupted, distinct. This species is found very rarely in the fresh-water deposits of Japan. The structure of frustule somewhat differs from it of marine form.

Navicula ovalis W. SM.

Text-fig. 37.

SMITH (1853): *Brit. Diat., Vol. I*, p. 48, Pl. XVIII, fig. 153.

Valve elliptical, occasionally inflated; striae distinct. This species was named *N. elliptica* by KUTZING and also identical with *Diploneis elliptica* after CLEAVE.

Found in the diatomite of Hirazawa (Miyagi), Kawabe (Nagano), and in the mudstone of Mitsuwa (Nagano) Nakaterao (Yamanashi).

Navicula placentula (EHR.) GRUN.

Text-fig. 36, 38.

SKVORTZOV (1937): *Neo. Diat. Wamura., Coll. Sci. Kyoto, Vol. XII*, p. 146, Pl. VI, fig. 11.

Valve elliptical-lanceolate with subrostrate extremities. Striae radiate. Central area somewhat orbicular.

Found in the mudstone of Kahoku Lagoon (Ishikawa).

Navicula subrotundata HUST.

Text-fig. 39.

KRASSKE (1949): *Diat. Patagoniens und Feuerlands. Ser. A, IV. 14*, p. 91, fig. 16, 17.

Valve elliptical, striae somewhat radiate. Raphe distinct.

Pinnularia cardinalis EHR.

Text-fig. 44.

SMITH (1853): *Brit. Diat., Vol. I*, p. 55, pl. XIX, fig. 166.

Valve linear, extremities rounded; costae radiate, absent from the center of valve.

Found in the diatomite of Kanou and Coike (Nagano).

Pinnularia Gastrum EHR.

Text-fig. 45.

EHRENBERG (1854): *Mikrogeol.*, T. V, I, fig. 12.

Valve attenuate, curved at the extremities; striae distinct.

Found in the diatomite of Hirazawa (Miyagi).

Pinnularia gentilis (DONKIN) CL.

Text-fig. 46.

OKUNO (1940): *Diat. Japan, I, Jour. Sci. Hiroshima, Ser. B, Div. 2, Vol. 4*, p. 62, fig. 37.

Valve linear, with rounded extremities, slightly inflated in the middle. Central are widened. Striae somewhat divergent in the middle, convergent at the extremities.

Found in the mudstone of Nakaterao (Yamanashi).

Pinnularia interrupta W. SM.

Text-fig. 48.

SMITH (1853): *Brit. Diat., Vol. I*, p. 59, Pl. XIX, fig. 184.

Valve linear, constricted at the rounded extremities, costae absent from the center of the valve.

Pinnularia microstauron (EHR.) CL.

Text-fig. 49.

SKVORTZOV (1937): *Neo. Diat. Wamura., Coll. Sci. Kyoto, Vol. XII*, p. 146, Pl. V, fig. 6.

Valve linear with subrostate-capitate extremities. Central area a broad stauros.

Found in the mudstone of Nakaterao (Yamanashi), and in the diatomite of Kanou (Nagano).

Pinnularia nobilis EHR.

Text-fig. 50.

SKVORTZOV (1937): *Neo. Diat. Wamura, Coll. Sci. Kyoto, Vol. XII*, p. 148, Pl. IV, fig. 1.

Valve linear, somewhat gibbous in the middle and at the broadly rounded extremities. Striae convergent at the ends. Central area widened.

Found in the diatomite of Kanou (Nagano).

Pinnularia radiosa W. SM.

Text-fig. 51.

SMITH (1853): *Brit. Diat., Vol. I*, p. 56, Pl. XVIII, fig. 173.

Valve lanceolate, obtuse; costae radiate, contiguous.

Found in the mudstone of Mitsuwa (Nagano).

Pinnularia viridis W. SM.

Text-fig. 52.

Valve elliptical, attenuated, costae somewhat radiate, distant.

Found in the mudstone of Ooike (Nagano) and Nakamura-Irizawa (Yamanashi).

Caloneis silicula (EHR.) CL.

Text-fig. 6.

SKVORTZOV (1937): *Neo. Diat. Wamura., Coll. Sci. Kyoto. Vol. XII*, p. 142, Pl. IV, fig. 12.

Valve linear-lanceolate, slightly capitate extremities. Center of the valve shows rectangular dilated area.

Found in the diatomite of Kanou and Kawabe (Nagano), Ureshino (Saga).

Neidium bisulcatum (LAGERST.) CL. var. *nipponica* SKV.

Text-fig. 66.

SKVORTZOV (1937): *Neo. Diat. Wamura., Coll. Sci. Kyoto. Vol. XII*, p. 143, Pl. IV, fig. 8.

Valve sublinear, attenuated towards the round extremities.

Stauroneis construens EHR.

Text fig. 56.

EHRENBERG (1854). *Mikrogeol.*, T. V, II, fig. 23.

Valve small, cross-shape; four extremities round.

Stauroneis dilatata W. SM.

Text-fig. 57.

SMITH (1853): *Brit. Diat., Vol. I*, p. 60, Pl. XIX, fig. 191.

Valve elliptical, extremities somewhat produced; stauros linear, not reaching the margin.

Stauroneis phœnicenteron EHR.

Text-fig. 58.

SMITH (1853): *Brit. Diat., Vol. I*, p. 59, Pl. XIX, fig. 185.

Valve lanceolate, with obtuse or somewhat rostrate extremities.

Found in the diatomite of Hirazawa (Miyagi), Ooike and Mitsuwa (Nagano), and in the mudstone of Kawabe (Nagano), Nakaterao (Yamanashi), and in the clay of Kahoku lagoon (Ishikawa).

Sub-tribe b. *Gomphoneminae*

Genus *Gomphonema* AG., 1824.

Gomphonema acuminatum EHR.

Text-fig. 28, a, b, c.

SMITH (1853): *Brit. Diat., Vol. I*, p. 79, Pl. XXVIII, fig. 238.

Valve constricted somewhat triangular and apiculate above, attenuated below.

Found in the diatomite of Ooike (Nagano), and in the mudstone of Nakaterao (Yamanashi).

Gomphonema augur EHR.

Text-fig. 29.

OKUNO (1942): *Diat. Japan., II. Jour. Sci. Hiroshima, Ser. B, Div. 2, Vol. 4*, p. 38, fig. 34.

Valve clavate, one extremity narrow rounded, other somewhat broad with apiculate apex. On one side the median striae with a stigma.

Gomphonema capitatum EHR.

Text-fig. 30.

SMITH (1853): *Brit. Diat., Vol. I*, p. 80, Pl. XVIII, fig. 237.

Valve slightly attenuated towards the upper extremities, which is rounded; much attenuated towards the lower, which is somewhat acute.

Found in the diatomite of Mitsuwa (Nagano).

Gomphonema gracile EHR.

Text-fig. 31.

SMITH (1853): *Brit. Diat., Vol. I*, p. 79, Pl. XXVIII, fig. 240.

Valve lanceolate, slightly cuneate, truncated. This species is identical with *G. dichotomum* KTZ.

Found in the diatomite of Kawabe (Nagano).

Gomphonema lanceolatum EHR. var. *insignis* (GREG.) CL.

Text-fig. 32.

SKVORTZOV (1937): *Neo. Diat. Wamura. Coll. Sci. Kyoto, Vol. XII*, p. 152, Pl. IV, fig. 2.

Valve lanceolate. Extremities slightly constricted. Striae robust, on one side the median stria with a stigma, other side striae short.

Found in the diatomite of Kanou (Nagano).

Sub-tribe c. *Cymbellinae*

Genus *Cymbella* AG., 1830.

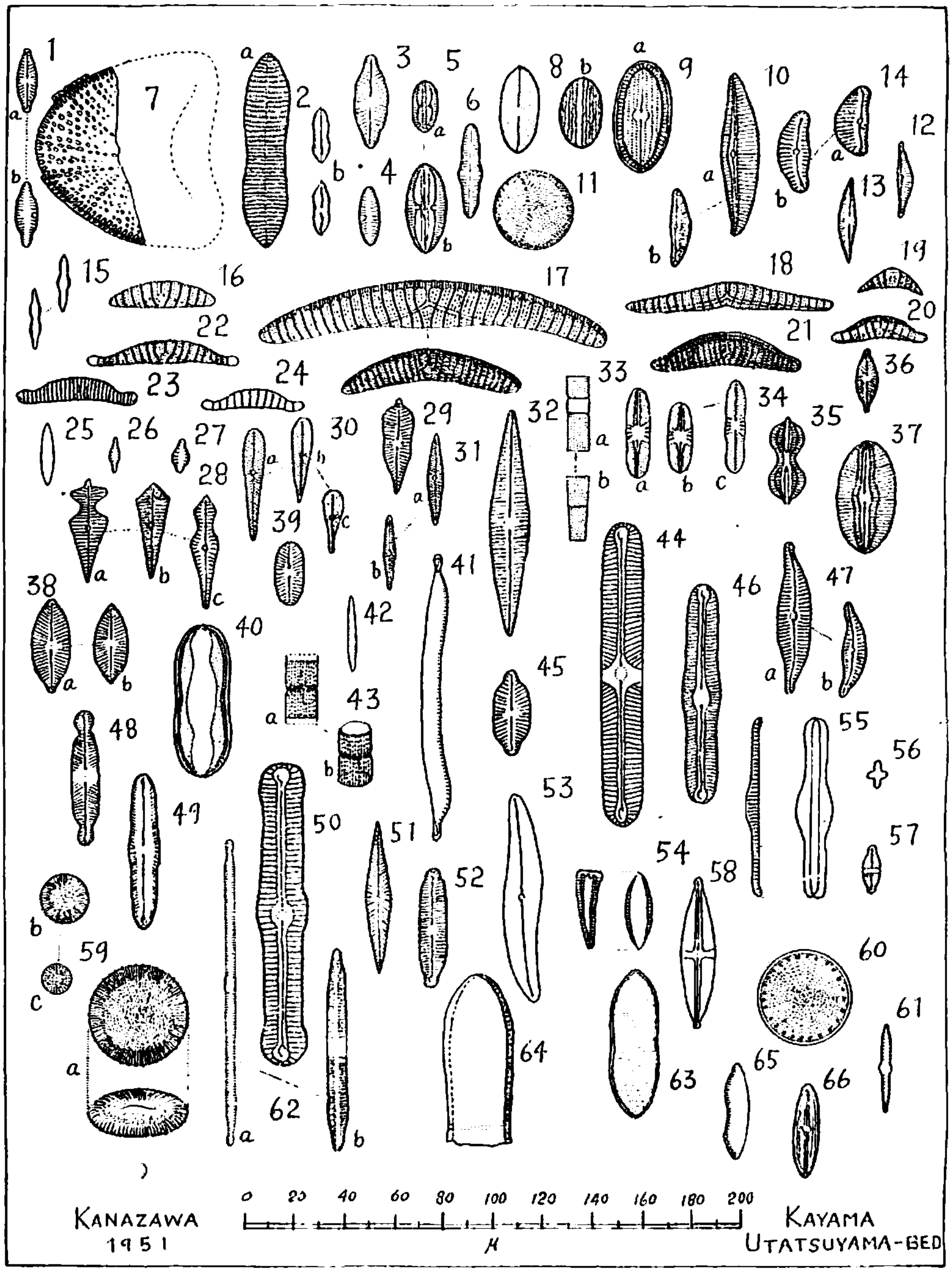
(*Cocconema* EHR., 1829)

Cymbella affinis KTZ.

Text-fig. 12.

SMITH (1853): *Brit. Diat., Vol. I*, p. 18, Pl. XXX, fig. 250.

Valve elliptical-lanceolate, extremities slightly produced. Striae faint.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Cymbella gracilliam HUST.

Text-fig. 13.

KRASSKE (1918): *Diat. Trop. Moosrasen. BD. 42, H. 4*, p. 436, T. II, fig. 41.

Valve lanceolate, extremities gradually attenuate. On one side the median striae with a stigma.

Cymbella prostrata (BERK.) CL.

Text-fig. 14.

SKVORTZOV (1937): *Neo. Diat. Saga., Coll. Sci. Kyoto. Vol. XII*, p. 168, Pl. X, fig. 16.

Valve asymmetrical, subelliptical with arcuate dorsal and slightly arcuate at ventral margins or lunate with curvate extremities.

Found in the mudstone of Nakamura-Irizawa (Yamanashi).

Cocconema cymbiforme EHR.

Text-fig. 10.

SMITH (1853): *Brit. Diat., Vol. I*, p. 76, Pl. XXIII, fig. 220.

Valve narrow, concave margin scarcely inflated. Striae somewhat radiate, extremities gradually attenuate.

Found in the mudstone of Nakaterao (Yamanashi), Mitsuwa (Nagano).

Genus Amphora EHR., 1831.

Amphora ovalis KTZ.

Text-fig. 5.

SMITH (1853): *Brit. Diat., Vol. I*, p. 19, Pl. II, fig. 26.

Valve exceedingly convex. Internal margin of valve inflated at the nodule. Striae spotted.

Found in the diatomite of Kanou (Nagano), Hirazawa (Miyagi), Ureshino (Saga), and in the lignite bed of Hanamaki (Iwate).

Sub-tribe e. *Pleurosigminae*

Genus *Pleurosigma* W. SM., 1853.

Pleurosigma rigidum W. SM.

Text-fig. 53.

SMITH (1853): *Brit. Diat., Vol. I*, p. 64, Pl. XX, fig. 198.

Valve linear-lanceolate; flexure slight; extremities rounded; median line central.

Sub-family *Surirelloideae-Carinatae*

Tribe 15. *Surirelleae*

Genus *Surirella* TURP., 1828.

Surirella Librile EHR.

Text-fig. 63.

EHRENBERG (1854): *Mikrogeol.*, T. XXV, VII, fig. 23.

Valve elliptical acute, usually with a central constriction, canaliculi delicate.

Genus *Campylodiscus* EHR., 1840.

Campylodiscus cribrosus W. SM.

Text-fig. 7.

Valve nearly circular; surface with the characteristic contortion. Cells irregularly circular, in radiating lines.

Found in the diatomite of Yatsuka (Okayama).

Tribe 16. *Epithemieae*

Genus *Epithemia* BRÉB., 1844.

Epithemia argus W. SM.

Text-fig. 16.

SMITH (1853): *Brit. Diat., Vol. I*, p. 12, Pl. I, fig. 5.

Valve slightly arched, extremities gradually attenuate. Canaliculi indistinct.

Found in the diatomite of Ooike (Nagano).

Epithemia Hyndmanii W. SM.

Text-fig. 17.

SMITH (1853): *Brit. Diat., Vol. I.* p. 12, Pl. I, fig. 1.

Valve much and regularly arched, extremities rounded, not recurved. Canaliculi inconspicuous.

Found in the diatomite of Yatsuka (Okayama), Hirazawa Ooike Kawabe and Kanou (Nagano), Ureshino (Saga), and in the mudstone of Nakamura-Irizawa (Yamanashi).

Epithemia longicornis EHR.

Text-fig. 18.

SMITH (1853): *Brit. Diat., Vol. I,* p. 13, Pl. XXX, fig. 248.

Valve somewhat angular in the dorsal ridge, extremities obtuse.

Epithemia Musculus KTZ.

Text-fig. 19.

SMITH (1853): *Brit. Diat., Vol. I,* p. 14, Pl. I, fig. 10.

Valve regularly and strongly arcuate, extremities acute. Canaliculi distinct.

Epithemia sorex KTZ.

Text-fig. 20.

SMITH (1853): *Brit. Diat., Vol. I,* p. 13, Pl. I, fig. 9.

Valve attenuate, slightly recurved at the extremities, dorsal line highly arcuate. Canaliculi minute, indistinct.

Epithemia turgida W. SM,

Text-fig. 21.

SMITH (1853): *Brit. Diat., Vol. I,* p. 12, Pl. I, fig. 2.

Valve slightly arched, extremities suddenly attenuate, obtuse. Canaliculi distinct.

Found in the diatomite of Yatsuka (Okayama), Kanou (Nagano), Ureshino (Saga), Hirazawa (Miyagi), and in the tuffaceous mudstone of Nukatsukayama (Nagano), and in the mudstone of Nakamura-Irizawa (Yamanashi).

Epithemia zebra (EHR.) KTZ. var, *porcellus* (KTZ.) GRUN.

Text-fig. 22.

OKUNO (1944): *Japan. Diat. Dep., Bot. Mag., Vol. 58,* No. 685, p. 11, fig. 4, d-e.

Valve slightly arched, extremities long attenuate. Canaliculi indistinct.

Genus *Rhopalodia* O. MÜLL., 1895.

Rhopalodia gibba (EHR.) O. MÜLL.

Text-fig. 55.

MUROBUSE (1936): *Diat. Ashi., Suisankenkyushi. Vol. 31,* No. 6, p. 8, Pl. III, fig. 4.

Valve linear, inflated at center and extremities.

Tribe 17. *Eunotieae*

Genus *Eunotia* EHR., 1837.

Eunotia praerupta EHR.

Text-fig. 23.

EHRENBERG (1854): *Mikrogeol.,* T. II, fig. 27.

Valve lunate, arcuate with recurved extremities. Pseudorodules distinct. Striae robuste.

Eunotia zebrina EHR.

Text-fig. 24.

EHRENBERG (1854): *Mikrogeol.,* T. IV, II, fig. 23.

Valve recurved at the obtuse extremities. Striaes large. This species bears some resemblance to genus *Epithemia.*

Sub-family X. *Nitzschioideae*

Tribe 18. *Nitzschiae*

Genus *Nitzschia* HAS., 1845.

Nitzschia bilobata W. SM.

Text-fig. 40.

SMITH (1853): *Brit. Diat., Vol. I*, p. 42, Pl. XIII, fig. 112.

Frustule elliptical, with a central constrictions and round or truncate extremities.

Nitzschia plana W. SM.

Text-fig. 64.

SMITH (1853): *Brit. Diat., Vol. I*, p. 42, Pl. XV, fig. 114.

Valve elliptical, slightly constricted towards the center and tapering toward the somewhat truncate extremities.

Nitzschia sigmoidea (EHR.) W. SM.

Text-fig. 41.

SMITH (1853): *Brit. Diat., Vol. I*, p. 38, Pl. XIII. fig. 104.

Valve linear, suddenly tapering towards the acute extremities; keel with a single line of puncta.

Genus *Hantzschia* GRUN., 1877.

(*Denticula* KG., 1844)

Hantzschia amphioxys (EHR.) GRUN. var. *xerophila* GRUN.

Text-fig. 65.

SKVORTZOV (1936): *Neo. Diat. Ampen., Rep. Tyosen Geol. Sur. No. 12*, p. 34, Pl. IV, fig. 9.

Valve linear-lanceolate with constricted ventral and convex dorsal margins. Extremity subrostrate.

Denticula obtusa KTZ.

Text-fig. 15.

SMITH (1856): *Brit. Diat., Vol. II*, p. 19, Pl. XXXIV, fig. 292.

Valve lanceolate, or linear, and attenuate towards the extremities, which are obtuse; striae delicate and not found commonly.

Many fragments of frustules are found in the Kayama clay-shale. Some of them seem to bear a remarkable resemblance to *Surirella robusta*. Some of the other remaining diatoms contain fragments of *Coscinodiscus* sp., *Tryblionella* sp. and *Achnanthes* sp. besides the sixty-five species above-mentioned.

SUMMARY

The nineteen species of the fossil diatoms in the Kayama clay shale are found in Japanese lakes and ponds. Fourteen of them are, in their ecological characters, known as Oligohalob. Fifty-one of the species are all known existing in fresh-water. The Kayama clay-shale, therefore, belongs to fresh-water origin.

The Kayama clay-shale is one facies of the Utatsuyama bed. From this reason some part of the Utatsuyama bed is of fresh-water origin, and it differs from its bed rock of the Onma series which is of marine origin.

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Three roots branch off from the base of the trunk. This must have been a large and tall tree over 25 m. high. The third locality is a precipitous cliff adjacently to the east of Ichinose where three erect stumps are imbedded in a similar alternation, and this in turn is overlain by alternating beds of conglomerate and sandstone, about 10 m. thick.

Looking through these occurrences it is noteworthy that the roots are mostly horizontal and very slender, compared with the diameter of the trunk, because the features suggest hygrophytic adaptation for the tree. How the trunks were cut off at a certain height transversally is a question left for future study.

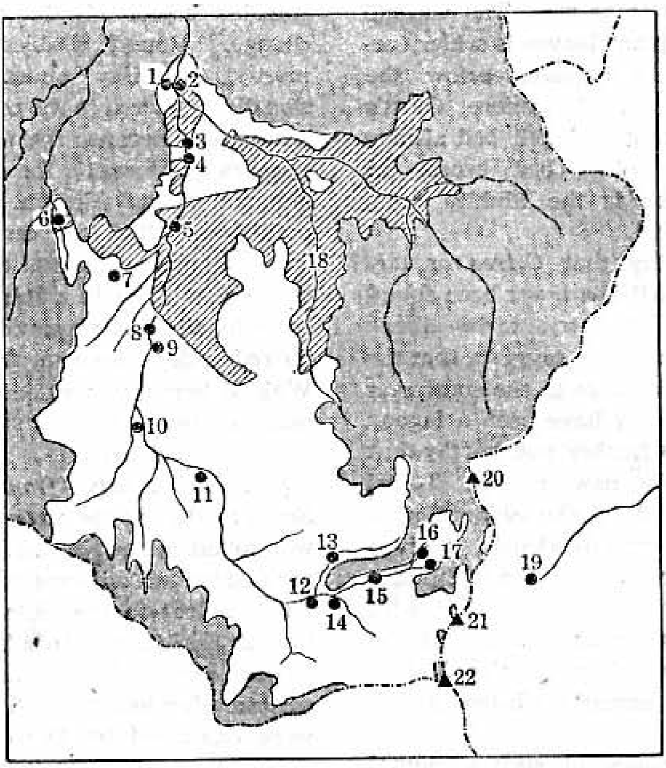
The trunk-bearing horizon in the Tetori Series:—The Tetori series around Hakusan can be divided into three parts. In the upper Kuzuryu valley on the southwest side MAEDA (1950) found a discordance between the paralic middle division (Itoshiro stage) and the lower division (Kuzuryu stage) yielding ammonites in its upper part. Because *Seymourites* was found there (KOBAYASHI, 1947) beside perisphincti and oppelids (YOKOKAMA, 1904), the Itoshiro stage superjacent to the Kuzuryu is undoubtedly post-Calloveian. In the Makito area to the southeast of Hakusan the two are conformable and the lower division yields corbiculids at a place and ammonites and other marine shells at another (IWAYA, 1940, MAEDA, 1949). The middle division is disconformably overlain by the upper division called Akaiwa sandstone (NAGAO in OISHI, 1933).

Because facies and thickness are changeable, it is difficult to make any exact correlation among the sequences around Hakusan. In the Tetori tributaries to the west of Hakusan, however, the larger part of the lower division appears to lack. The sequence commences there with the Gomijima conglomerate which is a valley filling of the Hida gneiss terrain. The plane of discordance is very uneven. Its basal part contains pebbles, cobbles and boulders mostly of gneiss and crystalline limestone which were derived from the subadjacent Hida gneiss group. Their size varies greatly and many of them are angular or subangular.

This rude conglomerate, or breccia in part, becomes better sorted upward through fanglomeratic part till it merges with the alternation of sandstone and shale. The Gomijima conglomerate is 130 m. at the thickest but soon tails out laterally. Seeing that the conglomerate is very thin, if not absent, on the ridges on the east and west sides of the Mekko gorge, it is presumed that the part of the gneiss terrain must have been a land at the time of the deposition of the Gomijima conglomerate.

The leading member of the superjacent alternation is shale in its lower part but sandstone in its upper. Conglomerates are wedged in the alternation at some places. In the vicinity of Ichinose there is a fairly persistent layer of conglomerate above the trunk-bearing horizon. Therefore, for the sake of convenience, the Shiramine alternation with the conglomerate at its base is distinguished from the Kuwashima alternation below it.

Plant leaves occur in the Shiramine as well as in the Kuwashima alternation, although more abundantly in the latter. The latter yields corbiculids, *Ostrea*, *Gervilleia*, and other brackish shells, but not the former. These shells occur in form of fossil beds or banks in various horizons in the Kuwashima and its equivalent formations, and in the Makito area they are found in the lower



Map showing the localities

Post-Jurassic formations and igneous rocks, shaded
Jurassic Tetori Series, white
Hida gneiss Group, obliquely lined

1. Yoshino-tani (drift wood) 吉野谷
2. Kinameri-shin 木滑新
3. Onabara 女原
4. First bridge above Onabara (boulder) 第一大橋
5. Kurinuma bridge (boulder) 栗沼大橋
6. Otawa-dani (boulder) 大田和谷
7. Urodani (boulder) 空洞谷
8. Kuwashima 桑島
9. Kaseki-kabe (erect stump) 化石壁
10. Shiramine 白峯
11. Kochi-dani (drift wood) 河内谷
12. Ichinose 市ノ瀬
13. Yudani (erect stump) 湯谷
14. Cliff, east of Ichinose (erected stump)
15. Yanagidani (boulder) 柳谷
16. Betto-dani (boulder) 別当谷
17. Akadani (boulder) 赤谷
18. Mekko gorge 目附谷
19. Kagidani (boulder?) カギ谷
20. Hakusan 白山
21. Bessan 別山
22. Sanno-mine 三ノ峯

or the Kuzuryu stage too. The vertical distribution of plant leaves is wider, occurring in many horizons below the Akaiwa sandstone. Therefore OISHI's opinion (1940) that the shell bed always lies above the plant bed except in Ushimaru section in the Makito area, can not be upheld.

It is noteworthy that *Ostrea* or any other marine shell has never been found in the upper Tetori tributaries above Kuwashima, because it suggests that the Kuwashima alternation to the southwest of Mekko land may have been a lagoon or a lake. It is further noteworthy that non-marine shells new to the Tetori fauna were found in Oarashidani in a boulder which was obviously derived from the upper part of the Ushimaru alternation. *Trigonioides* together with *Viviparus* occurs near the top of the Kuwashima equivalent in the Makito area, while the formations below it are paralic.

The abrupt change of such a faunal aspect and the occurrence of erect stumps, combined with occasional intercalations of conglomerate, which are all met with in the passage from the Kuwashima to the Shiramine alternation, reveal an emergence in their transitional time.

Trigonioides (KOBAYASHI and SUZUKI, 1936) is a peculiar limnic genus solitary in the Trigoniidae, which is supposed to have been introduced by endemic adaptation as a relict in the basin thus enclosed. The stumps must be the remnants of a past forest along the strand line of the basin. The distribution of their localities from Northwest to Southeast in accordance with the supposed land of Mekko may therefore not be accidental.

The Ichinose alternation merges up into the Akaiwa sandstone which is barren of fossil. The absence of plant remains is probably due to the climatic change. Round pebbles and cobbles mostly of milky quartzite are occasionally scattered in the coarse quartzose sandstone. Because the milky quartzite appears to be exotic for this region, the material of the Akaiwa sandstone was possibly supplied from any remote place. The mode of sedimentation is suggestive of a grand delta in a fairly arid inland basin for the Akaiwa sandstone. Because no red rock as seen in the Inkstone or Wakino Series is contained, the Akaiwa may not be younger than Wealden or the Toyonishi Series.

Silicified woods from the Tetori Series:—During the survey a drift wood was found in the Kuwashima alternation at Yoshinotani adjacent to Kinameri and another drift in the Shiramine alternation at Kochidani. In addition, silicified woods were collected as boulders at several other localities. These specimens were examined by OGURA in thin section. Internal structure was lost in the Kochidani specimen. The Yoshinodani specimen has a structure similar to *Pinus*, but its bad preservation does not admit any accurate observation.

Putting aside these two indeterminable drift woods, all others were determined as *Xenoxylon latiporosum*. This species of wood is characterized by the presence of closely arranged elliptical pits on the tracheidal wall, large oval pits on the cross field, thin-walled tylosis within the tracheid, as well as the absence of parenchyma (Figs. 1–3). Various plant leaves of the Filicales, Cycadales, Ginkgoales, Coniferales and others are found in the same locality with the trunks, so that may we expect one of these leaves belongs to *Xenoxylon*. *Xenoxylon latiporosum* must be a wood of a Coniferous tree, and NATHORST (1897) suggested the possible connection of *Xenoxylon* (*Arau-*

carioxylon) *latiporosum* with the shoot of *Elatites curoifolia*, whose affinity is also uncertain.

In the Tetori flora *Dictyozamites* is represented by 4 species, *Nilssonia* by 3, *Otozamites* and *Ginkgoites* each by 2, *Ctenis*, *Pseudocycas*. *Pterophyllum*, *Ptilophyllum*, *Sagenospteris*, *Ginkgodium* and *Czeckanowskia* each by one (OISHI, 1940), but the frequency of individual specimens disagrees with the order of these specific number. *Nilssonia* and *Ginkgodium* are fairly common members, but *Podozamites* is found more common in these localities of the trunks, if *Cladophlebis* and *Onychiopsis* are ignored. The abundant occurrence of *Podozamites* in association with the silicified wood at Kagidani has also noted by TANAKA.

Podozamite occurs in various formations from Triassic to Lower Cretaceous. *P. lanceolatus* has a wide distribution, while *P. reini* is endemic to the Tetori basin. *Xenoxylon latiporosum* is known from Spitzbergen, England, Poland, Indochina (Central Annam), North China, Manchuria (Shahotzu, Tapashan, Tayan) and Korea (Heijo and Naktong) and Japan, all in the Jurassic formations except the Naktong series which is Wealden. (OGURA, 1950). Therefore KOBAYASHI calls attention on the meaning of the common association of so-called *Podozamites* and with *Xenoxylon* as a fascinating subject for future study.

OGURA noted in thin section that the specimens from Kaseki-kabe (*in situ*), Urodani of Togatani (boulder), at a point 100 m. below the Kurinuma bridge between Fukase and Kamatani (boulder), Otawadani (boulder) and Akadani (boulder) were all brown coloured and the structure is excellently well preserved. Those from Yanagidani (boulder), Betto above a water fall (boulder) and Yudani (*in situ*) were black coloured and not so well preserved. According to Prof. SAKAMOTO the brown coloured ones are carbonaceous, while the black coloured ones are anthracitic. Therefore it is suggestive that the burying site was aerobic for the former but anaerobic for the latter. Is it to much guessing that the northwest side of the upper Tetori tributaries where most of the former type occur was paludal, while the other side where the latter occurs, was the topset of a delta or the like which was more open?

TANAKA noted ring structure in his specimen, but interpreted them as the products of secondary coagulation of colloidal silica. The growth rings are, however, clearly shown in the illustrations of SHIMAKURA's specimen and further in the present ones before hand.

In the comprehensive work on the Mesozoic floras in Japan OISHI (1940) noted that the climate indicated by the *Onychiopsis* suite of floras from middle Jurassic to early Cretaceous is subtropical. But some difference in climate is easily expectable between the inner and outer sides of Japan in the span of the prolonged time, especially because the two sides were separated by a swelling axis called Eo-Nippon cordilella (KOBAYASHI, 1941). Further a temporary inflow of cold current into the Tetori basin is indicated by *Seymourites* (KOBAYASHI, 1947) which is a characteristic Callovian genus of the Arcto-Boreal province. On the outer side of Japan, on the contrary, there is a chain of reef limestones which are mostly upper Jurassic but partly lower Cretaceous. OGURA noted that there is no trace of growth rings in the silicified woods of *Araucarioxylon* type from Fujinami in the Yuasa basin, Province of Kii. Therefore it is quite probable that the early Cretaceous Fujinami forest has flourished under the tropical monsoon climate. KOBAYASHI (1942) has already pointed out that the forest composition of the Tetori flora suggests the climate of the temperate zone, the conclusion being further endorsed by the growth rings.

Finally various opinions were expressed on the age of the Tetori flora, as summarized by KOBAYASHI (1938). Recent researches in the Tetori series has shown that the plant leaves occur in various horizons below the Akaiwa sandstone, but nevertheless the middle division (Itoshiro stage) and especially its lower part (Kuwashima alternation) is most prolific. Therefore it is quite certain that the principal part of the Tetori flora is late Jurassic, although its range extends down to the middle Jurassic.

The oldest fossil plants known in Japan are ***Leptophloeum*** cfr. ***australe*** and ***Cyclostigma*** sp. from the Famenian Tobigamori formtion (TACHIBANA, 1950). Leaves or stems occur in later formations and becomes abundant from the Upper Triassic formations. ***Araucarioxylon*** is known to occur in the Liassic Shizukawa series (SHIMAKURA, 1936). Of the erect stumps ***in situ***, however, the Tetori forest is the oldest in Japan.

Acknowledgement :—In closing this report the authors wish to express their thanks to Prof. TAKAO SAKAMOTO of our institute for his sedimentological suggestion and to Prof. Wataru ICHIKAWA of the Kanazawa University and Mr. Shin KATO of the Ishikawa Prefecture Office for the facilities in their field survey.

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Postscript:–Through the exploration in summer, 1951, a large collection including numberous *Carpolithes* was made at Kasekikabe and other localities in this region and its study is now in progress. Furthermore a flora comprising *Sequoia*, (?), *Ginkgo*, dicotyledonous leaves, pinnules of *Cladophlebis* and several others were found in shales in the top division of the Tetori series which is called here *Omichidani alternation*. It overies the Akaiwa sandstone conformably. Tuffs were found in the transition from the Akaiwa sandstone to the Omichidani alternation and within the latter. The Omichidani flora is most probably younger than the Lower Cretaceous Ryoseki flora. Therefore the Akaiwa sandstone must be the product of the crustal disturbace in the late Jurassic and early Cretaceous periods which has already been detailed by KOBAYASHI (1941). Accordingly the Itoshiro division whence the larger part of the Tetori flora was procured is late Jurassic.

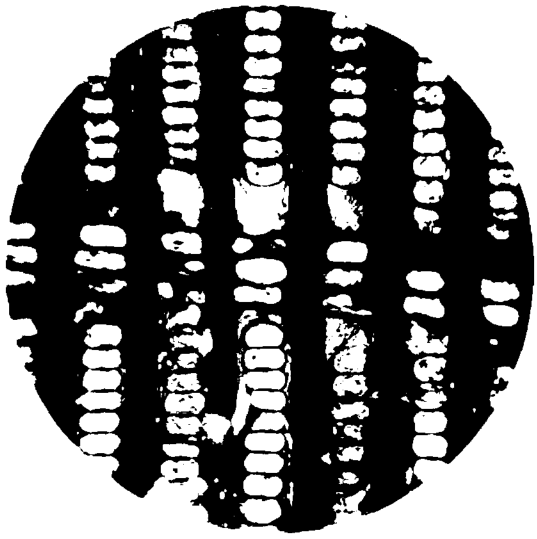
Explantion of Plate 9.

Figures 1-3. *Xenoxylon latiporosum* (CRAMER)

Figure 1. Tangential section × 200 Loc. Kaseki-kabe (boulder)
Figure 2 Radial section × 200 Loc. Kaseki-kabe (in situ)
Figure 3. Cross section × 35 Loc. Horadani, (boulder)

Figure 4. An erect stump at Yudani.

1



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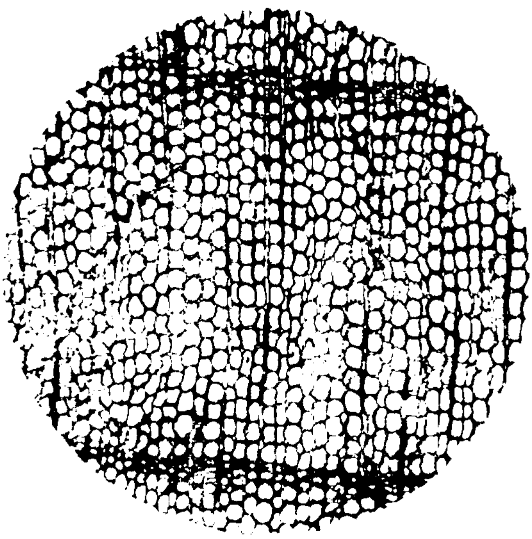

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Trans. Proc. Palaeont. Soc. Japan N.S., No. 4, pp. 121–129, pls. 10–11 Nov. 1951.

208. STRATIGRAPHICAL AND PALEONTOLOGICAL STUDIES OF THE LATER PALEOZOIC CALCAREOUS ALGAE IN JAPAN I.

Several new species from the Sakamotozawa section, Hikoroichi-mura, Kesen-gun, in the Kitakami Mountainous Land.[1)]

RIUJI ENDO[2)]

日本產上部古生代石灰藻化石の層位学的及古生物学的研究第一報 「岩手県気仙郡日頃市村坂本沢產新種について」: 岩手県気仙郡日頃市村坂本沢に露出する所謂差沢階中に多くの石灰藻化石が產する事は古くから知られて居た。筆者は玆より下部石炭紀から中部二疊紀の間に於て10数種の石灰藻を採集検出した。その中新種として Dasycladaceae に入るもの3種, Codiaceae に入るもの2種を記載し, 新属 *Hikorocodium* を創定した。之等の中, *Mizzia* は常に中部二疊紀から, *Anthrccoporella* と *Hikorocodium* は常に下部二疊紀と下部石炭紀からのみ発見される。 遠藤隆次

Introduction and Acknowledgements

For many years ago it is known that many fine specimens of later Palaeozoic Calcareous algae occur in association with many fusulinids at the so-called Sashizawa Stage, Sakamotozawa, Hikoroichi-mura, Kesen-gun, Iwate Pref. I[2)] formerly also reported its occurrence in the Japanese Jour. of Geol. Soc. Japan. However, unfortunately as far as I know now no body studied in detail, these calcareous algae up to date. Since, lately I have a good chance to study these specimens under the kind suggestion of Prof. Hisakatsu Yabe, described some of them as follows.

I take this opportunity to express my hearty thanks to Prof. J. Harlan Johnson, Colorado School of Mines, for his helpful suggestions and criticisms. I express also my graditude for the financial help provided by the Educational Department.

Stratigraphy

The so-called Sashizawa Stage at the Sakamotozawa valley consists of thick grey to black limestone with thin shales at irregular intervals, and it forms very steep cliffs. Its total thickness is about 200 m. I studied this locality in detail and made two north and south sections which are sepalated 800 m apart for which I want to give the name of Sakamotozawa sections. Fifty fossil zones for each section were observed.

The North Section.

The North Section begins at the northwest side of Yubanosawa mineral spring in the middle part of Sakamotozawa and extends northwestwardly and ascends to the top of a steep cliff. The beds dip 25° to 30° to the northwest. Fifty fossil zones are distributed as in table 1.

The South Section.

The South Section is located southwest of Yubanosawa mineral spring and extends up the steep southeastern slope of the 551 meter hill. In this section the strata of the so-called Sashizawa

1) Read April 5, 1951; received June 28, 1951

2) Contribution from the Laboratory of Earth Sciences, Liberal Arts, Saitama Univ. in Urawa.

Stage are well exposed, all dipping monoclinally 25° to 30° to the northwest. Fifty fossil zones occur as shown in table 2.

Table 1.

The north Sakamotozawa section

No. 1. Limestone 1m. *Anthracoporella spectabilis* PIA. *Hikorocodium elegantae* n. sp.
Clayslate 6m. Fault.
Clayslate and limestone 5.3 m.

No. 2. Limestone 3 m. *Teutroporella* cfr. *triasina* SCHAUROTH.
Clayslate 2 m.
Teutroporella cfr. *triasina* SCHAUROTH.
Clayslate 2 m.

No. 3. Limestone 2 m. *Mizzia velebitana* SCHUBERT. Alternation of sandstone and clayslate 8 m.

No. 4. Limestone 5m. *Mizzia velebitana* SCHUBERT.
Clayslate 15.4 m.

No. 5. Limestone 1 m. *Mizzia velebitana* SCHUBERT.
Clayslate 5 m.
Dyke of hormblende lamprophyre 1 m.
Alternation of clayslate & limestone 16.5 m.

No. 6. Limestone 1 m. *Mizzia velebitana* SCHUBERT. *Schwagerina kraffti* (SCHELLWIEN)
Alternation of clayslate and limestone 39.1 m.

No. 7. Limestone 2 m. *Hikorocodium elegantae* n. sp. *Anchicodium magnum* n. sp.
Alternation of clayslate and limestone 20 m.

No. 8. Limestone 1.5 m. One species of Dasyclacadeae, indet.
Alternation of clayslate & limestone 10.1 m.

No. 9. Limestone 1m. *Epimastopora japonica* n. sp. *Quasifusulina longissima* (LEE)
Clayslate 2 m.

No. 10. Limestone 2 m. *Hikorocodium elegantae* n. sp. *Epimastopora japonica* n. sp.
Clayslate and limestone 5 m.

No. 11. Limestone 3 m. *Anchicodium magnum* n. sp. *Macroporella* sp.
Clayslate and limestone 13.5 m.

No. 12. Limestone 2 m. *Anchicodium magnum* n. sp.

Table 2.

The south Sakamotozawa section

No. 1. Limestone 2 m. *Siphonodendron densitabulata* (YABE & HAYASAKA).
Clayslate, limestone and sandstone 12.5 m. Fault.
Limestone 8 m.

No. 2. Limestone 2m. *Mizzia velebitana* SCHUBERT.
Atractyliopsis (?) sp.
Alternation of clayslate and limestone 10.6 m.

No. 3. Limestone 1.7 m. Some algal remains.
Alternation of clayslate and limestone 23.5 m.

No. 4. Limestone 2 m. *Macroporella* sp.
Alternation of clayslate and limestone, with sandstone in the lower part. 6.3 m.

No. 5. Limestone 0.8 m. *Gyroporella* (?) *longipora* n. sp. *Mizzia velebitana* SCHUBERT.
Alternation of clayslate and limestone, with sandstone in the lower part. 32.4 m.

No. 6. Limestone 2 m. *Anthracoporella magnipora* n. sp. *Gyroporella* (?) *longipora* n. sp.
Limestone 15 m.

No. 7. Limestone 1 m. *Anchicodium magnum* n. sp. *Anthracoporella magnipora* n. sp. *Gyroporella* (?) *longipora* n. sp.
Limestone 6 m.

No. 8. Limestone 1 m. Some algal remains.
Limestone 1.5 m.

No. 9. Limestone 1.5 m. *Anchicodium magnum* n. sp. *Epimastopora japonica* n. sp. *Hikorocodium elegantae* n. sp.
Limestone 4 m.

No. 10. Limestone 2 m. *Epimastopora japonica* n. sp. *Hikorocodium elegantae* n. sp.
Limestone 2 m.

No. 11. Limestone 1 m. *Anchicodium magnum* n. sp. *Epimastopora japonica* n. sp. *Hikorocodium elegantae* n. sp.
Limestone 4 m.

No. 12. Limestone 2 m. *Diplopora phanerospora* PIA *Epimastopora japonica* n. sp. *Anchicodium magnum* n. sp. *Hikorocodium*

Limestone 3 m.

Clayslate and limestone 6 m.

NO. 13. Limestone 1 m. *Anchicodium magnum* n. sp. *Epimastopora japonica* n. sp. *Quasifusulina longissima* (LEE)

Clayslate and limestone 6 m.

No. 14. Limestone 2.4 m. *Hikorocodium elegantae* n. sp. *Epimastopora japonica* n. sp. *Anchicodium magnum* n. sp. *Anthracoporella magnipora* n. sp.

Limestone and clayslate 7 m.

Dyke of hormblende lamprophyre 1 m.

Clayslate 2 m.

No. 15. Limestone 1 m. *Anchicodium magnum* n. sp.

Clayslate, sandstone and limestone 10.4 m.

Dyke of augite dolerite

elegantae n. sp.

Clayslate and limestone 2.5 m.

No. 13. Limestone 1.5 m. *Anchicodium magnum* n. sp. *Epimastopora japonica* n. sp.

Limestone and clayslate 2 m.

No. 14. Limestone 1 m. *Anchicodium magnum* n. sp *Epimastopora japonica* n. sp.

Limestone 1.5 m.

No. 15. Limestone 1 m.

Anchicodium magnum n. sp. *Hikorocodium elegantae* n. sp. *Anthracoporella magnipora* n. sp. *Epimastopora japonica* n. sp. *Macroporella* sp.

Dyke of augite dolerite

Alternation of clayslate and sandstone 15.5 m.

Sakamotozawa conglomerate.

As will be seen from the above tables inserted, the uppermost fossil zone (No. 1) in these two sections contain noticeable fossils of the Lower Carboniferous Onimaru Series namely, *Siphonodendron multitabulatum* (YABE and HAYASAKA), *Anthracoporella spectabilis* PIA and *Hikorocodium elegantae*, n. sp. On the contrary, the underlying fossil zones (from No. 2 to No. 6) yield *Mizzia velebitana* SCHUBERT which is the leading fossil of the Middle and Upper Permian ages. Moreover, we can find a good stratigraphical fault evidences between these No. 1 and No. 2 fossil zones in the field. So, it is rather interesting matter to be able to find fault evidences in these two sections from the both paleontological and stratigraphical sides.

Near the bottom of this section, namely from fossil zones No. 7 to No. 15, *Hikorocodium elegantae* is always found associated with *Epimastopora japonica*, *Anthracoporella magnipora*, *Anchicodium magnum* and *Osagia* sp. It is noticeable that these fossils are never found in the upper zones (No. 2 to No. 6) of this section.

Rokuro MORIKAWA, lecturer in our laboratory, is now studying the paleontological evidences of Fusulinidae in this Sakamotozawa section. According to his recent investigation, *Schwagerina krafftí* (SCHELLWIEN) and *Quasifusulina longissima* (LEE) are found respectively in the upper (No. 2 to No. 6) and lower (No. 7 & No. 13) parts of this Sakamotozawa section. Thus the Sakamotozawa section may also be distinctly divisible into two parts on the standpoint of paleontological studies of Fusulinids as well as from the algal remains.

BRIEF NOTE OF PALEONTOLOGY

The descriptions include 3 genera of the family Dasycladacea group, namely *Anthracoporella*, *Epimastoporella*, and *Gyroporella*; 2 genera of the family Codiaceae group, such as *Anchicodium*, and *Hikorocodium* of which the latter is a new genus. One genus of Cyanophyta algae, *Osagia* is included in my collection.

SYSTEMATIC DESCRIPTION

The symbols used for the measurements in the following description are listed in below, as followed the examples of J. V. PIA and J. Harlan JOHNSON.

D—Outer diameter of calcareous body. d—Inner diameter of calcareous body. p—Diameter of pores. w—Number of verticillatae in a single member. h—Distance between centers of vertillatae. st—Diameter of stem cell. s—Thickness of calcareous wall.

Class *Chlorophyta*

Subclass *Chlorophyceae*

Order *Siphonocladales*

Family Dasycladaceae

Genus *Anthracoporella* PIA, 1929

Anthracoporella Magnipora, new species

Plate 10, Figures 5.

Measurements	*Anthracoporella Magnipora* ENDO				
	D.	d.	p.	w.	s.
No. 14	2.6050 mm	1.3025 mm	0.1042 mm		
No. 32	2.5008	0.7294	0.1563		
No. 62	4.689	3.3855	0.1824	ca 45	0.5731 mm

Descriptions:—The present species show characteristic features of genus *Anthracoporella* in having remarkably well bifulcated pores which are arranged perpendicularly to both inner and outer surfaces of the calcareous wall, numerous pores in a whorl and some rounded protuberances on the surface of thalli.

Comparisons:—The larger pores and the presence of a smaller number of pores in a whirl serve readily to distinguish this species from *A. spectabilis*.

Remarks:—Observed specimens are found in associated with *Hikorocodium elegantae*, *Anchicodium magnum*, *Epimastopora japonica*, and *Osagia* sp.

Occurrence:—Lower Permian: In the banded limestone in the lower part of north and south Sakamotozawa sections.

Cotypes:—L.E.S., Saitama Univ., Slides 14, 32, 62, Specimen 10760.

Genus *Epimastopora* PIA, 1922

Epimastopora Japonica, new species

Plate 11, Figures 1, 2.

Measurements	*Epimatopora Japonica* ENDO			
	D (?)	d (?)	p	s
No. 81	1.042 mm.	0.5731 mm	0.1563 mm	0.2605 mm
No. 14	1.1462	0.5210	0.1563	0.2605

Descriptions:—This species is based on numerous fragments. However, the specimens shown in Plate may represent the thalli which are long and somewhat undulating crylindrical forms. The calcareous walls are perforated by numerous, rather large pores. The pores are characteristic in having rather peculiar features, namely, some of them given off from the stem cell at rather narrower pedicel like filament which expand into the ball-like globule at its midway and narrow again forwards exterior while the others open to exterior with the state of ball like expansion. Pores are nearly perpendicular to the exterior or slightly ascending. Ball-like expanded portion of pores may represent the sporangia.

Comparison :—This species differs from all the species of this genus formerly described in having larger size of pores and thicker calcareous walls.

Remarks :—This alga is associated with *Anchicodium magnum*, *Anthracoporella magnipora*, *Hikorocodium elegantae*, *Macroporella* sp., *Osagia* sp. and *Quasifusulina longissima* (LEE).

Occurrence :—Lower Permian: The specimens are found at the several horizons ranging from No. 9 downwards to No. 15 in the middle and lower parts of the Sakamotozawa section.

Colypes :—L.E.S., Saitama Univ. Slides 14, 81, Specimen 10763.

Genus *Gyroperella* GÜMBEL em.

BENECKE, 1876

Gyroporella (?) *Longipora*, new species.

Plate 10, Figures 6; Plate 11, Figures 6, 7.

Measurements	*Gyroporella* (?) *Longipora* ENDO					
	D	d	p	g (w)	st	s
No. 8. (Cross section)	4.8 mm	4.0 mm	0.2084 mm	40	0.9899 mm	0.2605 mm
No. 34. (Cross section)	8.8	7.0	0.2084		1.8235	0.2647
No. 32. (Longitudinal fragment)			0.2081			0.3647

Descriptions :—Thallus long, cylindrical and slightly undulating; circular or oval in cross-section. Pores may consist of very slender, longer pedicel like filaments with ball-like expansions at its ends. Pores may be nearly perpendicular to the exterior or slightly ascending and open to the exterior. Central stem cylindrical and relatively narrow in proportion to the entire thallus. Sporangia may be developed in the ball-like ends of the branches. The development of the calcified portions are relatively thin and may cover only the outer parts of central stem and the terminal portions of the branches but not the area between.

Remarks :—The relatively narrower central stem and longer branches (pores) serve to distinguish the present species from any other described species of *Gyroporella*. All described European species of *Gyroporella* were reported only from rocks of Triassic age while one species, *G. symetrica* JOHNSON, was found in the Permian strata in the United States. Thus, this species becomes the second recorded from Permian strata. This species is associated with *Anthracoporella magnipora*, *Anchicodium magnum*, and *Osagia* sp.

Occurrence :—Middle and Lower Permian: In the banded limestone of the middle and upper parts of Sakamotozawa section.

Colypes :—L. E. S., Saitama Univ., Slides 8, 32, 34, Specimen 10765.

FAMILY, CODIACEAE

Genus *Anchicodium* J. H. JOHNSON, 1946

Anchicodium Magnum, new species

Plate 11, Figures 3—5.

Measurements	*Anchicodium Magnum* ENDO			
	D	d	s	p
No. 20.	0.7815 mm	0.3647 mm	0.1563 mm	0.0521 mm
No. 18.	1.5630	0.5210	0.1563	0.0782
No. 2.	0.7294			0.0782

Descriptions:—Thalli long, relatively slender, cylindrical, and slightly undulating. One specimen (Pl. 11, Fig. 4,) indicates the presence of crusty base from which cylindrical thalli develop. Center of thallus is poorly organized, and it is composed of a spongelike mass of very fine thread-like filaments. Toward outer margins of thalli, branches tend to become parallel and end in tufts of fine branches that usually are almost perpendicular to outer surface of thallus. Outer part of thallus rather slightly calcified. No spongia observed. Diameter of thallus ranges from 0.4689 mm. to 2.1882 mm. Thallus to 1.5 cm. long is observed. Diameter of ordinary pores are from 0.0521 to 0.0782 mm., and that of fine terminal branches about 0.02 mm.

Comparison:—This species differs from all other described species of *Anchicodium* in its longer thalli with broader diameters of thalli and branches.

Remarks:—Observed specimens are associated with *Quasifusulina longissima* (LEE), *Hikorocodium elegantae* and *Epimastopora japonica*.

Occurrence:—Lower Permian: abundant in the middle and lower parts of the banded limestone beds of the Sakamotozawa section.

Cotypes:—L.E.S., Saitama Univ., Slides 2, 18, 20, Specimen 10768.

Genus *Hikorocodium*, new genus.

Diagnosis:—Thalli cylindrical, rather straight or undulating with rounded end. It may branch or develop rounded protuberances. Some are irregularly constricted. Each thallus is composed of a poorly organized, pith like, central stem and branched, anastomosing, tubular pores in the peripheral part. The central stems are seen in a width of 0.9899 to 2.2403 mm. in each cross section, and usually it consisred of one stem. However, some specimen shows two central stems, as if the section should have cut two bifurcating central stems near in the point of division (Pl. 10, Fig. 3). The central stem may be composed of a sponge-like mass of very fine rounded thread-like filaments. Outer part of thallus are well calcified, but the thickness of calcification varies from 0.2084 mm. to 0.6773 mm. The radiating and anastomosing tubular pores 0.2084 to 0.2605 mm. wide, are given off from the central stem at about right angles or slightly ascending towards one end of the thallus, which may consequently be regarded as the apical end. Where the point of connection between the central stem and radiating pores is visible, no cross-walls are to be observed, the cavities corresponding freely. The radiating pores are usually undulating, and more or less distinctly dichotomously branched. The pores usually run with the same width from the central stem to near the surface of thallus where they end blingly with rounded terminations apparently nearer opening on the exterior surfaces of the thallus. Sometimes, however, one may find the peculiar mode of branching, with a small number of minute pores from the rounded end of a radiating pore and the latter minute pores appear to open to the exterior surface. It is, however, most unlikely that they really do so. Reproductive organs not observed.

Comparison:—From the above description it can be seen that this new genus is allied to *Gymnocodium*, but differs in having more finely anastomosing, outwardly blinded pores, relatively thick calcification of the outer part of thallus and larger sizes of every organs.

Genotype:—*Hikorocodium Elegantae*, new species.

Hikorocodium Elegantae, new species

Plate 10, Figures 1—3.

As there is only one spepies in this genus at present the generic description will surffice, with the addition of the measurements given below.

Measurement	*Hikorocodium Elegantae* ENDO				
	Length	D	d	s	p
No. 41 mm.		6.5 mm	2.2403 mm		0.2605 mm
No. 59.	3.2	2.3448	0.9899	0.7294	0.2084
No. 60.		2.8655	1.2504	0.6774	0.2084

Remarks:—The present species is found associated with *Anchicodium magnum*, *Anthracoporella magnipora*, and *Epimastopora japonica* in the Permian strata, while it also collected with *Anthracoporella spectabilia* PIA from the Lower Carboniferous formation.

Occurrence:—Lower Carboniferous and Lower Permian: Limestones in the uppermost and lower parts of the north and south Sakamotozawa sections.

Genotypes:—L. E. S., Saitama Univ., Slides No. 41, 59, 60, Specimen, 10769.

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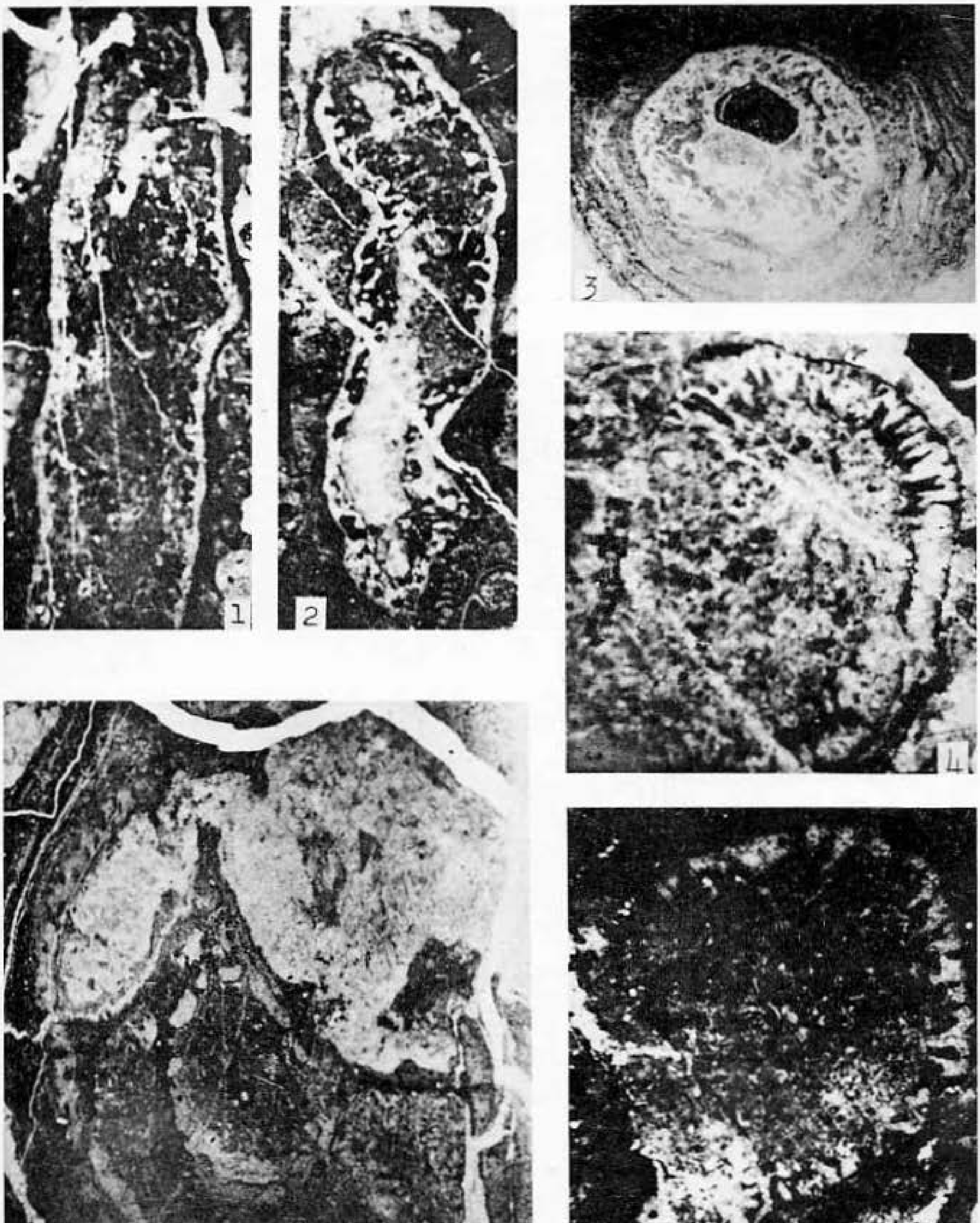
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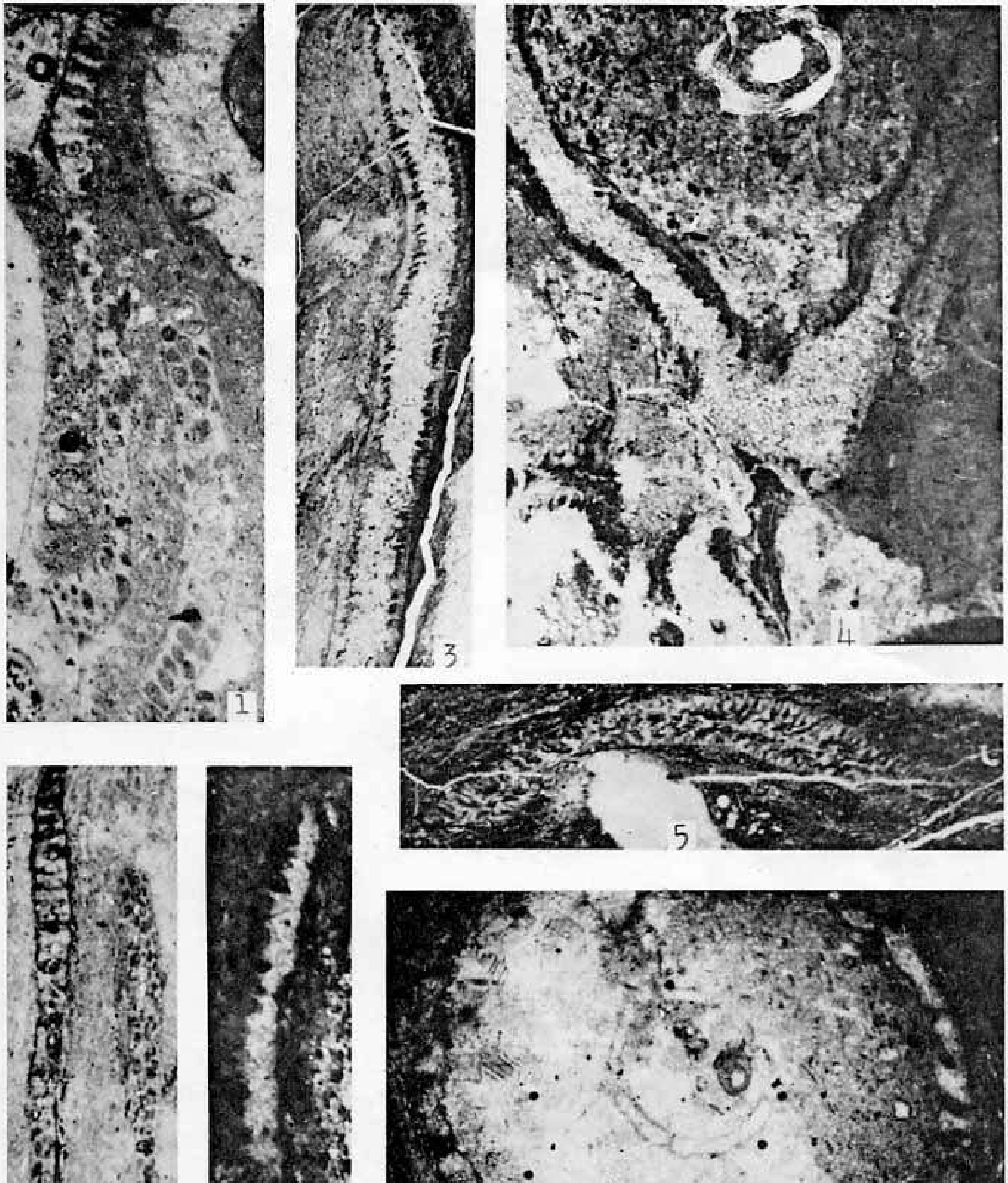
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Explanation of Plates 10—11

The symbols used for the explanation of these plates are as follows.

H. no. = Fossil horizon number	S. = South section
N. = North section	S. no = Slide number

Plate 10.—*Hikorocodium, Anthracoporella and Gyroporella*

Figs. 1-3. *Hikoroccdium elegantae*, new species (×9).
Figs. 1-2. Two longitudinal sections showing undulated outlines, rounded protuberances, and branched, anastomosing, tubular pores which end blindly near the outer surface. (S. nos. 59, 60).
Fig. 3. A specimen of cross section showing a just dividing point of bifulcating central stem, coated with dark layers of some kind of sponge. (S. no. 41).
Lower Carboniferous and Lower Permian: Limestone in the lower parts of the north and south Sakamotozawa sections. (H. no. N. 1, 10, 14, S. 9, 13, 14 etc.).
Figs. 4-5. *Anthracoporella magnipora*, new species (×15).
Two imperfect specimens of cross section showing well bifurcated pores. (S. nos. 32 and 62).
Lower Permian: Limestone in the lower part of the Sakamotozawa section. (H. nos. S. 6, 15, N. 14).
Fig. 6. *Gyroporella* (?) *longipora*, new species (×9).
Cross section showing central stem and character of pores. (S. no. 34).
Middle and Lower Permian: Limestone in the middle and lower parts of the Sakamotozawa section. (H. no. S. 5 and 9).

Plate 11.—*Epimastopora, Anchicodium, and Gyroporella.*

Figs. 1-2. *Epimastopora japonica*, new species. (×15).
Longitudinal sections showing character of wall and outlines of pores. (S. nos. 14 and 81).
Lower Permian: Limestone in the north and south Sakamotozawa sections. (H. nos. N. 11, S. 15).
Figs. 3-5. *Anchicodium magnum*, new species. (×15).
Fig. 3. Longitudinal section, showing undulating outlines of walls, characters of thread like filaments and fine branches. (S. no. 20).
Fig. 4. Specimen showing a crusty base and dichotomously bifurcating, cylindrical thalli. (S no. 18).
Fig. 5. Tangential sectson, showing branches and its tufts. (S. no. 2).
Lower Permian: Limestone in the lower part of the north and south Sakamotozawa sections (H. no. S. 7 (?) 11, N. 7).
Figs. 6-7. *Gyroporella* (?) *longipora*, new species. (×9).
Fig. 6. Cross sections showing central stem and characters of pores. (S. no. 8).
Fig. 7. A longitudinal section of fragmental walls. (S. no. 32).
Middle and Lower Permian: Limestone in the middle and lower parts of the south Sakamotozawa section. (H. no. S. 5 and 9).

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7. It will be necessary for the author to pay for any cost incurred beyond that allowed by these regulations.
8. Manuscripts should also have a title and a brief abstract in Japanese. (This will be furnished for persons not familiar with the European languages).
9. Literature cited or referred to should be listed at the end of the manuscript in the form of a bibliography. The bibliography should be arranged in alphabetic order by author and year. The order will be: Author, Year, Title of Paper, Name of Journal, Volume, Page, Plates, Figures, Maps, Tables.
10. The author's official address should be given below his name, under the title.
11. The desired number of reprints should be indicated on the right corner of the front page of the manuscript. 30 reprints without cover, but with reference to volume, number, and year, will be furnished free of charge to the author. If more than one author is involved, they shall be divided. Additional reprints will be furnished at the printer's rate.
12. Before submitting for publication, manuscripts should be preedited at the author's responsibility by someone to whom the language used is native, or by some equally competent person.

Editorial Regulations

1. The Editorial staff will receive, edit, and preserve the manuscripts.
2. When the Editorial staff receives a manuscript, a notification with date will be sent to the author if the manuscript is acceptable and conforms with the regulations.
3. Acceptance or non-acceptance of manuscripts will be decided by the Publication Committee.
4. Manuscripts not accepted for publication will be returned to the author with notification from the Editor of the reasons for its rejection.
5. Manuscripts accepted will be published in the order received with the date of acceptance indicated thereon.
6. Manuscripts whose contents are altered by the author after being accepted for publication will have their date of acceptance changed.
7. Proof reading will be the responsibility of the Publication Committee.
8. The printing style will correspond to that of the Journal of Paleontology (U. S. A).

CONSTITUTION
of the
PALAEONTOLOGICAL SOCIETY OF JAPAN

ARTICLE 1. Name

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

ARTICLE 2. Object

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

ARTICLE 3. Achievement

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

ARTICLE 4. Membership

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

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

ARTICLE 6. Administration

The Society shall have the following organizations for its administration.

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

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

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

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

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

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

By-Laws and Administration

ARTICLE 8. The Society's journal shall be issued three times a year.

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

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

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

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

Dues

ARTICLE 13. Rates for annual dues of the Society shall be decided during the general meeting. Annual dues for regular members is Yen 400.00 (domestic members) and U.S. $2.00 (foreign members). Patrons are individuals or organizations donating more than Yen 10,000.00 annually. Honorary members are free from obligations.

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

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

Addendum

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

ARTICLE 2. The Society journal shall be issued twice a year for the present.