The Species of Rhodochorton from Japan II.

By

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In the present paper twelve species of *Rhodochorton* are enumerated which have been studied using the specimens preserved in formalin solution.

Sincere thanks are expressed to Prof. Y. YAMADA for his kind guidance during the course of this work.

Rhodochorton terminale spec. nov. Text-fig. 1.

Thallo minuto, caespitoso, 200–300μ alto, ad apicem utriculorum Codii saccati crescenti; spora germinante subglobosa, 11μ×12μ, plerumque in quattor cellulas cruciatim, rarius in plures cellulas, divisa; cellulis his diutissime conspicuis, lateraliter discum basalem et sursum unum filum erectum procreantibus; disco basali unistratoso, initio parenchymatico, cellulis marginalibus dein in fila repentia coherentia plus minus radiantia excrescentibus; cellulis disci basalis irregularibus, 3–4μ latis, 6–7μ longis; filis erectis numerosis, inferne simplicibus, superne ramosis; ramificatione plus minus irregulari vel subdichotoma; ramis rectis, sub anglo acuto egredientibus; cellulis filorum erectorum plus minus moniliformibus, in parte media filorum 5.5–6.5μ latis, basin apicemque versus sensim attenuatis (4.5–5.0μ latis), diametro fere aequilongis vel saepius paullo longioribus; chromatophoris axile stellatis, unum pyrenoide magnum centrali instructis; pilis hyalinis rarius apicalibus; monosporangiis ad apicem filorum erectorum et ramorum semper terminalibus, ellipsoideis, 7.5–8.5μ latis, 10.0–12.5μ longis.

Hab.: Hayama, Sagami Prov. (Herb. Biol. Labor., Imp. Palace, Tokyo, No. 2328).

Plant minute, caespitose, 200–300μ long, growing on the apex of the utricles of *Codium saccatum*; germinating spore subglobose, 11μ×12μ, usually dividing into four cells cruciately, rarely more than four cells; daughter cells of the spore recognizable for a long time, giving off laterally a basal disc, upwards a single erect filament; basal disc unistratose, originally parenchymatous, growing out coherent more or less radiating creeping filaments from its marginal cells; cells of the basal disc irregular in shape,

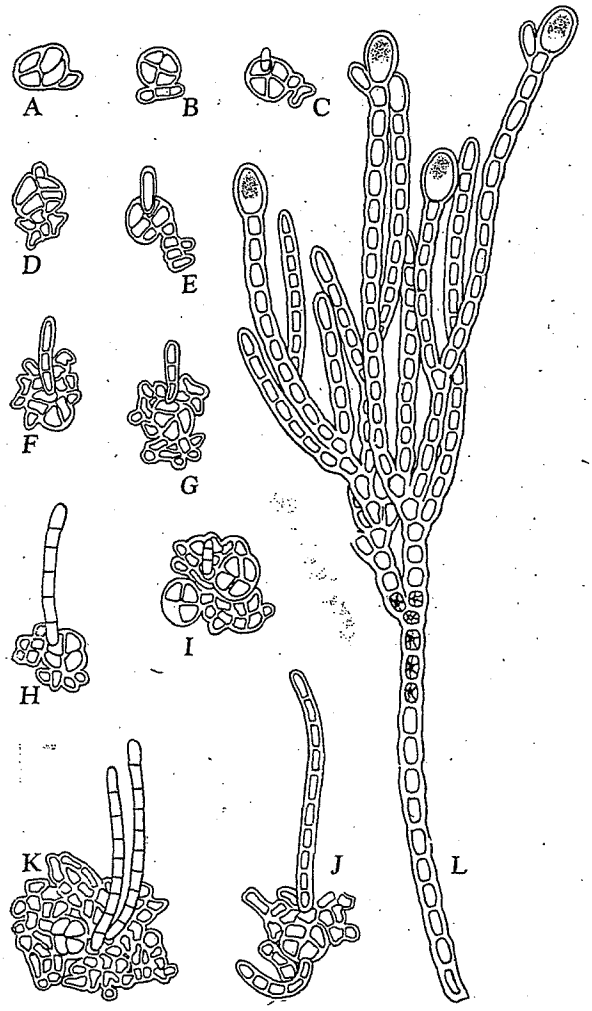

Fig. 1. *E. terminale* NAKAMURA. A–H. Germination stages. ×500. I–K. Young plant showing the basal structure. ×500. L. Mature plant with monosporangia, showing stellate chromatophores. ×500.

3–4μ broad, 6–7μ long; erect filaments arising numerously from the basal cells as well as the daughter cells of the spore, in the lower parts of the filaments simple, in the upper-half branched; branching more or less irregular, having a tendency to become subdichotomous; branches straight, arising with an acute angle, equaling main axis in length; cells of the erect filaments more or less moniliform, in the middle parts of the filaments 5.5–6.5μ broad, decreasing to 4.5–5.0μ towards both base and apex; chromatophores axial stellate with a large central pyrenoid; hyaline hairs apical, rarely present; reproduction by monospores; monosporangia always terminal on both main filaments and branches, ellipsoid in shape, 7.5–8.5μ wide, 10.0–12.5μ long.

This species was found growing on the apex of the utricles of *Codium saccatum*, forming minute dark-red spots. This plant is microscopical, but its presence may be recognized with naked eyes, since it gives the host a dark-red mottled appearance. The basal parts never immerse into the tissues of the host.

The germinating spore divides into mostly four cells by the crossing-walls and rarely more than four cells. These daughter cells of the spore develope immediately into a parenchymatous disc of an irregular outline and are distinguishable for a long time in the basal disc, as they are larger than the rest of the basal cells and remain unchanged their original state. The original spores more than two often germinate close to each other and they develope into one extensively expanded basal disc, confusing together.

The erect filaments often arise from the daughter cells of the spore as well as from the other basal cells. They are slightly constricted at the transverse walls and give off the branches with an acute angle in their upper-half. The ramification is rather irregular, however, it has a tendency to become subdichotomous. The branches reach a almost equal height of the main filaments.

The hyaline terminal hairs were rarely observed. The chromatophore seems to be axial stellate in the formalin-preserved material at hand. The sporangia are borne singly at the apex of the filaments and always terminal as far as could be observed.

The originally parenchymatous basal disc is one of the most distinct characters of this species. Several species of *Rhodochorton* with an originally parenchymatous basal disc have been reported from various parts of the world. Among them, *Acrochaetium fuegense* KYLIN is closely related to this species, but *A. fuegense* apparently differs from *R. terminale* in many other respects.

Another distinguishing feature of *R. terminale* is what the sporangia are always terminal. In this respect, *R. terminale* is close to *R. concrescens* DREW, *R. Desmarestiae* (KYLIN) DREW and others, but these are all different from *R. terminale* in other features.

Rhodochorton densum DREW Text-fig. 2.

Revis. *Chantransia, Rhodochorton, Acrochaetium,* 1928, p. 168, pl. 38, figs. 17–24.

Hab.: Hukaura, Mutu Prov. (T. TANAKA).

Distr.: Fort Point, San Francisco.

Plant epiphytic, minute, 100–300μ high; germinating spore globular, about 10μ diam., dividing into two nearly equal cells; daughter cells of the spore giving rise to both erect and creeping filaments, for a long time easily recognizable from the other basal cells by their peculiar appearance; creeping filaments given off from daughter cells at first mostly at their opposite ends or rarely on the same side, later on all sides, usually not

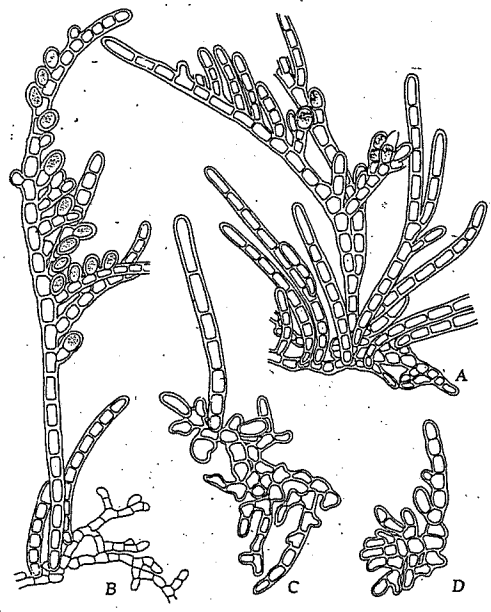

Fig. 2. *R. densum* DREW. A. Mature plant bearing monosporangia, often two together one below the other. ×250. B. More or less constricted form bearing sessile seriated monosporangia. ×250. C–D. Young plant showing basal development. ×333.

confluent, often more or less confluent in pseudoparenchymatous basal layer; cells of the basal creeping filaments irregular in shape, 5.0–9.0μ broad, 7.0–14.5μ long; erect filaments arising from cells of the creeping filaments as well as from the daughter cells of the spore, seldom branched, more or less arcuate, often constricted at the transverse walls especially in the fructiferous parts of the filaments; branching irregular; branchlets short, more or less secund, often opposite; cells of the erect filaments usually cylindrical, often orbicular, 9.0–10.0μ broad, decreasing to 7μ at the apex of the filaments, 1–2 times as long; chromatophores parietal lobed, pyrenoid central; hyaline hairs wanting; monosporangia sessile seriate or pedicellate (one-celled pedicel), terminal or lateral on the main filaments and branches, oval, 7.5–10.0μ by 11.0–15.0μ, chromatophores stellate or more or less lobed apical plate.

This species was found on *Polysiphonia,* growing on *Sargassum,* associated with *Erythrotrichia* sp.

The germinating spore divides into two equal cells. These two daughter cells grow out into creeping filaments usually at their opposite ends, often on the same side or without any order. Later these two cells give rise to erect filaments and more creeping ones. The basal creeping filaments are often more or less confluent and develope into a pseudoparenchymatous basal layer.

It is not rare in the material at hand that the cell adjacent to the sporangium resembles a sporangium both in shape and in the cell contents, as in the DREW's plant, and this cell acts as a second sporangium after the liberation of the first spore.

The chromatophore of monospore is not stellate as like as in the DREW's

plant, but more or less lobed apical plate, as far as could be observed.

The material examined contains two forms. The one agrees quite well with DREW's original descriptions and figures of *R. densum*. The other is more or less constricted at the transverse walls in the erect filaments and its sporangia are mostly sessile seriate or opposite. At first sight, these two forms have impressed the writer as two different species. However, it became clear that the well developed fructiferous plants might more commonly have taken the latter constricted form, and the various intermediate forms between the two above mentioned forms have been found by further observation. Therefore, it is not easy to delimit clearly these two forms as the distinct species.

The writer's diagnosis mentioned above are added these several characters to the DREW's original description of *R. densum*.

Rhodochorton attenuatum Text-fig. 3.
(ROSENVINGE) comb. nov.

Chantransia attenuata ROSENVINGE, Mar. Alg. Denmark, pt. 1, 1909, p. 106, fig. 35.

Acrochaetium attenuatum (ROSENV.) HAMEL, Recher. *Acrochaetium* et *Rhodochorton*, 1927, p. 99.

Hab.: Hatuse, Sagami Prov. (Herb. Biol. Labor., Imp. Palace, Tokyo, No. 2324).

Distr.: Denmark.

Plant epiphytic, 500–800μ high, forming a fringe along the thallus of the host; germinating spore spherical, 10.0μ×12.5μ, divided into two equal cells; daughter cells of the spore give off an erect filament upwards, a disc of a few cells laterally from which the creeping filaments are issued; basal disc unistratose, of an irre-

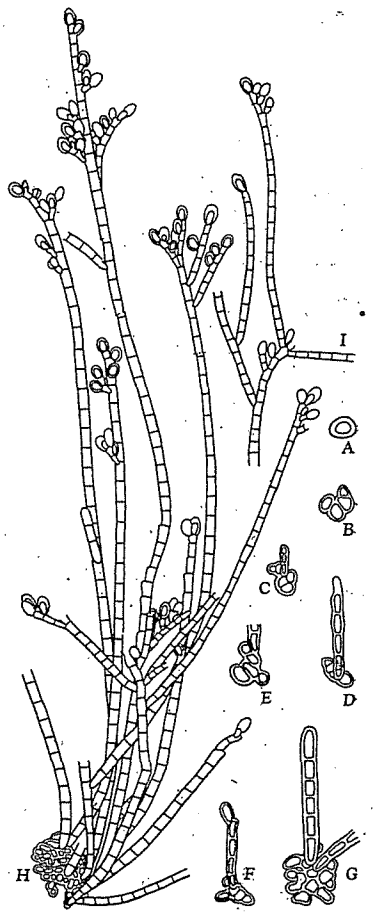

Fig. 3.
R. attenuatum (ROSENV.) NAKAMURA. A–G. Germination stages. ×240. H. Mature plant with monosporangia. ×166. I. Opposite branches. ×166.

gular outline, composed of coherent creeping filaments; cells of the basal disc somewhat isodiametric, 5–7μ broad, 6–8μ long; erect filaments numerous, arising from the basal cells, branched sparsely; branchlets short, numerous in the upper-half of the filaments; branching rather irregular, alternate, secund or often opposite; cells of the erect filaments cylindrical, about 10μ broad, decreasing to 7.5μ at the apex, 5.5μ broad in the ultimate ramuli, 1½–2 times as long as broad (11–15μ long); chromatophores parietal laminate, with a large lateral pyrenoid; hyaline hairs (?); monosporangia terminal or lateral, sessile or pedicellate, solitary or most often by two, borne on the inner side of the branchlets or on the terminal end of the filaments; monosporangia oblong, 7.5–10.0μ wide, 11.0–15.0μ long, very often occurring the renewal of the emptied sporangia from the underlying cell.

This species was found growing on the leaves of *Zostera marina*. The germinating spore divides into two equal cells from which an erect filament and a disc of a few cells are given off. The marginal cells of the original disc issue the creeping filaments which unite together, forming a disc of an irregular outline.

The ramification is rather irregular, sometimes alternate or secund, sometimes dichotomous or often opposite. The opposite branches may often be found where the growth of the filament was stopped.

The sporangial branchlets occur mostly in the upper parts of the plant. The sporangia are placed relatively often singly, more rarely two together on unicellular branchlets or very rarely sessile and sometimes are terminal on the branches. The renewal of the emptied sporangium from the underlying cell occurs very often in the material examined.

This plant agrees well with the description and figures of *Chantransia attenuata* ROSENVINGE. In the material at hand, the hyaline hairs could not be observed, although ROSENVINGE has stated that the hair had usually disappeared, leaving only a faint scar, in some few cases it was still visible.

Rhodochorton seriatum (BÖRGESEN) comb. nov. Text-fig. 4.

Acrochaetium seriatum BÖRGESEN, Mar. Alg. D.W. Indies, 1915, p. 32, figs. 25–28; HAMEL, Recher. *Acrochaetium* et *Rhodochorton*, 1927, p. 99.

Chantransia seriata (BÖRG.) DE TONI, Syll. Alg. VI, 1924, p. 53.

Hab.: Hayama, Sagami Prov. (Herb. Biol. Labor., Imp. Palace, Tokyo, No. 1759, S. 558).

Distr.: St. Croix and St. Thomas, Danish W. Indies.

Plant epiphytic or epizoic, caespitose, about 1 mm high; basal parts

consisted of short irregularly bent creeping filaments, confusing together in the middle into a small disc; basal disc unistratose, composed of isodiametric, rather thick-walled cells; erect filaments branched often quite near the base, in the lower parts of the filaments irregularly on all sides, higher up often quite unilaterally with branches lying in the same plane; branches ramified in the same way, so the plant showing an elegant pectinate appearance; cells of the erect filaments cylindrical, about 8–10μ broad, decreasing to 5–7μ at the apex, 15–24μ long, the length of the cell almost equal along the whole filaments, in the thinner branches only about 4μ broad, 30μ long; chromatophores parietal lobed with a large lateral pyrenoid; hairs absent; reproduction by monospores; sporangia oblong-ovate, (6–)8–11μ broad, (9–)11–15μ long, sessile or often pedicellate (one-celled pedicel), usually secundly seriated in long rows placed on the inner side of the branches, sometimes more or less scattered.

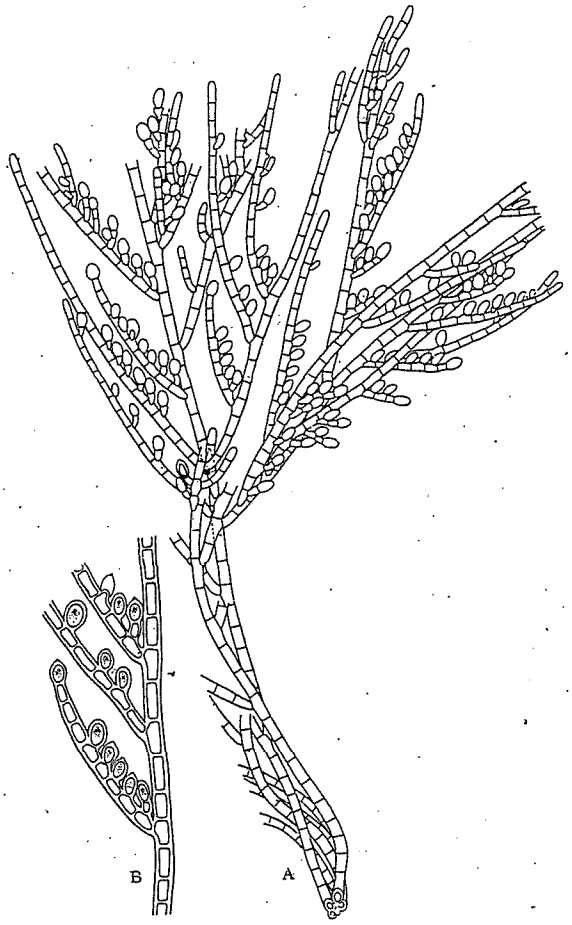

Fig. 4. *R. seriatum* (Börg.) Nakamura. A. Mature plant with monosporangia. ×166. B. Branches bearing sessile seriated monosporangia showing small thickenings at the summit of the sporangia. ×250.

This plant was found on *Gelidium* and *Reniera*, associated with *Rhodochorton Sancti-Thomae*, *R. Daviesii* and *Ectocarpus* sp., but the present species is easily distinguished from the other species by its elegant pectinate appearance.

The present material agrees quite well with *Acrochaetium seriatum* BÖRGESEN.

Rhodochorton Daviesii (DILLWYN) DREW Text-fig. 5.

Revis. *Chantransia, Rhodochorton, Acrochaetium*, 1928, p. 172.

Conferva Daviesii DILLWYN, "Intro. Brit. Confervae, 1809, p. 73, Suppl., pl. F; Eng. Bot., vol. 33, 1814, pl. 2329."

Callithamnion Daviesii, LYNGBYE, Hyd. Dan., 1819, p. 129; HARVEY *in* "HOOKER's Brit. Flora, vol. 2, pt. 1, 1833, p. 348"; *id.*, Man. Brit. Mar. Alg., ed. 1, 1841, p. 117, *ibid.*, ed. 2, 1849, p. 184; *id.*, Phyc. Brit., pl. 315, (1849–1851); *id.*, Ner. Bor. Amer., pt. 2, 1853, p. 243; KÜTZING, Sp. Alg., 1849, p. 638; *id.*, Tab. Phyc., vol. 11, 1861, pl. 56 d (doubtful); J. AGARDH, Sp. Alg., vol. 1, 1851, p. 11 and vol. 3, 1876, p. 80.

Trentepohlia Daviesii ARESCHOUG, Enum. Phyc. Scand., 1846, p. 116; FARLOW, Mar. Alg. New Eng., 1881, p. 109.

Acrochaetium Daviesii NAEGELI, Beitr. Morph. und Syst. Ceram., 1861, p. 171, figs. 26–27; BORNET, Deux *Chantransia corymbifera* THUR., 1904, p. XXII; BÖRGESEN, Mar. Alg. (*in* Plants from Beata Isl.), 1924, p. 25, fig. 8; *id.*, Mar. Alg. Canary Ils., 1927, p. 25, fig. 15; HAMEL, Recher. *Acrochaetium* et *Rhodochorton*, 1927, p. 39, fig. 31 and p. 98; TAYLOR, Mar. Alg. N. E. Coast of N. Amer., 1937, p. 234, pl. 31, figs. 8–10.

Chantransia Daviesii (DILLWYN) THURET, *in* LE JOLIS, Liste, 1863, p. 106; KYLIN, Stud. Algenfl. Westküste, 1907, p. 117, fig. 27; ROSENVINGE, Mar. Alg. Denm., pt. 1, 1909, p. 104, fig. 34; DE TONI, Syll. Alg. IV, 1903, p. 69, *ibid.*, VI, 1924, p. 55; LEVRING, Kenntn. Alg. norweg. Westküste, 1937, p. 88.

Hab.: Hayama, Sagami Prov. (Herb. Biol. Labor., Imp. Palace, Tokyo, No. 1759, 1868, 2319 and S. 558).

Distr.: Cosmopolitan.

Plant epiphytic or epizoic, composed of basal creeping filaments and erect filaments; basal filaments contorted, more or less confused together, forming a basal disc; basal cells rather irregular in shape, about 10.0μ $\times$12.5μ; erect filaments branched alternately or secundly, slightly attenuated, composed of short fairly thick-walled cells; branchlets ramified, developing on the adaxial side of the base of the branches, so forming axillary clusters, or scattered along the main filaments; cells of the erect filaments cylindrical, about 9–12μ thick, decreasing to 7.5μ at the apex of the branches, 1½–2 times as long as broad, cell-wall about 2μ thick; chromatophores parietal, containing a large prominent pyrenoid; hair-like prolonga-

tions present, decreasing to 2μ thick at the apex, up to 50μ long; reproduction by monospores and tetraspores; sporangial branchlets more or less repeatedly branched, forming a fan-shaped fascicle; sporangia pedicellate, terminal or lateral, ovate in shape, monosporangia 8–10μ by 14–18μ, tetrasporangia 12μ by 15μ.

This species is epiphytic on *Chondrus, Gelidium* and *Ecklonia,* and epizoic on *Reniera,* associated with *Rhodochorton seriatum, R. Sancti-Thomae* and *Ectocarpus* sp.

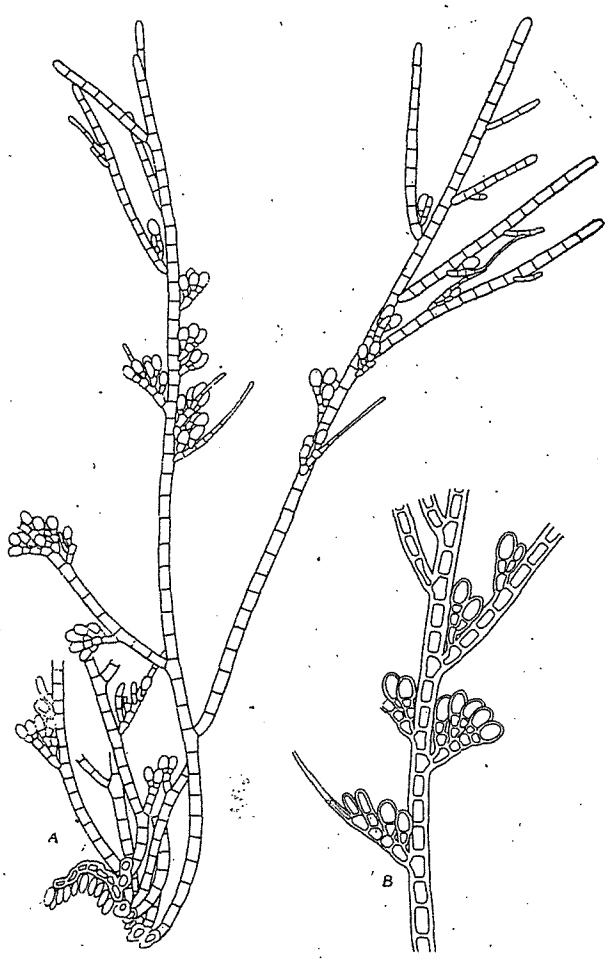

Fig. 5. *R. Daviesii* (DILLWYN) DREW. A. Mature plant with monosporangia. ×166. B. Branch with fasciculated sporangia-bearing branchlets. ×250.

R. Daviesii is the first described of all the marine species of the genus *Acrochaetium* and is known to be distributed throughout the world. Full account of this species has been given by ROSENVINGE (1909, p. 104, fig. 34) and the specimens at hand agree well with it.

The thick-walled and short-celled filaments and the fasciculated sporangia-bearing branchlets are the striking characters of this species. The basal parts consist of branched creeping filaments which may become so densely interwoven that they form a continuous basal disc, but a real parenchymatous disc has never been seen, as stated by ROSENVINGE.

The material examined bears monosporangia only, as described by ROSENVINGE and DREW, but KYLIN states that tetrasporangia may occur

together with monosporangia.

Rhodochorton plumosum DREW Text-figs. 6–7.

Revis. *Chantransia, Rhodochorton, Acrochaetium,* 1928, p. 173, pl. 39, fig. 29.

Hab.: Esasi, Osima Prov., Hokkaido; Hukaura, Mutu Prov. (T. TANAKA).

Distr.: Pacific Coast of Central California.

Plant epiphytic, 1.0–1.5 mm high, forming a dense fringe along the frond of the host; germinating spore subglobose, about 11μ×13μ, divided into two equal cells giving off creeping filaments usually in the opposite direction, often irregularly; base composed of more or less coherent radiating filaments, basal layer usually unistratose, rarely multistratose; basal cells irregular in shape, mostly isodiametric or more or less elongated, about 5–8μ broad, 7–13μ long; erect filaments when well developed several milimeters long, well branched; branches arising at irregular intervals; branchlets numerous, developing for the most part on the upper-half of the filaments, branched mostly opposite, very often secund or alternate, both branches and branchlets usually in one plane; cells of the erect filaments decreasing in size from the base to the apex of the filaments, 5–9μ diam., 1½–3 times as long as broad at the apex, 10–13(–17)μ diam., 3–4 times as long as broad at the base; cells slightly wider at the top than at the base of the cell, especially where the cell gives rise to a branch, cell contents very dense in the formalin-preserved material; chromatophores parietal with a single pyrenoid; monosporangia terminal or lateral on the branchlets, pedicellate or sessile, 7–10μ wide, 10–14μ long, chromatophores apical, somewhat lobed; sexual reproduction unknown.

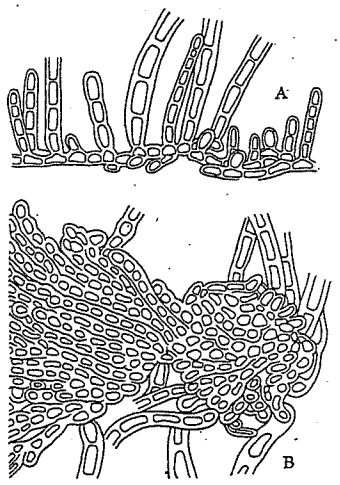

Fig. 6. *R. plumosum* DREW. A. Basal parts in transverse section. ×250. B. Basal parts seen from below. ×250.

This plant was found upon *Sargassum,* growing on rocks facing to the surf. The place where this plant grows is tinged with dark-red all over since the thallus of the host are densely covered with this species.

The present material agrees well with *Rhodochorton plumosum* DREW,

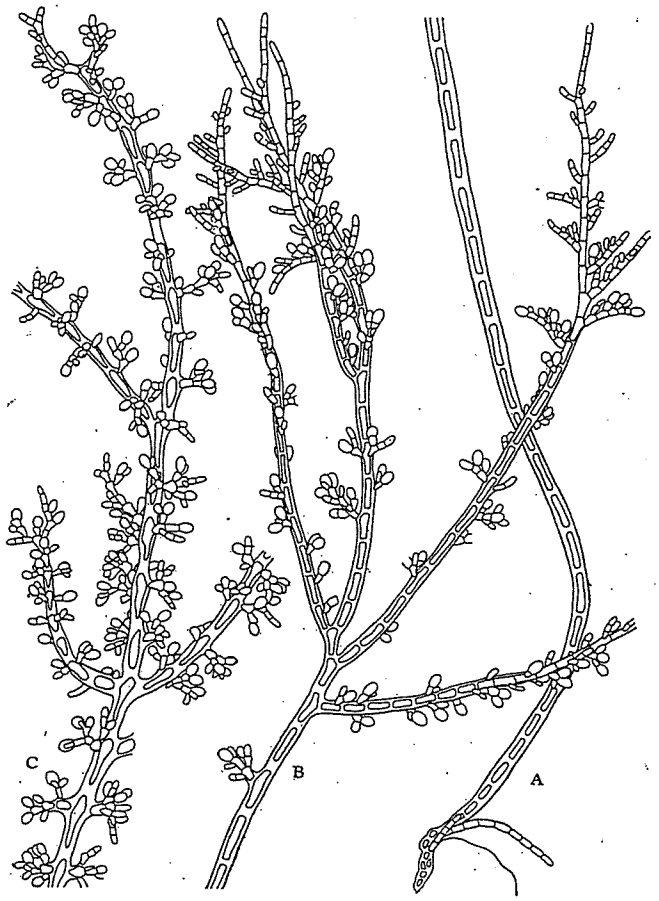

Fig. 7. *R. plumosum* DREW. A–B. Plant collected from Hukaura. ×166.
C. A part of plant collected from Esasi showing the opposite branches predominatingly. ×166.

although it does not always branch in one plane as DREW's original specimen, and also is most closely related to *R. variabile* DREW. It is not easy to separate *R. variabile* from *R. plumosum*, as DREW states in details in his original description.

In fact, the material collected from Esasi in April has the opposite branchlets predominatingly, showing the feathery appearance, but that from Hukaura in January has usually the secund branchlets as well as the opposite ones and does not exactly show the distinct feathery appearance. Besides the typical form of *R. plumosum*, forms of *R. plumosum* which have graded into some forms of *R. variabile* was found, but the typical

form of *R. variabile* could not be detected clearly in the material examined. Furthermore, judging from the date of collection and the other respects, the material from Esasi appears to be a well developed mature form of that from Hukaura.

Further observation should be carried out, comparing the specimens at hand with DREW's type specimens of *R. plumosum* and *R. variabile*.

Rhodochorton callithamnioides spec. nov. Text-fig. 8.

Thallo caespitoso, ad 0.5–1.0 mm alto, e filis erectis filisque endophyticis repentibus composito; (spora germinante? non divisa, circiter 18μ diam. metiente); filis endophyticis inter cellulas plantae hospitis penetrantibus, saepe usque ad superficiem oppositam pervenientibus; cellulis filorum endophyticorum elongatis, in parte medio paullum incrassatis, 8–9μ latis, 34–50μ longis; filis erectis e cellulis filorum endophyticorum emittentibus, gracilibus, plus minus flexuosis, in pariete transverso paullum constrictis, e basi subdichotome ramosis; ramulos plerumque 1–4 articulatis, irregulariter alternatis, saepe subunilateralibus, raro oppositis; articulis filorum erectorum 8–11μ latis, sensim attenuatis ad 5–6μ latis, diametro 2–3 plo longioribus; cellulis pariete crassiusculo 1–2μ crasso instrictis, praecipue in filis endophyticis; chromatophoris ignortis; pilis nulis; monosporangiis terminalibus vel lateralibus, plerumque 3–5 aggregatis, saepe solitariis, raro secundatis ad ramulos insidentibus, ellipsoideis, 10–12μ by 15–17μ, pariete tenuissimo donatis; fasciculis spermatangiorum numerosis, antheridiis terminalibus vel lateralibus ad ramulos breves secundatim vel opposite ramosos gerentibus, 5–6μ by 7–8μ; cystocarpiis ignortis.

Hab.: Hatijo Il., Ogasawara Ils. (Herb. Biol. Labor., Imp. Palace, Tokyo, No. 1829).

Plant caespitose, 0.5–1.0 mm high, composed of erect filaments and endophytic creeping filaments; (germinating spore? not divided, ca. 18μ in diam.); endophytic filaments penetrating between and through cells of the thallus of the host, often reaching to the opposite surface of the thallus of the host; cells of the endophytic filaments elongated, slightly swollen in the middle parts, 8–9μ broad, 34–50μ long; erect filaments arising from cells of the endophytic filaments, very slender, more or less flexuose, slightly constricted at the transverse walls, branched subdichotomously from quite near the base of the filaments; branchlets mostly composed of 1–4 cells, irregularly alternate, often with some tendency to be unilateral, rarely opposite; cells of the erect filaments 8–11μ broad, decreasing to 5–6μ at the apex of the filaments, 2–3 times as long as broad; cell-wall rather thick,

especially in the endophytic filaments, 1–2μ thick; chromatophores not observed; hairs apparently wanting; monosporangia terminal or lateral on the branchlets, mostly 3–5 sporangia aggregate, often solitary, rarely in secund series, elliptical in shape, 10–12μ by 15–17μ, thinner-walled than the vegetative cells; antheridial clusters numerous, antheridia terminal or lateral on the ramified branchlets, 5–6μ by 7–8μ; antheridial branchlets secund or opposite; cystocarps unknown.

This species has been found in the thallus of *Endarachne Binghamiae*, associated with *Erythrotrichia* sp. The endophytic filaments are deeply penetrating between the cells of the host and giving rise to other branches which grow free of the host. Most of the endophytic filaments are growing in a radial direction into the host and some of them more or less tangentially.

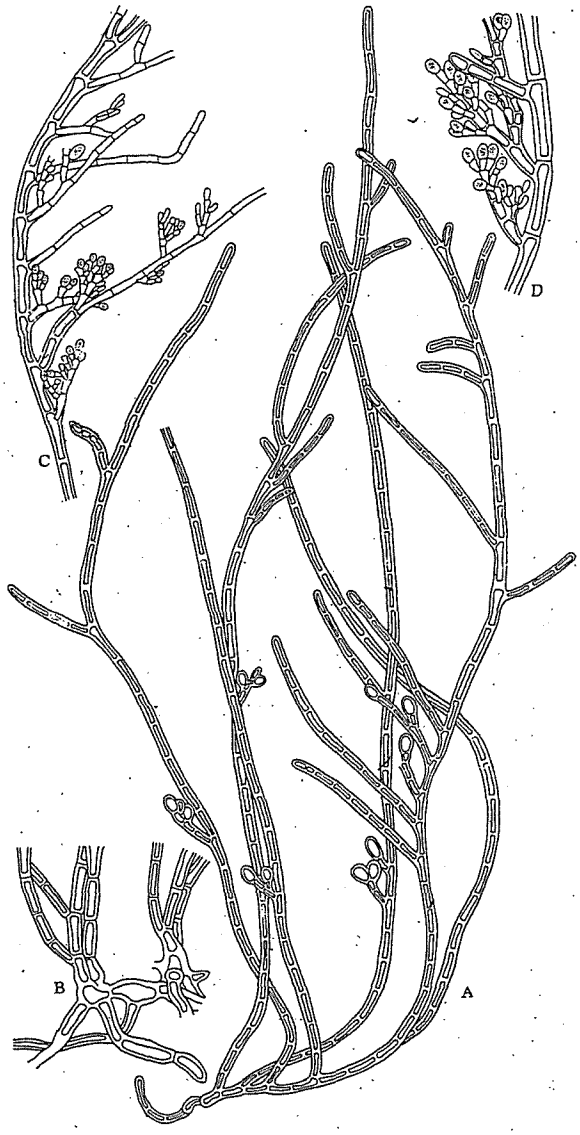

Fig. 8. *R. callithamnioides* NAKAMURA. A. Plant with monosporangia. ×140. B. Basal parts. ×223. C. Branch with antheridial branchlets and one monosporangium. ×166. D. Branch with antheridial branchlets showing their arrangement. ×250.

The thick-walled rather irregular shaped cells having dense homogenous

cell contents, are often found in the endophytic filaments. These peculiar cells are mostly situated at the bottom of the well developed erect filaments. These cells appear to be germinating spores, although the germination of the original spore could not be followed clearly.

The chromatophores could not be observed in the formalin-preserved material at hand. The monosporic plant is by far the most abundant in the material examined. The carposporic plant has never been found as far as could be observed, but the antheridial one frequently occurs and often bears monospoangia besides antheridia.

R. callithamnioides is closely allied to *R. Macounii* (COLLINS) DREW. The endophytic filaments of *R. callithamnioides,* however, are quite different from those of *R. Macounii,* never forming a tuft of the rhizoidal filaments, but spreading loosely a large area. In addition, the general appearances are quite different and those of *R. callithamnioides* are coarse and more or less flexuose. In this respect, this plant rather approaches the genus *Callithamnion.* In the basal structure, *R. callithamnioides* is nearly related to *R. Hyalosiphoniae* NAKAMURA, but this is quite different from it in other respects.

Rhodochorton codii (CROUAN) comb. nov. Text-fig. 9.

Callithamnion codii CROUAN, "Liste, 1860, p. 2."

Callithamnion caespitosum CROUAN, "Flor. Finist., 1867, p. 135 (partim)."

Acrochaetium codii (CROUAN) BORNET, *Acrochaetium* et *Chantransia,* 1904, p. XX; HAMEL, Recher. *Acrochaetium* et *Rhodochorton,* 1927, p. 30, fig. 27 and p. 92.

Chantransia codii (CROUAN) LEVRING, Kenntn. Alg. norweg. Westküste, 1937, p. 89, fig. 13.

Hab.: Akkesi, Hokkaido.

Distr.: Morocco, France, Norway.

Plant endophytic below, caespitose, 1.5–3.0 mm high; basal parts composed of endophytic penetrating filaments, bending round along the walls of the utricles of the host; endophytic filaments irregularly branched, consisted of elongated thin-walled cells; cells of the endophytic filaments 7.5–12.5μ broad, 3–6 times as long as broad (25–50μ long), cell-wall more or less sinuated; erect free filaments less branched; branches mostly arising near the surface of the host; branchlets scattered along the filaments, mostly alternately, often secundly; cells of the free filaments cylindrical, 10–13μ broad, 7μ at the summit of the branchlets, 1–2 (–3) times as long as broad

(10–25μ long), cell-wall rather thick, about 2μ thick; branchlets terminating into hyaline hair-like prolongations; chromatophores parietal lobed plates with a single pyrenoid; monosporangia borne on the inner side of the branchlets, 1–2 sporangia on 1–(2–) celled pedicel; sporangia-bearing branchlets often repeatedly branched, forming a fan-shaped fascicle; monosporangia 7.5–10.0μ by 12.5–15.0μ.

This species is growing in *Codium tomentosum*, associated with *Rhodochorton rhizoideum*. The present material agrees quite well with the description and figures given by LEVRING for *Chantransia codii*, but is more or less different from HAMEL's description of *Acrochaetium codii*. After HAMEL, the cells and sporangia of the specimens from France are fairly larger than those of the present material. The free erect filaments of this species are very like those of *R. Daviesii*, but they are quite different in the basal structure.

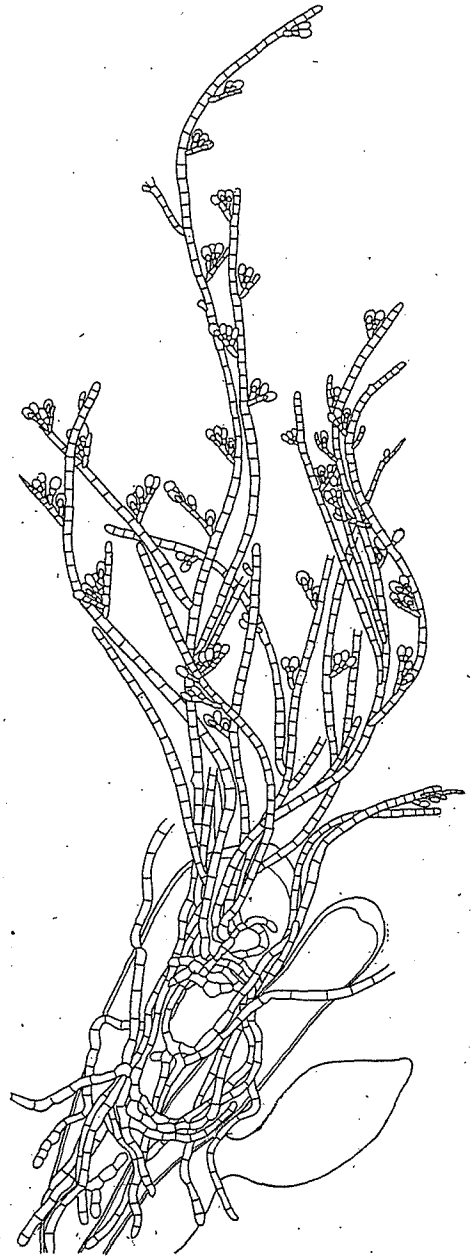

Fig. 9. *R. codii* (CROUAN) NAKAMURA. Plant with monosporangia showing the tangled, endophytic, rhizoidal fiaments, bending round along the utricles of *Codium*. ×110.

Rhodochorton codicola

(BÖRGESEN) comb. nov.

Text-fig. 10.

Acrochaetium codicola BÖRGESEN, Mar. Alg. Canary Ils., 1927, p. 33, figs. 18–20.

Hab.: Zusi (T. TANAKA) and Hayama (Herb. Biol. Labor., Imp. Palace, Tokyo, No. 1725, 2233 c), Sagami Prov.

Distr.: Teneriffe and Gran Canaria, Canary Ils.

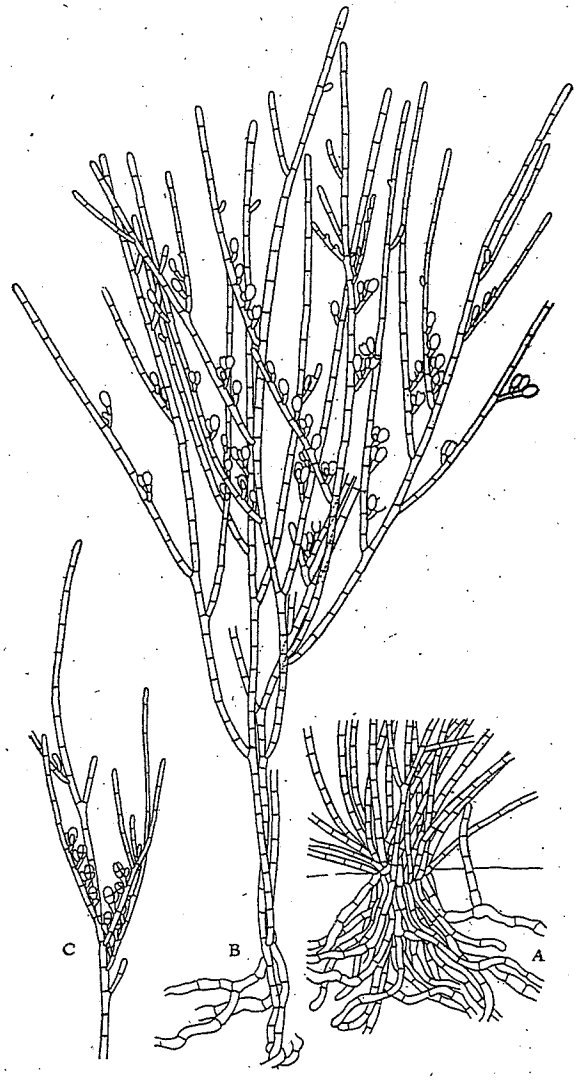

Fig. 10. *E. codicola* (BÖRG.) NAKAMURA. A. Basal parts of plant collected from Zusi showing dense bunched endophytic filaments. ×40. B. Plant with monosporangia collected from Hayama. ×60. C. Upper parts of plant with tetrasporangia. ×60.

Plant endophytic below, caespitose, 2.5–7.0 mm high, forming a fringe along the frond of the host; basal parts composed of endophytic creeping filaments; endophytic filaments more or less richly, irregularly branched, consisting of cells with thin sinuated walls; cells of the endophytic filaments (20–) 25–35μ broad, 2–3 times as long as broad (50–100μ long); erect filaments arising as branches of the endophytic filaments, straight, strictly virgate, rather richly ramified from near the base to the summit of the filaments; ramification rather irregular on all sides, alternate, very rarely opposite, in the upper parts of the filaments more or less secund, branches given off with acute angles, shorter or longer intervals, bearing sporangial branchlets on their upper side; cells of the

erect filaments cylindrical, not constricted at the cross-walls, 15–20μ broad, decreasing to 7–11μ at the apex of the branches, 40–60(–80)μ long; apical cells of the filaments slightly inflated at the end, obtuse at the apex; hairs and hair-like prolongations wanting; chromatophores parietal lobed, divided into several pieces in the older cells, pyrenoids 1–2 or more, usually 4–5 in the larger cells; reproduction by monospores and tetraspores; sporangial branchlets arranged in secund series on the inner side of the branches, mostly at their base, often along the whole length, usually composed of a single cell, bearing one or very often two sporangia at their top, rarely composed of more than one cell, in this case, usually bearing three sporangia on the same branchlet; sporangia sessile or pedicellate, oval or obovate in shape; monosporangia 20–22μ wide, 35–40μ long; tetrasporangia 20–28μ wide, 40–50μ long, cruciately divided.

This species was found growing in *Codium fragile*, usually with other minute algae, *Ceramium*, *Rhodochorton*, *Goniotrichum*, *Ectocarpus* and some *Cyanophyceae*.

The endophytic filaments are extensively developed and often placed in bunches between the utricles of the host. The cell-wall of the endophytic filaments is rather thin and sinuated.

The tetrasporangial plant has not been reported in the Canarian plants, but in the material at hand it was found very commonly, sometimes in the same individuals as the monosporangia-bearing plants.

Excepting the tetrasporangia, the present plant is quite like *Acrochaetium codicola* Börgesen. The material from Zusi has more or less thicker cell-wall and denser bunched endophytic filaments than that from Hayama, but they are not sufficiently different to justify their separation as the distinct species.

Rhodochorton rhizoideum Drew Text-fig. 11.

Revis. *Chantransia, Rhodochorton, Acrochaetium*, 1928, p. 182, pl. 42, figs. 42–44.

Hab.: Akkesi and Urakawa, Hokkaido.

Distr.: From Washington to southern California.

Plant endophytic below, caespitose, 3–4 mm or more high, forming a dense fringe along the frond of the host; base composed of endophytic rhizoidal filaments, growing between the utricles or cortical cells of the host; endophytic rhizoidal filaments branched; cells of the endophytic filaments irregular in shape, up to 28μ diam. (average 20μ), 60–100μ or more long, cell-wall not sinuated; erect filaments arising from the endophytic

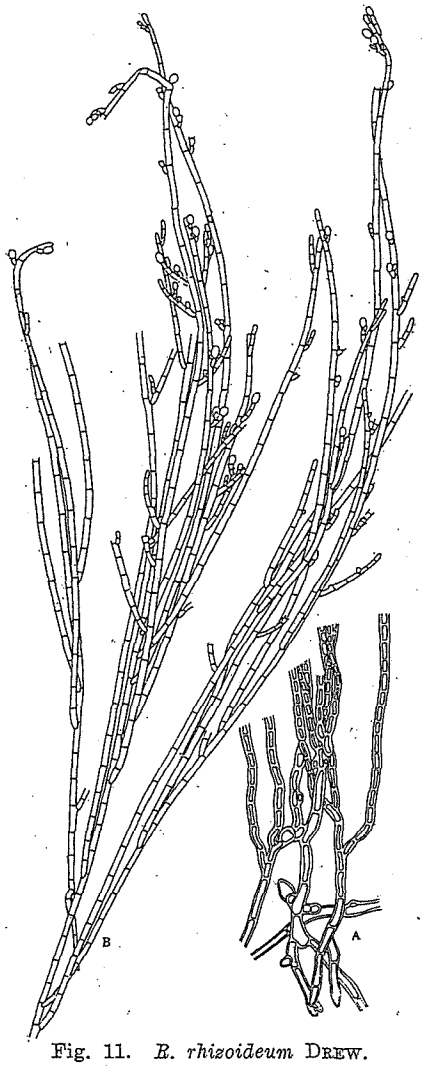

Fig. 11. *R. rhizoideum* DREW.
A. Basal parts. × 45.
B. Upper parts of plant with monosporangia. × 45.

filaments, branched irregularly, rarely unbranched, most of the branches arising from near the base; branchlets scattered along the filaments, often interrupted series; cells of the erect filaments cylindrical, decreasing in size from the base of the filaments to the apex, (14–)15–20μ broad, 2–5(–7) times as long as broad (30–130μ long); cell-wall very thick, especially near the base of the filaments, up to 5μ thick, averaging 2μ thick; chromatophores parietal, usually band-shaped occupying the whole length of cells, rarely fenestrate in the cells of the free filaments, either a single reticulate or several ribbon-shaped in the cells of the endophytic filaments; 1–4 prominent pyrenoids in the cells of the free filaments, sometimes none in the cells of the endophytic filaments, up to 4μ diam.; reproduction by monospores; sporangia terminal or lateral on the branchlets, rarely sessile, ovoid in shape, (16–)20–25μ by (22–)30–35μ.

This species was found growing in *Cystophyllum hakodatense* and *Codium tomentosum*, usually with other epiphytic algae. In the material growing in the stipe of *Cystophyllum hakodatense*, the endophytic filaments are not so freely developed as in the material growing in *Codium tomentosum*.

This plant agrees quite well with *Rhodochorton rhizoideum* DREW and is one of the largest as well as one of the commonest of the monosporangia-bearing species on the pacific coast of Hokkaido. This is also easily distinguished by its cell-structure since the cell-wall is very thick and the

pyrenoids are prominent.

Rhodochorton Howei YAMADA Text-fig. 12.

Notes Jap. Alg. VIII, Sci. Pap. Inst. Alg. Res., Fac. Sci., Hokkaido Imp. Univ., vol. II, No. 1, 1938, p. 127.

Rhodochorton affine YAMADA (non DREW), Notes Jap. Alg. III, Journ. Fac. Sci., Hokkaido Imp. Univ., Ser. V, vol. 1, 1932, p. 114, fig. 3, a–d.

Hab.: Iragozaki, Mikawa Prov. (K. INAGAKI); Morozaki, Owari Prov. (T. SEGI); Azirozaki, Sagami Prov. (Herb. Biol. Labor., Imp. Palace, Tokyo, No. 2321).

Plant endophytic below, caespitose, forming a fringe along the frond of the host, 3–5 mm high; endophytic basal system much developed, branched irregularly, growing between the utricles of the host; cells of the endophytic filaments more or less sinuated, thin-walled, 18–27μ broad, 2–3 times as long as broad; erect filaments arising from the horizontally creeping endophytic filaments, more or less contorted, irregularly branched; branching interrupted, having a tendency to be in more or less dense clusters in the upper-half of the main filaments; branches moderately long; sporangial branchlets scattered along the filaments, often secund; apical cells of the filaments slightly inflated at the end, obtuse at

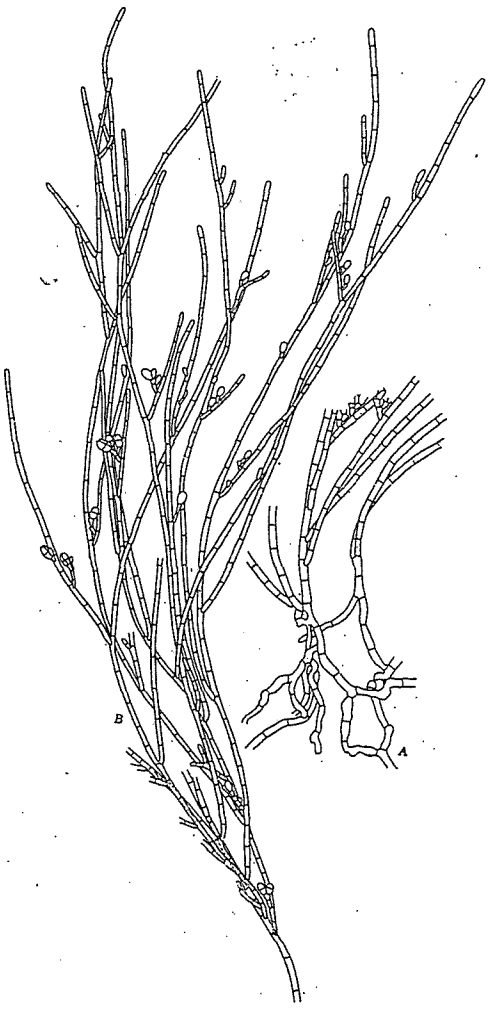

Fig. 12. *R. Howei* YAM.
A. Basal parts. × 45.
B. Upper parts of plant with tetrasporangia. × 45.

the apex; cells of the erect filaments cylindrical, 16–18μ broad, decreasing to 15μ at the apex of the filaments, 4–6 times as long as broad (30–100μ long); chromatophores parietal, reticulate, band- or ribbon-shaped, sometimes divided into several lobed plates, pyrenoid 1–2 or more; reproduction by tetraspores, sporangia terminal or lateral on the branchlets, often sessile, elliptical in shape, (15–) 22–25μ by (30–) 40μ, cruciately divided.

This species was found growing in *Codium*, associated with *Ceramium*, *Ectocarpus* and some *Cyanophyceae*. This plant is very common in fronds of *Codium latum* on the pacific coast of central Honsyu and is one of the largest species of this genus.

Rhodochorton infestans (HOWE et HOYT) DREW Text-fig. 13.

Revis. *Chantransia, Rhodochorton, Acrochaetium*, 1928, p. 151.

Acrochaetium infestans HOWE et HOYT, Mar. Alg. Beaufort, N. Carolina, 1916, p. 116, pl. 14, figs. 1–12; DE TONI, Syll. Alg. VI, 1924, p. 64.

Hab.: Wagu, Sima Prov. (S. INOH).

Distr.: Beaufort, N. Carolina.

Plant composed of endozoic penetrating filaments and short epizoic erect filaments; endozoic filaments tortuous, intricate, serpentine, or labyrinthine, branched very irregularly, laterally, subdichotomously, or very rarely oppositely, commonly divaricated from near the middle of a cell; branches of the endozoic filaments often subcircinately reflexed or inflexed, rarely forming a sort of pseudoparenchyma with irregular cells; cells of the endozoic filaments commonly curved or contorted, thin-walled, of irregular or fluctuating diameter, (2.0–)5.5–7.0(–13)μ diam., 3–8 times as long as broad (12–60μ long); terminal cells of the endozoic branches often enlarged, subhamate, irregularly clavate, or subdivaricately forking; erect sporangiferous filaments external, the simpler consisting of a single pedicel cell bearing 1–3 sporangia or very rarely exserted sporangium sessile on the endozoic filaments, the larger showing 1–9

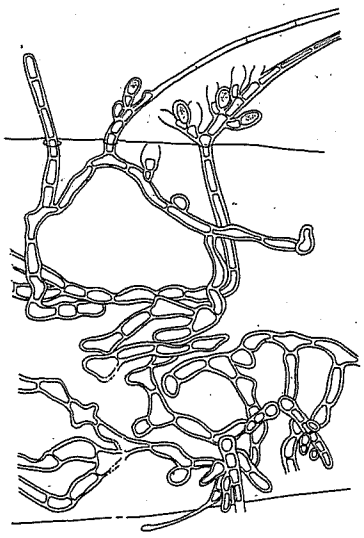

Fig. 13. *R. infestans* (HOWE et HOYT) DREW. Plant showing endozoic penetrating filaments and short epizoic erect ones with monosporangia and hairs. × 333.

short branches, up to 300μ high, including hairs; branches 1–3 celled, rarely secund; cells of the erect filaments 4.5–6.5μ broad, 1–2 times as long as broad; chromatophores small, substellate or irregular discoid, near the centre of the cell or subparietal, showing a single pyrenoid; hairs and hair-like prolongations present, 2.5μ wide, attaining a length of 125–170μ long; monosporangia terminal or lateral, solitary, binate, or ternate, ovoid or ellipsoid, 10–14μ by 6.0–8.5μ.

This species has been found in and on the stalks, stolons and less commonly hydranths of small campanularian hydroids attached to *Sargassum serratifolium*. The endozoic parts are embedded principally in the inner layers of the perisarc of the stalks, stolons and occasionally the hydranths.

This plant agrees quite well with *Acrochaetium infestans* Howe et Hoyt. The material examined is undoubtedly the same species that Howe and Hoyt described from Beaufort, although the endozoic filaments of the present specimens are more or less broader than those of the specimens from Beaufort.

The expense for collecting material of the present study was defrayed partly by the subsidy from the Department of Education and partly by that from the Japan Society for Promotion of Scientific Research, for which the writer expresses his best thanks.