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ON NEW SPECIES OF HETEROECIOUS FERN RUSTS

BY

SENJI KAMEI

From the antiquity of the host plants, fern rusts are now generally considered to be the most ancient and primitive group. Among some forty described species most of them belong to three genera of Pucciniastreae, namely Uredinopsis MAGN., Milesina MAGN. and Hyalopsora MAGN. So far concerned with the species hitherto investigated, their aecidial phaces are invariably found on Abies. So it is very natural that one is apt to imagine the heteroecism in the rust fungi must have originated from these fern rusts and consequently to call forth the inquiries about this group from various sides of the mycological point of view.

Up to this day, since FRASER (3, 4, 5) had succeeded in the verification of the life cycle of Uredinopsis connecting the five species of fern rusts to *Peridermium balsameum* PECK, thirteen species of three genera above mentioned were proved to be heteroecious between Abies especially by FAULL and his students (1, 2), partly also by KLEBAHN (12), MAYOR (13, 14), WEIR and HUBERT (16) and the writer (9, 10, 11).

In our country, while eight species of fern rusts were already mentioned by NAOHIDE HIRATSUKA (6, 7), no records of any cultural experiments except three species with which the writer (9, 10, 11) is concerned have been published.

In Hokkaido, *Abies Mayriana* MIYABE et KUDO and *Abies sachalinensis* FR. SCHM. are widely distributed all over the island constituting the most important forest trees. Needles of both adult trees and seedlings are commonly attacked by peridermial stages which weaken the vigor of the trees and frequently inducing them to death. These peridermia are divided into two groups at a glance, white and orange yellow. The former group is more abundant and more widely distributed, and are connected with fern rusts.

In the course of his life-history studies of fern rusts of our country carried on for the past several seasons, the writer has succeeded in the proof of heteroecious relationship of fifteen species, containing nine new species, every one of which issues its aecidial phace on the needles of *Abies Mayriana* MIYABE et KUDO and

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other related species. In the present paper the writer intends to record only the diagnoses of seven new species, each of which is accompanied by the corresponding peridermial stage (except one imperfect case) which was obtained by cultural experiments.

The writer wishes to express his sincere thanks to Prof. Emer. KINGO MIYABE and Prof. SEIYA ITO for their kind directions and he is also indebted to Dr. GUBLER for the courtesy of translating of my descriptions into Latin.

1. *Uredinopsis Woodsiae* KAMEI, sp. nov.

O. Spermogoniis amphigenis, praecipue hypophyllis, minutis, abundantibus, irregulariter densiusque in areis decoloratis et deformibus dispositis, subcuticularibus, solitariis vel subinde confluentibus, paulum supra folii superficiem elatis, lenticularibus vel applanato-conoideis, 37–66.5 μ altis, 92–137 μ latis; spermatophoris simplicibus, obclavatis, septatis, hyalinis; spermatiis oblongis, 1.6–2.4 × 4.0–5.6 μ, hyalinis, levibus.

I. Peridermiis ex mycelio limitato, amphigenis, plerumque hypophyllis, irregulariter in series duas, ab utroque latere nervi meridiani dispositis, albis, cylindricis, apice ruptis, saepius 1 mm. longis, 0.15 mm. dimetientibus; cellulis peridii polygonalibus vel ellipsoideis, 15–26 × 22–37 μ, leniter imbricatim positis, parietibus interioribus grossiuscule verrucosis, ca. 4 μ crassis, parietibus exterioribus levibus, tenuibus, ca. 1 μ. Aecidiosporis globosis vel ellipsoideis, minime verrucosis, 14–22 × 15–28 μ, saepius 18.5 × 22 μ, contentibus hyalinis.

II. Soris uredosporiferis hypophyllis, in areis discoloribus sparsis, minutis, subrotundatis, 0.5–1.0 mm. dimetientibus, flavidis vel brunneolis; pseudoperidiis hemisphaericis. Uredosporis biformibus, sporis primis ex fisso peridii fere in massam albidam evolutis, ovato-oblongis vel ovato-fusiformibus, 13–19.5 × 27.5–47 μ, ad apicem subinde in mucronem breviorem abeuntibus, saepe nudis; episporio tenui, 1–2 μ, serie una longitudinali verrucarum minutarum laxe positarum obsito, utrobique laxiusque et minute verrucoso; contentibus hyalinis; sporis secundariis (amphisporis) in peridio firmo posterius evolutis, angulatioribus, plerumque pedicellatis; episporio crassiore, minutissime verrucoso; contentibus hyalinis; poris germinationis indistinctis.

III. Teleutosporis amphigenis, subepidermicis, saepe in profundo mesophyllo insidentibus, intercellulalibus, globosis vel subglobosis, fere 2–4, raro pluri- vel unicellularibus, 16.5–24 × 18.5–29.5 μ, hyalinis; episporis tenuibus, levibus; sporidiis subglobosis, ca. 8 μ latis hyalinis, levibus.

Habitat. O and I on one-year-old needles of *Abies Mayriana* MIYABE et KUDO (*Aotodomatsu*) formed by the inoculation of sporidia gained by the germination of overwintered teleutospores collected in the previous autumn.

II, II[x] and III on the fronds of *Woodsia polystichoides* EAT. var. *nudiuscula* HOOK. (*Yezo-iwadenda*). The specimens examined are as follows:—

II, II[x], III. Hokkaido: Prov. Ishikari: Mt. Teine, Sept. 28 1924; Oct. 22 1924, S. KAMEI; Jôzankei, Oct. 19 1924, S. KAMEI.

This is a striking species of Uredinopsis. So far as the writer is aware, any species of Uredinopsis which attacks a fern belonging to the genus Woodsia is yet unknown. The uredospores are of two forms just as in the case of *Uredinopsis Struthiopteridis* STROEMER, *Uredinopsis filicina* MAGN. and others. But the difference in shape between two spore forms is not so distinct as in the case of *Uredinopsis Struthiopteridis* STROEMER. Primary uredospores have very short beak or sometimes quite lacking, which is an another characteristic.

2. *Uredinopsis Athyrii* KAMEI, sp. nov.

O. Spermogoniis amphigenis, praecipue hypophyllis, minutis, numerosis, dense aggregatis, in areis decoloratis et deformibus, solitariis vel confluentibus paulum supra folii superficiem elatis vel epidermide depressis, inconspicuis; in sectione subcuticularibus, applanato-conoideis vel hemisphaericis, 37–77 μ altis, 74–137 μ latis; spermatophoris simplicibus, obclavatis, septatis; spermatiis oblongis, 1.6–2.4 × 4.8–6.4 μ, hyalinis, levibus.

I. Peridermiis e mycelio limitato, solitariis vel adhaerentibus, in duas series utrimque ad nervum positis, in areis plus minus decoloratis, partem vel totum folii occupantibus, 0.7–1.3 mm. altis, 0.2–0.7 mm. dimetientibus, cylindricis, profundo immersis; peridiis hyalinis, apice ruptis; cellulis peridii adjacentibus, polygonalibus et ellipticis, 15–29.5 × 26–44.5 μ, parietibus interioribus asperioribus et fortiter verrucosis, 2–4 μ crassis, parietibus exterioribus levibus, tenuibus 1–2 μ; aecidiosporis plerumque obovatis vel ellipsoideis, 12–23.5 × 13–27.5 μ, saepissime 19.5 × 21 μ; episporio hyalinio, ca. 1 μ, minute verrucoso; contentibus hyalinis.

II. Soris uredosporiferis hypophyllis, in areis discoloribus, subinde in nervis et petiolis, minutis, rotundatis, 0.1–0.5 mm. in diam., in sectione plus minus hemisphaericis; peridiis delicatis, apice dehiscentibus; sporis in molem album filiformem exeuntibus; uredosporis fusiformibus vel ovato-oblongis, 11.5–17.5 × 21–42 μ, saepissime 13 × 32 μ, episporio 1 μ, hyalino, serie una longitudinali verrucarum minutarum dense positarum obsitis, ceterum disperse verruculosis, ad apicem subinde in mucronem brevem, fortem, 2.5–5 μ longum abeuntibus; contentibus hyalinis.

III. Teleutosporis sub epidermide superiore et inferiore foliorum sitis, infra

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The sign II[x] means the sorus of secondary uredospores or amphispores

plurioribus, plerumque 2–5 cellulis, globosis vel subglobosis, 13–25 × 15–37 μ; episporio tenui, ca 1 μ, hyalino, levi, contentibus hyalinis; sporidiis subglobosis, 7–11 μ latis, hyalinis, levibus.

Habitat. O and I on the current year needles of *Abies Mayriana* MIYABE et KUDO (*Aotodomatsu*) formed by the inoculation of the sporidia gained by the germination of the overwintered teleutospores collected in the previous autumn.

II and III on the fronds of *Athyrium Filix-foemina* ROTH. var. *melanolepis* MAKINO (*Meshida*). The specimens examined are as follows:—

II. Hokkaido: Prov. Ishikari: Nopporo, Oct. 22 1922, S. KAMEI; Mt. Teine, Sept. 27 1925, S. KAMEI. Prov. Iburi: Mt. Makkarinupuri, Aug. 27 1922; Aug. 24 1924, S. KAMEI; Tôasa, Sept. 12 1923, S. KAMEI; Chitose, Sept. 18 1931, S. KAMEI.

II and III, Prov. Ishikari: Sapporo, Botanic Garden, Sept. 30 1922, S. KAMEI; Kotoni near Sapporo, Oct. 25 1922, S. KAMEI. Prov. Iburi: Mt. Makkarinupuri, Aug. 27 1923, Nov. 12 1924, Sept. 9 1925, S. KAMEI.

This is also a striking species of Uredinopsis nearly related to *Urediuopsis Copelandi* SYDOW found in California on *Athyrium cyclosorum* RUPR. The beak of the uredospore of this species, however, is shorter and the amphispores that are described in the Californian species are not yet found in this species. The writer has an another form parasitic on *Athyrium Vidalii* NAKAI (*Yama-inu-warabi*) which is commonly found in the vicinity of Sapporo. The primary uredospores are scarcely different from those of the species concerned. Further observations are needed before the determination, whether this form is to be included in this species or not is made.

3. *Uredinopsis hirosakiensis* KAMEI et HIRATSUKA, f. sp. nov.

O. Spermogoniis amphigenis, plerumque hypophyllis, minutis, abundantibus, irregulariter in partibus affectis follii flavidis decoloratis et deformibus sparsis, solitariis vel confluentibus, subcuticularibus, parum supra superficiem elatis vel non multum depressis, in sectione conoideis vel fere hemisphaericis, 74–137 μ latis, 37–92.5 μ altis, melleis; spermatiis oblongis vel oblongo-ellipsoideis, 1.6–2.7 × 4.8–6.4 μ, hyalinis, levibus.

I. Peridermiis ex mycelio limitato, raro amphigenis, plerumque hypophyllis, in areis decoloratis in series duas utrimque ad nervum medianum disperse dispositis, profundo immersis, cylindricis, apice ruptis, 0.2–0.3 mm. dimetientibus, 0.6–1.2 mm. altis. Peridiis hyalinis; cellulis peridii ovoideis vel obovoideis, fragilibus, vix imbricatim positis, 13–22 μ latis, 20–37 μ longis, parietibus interioribus crassis, 3–7 μ, asperius verrucosis, parietibus exterioribus tenuibus, 1 μ; aeci-

diosporis globosis vel obovoideis, 11–17.5 × 15–26.5 μ, saepissime 18.5 × 20.5 μ; episporio hyalino, tenui, 1.0–1.5 μ, parte minuta levi excepta, minutissime verrucoso; contentibus hyalinis.

II. Soris uredosporiferis hypophyllis in areis discoloribus sparsis, plerumque ad nervum et marginem saepe in petiolis dispositis, rotundatis, minutis, 0.1–0.3 mm. dimetientibus, dilute flavidis; pseudoperidiis delicatioribus, depresso-hemisphaericis vel subconoideis, apice dehiscentibus, pulverem album sporarum protrudentibus. Uredosporis ovoideis vel ellipsoideis, 11–24.5 × 15.5–33 μ, saepissime 19 × 24 μ; episporio tenui, ca. 1 μ, hyalino; disperse sed distincte verrucoso-echinulatis; contentibus hyalinis.

III. Teleutosporis amphigenis in mesophyllo sub epidermibus inferioribus et superioribus dense raro sparse positis, globosis, vel ellipsoideis, 15.5–24 × 17.5–40 μ, plerumque 2–4 cellulis, subinde pluri- vel unicellularibus, hyalinis; episporio tenui, ca. 1 μ, hyalino levi. Sporidiis subglobosis, 7.5–11 μ longis, 7.5 μ latis, levibus, hyalinis.

Habitat. O and I on the current year needles of *Abies Mayriana* MIYABE et KUDO (*Aotodomatsu*) formed by the inoculation of sporidia which were gained by the germination of the overwintered teleutospores collected in the previous autumn.

II and III on the fronds of *Dryopteris Thelypteris* (L.) A. GRAY (*Himeshida*). The specimens examined are as follows:

II and III. Honshu: Prov. Mutsu: Hirosaki, Sept. 8 1897; Sept. 12 1897, NAOHARU HIRATSUKA. Hokkaido: Prov. Ishikari: Bibai, Sept. 12 1920, K. TOGASHI; Sapporo, Sept. 20 1920, T. FUKUSHI; Sept. 30 1922, S. KAMEI; Nopporo, Sept. 7 1924, S. KAMEI. Prov. Iburi: Tôasa, Sept. 12 1923, S. KAMEI.

This species was named after Hirosaki where Dr. NAOHARU HIRATSUKA collected this fungus for the first time in Japan. The characters of the uredospores as well as the teleutospores are similar to those of a species of Pucciniastrum except the color of their contents. However, according to the writer's repeated inoculation experiments the spermogonia and peridermia which had issued on the leaves of *Abies Mayriana* M. et K. are always colorless, by which characters the present species is distinguished from the species of Pucciniastrum heteroecious on Abies, such as in the case of *Pucciniastrum Tiliae* MIYABE, *Pucciniastrum Styracinum* HIRATSUKA and *Pucciniastrum Epilobii* OTTH., every one of which is also proved by the writer to be parasitic on *Abies Mayriana* M. et K. Moreover, the spermogonia which were gained from the inoculation experiments were seen to be nearly of the same type with

those typical species of Uredinopsis. So, the writer admits that it is a species of Uredinopsis deviating toward a species of Pucciniastrum.

4. *Uredinopsis intermedia* KAMEI, sp. nov.

O. Spermogoniis hypophyllis, minutis, paucis, sparsis, inconspicuis, in sectione conspicuis, subepidermicis, in profundo insidentibus, globosis vel subglobosis, 120–187 μ altis, 130–209 μ latis; spermatiis oblongis, 1.9–2.4 μ latis, 5.6–6.7 μ longis, hyalinis, levibus.

I. Peridermiis ex mycelio limitato, hypophyllis, in duas ordines in areis flavo-decoloratis dispositis, partem vel totum folii occupantibus, 0.2–0.4 mm. dimetientibus, 0.6–1.2 mm. altis, cylindricis; peridiis hyalinis, apice irregulariter ruptis; cellulis peridii rhomboideis vel ovoideis, 15–26 × 22–37 μ, parietibus exterioribus levibus, tenuibus, 1 μ; parietibus interioribus crassioribus, cum tuberculis 3–7 μ, fere striatis, asperioribus verruculosis, vix vel paulum imbricatim positis. Aecidiosporis plus minusve globosis, 11.5–23.5 × 16–29 μ, saepissime 19.5 × 21 μ, pariete tenui verruculoso parte minuta levi eximia; contentibus hyalinis.

II. Soris uredosporiferis hypophyllis, flavidis vel fulvis, in area discolorata sparsis, parvis, 0.2–0.3 mm. dimetientibus, poro medio ruptis. Pseudoperidiis hemisphaericis tenuibus. Uredosporis biformibus, sporis primis maturius evolutis fere in cirrhos albidos protrusis, forma valde discrepantibus, rhomboideis, cuneatis vel flavellatis raro triangulis, 13–30 × 14.5–32 μ, saepissime 16 × 24 μ, episporio 1 μ, ad angulos crassiore, hyalino levi; sporis secundariis (amphisporis) posterius evolutis in peridio firmo, fere vere rupturis in pulverem flavo-sordidum protrudescentibus, formis aequalibus, ovoideis vel oblongis saepissime pedicellatis, 7.5–37 μ longis, episporio crassiore, 13–19.5 × 17.5–24 μ, minutissime verrucoso; contentibus hyalinis.

III. Teleutosporis subepidermicis, amphigenis, infra abundantibus, intercellularibus, globosis vel ellipsoideis, plerumque 2–6 cellulis, 15–22 × 18.5–33.5 μ, hyalinis; episporio gracili 1 μ, levi; sporidiis subglobosis, 5.5–9.0 × 7.5–11 μ, hyalinis, levibus.

Habitat. O and I on the current year needles of *Abies Mayriana* MIYABE et KUDO (*Aotodomatsu*) formed by the inoculation of sporidia obtained by the germination of overwintered teleutospores collected at the previous autumn.

II and III on the fronds of *Athyrium acrostichoides* DIELS (*Miyamashikeshida*) and of *Athyrium pterorachis* H. CHRIST. (*O-meshida*) The specimens examined are as follows:—

On *Athyrinm acrostichoides* DIELS.

II, II^x, III. Hokkaido: Prov. Ishikari: Mt. Teine, Sept. 28 1924, S. KAMEI;

Prov. Iburi: Chitose, Sept. 17 1931, S. KAMEI.

II^x, III. Hokkaido: Prov. Ishikari: Nopporo, Nov. 12 1922: Nov. 8 1923, S. KAMEI.

On *Athyrium pterorachis* H. CHRIST.

II, II^x, III. Hokkaido; Prov. Ishikari: Sapporo Botanical Garden, Sept. 30 1922, S. KAMEI; Mt. Teine, Sept. 28 1924, S. KAMEI.

II^x, III. Hokkaido: Prov. Ishikari: Nopporo, Nov. 12 1922; Oct. 23 1923; Nov. 8 1923, S. KAMEI; Prov. Iburi: Morap, Sept. 18 1931, S. KAMEI.

II, III. Hokkaido: Prov. Iburi: Mt. Makkarinupuri, Aug. 27 1922, S. KAMEI.

That the hibernating intercellular teleutospores germinate in the spring and infect the young needles of Abies is essentially the same as the other species of Uredinopsis. Moreover, besides the primary uredospores slightly thick-walled pedicellate uredospores (amphispores) are secondarily formed in the firmer pseudoperidium. With these secondary uredospores it was proved that they infect the young fronds of the same fern, indicating that this species can also pass the autoecious life, just as in the case of *Uredinopsis Struthiopteridis* STROEMER and *Uredinopsis filicina* MAGN. But the spermogonia formed on the young needles of *Abies Mayriana* M. et K. are invariably large sized and subepidermal, which characters are nearly related to the case of *Uredinopsis ossaeiformis* n. sp. Besides, the primary uredospores are peculiar shaped and the epispores are quite smooth having neither any markings nor ridges. Such smoothness of the uredospores are seen also in the case of *Uredinopsis ossaeiformis* n. sp. In short, considering from the characters of uredospores and the spermogonia this species is with *Uredinopsis ossaeiformis* deviated from the usual species of Uredinopsis toward Milesina, especially nearing to *Milesina Miyabei* n. sp. and *Milesina polypodophila* FAULL. The specific name is based on the intermediate natures between Uredinopsis and Milesina.

5. *Uredinopsis ossaeiformis* KAMEI, sp. nov.

O. Spermogoniis hypophyllis, minutis, paucis, primo inconspicuis, posterius brunneis, in areis flavidis decoloratis, plerumque in superficie stomatifera irregulariter disperse dispositis, secto folio conspicuis, subepidermicis, profundo insidentibus, subsphaericis, in sectione transversali 192.5–270 μ latis, in sectione longitudinali 154–259 μ latis, 110–241 μ altis; spermatophoris simplicibus vel ramosis, obclavatis, septatis. Spermatiis ellipticis vel oblongis, 1.2–2.3 × 3.6–6.6 μ, hyalinis, levibus.

I. Peridermiis ex mycelio limitato, amphigenis, praecipue hypophyllis, in series duas juxta nervum medianum dispositis, in areis plus minus flavis de-

coloratis sparsis, ca. 30 pro folio, profundo insidentibus, cylindricis, apice apertis, 0.2–0.5 mm. dimetientibus, 0.5–1.1 mm. altis; peridiis hyalinis, cellulis peridii paulum imbricatim positis, fortiter conjunctis, quadri- vel sexangulis, saepe cuneatis vel oblongis, 14.5–24.5 μ latis, 24.5–44.5 μ longis, parietibus interioribus dense et minute verrucosis, cum tuberculosis 3–5 μ crassis; parietibus exterioribus levibus, tenuibus, ca. 1 μ. Aecidiosporis ellipsoideis vel subglobosis, 16–25 × 21–30.5 μ, saepius 24 × 25.5 μ; episporio hyalino, 1.0–3.2 μ crasso, minute verrucoso parte minuta levi excepta; contentibus hyalinis; poris germinationis obscuris.

II. Soris uredosporiferis hypophyllis, in areis discoloribus sparsis, saepius ad nervum et marginem abundantibus, interdum in petiolis et nervis positis, dilute flavis, rotundatis, minutis, 0.2–0.3 mm. dimetientibus; sporis ex poro centrali in cirrhos albidos protrudentibus; pseudoperidiis subepidermicis, hemisphaericis, vel applanato-conoideis; cellulis peridii apice polygonalibus in lateribus elongatis. Uredosporis saepissime ossaeiformibus, subangulatis, apice truncatis vel vix rotundatis, raro subglobosis vel polygonalibus, 13–22.5 × 22.5–43 μ, saepissime 16 × 35.5 μ; episporio hyalino, 1.5 μ, ad angulos ca. 3 μ, levi; contentibus hyalinis; poris germinationis obscuris.

III. Teleutosporis numerosis, dense aggregatis, sub epidermide superiore et inferiore foliorum sitis, infra pluribus, saepissime circum sorum uredosporiferum positis, subinde profundo mesophyllo insidentibus, intercellularibus, globosis, ellipsoideis vel piriformibus, longitudinaliter et transverse septatis, 2–7 cellulis, plerumque 4 cellulis, raro nonseptatis, 15.5–26.5 × 17.5–31 μ, episporio hyalino, levi tenui, ca. 1 μ; contentibus hyalinis; sporidiis subglobosis, 5.5–7.4 × 7.7–9.2 μ, hyalinis, levibus.

Habitat. O and I on the current year needles of *Abies Mayriana* MIYABE et KUDO (*Aotodomatsu*), *Abies sachalinensis* FR. SCHMIDT (*Akatodomatsu*) and *Abies firma* SIEB. et ZUCC. (*Momi*) formed by the inoculation of sporida which were obtained by the germination of the overwintered teleutospores collected at the previous autumn.

II and III on the fronds, sometimes also on the stipes of *Dryopteris dilatata* A. GRAY (*Shirane-warabi*) and *Dryopteris monticola* C. CHR. (*Miyama-benishida*). The specimens examined are as follows:—

On *Dryopteris dilatata* A. GRAY

II. Hokkaido: Prov. Ishikari: Utashinai, Sept. 24 1892, E. TOKUBUCHI; Mt. Teine, Sept. 18 1927, S. KAMEI; Nopporo, Oct. 15 1920; Nov. 23 1921; Oct. 13 1929, S. KAMEI. Prov. Tokachi: Shikaribetsu, Sept. 30 1929, S. KAMEI. Prov. Iburi: Mt. Makkarinupuri, Aug. 21 1921; Aug. 23 1924; Sept. 27 1925; Oct. 6 1930, S. KAMEI. Prov. Teshio: Mt. Rishirifuji, Aug. 5 1922,

K. TOGASHI. Island Kunashiri: Furukamappu, Aug. 11 1929, M. NAGAI and M. SHIMAMURA.

III. Hokkaido: Prov. Ishikari: Mt. Teine, Oct. 10 1926, I. TANAKA; Nopporo, Oct. 20 1922; Nov. 17 1923, S. KAMEI.

II, III. Hokkaido: Prov. Ishikari: Nopporo, Nov. 20 1920; Oct. 14 1923, S. KAMEI. Prov. Iburi: Mt. Makkarinupuri, Aug. 27 1923, S. KAMEI; Lake Shikotsu, Sept. 18 1931, S. KAMEI.

On *Dryopteris monticola* C. CHR.

II. Hokkaido: Prov. Ishikari: Nopporo, Oct. 20 1922; Sept. 9 1925; Oct. 13 1929, S. KAMEI.

III. Hokkaido: Prov. Iburi: Mt. Makkarinupuri, Nov. 17 1925, S. KAMEI.

II, III. Hokkaido: Prov. Ishikari: Nopporo, Sept. 29 1923; Oct. 24 1925, S. KAMEI. Prov. Iburi: Aug. 24 1924, S. KAMEI.

The uredospores are typically bone shaped and the specific name is given from this character. In spite of this peculiar characters of the uredospores, the teleutospores are apparently the same as those of the usual species of Uredinopsis. They are subepidermal, intercellular and sometimes also immersed deeply into the mesophyll. These teleutospores complete their development before winter and hibernate, germinating in the late spring during May to infect young needles of Abies just as in the case of the usual species of Uredinopsis. But the spermogonia which issue after the inoculation of the sporidia are always subepidermal and deeply seated inside the mesophyll tissue and very large sized. These characters are clearly distinct from the subcuticular and smaller type formed in the case of the usual species of this genus such as *Uredinopsis Struthiopteridis* STROEMER, *Uredinopsis filicina* MAGN., *Uredinopsis Pteridis* DIET. et HOLW., *Uredinopsis Adianti* KOMAROV, *Uredinopsis Athyrii* n. sp. and *Uredinopsis Woodsiae* n. sp. Such difference in the uredospores and spermogonia of this species from the usual species of Uredinopsis are also seen in *Uredinopsis intermedia* n. sp. which makes one remind that these two species are closely related and deviate together toward some species of Milesina such as *Milesina Miyabei* n. sp. and *Milesina polypodophila* FAULL. But compared with *Uredinopsis intermedia* n. sp. the present species lacks the secondary uredospores. If the absence of the secondary uredospores is one of the common characters of Milesina this species is more closely related toward Milesina than *Uredinopsis intermedia* n. sp. The uredospores of this species are similar to those of *Milesina Miyabei* n. sp. but easily distinguished by the shorter and broader shape.

6. *Milesina Miyabei* KAMEI, sp. nov.

O. Spermogoniis hypophyllis, paucis, minutis, in areis flavidis decoloratis

sparsis, fere inconspicuis, subepidermicis, profundo immersis, fere sphaericis, in sectione longitudinali 160–280 μ latis, in sectione transversali 200–250 μ latis, 190–240 μ altis. Spermatophoris simplicibus vel ramosis, septatis. Spermatiis oblongo-ovatis vel oblongo-ellipsoideis, 1.6–2 μ latis, 4.8–7.6 μ longis, hyalinis, levibus.

I. Peridermiis ex mycelio limitato, hypophyllis, paucis, in duas series utrimque ad nervum disperse dispositis, albis, cylindricis, usque ad 2 mm. longis, 0.5 mm. latis, apice ruptis, profundo immersis; Peridiis hyalinis; cellulis peridii plerumque quadri- vel sexangulis, saepe margine rotundatis, imbricatis, 17.5–26 × 23–41 μ, parietibus interioribus crassioribus, 2–4 μ, verrucosis, parietibus exterioribus tenuibus, levibus. Aecidiosporis globosis vel ellipsoideis, 14–24 × 15–29.5 μ, saepissime 18.5 × 22 μ, episporio ca. 2 μ, in parte majore densius verrucoso; contentibus hyalinis.

II. Soris uredosporiferis hypophyllis, inconspicuis, in areis posterius brunneolis discoloribus sparsis, plerumque ad nervum et marginem folii positis, rotundatis, minutis, dilute flavidis vel fuscis, 0.15–0.35 mm. dimetientibus, poro centrali dehiscentibus; peridiis subepidermicis, applanato-hemisphaericis, delicatioribus. Sporis plerumque in molem albam filiformem exeuntibus; uredosporis ossaeiformibus, angustioribus, plerumque apice truncatis, subinde vix rotundatis sed nunquam acutis, 11–20 × 26–55.5 μ; episporio tenui, ca. 1 μ, ad angulos parum crassiore; poris germinationis indistinctis; contentibus hyalinis.

III. Teleutosporis amphigenis, intra cellulas epidermidis evolutis, globosis vel oblongis, longitudinaliter vel oblique septatis, plerumque 3–5 cellularibus, subinde non septatis, 11–26 × 22–52 μ; episporio tenui, levi; contentibus hyalinis; sporidiis ovoideis vel subellipsoideis, 7–10 × 11–13 μ, hyalinis, levibus.

Habitat. O and I on the current year needles of *Abies Mayriana* MIYABE et KUDO (*Aotodomatsu*) formed by the inoculation of sporidia obtained by the germination of the teleutospores in the overwintered fronds of the fern host collected in the early summer.

II and III on the fronds, sometimes also on the stipes of *Dryopteris crassirhizoma* NAKAI (*Yezo-memma*). The specimens examined are as follows:—

II. Hokkaido: Prov. Ishikari: Mt. Moiwa, Oct. 20 1923, S. KAMEI; Noppro, Nov. 3 1921; Oct. 20 1922; Sept. 9 1924; Oct. 26 1925; Oct. 22 1927; Oct. 13 1929; Oct. 24 1929; Apr. 20 1930, S. KAMEI. Prov. Iburi: Tomakomai, Oct. 24 1910. K. MIYABE; Chitose, Sept. 18 1931, S. KAMEI; Mt. Makkarinupuri, Aug. 27 1922; Aug. 27 1923; Aug. 24 1925; Sept. 9 1925; Nov. 1926; Nov. 2 1928; Oct. 6 1930; S. KAMEI. Prov. Tokachi: Shikaribetsu, Sept. 30 1929, S. KAMEI.

II and III. Hokkaido: Prov. Ishikari: Nopporo, Nov. 12 1922; June

12 1926; May 24 1931, S. KAMEI; Prov. Iburi: Mt. Makkarinupuri, Nov. 12 1924; Nov. 17 1925; Nov. 2 1928, S. KAMEI.

The species was named after Prof. Emer. K. MIYABE, who had collected the fungus for the first time in Japan.

The shape of the uredospores of this species is very characteristic, being more or less bone-shaped. They are apparently related to *Uredinopsis ossaeiformis* n. sp. So the observer may be apt to think these two species as belonging to one and the same genus until he sees each corresponding teleutospores. The writer once saw very immature teleutospores formed inside the epidermal cells of a frond collected in November 12 in Mt. Makkarinupuri. But the matured spores were always seen in the affected part of overwintered fronds collected usually in the first part of June.

The spermogonia gained from the inoculation experiments are invariably subepidermal and very large sized. Among those species of Milesina which were heretofore described *Milesina polypodophila* FAULL from Canada is the only one species having the subepidermal spermogonia. Comparing with the description of spermogonia of this Canadian species made by HUNTER (8) our species is almost similar in height though slightly wider in breadth. On the other hand, in the description of the uredostage MOSS (15) said that *Milesina polypodophila* FAULL and *Milesina marginalis* FAULL et WATSON "exibit rather striking morphological difference and so will be considered separately". Moreover, according to HUNTER (8) the spermogonia of *Milesina marginalis* FAULL et WATSON are subcuticular and smaller, differing clearly from those of *Milesina polypodophila* FAULL.

In our locality, there are some seven species of Milesina found mostly in the vicinity of Sapporo. Of these, *Milesina Miyabei* n. sp. is quite different from other species. The uredospores of the species under consideration are quite smooth and peculiar shaped unlike those of *Milesina Kriegeriana* MAGN., *Milesina vogesiaca* SYDOW, *Milesina Scolopendri* JAAP, *Milesina jezoensis* KAMEI et HIRATSUKA and others. The spermogonia of the last mentioned three species are observed to be subcuticular and smaller sized, in which characters they are distinctly different from the case of *Milesina Miyabei*. Considering those common characters exibited between *Milesina Miyabei* and *Milesina polypodophila* FAULL, these two species are rather nearly related and unusually deviate from the typical species of Milesina.

7. *Milesina Dryopteridis* KAMEI, sp. nov.

O. Spermogoniis hypophyllis, in superficie stomatifera sparsis, minutis, inconspicuis.

I. Peridermiis adhuc ignotis.

II. Soris uredosporiferis hypophyllis, in partibus matricis restrictis decoloratis brunneolis insidentibus, subinde in petiolis, sparsis, minutis, rotundatis, 0.1–0.25 mm. dimetientibus; pseudoperidiis hemisphaericis, subepidermicis, delicatis, apice ruptis, cellulis polygonalibus, 8–15 μ dimetientibus. Uredosporis ex poro centrali saepissime in cirrhos albidos protrusis, obovatis vel ovato-oblongis vel late-clavatis, 12–14.5 × 17.5–27.5 μ, saepissime 13 × 22 μ, pariete tenui 1.5–2.5 μ, disperse echinulato; contentibus hyalinis.

III. Teleutosporis intra cellulas epidermidis evolutis, 1–4 (vel pluri-) cellularibus, 26–37 μ latis, ca 20 μ altis, hyalinis, levibus.

Habitat. O (probably also I) on the current year needles of *Abies Mayriana* MIYABE et KUDO (*Aotodomatsu*) formed by the inoculation of sporidia obtained by the germination of the teleutospores in the overwintered fronds of the host fern collected in the early summer.

II and III on the fronds, sometimes also on the stipes of *Dryopteris viridescens* O. KUNTZE (*Kogane-warabi*).

The specimens examined are as follows:—

II. Hokkaido: Prov. Ishikari: Maruyama, near Sapporo, May 7 1890, K. MIYABE; May 6 1928, S. Ito; Sept. 23 1922; Aug. 28 1923; June 11 1924; June 1929; June 14 1931; S. KAMEI; Mt. Moiwa, near Sapporo, Nov. 18 1913, S. KAMEI; Mt. Teine, Sept. 27 1926, S. KAMEI. Prov. Iburi: Mt. Makkarinupuri, Aug. 28 1923, S. KAMEI.

II, III. Hokkaido: Prov. Ishikari: Maruyama, near Sapporo, June 16 1931, S. KAMEI.

This species is rather nearly related to *Milesina vogesiaca* SYDOW on *Polystichum Braunii* Feè in our locality, but the uredospores of this species are smaller and more clearly echinulated. The mature teleutospores can be detected in the epidermal tissue of overwintered fronds and germinate in the early summer. With the sporidia thus gained the writer executed inoculation experiments and gained some numbers of spermogonia issuing on the first year needles of *Abies Mayriana* No. XVI_{11}, after thirty eight days from the beginning of the inoculation experiments. However, he failed to get the peridermia, and so the back inoculation is yet remaining to be carried in the future time. But it is highly probable that this species is heteroecious between Abies and *Dryopteris viridescence* completing its aecidial phace on the current year needles as in the usual species of Milesina.

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摘　　要

異株寄生羊歯銹菌新種に就て

龜井專次

接種試驗に依りて其異株寄生性を確め得たる羊歯銹菌新種（ウレジノプシス屬五種、ミレシナ屬二種）の記載文を揭げたり。其菌名、寄主名及採集地方名を表記せば次の如し。

菌名	寄主植物名		採集地方名
	雄精器及銹子腔時代	夏胞子及冬胞子時代	
Uredinopsis Woodsiae KAMEI	アチトドマツ	エゾイハデンダ	石狩
Uredinopsis Athyrii KAMEI	アヲトドマツ	メシダ	石狩、膽振
Uredinopsis hirosakiensis KAMEI et HIRATSUKA f.	アヲトドマツ	ヒメシダ	陸奥、石狩、膽振
Uredinopsis intermedia KAMEI	アチトドマツ	ミヤマシケシダ オホメシダ	石狩、膽振
Uredinopsis ossaeiformis KAMEI	アチトドマツ アカトドマツ モミ	シラネワラビ ミヤマベニシダ	石狩、膽振、十勝、天鹽、國後
Milesina Miyabei KAMEI	アヲトドマツ	エゾメムマ	石狩、膽振、十勝
Milesina Dryopteridis KAMEI	アチトドマツ（但し雄精器のみ）	コガネワラビ	石狩、膽振