ON HEDOPHYLLUM BONGARDIANUM (POST. ET RUPR.) YENDO AND FIVE SPECIES OF LAMINARIA FROM THE NORTH KURILES

BY

KINGO MIYABE and MASAJI NAGAI

(With 1 Plate and 4 Text-figures)

In 1901, SETCHELL established a new genus Hedophyllum taking *Laminaria sessilis* AGARDH as the type species and also added to it the another species, *H. subsessile* (ARESCH.) SETCH., elevating ARESCHOUG's forma *subsessilis* of *Hafgygia Bongardiana* (POST. et RUPR.) KÜTZ. to the specific rank. Both are found in the Northern Pacific, the former ranging from Yakutat Bay, Alaska to Point Sur, California and the latter in Bering Sea and its adjacent waters. After two years later, YENDO found and described an alga of this genus for the first time in our boundary (Shumushu Isl. of the North Kuriles), naming it *H. spirale* YENDO. Later he amalgamated his plant together with *H. subsessile* and some species of Laminaria under the name of *H. Bongardianum* (P. et R.) YENDO. However SETCHELL and GARDNER did not accept his opinion, and maintained *H. subsessile* as quite distinct from YENDO's *H. spirale*. They pointed out that judging from YENDO's account he seems to have confused several different plants and to entertain distinctly different views on relationships. In the course of the research on the Laminariaceae of Japan, the authors found again the present plant in the North Kuriles. In the present paper, we intend to describe the morphological characters of this plant together with some species of Laminaria found in this region.

Hedophyllum Bongardianum (POST. et RUPR.) YENDO

Notes on Algae new to Japan. II, p. 269, with fig., 1914 (excl. synonyms, *Hafgygia Ruprechtii* ARESCH., *Laminaria Ruprechtii* DE TONI, *L. Ruprechtii* MIYABE, *L. crassifolia* P. et R., *L. nigripes* KJELLM.)—OKAMURA, Enum. of Jap. Alg. 2nd Ed., p. 168, 1916 (excl. synonym, *Laminaria Ruprechtii* MIYABE).

Syn. *Laminaria Bongardiana* POST. et RUPR., Illustr. Alg., p. 10, Tab.

[Transact. Sapporo Nat. Hist. Soc., Vol. XII, Pt. 4, December, 1932]

XIII, XIV, 1840—KJELLMAN, Beringhafv. Algfl., p. 43, 1889 (excl. f. *taeniata* KJELLM.).

Hafgygia Bongardiana KÜTZ., Spec. Alg., p. 577, 1849—ARESCHOUG, Observ. Phyc. IV, p. 5, 1883.

Laminaria digitata RUPR., Tange d. Ochotsk. Meeres, p. 352, 1851 (ex parte).

Arthrothamnus Bongardianus J. Ag., De Lamin., p. 28, 1868.

Hedophyllum subsessile (ARESCH.) SETCH., Notes on Algae I, Zoe, V, p. 122, 1901—SAUNDERS, Alg. HARRIMAN Exp., p. 430, 1901—SETCHELL et GARDNER, Alg. N. W. Amer., p. 263, pl. 20, 1903; Mar. Alg. Pacific Coast of N. Amer., p. 618, 1925.

H. spirale YENDO, Bot. Mag. Tokyo, XVIII, p. 165, pl. VI, fig. 1–6, 1903—OKAMURA, Rec. Oceanog. Wk. Jap., Vol. I, p. 54, Text-fig. 1, pl. XV, 1928.

Holdfast composed of filiform, 5–7 times di- or trichotomously branched verticilate hapteres; stipe generally short, stout, terete below, somewhat flattened, broadened upwards and canaliculated, ca. 5 mm. in diam. below, 9–20, mostly 11–15 mm. wide above, 2–7, mostly 4–6 cm. long; blade decumbent, simple, obovate or rarely oblong obovate, when young, rounded at the base, not plane but conspicuously bullated at the lower portion, later becoming broader than long, 29–45 × 56–78 cm. in size, and split into 2 or 3 wide segments in the upper end, at maturity much thickened in the external margins near the base, and the central portion of the blade torn and decayed away downwards to the base, forming at last two arms from the thickened bases of the old blade, on which partial blades enroll back towards the inner and then outer direction; mucilage lecunae in the stipe numerous, small, oblong, arranged in a row just beneath the periphery when young, becoming rather elongated when matured; the lacunae in the blade large, prominent, arranged rather sparsely in the subcortical layer; color dark brown; sori extended in irregular outlines on the basal portion of the blade.

Jap. name. *Nejire-kombu.*

Hab. Growing generally on the reefs exposed at ebb-tide.

Shumushu Isl.: Tenjin-iwa (M. NAGAI, July, 1932); Kataoka Bay (K. YENDO, 1903, M. NAGAI, Aug., 1930).

Paramushir Isl.: Kakumabetsu (M. NAGAI, July, 1930, July to Aug., 1932); Kamogawa (M. NAGAI, July, 1932); Arakawa (M. NAGAI, July, 1932); Suribachi Bay (M. NAGAI, Aug., 1932).

Distrib. Kamtschatka: Awatscha Bay (Russian collector); Baron Korfa (TAKAYAMA, after OKAMURA).

Bering Isl. (KJELLMAN).

Aleutian Isls.: Kyska Isl. (C. H. TOWNSEND); Amaknak Isl. in the Bay of Unalaska (W. A. SETCHELL and A. A. LAWSON, L. E. HUNT).

Alaska: Kadiak Isl., Uyak Bay (SETCHELL and LAWSON); Kukak Bay (SAUNDERS); Prince William Sound (SAUNDERS); Yakutat Bay (SAUNDERS).

State of Washington: Puget Sound (SAUNDERS).

In our plant, the rhizoidal hapteres on the thickened base of the old blade are not found, but in the older stage the short and small wart-like pseudo-rhizoidal protuberances are sometimes found on the stipe from base to near the transitional region, as well as even on the basal thickened portion of the blade. (Pl. V, fig. A). The mucilage lacunae in the stipe are small and nearly round or oblong in the juvenile stage, and this structure corresponds to the so-called "glandular cavity" of YENDO. (Pl. V, fig. D). In the adult ones, the lacunae are rather larger and somewhat elongated radially as stated above. (Pl. V, E). These characters of each different type are observed both in the simple and bifurcate forms. The junior author ascertained actually the blade of the plant to be decumbent, and not standing in its natural habit. Among our specimens, some ones show a very short stipe as in the illustration of SETCHELL and GARDNER's account, but others rather longer, flattened and slightly canaliculate as in the plate XIV of the illustrations of POSTELS and RUPRECHT. In the other case, some specimens show the palmate form with a shorter stipe as in the illustration of the cotype specimen found deposited in the Herbarium of the Botanical Museum of Berlin as sketched by YENDO. But the long-stiped form as figured in the plate XIII of POSTELS and RUPRECHT has not been found, and this from seems most likely to be one growing in a rather deeper water, and found stranded on the beach.

Laminaria longipes BORY

in Dict. Class., IX, p. 189, 1826—KÜTZING, Spec. Alg., p. 574, 1849—C. AGARDH, Spec. Alg. I, p. 133, 1820—ARESCHOUG, Obs. Phyc, IV, p. 15, 1883—KJELLMAN, Beringhafv. Algfl., p. 43, 1889—SETCHELL, Alg. Pribilof Isl. pp. 591, 592, pl. 95, 1899; Kelps of U. S. and Alaska, p. 150, 1912—SETCHELL et GARDNER, Alg. N. W. Amer., p. 260, 1903; Mar. Alg. of Pacific Coast of N. Amer. III, p. 597, 1925—YENDO, Notes on Alg. new to Jap. I, p. 125, 1909; Kaisan Shokubutsu-gaku, p. 295, 1910—OKAMURA, Enum. of Jap. Alg. 2nd Ed., p. 172, 1916.

Syn. *Laminaria saccharina*, f. *angustifolia* P. et R., Illustr. Alg., p. 10, Tab. XI, 1840.

Lessonia repens RUPR., Tange d. Ochotsk. Meer., p. 350, 1851.

Laminaria Ruprechtiana LE JOLIS, Examen, p. 71, 1855.

Arthrothamnus ? longipes J. AG., De Lamin., p. 26, 1867—DE TONI, Syll. Alg. III, p. 370, 1895.

Holdfast at first composed of a few hapteres arising from the basal part of the stipe, then these becoming rhizome-like, and giving off lateral-hapteres and also lateral erect shoots; stipe cylindrical, somewhat compressed at the apex, smooth on the surface (when wet), 13–37 cm. long, about 3–4 mm. in diam., without mucilage lacunae; blade plane, undivided, linear, cuneate at the base, acuminate or rounded at the apex, 2–7, mostly 2–4 cm. wide, 30–58 cm. long, with mucilage lacunae arranged rather sparsely in the cortex; color pale brown.

Jap. name. *Hime-kombu.*

Hab. Growing on the reefs in the low tide mark belt.

Alaid Isl.: Sekinezaki (H. ITO and G. KOMORI, Aug., 1926); Minami-ura (M. NAGAI, Aug., 1930).

Shumushu Isl.: Kataoka Bay (K. YENDO. 1903, M. NAGAI, July, 1930); Tenjin-iwa (M. NAGAI, July, 1932); Kosekigawa (M. NAGAI, July, 1932).

Paramushir Isl.: Kakumabetsu (M. NAGAI, July, 1930, July to Aug., 1932).

Distrib. Middle Kuriles: Shimushir Isl., Broughton Bay (M. NAGAI, July, 1930). South Saghalien: Eastern coast at Rorei (T. MIYAKE).

Bering Isl. (KJELLMAN).

Aleutian Isls.: Agattu Isl. (TOWNSEND); Kyska Isl. (TOWNSEND).

Alaska: St. Paul Isl. (GREELEY and SNODRASS).

The present plant is easily identified by the characteristics of the rhizome-like holdfast on which new erect fronds are formed, and the cylindrical stipe in which the mucilage lacunae are absent. In the North Kuriles, the present species grows abundantly on the reefs in the low tide water mark.

Laminaria taeniata POST. et RUPR.

Illustr. Alg., p. 10, Tab. XXXVIII, fig. f. 1840.

Syn. *Laminaria Bongardiana*, f. *taeniata* KJELLM., Beringhafv. Algfl., p. 44, 1889.

L. platymeris, f. *taeniata* SETCH. et GARDN., Mar. Alg. Pacific Coast of N. Amer. III, p. 606, 1925.

Holdfast composed of a globular mass of several times dichotomously branched hapteres; stipe subterete below, more or less compressed upwards, slightly rugulose on the surface (when dry), 5 mm. in diam., 6–9 cm. long, with

a row of mucilage lacunae which are elongated radially and crowded closely in the outer portion of the cortex; blade plane, coriaceous, moderately thick, narrowly cuneate at the base, linear, split into a few linear lobes at the upper end, more or less undulate on the margin, 8–15, mostly 11–14 cm. wide, 229–426 cm. long, pale brown in color when dry; mucilage lacunae of the blade scanty, small and inconspicuous, situated in the outer portion of the cortex; sori extended in longitudinal bands or scattered in small spots on the median and middle portion of the blade.

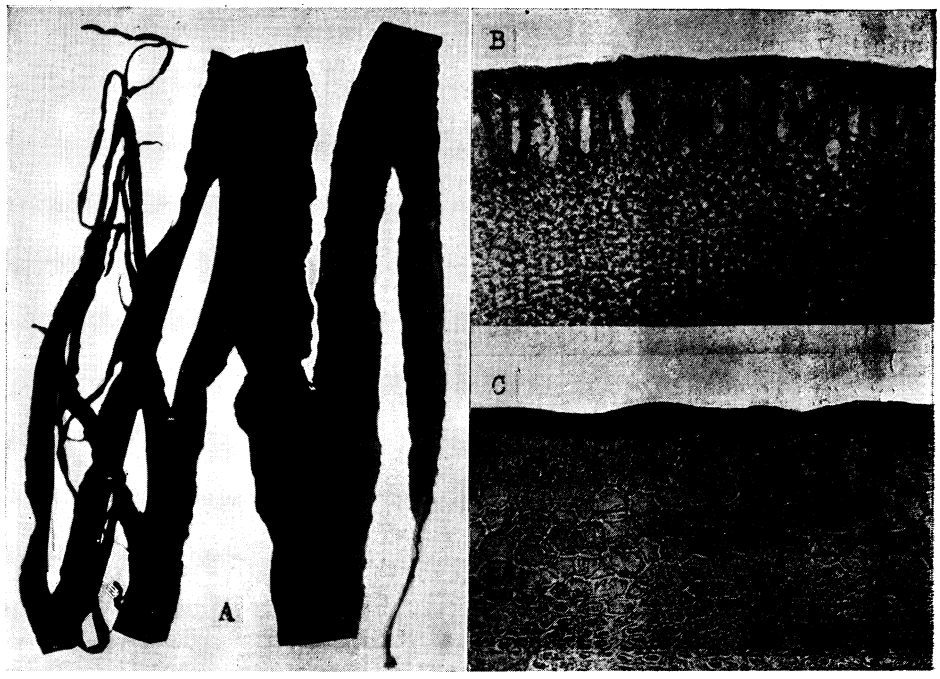

Fig. 1. A. Entire view of the plant. ×1/7. B. Cross section of the stipe, showing the closely arranged and radially elongated mucilage lacunae in the outer portion of the cortex. ×90. C. Cross section of the blade, showing three small mucilage lacunae arranged in the outer cortical layer. ×90.

Jap. name. *Hosoba-chasenkombu.*
Hab. Shumushu Isl.: Tenjin-iwa (M. NAGAI, July, 1932).
Paramushir Isl.: Suribachi Bay (M. NAGAI, Aug. 1932).
Distrib. Kamtschatka (Russian collector).
Bering Isl. (KJELLMAN).
Although we are not able to examine the authentic specimens, the charac-

ters of our plant coincide exceedingly well with the original description and illustration of POSTELS and RUPRECHT. The junior author collected a large number of the specimens of this most characteristic species in the North Kuriles, not far from the original type locality in the eastern coast of Kamtschatka. One of the specimens in our hand, is very narrow and linear, showing the measurement of the stipe 7 cm. long, and of the blade 3.5 × 295 cm. in size. The blade is already split into two narrow segments at the upper end. We are of an opinion that it is better to treat the present plant as an independent species in preference as a form of either *L. Bongardiana* or *L. platymeris*.

Laminaria cuneifolia J. AG.

De Lamin., p. 10, 1867.

f. ***subsimplex*** SETCH. et GARDN.

Mar. Alg. Pacific Coast of N. Amer. III, p. 602, 1925.

Syn. *Laminaria bullata*, f. *subsimplex* S. et G., Alg. N. W. Amer., p. 257, 1903—YENDO, Notes on Alg. new to Jap. I, p. 124, 1909—OKAMURA, Enum. of Jap. Alg., 2nd Ed., p. 174, 1916.

Holdfast composed of somewhat complanate hapteres which are several times dichotomously branched; stipe short and stout, terete below, somewhat compressed above, sometimes twisted, 4–6 mm. in diam., 3–8 cm. long, with a row of roundish mucilage lacunae of different sizes arranged just beneath the periphery; blade thick, somewhat coriaceous, cuneate or rarely somewhat rounded at the base, broadly linear, plane or rarely with a distinct row of bullae extending lengthwise for some distance above the base within each margin, entire or split into two or more broad segments from a half to a third of the distance to the base or sometimes nearly to the base, more or less wavy on the margin, 12–25, mostly 18–23 cm. wide, 76–219, mostly 88–128 cm. long, dark brown in color when dry, with moderately large mucilage lacunae arranged in a row in the outer portion of the cortex; sori extended in bands of irregular outlines on the outer portion from the upper to middle parts of the blade.

Jap. name. *Chishima-satsumatakombu.*

Hab. Growing on the reefs in the low tide mark belt, sometimes together with *Hedophyllum Bongardianum.*

Shumushu Isl.: Kataoka Bay (K. YENDO, 1903, M. NAGAI, Aug., 1930); Tenjin-iwa (M. NAGAI, July, 1932).

Paramushir Isl.: Kakumabetsu (M. NAGAI, July, 1930, July to Aug., 1932);

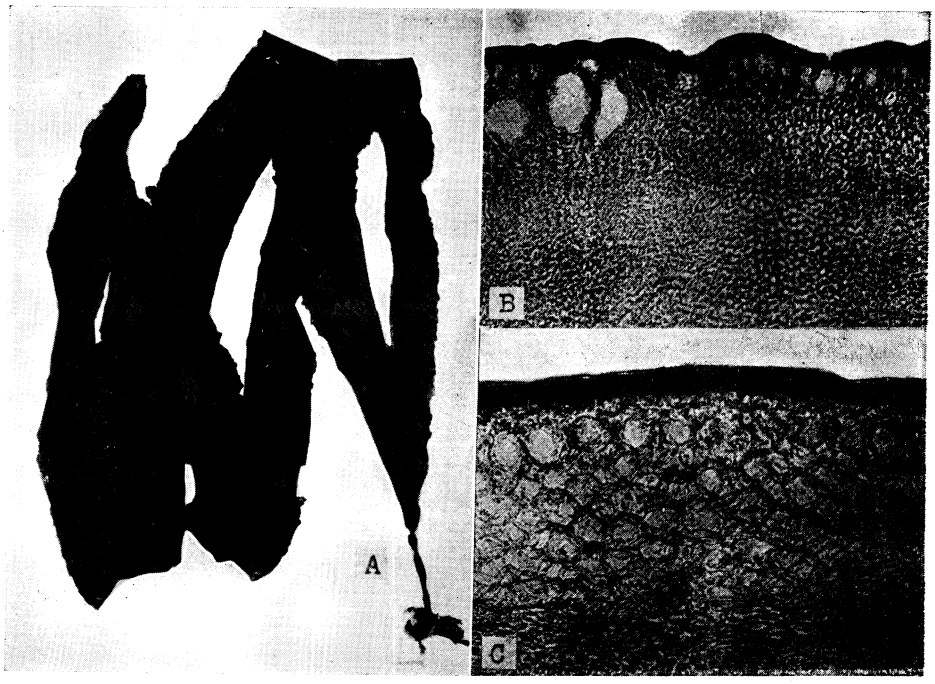

Fig. 2. A. Entire view of the plant. ×1/7 B. Cross section of the stipe, showing a row of small, round mucilage lacunae associated with some larger ones nearby to the former, in the outer portion of cortex. ×90. C. Cross section of the blade, showing a row of mucilage lacunae in the outer portion of the cortex. ×90.

Arakawa (M. NAGAI, July, 1932); Kamogawa (M. NAGAI, July, 1932); Suribachi Bay (M. NAGAI, Aug., 1932).

Distrib. State of Washington: Whidbey Isl. (GARDNER).

After the comparsion with the authentic specimen kindly distributed from the Department of Botany, California University, we were able to identify our plant with the present species. In our plant, the bullation does not usually appear on the blade, but it is shown only in the specimens from the eastern coast of Paramushir Isl. The stipe is terete below, but evidently compressed upwards, and sometimes twisted. The plant having narrower blade is somewhat similar to the wide form of the preceding species, but separable from it in the length of the blade and in the different forms of the mucilage lacunae in the stipe and blade. We are rather of an opinion that the present plant should better be treated as an independent species rather than as a form of *L. cuneifolia* J. AG.

Laminaria platymeris DE LA PYL.

Flore de Terre-Neuve, p. 52, 1829—SETCHELL, Kelps of U. S. and Alaska, p. 151, 1912 (ex parte)—SETCHELL et GARDNER, Mar. Alg. Pacific Coast of N. Amer. III, p. 605, 1925 (excl. synonyms, *Laminaria Bongardiana* P. et R., *L. taeniata* P. et R., *L. fissilis* J. AG.).

Syn. *Laminaria Ruprechtii* (not ARESCH.) MIYABE, Lamin. of Hokkaido, p. 42, pl. XIV, 1902.

L. dentigera, f. *longipes* SETCH. et GARDN., Alg. N. W. Amer., p. 259, 1903; Mar. Alg., p. 604.

Holdfast composed of strong, irregularly 5–6 times branched, closely set hapteres; stipe perennial, thick, elastic, somewhat rugulose (but smooth when wet) on the surface, very long, terete at the base, compressed upwards from about one forth to one third of the distance from the base, 1–1.5 cm. in diam.,

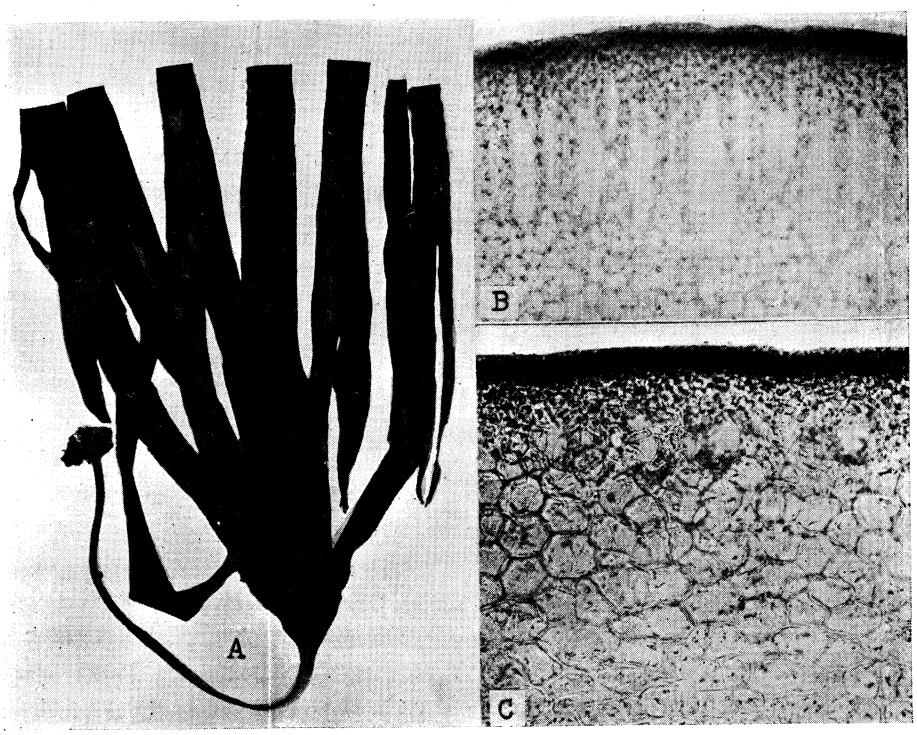

Fig. 3. A. Entire view of the plant. ×1/8. B. Cross section of the stipe, showing the closely arranged mucilage lacunae in the subcortical layer. ×90. C. Cross section of the blade, showing a row of the mucilage lacunae in the outer portion of the cortex. ×90.

30-58 cm. long, with large, closely arranged mucilage lacunae in the peripheral tissue; blade plane, thick, oblong to elliptical, cuneate to rounded at the base, split deeply near to the base into 3-7 wide segments, 34-173, mostly 80-162 cm. long, 15-41, mostly 22-33 cm. wide, with mucilage lacunae rather closely arranged in the subcortical layer; dark brown in color; sori seated in irregular outlines on the middle portion of the blade-segments.

Jap. name. *Chishima-goheikombu.*

Hab. Growing in the sublittoral belt.

Alaid Isl.: Sekinezaki (H. ITO and G. KOMORI, Aug., 1926); Minamiura (M. NAGAI, Aug., 1930).

Shumushu Isl.: Kosekigawa (M. NAGAI, July, 1923).

Paramushir Isl.: Chitose Bay (M. NAGAI, July, 1930); Suribachi Bay (M. NAGAI, Aug , 1932).

Distrib. Middle Kuriles: Shimushir Isl., Broughton Bay (M. NAGAI).

South Kuriles: Etorofu Isl., E. coast, Naibo-mura (YANAGAWA); Hitokappu Bay (M. NAGAI).

Bering Sea to the Strait of Juan de Fuca, Washington State, Arctic North Region of Atlantic Ocean.

In our plant, the stipe is usually rather long, but rarely short in length, of about 9-21 cm. In fresh materials the stipe is always cylindrical up to two-thirds or to three-forths of the distance from the base, and then compressed upwards near to the transitional region, but becomes conspicuously flattened, when dried, for a greater part of its length. We follow here tentatively the opinion of SETCHELL as to the specific identification, with the limitation as to his synonyms. The blade of the young or regenerated plant is frequently split slightly on the upper end or quite entire.

Laminaria dentigera KJELLM.

Beringhafv. Algfl., p. 45, Tab. 2, fig. 10-14, 1889—DE TONI, Syll. Alg. III, p. 341, 1895—SETCHELL et GARDNER, Alg. N. W. Amer., p. 259, 1903; Mar. Alg. Pacific Coast of N. Amer. III, p. 604, 1925—YENDO, Note on Alg. new to Jap. I, p. 124, 1909; Kaisan Shokubutsu-gaku, p, 293, Text-fig. 95, 1910—SETCHELL, Kelps of U. S. and Alaska, p. 151, 1912—OKAMURA, Enum. of Jap. Alg. 2nd Ed., p. 174, 1916—MIYABE, *in* Proc. Third Pan-Pacif. Sci. Congr. Tokyo, p. 955, 1926.

Holdfast composed of rigid, complanated, several times branched hapteres; stipe flexible, cylindrical, somewhat compressed at the apex, 6-8 mm. in diam., 20-43, mostly 23-30 cm. long, with large, densely crowded mucilage lacunae

in the subcortical layer; blade thick, coriaceous, sublanceolate, cuneate at the base, split into a few, sometimes repeatedly, narrower segments with lacerated margins, 80–174 cm. long, 9–19 cm. (segments 3–8 cm.) wide, with mucilage lacunae rather closely arranged in the subcortical layer; dark brown in color; sori extended on the middle portion of the blade.

Jap. name. *Kumadekombu.*

Hab. Growing in the sublittoral belt.

Alaid Isl.: Sekinezaki (H. ITO et G. KOMORI, Aug., 1926).

Shumushu Isl.: Kataoka Bay (K. YENDO, 1903).

Paramushir Isl.: Kakumabetsu (M. NAGAI, July, 1930); Kamogawa (M. NAGAI, July, 1932); Suribachi Bay (M. NAGAI, Aug., 1932).

Distrib. South Saghalien: Cape Notoro, at Shiranushi (TOKIDA).

Bering Isl. (KJELLMAN).

Aleutian Isls.: Agattu Isl. (TOWNSEND); Kyska Isl. (TOWNSEND).

The mucilage lacunae in the stipe are large, and somewhat rounded at the very base of the stipe, but rather elongated radially in the middle and upper portions.

Fig. 4. Entire view of the plant. × 1/8

The authors wish to acknowledge the indebtedness for the fund granted by the Imperial Academy for carrying out the present research.

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Explanation of Plate

Hedophyllum Bongardianum (POST. et RUPR.) YENDO

In natural state, the stipe of this plant is standing erect, but the blade decumbent. The specimens in entire view in the plates, are made flattened at the growing portion between the stipe and blade for taking photographs. The plant in Fig. A and B, is photographed from the upper side of the blade, and in C. from the under side.

Fig. A. Young plant, having obovate blade which is somewhat split at the upper end. The blade is wholly bullate on the lower portion. × 1/7.

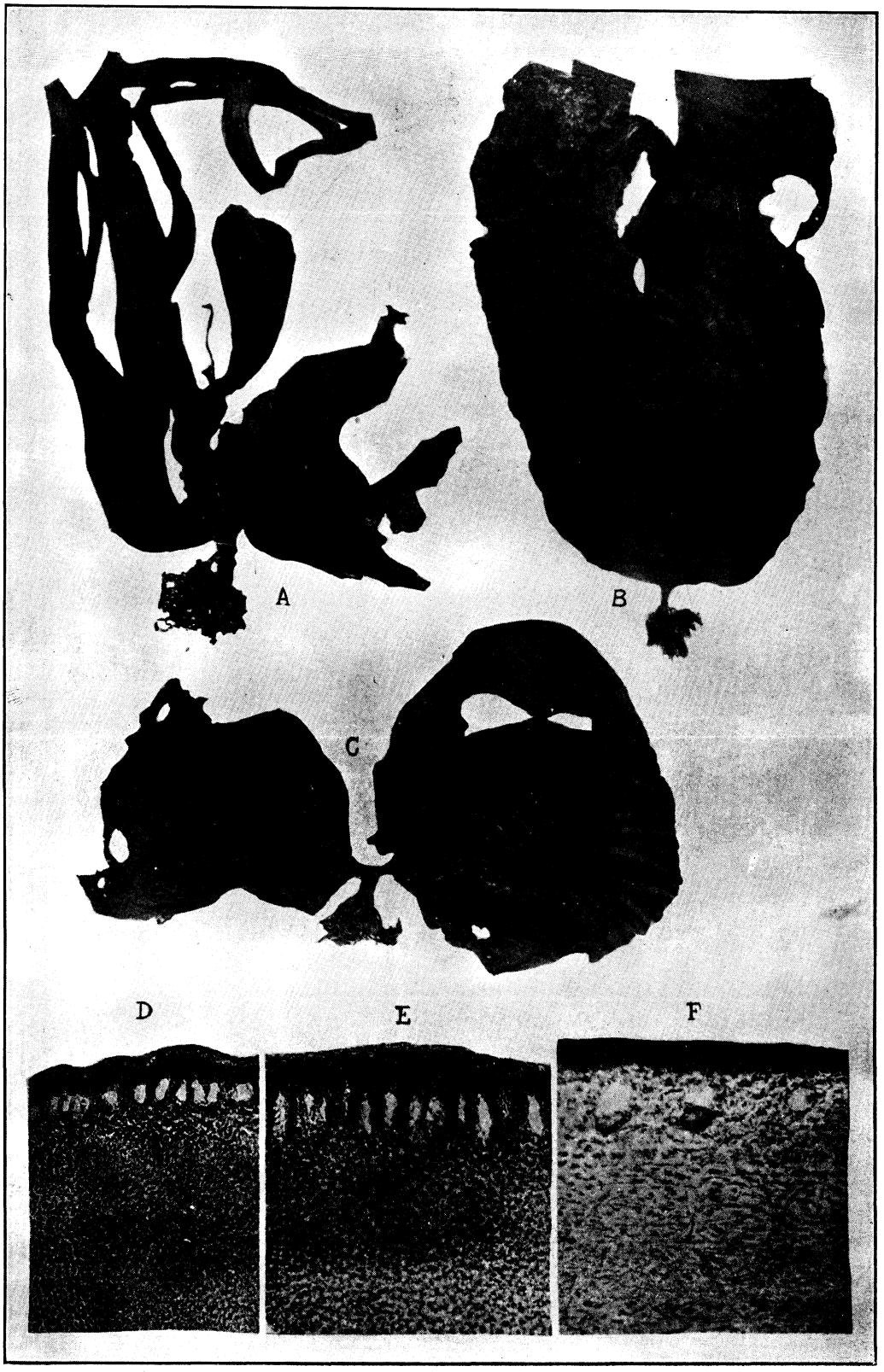
Fig. B. The plant, having the blade that died away on the upper and middle portions, and divided perfectly into two partial ones which enroll at each base. × 1/3.

Fig. C. Old plant, showing the blade separated and then died away in a most part upwards. The wart-like pseudo-rhizoidal protuberances are shown on both sides of the stipe. × 1/4.

Fig. D. Cross section of the blade, showing the mucilage lacunae arranged in the subcortical layer. × 90.

Fig. E. Cross section of the stipe in young plant, showing a row of small, roundish mucilage lacunae in the subcortical layer. × 90.

Fig. F. Ditto in the adult. The lacunae are more or less elongated radially. × 90.



M. NAGAI photo.

摘　　要

北千島産ねぢれこんぶ及昆布屬五種に就て

宮部金吾・永井政次

北千島産昆布科植物中ねぢれこんぶ屬一種、昆布屬五種に就て記載せり。

即ち　*Hedophyllum Bongardianum* (POST. et RUPR.) YENDO (ねぢれこんぶ)

Laminaria longipes BORY (ひめこんぶ)

L. taeniata POST. et RUPR. (ほそばちやせんこんぶ、新稱) (本邦新産)

L. cuneifolia, f. *subsimplex* SETCH. et GARDN.
(ちしまさつまたこんぶ、新稱)

L. platymeris DE LA PYL. (ちしまごへいこんぶ)

L. dentigera KJELLM. (くまでこんぶ)