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A NEW SPECIES OF MILESINA PARASITIC ON POLYPODIUM VULGARE L.

By

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(Wtih 3 Text Figures)

Two species of Milesina parasitic on *Polypodium vulgare* L. have been recorded up to the present. They are *Milesina Dieteliana* MAGNUS in Europe and *M. polypodophila* (Bell) FAULL in North America. The former species was first described in 1903 by SYDOW (8) as a species of Melampsorella and later transferred to the present genus by MAGNUS (6). The uredospores of this fungus are more or less oblong in shape and the wall is sparsely but strongly echinulated as in the case of the typical species of this genus, *Milesina Kriegeriana* MAGNUS. *Milesina polypodophila* was found in Canada and Pennsylvania, and investigated by several authors under Professor J. H. FAULL. H. P. BELL first collected its uredospores by Lake Timagami, Ontario, Canada and named it *Uredinopsis polypodophila* BELL. Observing that its teleutospores are intradermal, FAULL and WATSON (7, p. 826) transferred it to the genus Milesina and ARTHUR (1) renamed it *Milesia pycnogrande* (BELL) ARTHUR. The uredospores of this fungus are more or less fusiform, acute or acuminate above, with an apex prolonged into a moderately strong beak, showing a feature just reminding one of a typical species of Uredinopsis. However, the wall of the uredospores is quite smooth, free from any definite markings as illustrated by Moss (7, p. 840, Fig. 21 E) and the accompanying figure (Fig. 2 A) in this paper. So it is very natural that this species was classified by BELL as a species of Uredinopsis. Moreover, the same author suggested that his *Peridermium pycnogrande* on two to eight year old needles of *Abies balsamea* (L.) MILL. is probably connected with this species and FAULL and WATSON (3) proved the generic connection through inoculation experiments from fern to Abies and *vice versa*. According to BELL (2) and HUNTER (5) the spermogonia of this

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species are very large sized, deeply immersed under the epidermis of affected needles. In other species of the same genus, such as *Milesina Kriegeriana* MAGNUS and *Milesina marginalis* FAULL et WATSON, they are formed on the first year needles of the same tree, and are much smaller and subcuticular. Considering these characters of uredospores and spermogonia, *Milesina polypodophila* seems to be a very differentiated species. Fortunately, the present writer had a

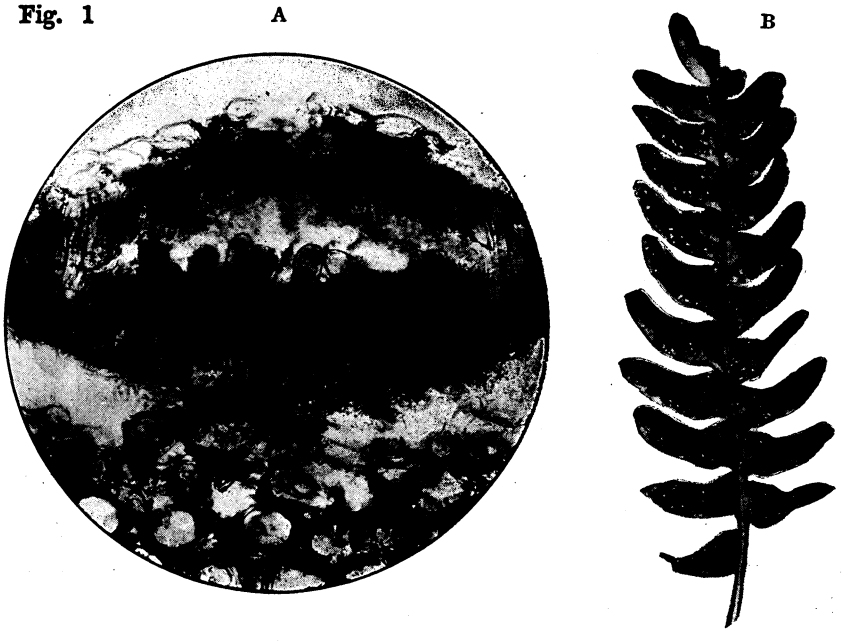

Fig. 1. Uredostage of *Milesina jezoensis*. Collected by the writer at Shikaribetsu on Sept. 30, 1929.
A. Median section of a uredosorus. × 200. B. Uredospores issuing from the sori. ca. × 1.

good opportunity to examine the specimens of *Milesina Dieteliana* in SYDOW's Exsiccati Uredineen No. 2597 preserved in our Herbarium and those of *Milesina polypodophila* which were kindly sent to me from Professors ARTHUR and FAULL.

In Hokkaido, *Polypodium vulgare* L. *(Yezo-denda)* is a common fern. In the summer of 1926, NAOHIDE HIRATSUKA collected the rusted specimens of this fern at Mt. Kurodake in the Taisetsu mountain range. The writer himself obtained rich specimens of the same fungus at the side of Lake Shikaribetsu, Prov. Tokachi in 1929 and studied on its morphological and biological characters in

detail. The diseased fern is noticed easily in the field by brownish to almost blackish discoloration of the fronds, and by the presence of uredopustules on the undersurface from which the spores issue in a white, slender filamentous mass (Fig. 1 B). The present fungus is quite different from the two species

Fig. 2

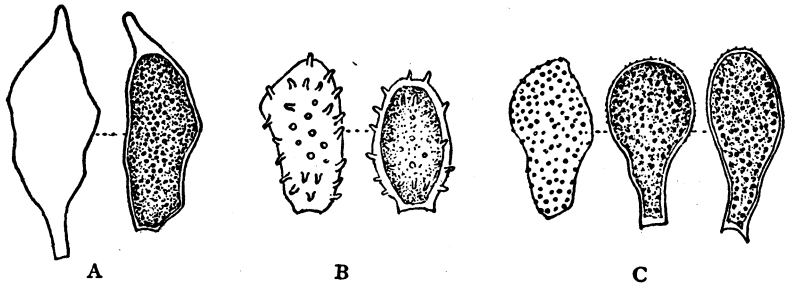

Fig. 2. Uredospores of three species of Milesina on Polypodium vulgare L. Left side: in dry state. Right side: in water. × 480.

A. *Milesina polypodophila* (BELL) FAULL. Collected by J. H. FAULL at Lake Timagami, Ontario, Canada on July 27, 1924. B. *Milesina Dieteliana* (SYDOW) MAGNUS. SYDOW's Exsiccati Uredineen, No. 2597.

C. *Milesina jezoensis* KAMEI et HIRATSUKA. Collected by the writer at Shikaribetsu, on June 11, 1931.

mentioned above which were described on the same host-plant from foreign countries especially in the characters of uredostage. From *Milesina Dieteliana* our fungus clearly differs in the presence of denser, minute markings on the wall of the uredospores and from *M. polypodophila* it is distinguished at once by more or less broadly clavate, never beaked and minutely verrucose uredospores (Fig. 2). The detailed comparison of every character of these three fungi is shown in Table 1. Recognizing that the present fungus is new to science, the writer proposes the name *Milesina jezoensis* KAMEI et HIRATSUKA.

Table 1. *Comparison of three species of Milesina on Polypodium vulgare L.*

	Mil. polypod.	*Mil. Dietelian.* *	*Mil. jezoensis*
Size of uredosori (mm)	0.1–0.4	0.1–0.15	0.2–0.4
Color of uredosori	pale yellow	yellowish brown to nearly black	pale yellow to brownish yellow

	Mil. polypod.	*Mil. Dietelian.**	*Mil. jezoensis*
Pseudo-peridia	delicate, irregularly dehiscent	———	firmer, dehiscent by central pore
Size of uredospores (μ)	15–23 × 45–55	15–25 × 24–42	17–24 × 37–48
Thickness of wall of uredospores (μ)	1	2.0–2.5	1.0–1.5
Shape of uredospores	fusiform-obovoid or fusiform, acute or acuminate above, narrowed below	ovate to oblong, rarely subglobose, very irregular in form	broadly clavate, obovate to oblong-ovate, sometimes angular
Markings of uredospores	smooth	sparsely and strongly echinulate	densely and minutely verrucose
Number of cells in a teleutospore	2–8	2–4	2–7
Shape of teleutospore	irregularly obovoid or oblong	———	subglobose to oblong
Size of teleutospore (μ)	16–26 × 24–45	12–20 × 12–25	23–30 × 26–44.5
Locality	Canada and Pennsylvania (10)	France, Germany, Austria, England, Denmark, and Norway	Hokkaido, Japan

* Characters of this species were taken from the diagnosis given by SYDOW (9). Under this specific name, however, GROVE (4) has given smaller measurements of uredospores (15–16 × 22–30 μ) basing on English specimens (uredospores on *Polypodium vulgare* var *serratum* and *Polypodium vulgare*) and described the spores as "colourless, oblong or obovate, strongly echinulated above, smooth below, wall moderately thick (1.5–2 μ)". But these uredospores described by GROVE seem to be different from SYDOW's diagnosis and also from those in their Exsiccati Uredineen No. 2597.

To pursue the life history of this fern-rust, the writer collected abundant materials of overwintered, affected fronds at Shikaribetsu during the two preceding seasons of 1930 and 1931 and some of the materials were put into a moist chamber which was placed under diffused light. After a comparatively long period (two to three weeks), germination of the teleutospores was detected on the affected, slightly brownish discolored areas of undersurface of the frond. Sections of diseased tissue in such condition have shown that the epidermal layer is easily separable from the mesophyll and hyaline hyphal cushion is seen just under the cells in which matured teleutospores are contained (Fig. 3 D). One or more teleutospores are grown in an epidermal cell. They are found either separated or closely compacted in the cells. They are usually

divided into two to several cells by vertical septations and from each cell one basidium is issued through a minute hole bored in the outer wall of the epidermis (Fig. 3 B and C), and sporidia produced are normally. With the sporidia thus obtained inoculation experiments were at once carried out, by the usual method, on the young needles of seedlings of *Abies Mayriana* which were transplanted in pots from the college nursery. In both of the seasons, only the spermogonial stage was produced in four pots out of nine after about 20 days from the inoculation. The aecidiospores did not develop throughout the experiments and the infected needles mostly dropped off before the winter. The spermogonia thus produced are mostly hypophyllous, few in number, more or less globose and always subcuticular, measuring about 150 μ in breath and about 120 μ in height.

Fig. 3

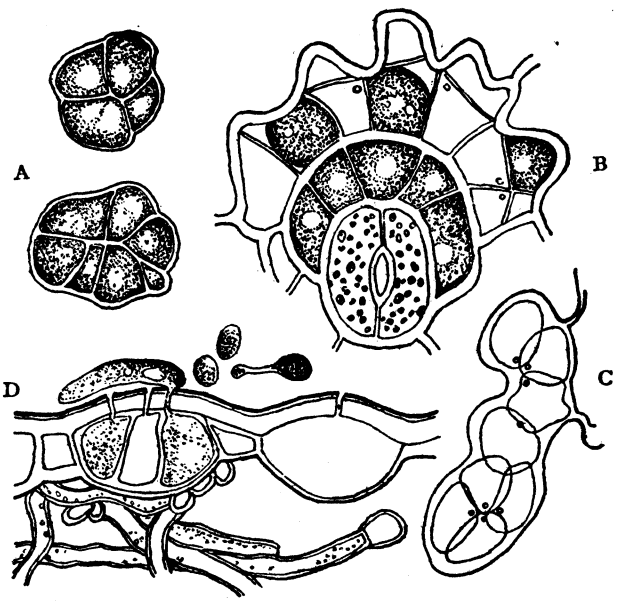

Fig. 3. Teleutospores of *Milesina jezoensis*.

Collected by the writer at Shikaribetsu, June 11, 1931. × 480.

A. Surface view of two teleutospores.
B. Surface view of teleutospores in the host-epidermis.
C. Surface view of teleutospores after germination.
D. Side view of germinating teleutospores and three sporidia.

These characters are quite different from those of *Milesina polypodophila*, but seems to be the same type with those of *Milesina Kriegeriana* and *Milesina marginalis* on *Abies balsamea* which were mentioned by HUNTER (5). The distinction of our present fungus from the American rust on the same species of fern could also be endorsed from the spermogonial characters. Further

research to determine whether the aecidial stage issues on the first year needles or on older needles remains for the future experiments.

The diagnosis of the new species is given as follows:—

Milesina jezoensis KAMEI et HIRATSUKA, n. sp.

0. Spermogonia hypophyllous, scattered on yellowish discolored areas, subcuticular, more or less globose, 110–165 μ in breath, 110–130 μ in height; spermatiophores obclavate, septate; spermatia oblong, 6.5–9.0 μ long, 2.0–3.0 μ broad.

I. Unknown.

II. Uredosori hypophyllous, subepidermal, in yellowish to brownish discolored areas, bullate, small, 0.2–0.4 mm. across, pale yellow to brownish yellow (Fig. 1 A & B). Pseudoperidia firm, cells isodiametric to irregularly polygonal, thin-walled, 7.5–15.0 × 10.0–25.0 μ, dehiscent by central pore formed under stomatal slit (Fig. 1 A). Uredospores broadly clavate, obovate to oblong-ovate, sometimes angular, often short stalked, 17.0–24.0 × 37.0–48.0 μ, wall colorless, thin, 1.0–1.5 μ, densely verruculose; contents colorless (Fig. 2 C); bladdery cells mixed in the sori.

III. Teleutospores mostly hypophyllous, in pale yellowish, discolored spots. Teleutospores in the epidermal cells, formed singly or 2 to several in compact mass, 2 to many celled with radial vertical septa, 23.0–30.0 × 26.0–44.5 μ, each spore subglobose to oblong, wall thin colorless, smooth; contents colorless (Fig. 3 A, B & C). Germinating after hybernation in the next spring. Basidia cylindrical to clavate, four celled, ca. 45 μ long, ca. 10 μ wide; sporidia subglobose, ca. 11 μ long, ca. 7 μ wide (Fig. 3 D).

II & III on *Polypodium vulgare* L. *(Yezo-denda).* At the side of Lake Shikaribetsu, Prov. Tokachi, Sept. 30, 1929 (II); June 6, 1930; June 11, 1931 (II and III) SENJI KAMEI.

At Mt. Kurodake, Taisetsu Mountain range, Prov. Ishikari, July 26, 1926 (II) NAOHIDE HIRATSUKA.

In conclusion the writer wishes to express his heartiest thanks to Prof. Emer. KINGO MIYABE and Prof. SEIYA ITO under whose direction this work was done

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摘　　要

エゾデンダに寄生するミレシナ屬の一新種に就て

鷲　井　專　次

著者は數年來北海道に自生するトドマツ類と其下草として生ずる羊齒植物との間に異株寄生をなす銹菌並に之が生活史に興味を有し連年繼續研究し來れり、玆に發表せんとする事項は其結果の一部にしてエゾデンダに寄生するミレシナ屬一新種と其生活徑路に關するものなり。エゾデンダは吾國のみならず歐洲諸國並に北米等にも分布する羊齒植物にして本道にありては屢々針葉樹林下又は岩壁上等にも生ず、而して今日此エゾデンダに寄生するミレシナ屬の銹菌に二種あり、甲は *Milesina Dieteliana* MAGN. にして歐洲諸國に發見され乙は *Milesina polypodophila* (BELL) FAULL にして北米カナダ地方及合衆國に發見さる。

元來ミレシナ屬はウレジノプシス屬と共に其生活史の各時代の胞子無色にして其夏胞子の性質（形、大さ及印刻等）と雄精器の性質（位置、大さ、形及發生針葉年數等）は其種類分別の重要準據なりとす、前記二種の中甲種は夏胞子の性質はミレシナ屬代表種に近似する程に本屬の特徴を有するに拘らず後種にありては之が發見並に種々なる研究を果したる北米 FAULL 氏及其門下生一同の結果よりすれば其冬胞子の位置により本屬に隷入され居るも其夏胞子は一見ウレジノプシス種の如く加ふるに其ペリダーミユム時代は北米産 *Abies balsamea* の二年乃至八年の古き針葉に發生し其雄精器の性質はミレシナ屬代表種の夫れに比して著しく大形なるのみならず其發生位置、被害針葉年數に於ても異ることを闡明され結局本種はミレシナ屬としては甚だ偏倚せる性質を有することを認められ居れり。著者は往年平塚直秀氏より同氏採集（一九二六年七月大雪山黒岳上）のエゾデンダ寄生銹菌標本の一部を寄與せられたる際上記二種との分類學的並に生活史的比較研究の必要を思ひたる儘過ぎたりしが偶ま一昨年九月末伊藤教授指導に係る學生修學旅行に參加して十勝然別湖畔に至れるとき同地針葉樹林下に計らずも本菌の多數發生することを知り歸來其形態を精査すると共に越年被害羊齒を採集して其冬胞子を發芽せしめ之をアヲトドマツに接種試驗を試みたり。幸に外國產前記二種の標本に接するを得之と比較するに北海道菌は第一表及第二圖に示せる如く種々の點にて兩菌と異ると共に他に之と一致する種類無きが故に之を新種と認め *Milesina jezoensis* KAMEI et HIRATSUKA と命名し記載文を揭げたり。又接種試驗にありては昨年、本年の二回供試根苗九本中四本は其接種針葉に雄精器を生ぜるも孰れも銹子腔を得ざりしも其雄精器の形態は北米菌の夫とは全く相異ることを認めたり。此等の事項は銹子腔に關するものと共に再三反覆研究を要す。尙ほ *Milesina polypodophila* 菌に關しては菌糸を以て越年し Abies 屬植物なくとも同株的に生存し得ることを擧げたる人あり、吾北海道に於ても或場合（例へば大雪山黒岳上の如き）にありては之と同樣に生存するものならむ、第一圖はミレシナ屬新種夏胞子堆斷面 (A) と夏胞子發生の狀(B)、第二圖はエゾデンダ上ミレシナ屬三種の夏胞子比較〔北米菌 (A)、歐洲菌 (B)、北海道菌(C)〕、第三圖はミレシナ屬新種の冬胞子 (A)、其形成 (B)、及其發芽 (C. D) の狀を示す。