Studies on the Melampsoraceae of Japan.

By

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With 2 Text-figures.

Introduction.

The study of the Melampsoraceæ of Japan began with the pioneer work of Dr. NAOHARU HIRATSUKA, my father, who in 1896 described fourteen species belonging to this group in his graduation thesis, entitled "Melampsoræ of Japan." prepared under the direction of Prof. K. MIYABE in the Phytopathological Laboratory, Sapporo Agricultural College, but, that paper was never published in its original form. However, under the title of "Notes on some Melampsoræ of Japan I (1897), II (1898), III (1900)", 8 species including 4 new species were reported in the Tokyo Botanical Magazine.

Since 1923, the writer has been studying on the subject relating to Plant Pathology and Mycology under the direction of Profs. K. MIYABE and S. ITÔ in the Botanical Institute, Hokkaidô Imperial University, and has had a good opportunity to carry on the study of the Japanese Melampsoraceæ which his father started thirty years ago. In the present paper, the writer intends to report on a part of some taxonomic study of the Melampsoraceæ of Japan.

In conclusion, I wish to express my heartiest thanks to Profs. K. MIYABE and S. ITÔ for their kind help and valuable advice, and to my father for his constant encouragement and assistance in supplying me with many valuable specimens collected by him.

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I. Melampsoridium Parasitic on the Japanese Species of Alnus.

So far as we can ascertain, *Melampsoridium Alni* (THÜM.) DIETEL is the only species of *Melampsoridium* known to be parasitic on *Alnus*. In 1878, THÜMEN[63] described the uredostage of this fungus on *Alnus viridis* DC. under the name, *Melampsora Alni* THÜM. The teleutostage had remained undescribed until 1895, when TRANZSCHEL[67] recorded it on the same host plant collected in the Urals and Siberia. After two years, NAOHARU HIRATSUKA[37] identified the fungus on *Alnus incana* WILLD. var. *glauca* AIT. (=*A. hirsuta* TURCZ.) with *Melampsora Alni* THÜM.

In 1899, the genus *Melampsoridium* was newly established by KLEBAHN[41] taking for its type species, *Melampsora betulina* TUL. on *Betula alba* L. In the next year, DIETEL[14] transferred *Melampsora Alni* THÜM. on *Alnus viridis* DC. to the new genus by TRANZSCHEL's description, and named it *Melampsoridium Alni* (THÜM.) DIET. In 1903, DIETEL[17] reported that *Alnus firma* SIEB. et ZUCC. (var. *Sieboldiana* WINKL.?) collected by S. KUSANO and N. NAMBU at Atami and Mt. Amagi is a new host plant of the latter species. In 1909, SYDOW[60] identified a *Melampsoridium* parasitic on *Alnus incana* WILLD. var. *glauca* AIT. (=*A. hirsuta* TURCZ.) collected by NAOHARU HIRATSUKA at Sapporo, with *Melampsoridium Alni* (THÜM.) DIET. in his Exsiccati and in 1913 he[61] also reported that those on the same host plant collected by M. MIURA at Ishie, Prov. Mutsu and Maruyama near Sapporo, are of the same species. Recently, in 1924, K. TOGASHI[64] stated that *Melampsoridium Alni* (THÜM.) DIET. occurs on *Alnus Maximowiczii* CALL. at Oshidomari (Rishiri) and Kabuka (Rebun), Prov. Kitami.

The writer made a comparative study on the *Melampsoridium* parasitic on the different species of *Alnus* in Japan, and came to the conclusion that besides *Melampsoridium Alni* (THÜM.) DIET., there are three other species, all new to science, namely, *Melampsoridium Hiratsukanum* S. ITÔ, *M. Alni-pendulæ* HIRATSUKA and *M. Alni-firmæ* HIRATSUKA.

1. Morphological studies.

A. Pseudoperidium of the uredosorus.

When THÜMEN described *Melampsora Alni* THÜM. on *Alnus*

viridis DC., no description was given of its pseudoperidium. In 1891, TRANZSCHEL[65] found the pseudoperidium of this fungus and described it as follows:—"Pseudoperidio hemisphærico tectis, ostiolo pseudoperidii dentibus longis, acutis, erectis ornato." According to this description, he clearly observed the ostiolar spines on the opening of the pseudoperidium. In 1897, NAOHARU HIRATSUKA[37] described and illustrated the ostiolar spines of *Melampsoridium* on *Alnus hirsuta* TURCZ. in his paper.

In 1899, KLEBAHN, who established *Melamsporidium*, gave the following description of the genus:—

"*Melampsoridium* nov. gen.: Aecidien vom Peridermium-Typus, blasenförmiger Pseudoperidie; Membran der Aecidiosporen mit Stäbchenstructur. Uredolager von einer halbkugeligen Pseudoperidie bedeckt, die sich am Scheitel mit einem Loche öffnet; Paraphysen fehlend oder wenigstens nicht von kopfig-keulenförmige Bau. Teleutosporen wie bei *Melampsora*." In the above description, no special attention was paid to the ostiolar spine of the pseudoperidium.

In their monograph, P. & H. SYDOW[62] gave the following description of its uredostage as the generic characters:—

"Sori uredosporiferi subepidermales, parum erumpentes, minuti, rotundati, peridio hemisphærico, firmo tandem superne poro rotundo aperto cincti, cellulis peridii ostiolaribus longe acutato-productis." He referred to the presence of the ostiolar spine as one of the characters of this genus in his description. Since then, no reports have appeared on the ostiolar spine of *Melampsoridium*.

In the writer's view, the ostiolar spine of pseudopesidium is an important character for the classification of the genus *Melampsoridium*. There are two different forms of the ostiolar spines in the Japanese species of *Melampsoridium* on *Alnus*. One of them is of a very long acute spine, while the other is of a very short one. The ostiolar cells of these two forms are measured as follows:—

1. 32.4–55.8 μ.
2. 21.6–32.4 μ.

The species of *Alnus* affected by the *Melampsoridium* having the ostiolar spine of the former type always belongs to the section "*Gymnothyrsus*", while the other belongs to the section "*Alnobetula*" (including "*Bifurcatus*"). Therefore the writer used the term "Long-spined form" or "*Gymnothyrsus*-form" to represent the species of *Melampsoridium* of the former type and "Short-spined

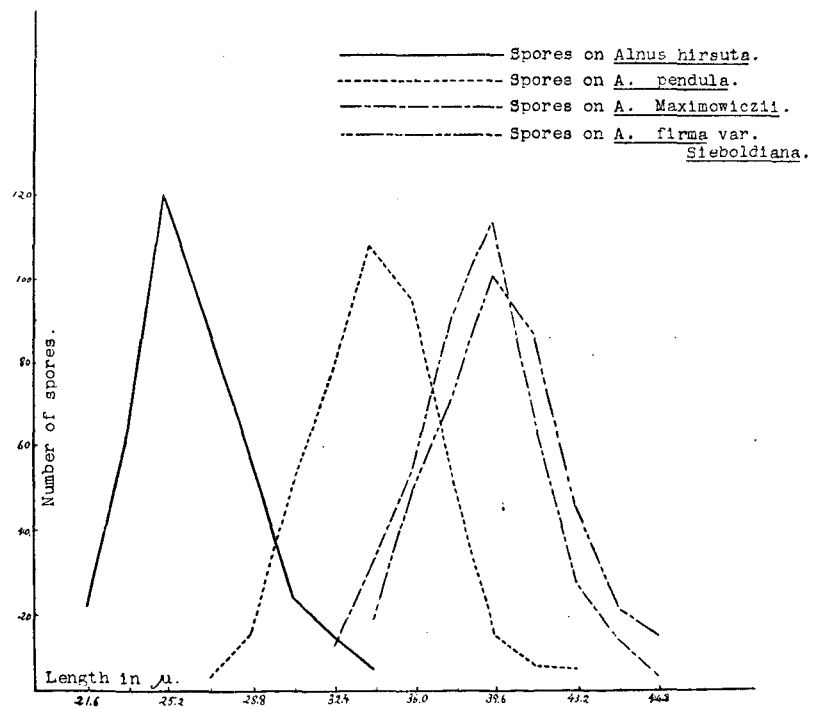
form" or "*Alnobetula*-form" for the latter.

B. Uredospore.

THÜMEN[63] in his original description stated that the uredospores of *Melampsora Alni* THÜM. are produced in chains, but, TRANZSCHEL[65] corrected it after the examination of THÜMEN's type specimen, reporting that the uredospores are not produced in chains, but are borne singly on a pedicel. The writer also observed the same fact on the uredospores of all the species of *Melampsoridium* on Japanese *Alnus*.

The writer noticed that there are some notable differences in the echinulation and size among the uredospores of these species of *Melampsoridium*. The uredospores on *Alnus hirsuta* TURCZ. and *A. firma* SIEB. et ZUCC. var. *Sieboldiana* WINKL. are densely echinulate over the whole surface without any spineless portion, while those on *Alnus Maximowiczii* CALL. and *A. pendula* MATSUM. are also echinulate, but there is a spineless portion at the apex, where the

Fig. I. *The graphical representation of the size of the uredospores on four different species of Alnus. 1. Length in Micron.*



epispore is very thin.

Another point of difference which must be considered is the measurements of the spores. The writer has measured four hundred uredospores on the different species of *Alnus* and obtained the results shown in the following graphs. (Fig. I & II)

Fig. II. *The graphical representation of the size of the uredospores on four different species of Alnus. II. Width in Micron.*

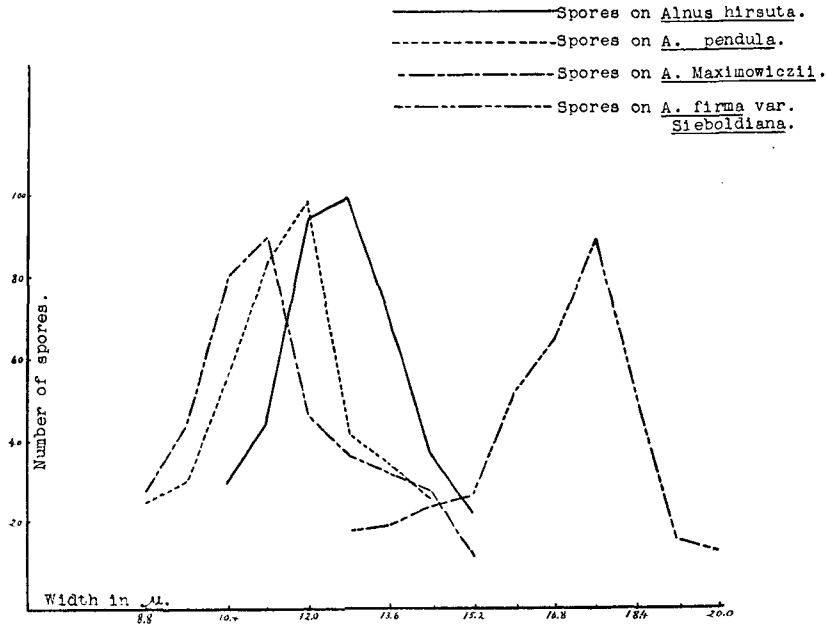


TABLE I.

Showing the measurements of the uredospores on four species of Alnus.

Host plant	Length (in μ)		Width (in μ)	
	Range	Majority	Range	Majority
Alnus hirsuta.	21.6–34.2	25.2	10.4–15.2	12.8
A. pendula.	27.0–43.2	34.2	8.8–14.4	12.0
A. Maximowiczii.	32.4–46.8	39.6	8.8–15.2	11.2
A. firma var. Sieboldiana.	34.2–46.8	39.6	12.8–20.0	17.6

From the above graphs and table, we can deduce the following facts:—

1. Spores on *Alnus hirsuta* are remarkably shorter in length than those on the other three species of *Alnus*.
2. Spores on *Alnus firma* var. *Sieboldiana* are remarkably wide.
3. Spores on *Alnus Maximowiczii* are more slender than those on *Alnus pendula*.

C. Teleutospore.

In 1895, TRANZSCHEL first recorded the teleutostage of *Melampsoridium* on *Alnus* and gave its description as follows:—

"Soris teleutosporiferis hypophyllis, pulvinatis, parvis, sæpe confluentibus, immaturis aurantiaco-fuscis vel fusco-purpureis, maturis atro-fuscis. Teleutosporis cylindricis vel prismaticis, membrana fusca, contentu aurantiaco præditis, usque ad 45 μ long., 13 μ crasso."

The writer made careful observations on the morphology of the teleutospores on *Alnus hirsuta*, *A. Maximowiczii* and *A. pendula*, but detected no remarkable differences among them in their size, shape and colour. The measurements of the teleutospores on three different species of *Alnus* are shown in the following lines:—

1. On *Alnus hirsuta*. $32.4-45.0\times10.8-16.2$ μ.
2. On *A. Maximowiczii*. $32.4-46.8\times12.6-18.0$ μ.
3. On *A. pendula*. $34.2-46.8\times12.6-16.2$ μ.

The teleutostage on *Alnus firma* var. *Sieboldiana* has not yet been observed by the writer.

2. Classification of Melampsoridium parasitic on the Japanese species of Alnus.

The writer considered the following morphological characters of the fungi as criteria for the classification of *Melampsoridium* parasitic on four species of *Alnus*.

1. The shape and size of the ostiolar spine of pseudoperidium.
2. The echinulation of the uredospore.
3. The measurement of the uredospore.

From these characters, *Melampsoridium* parasitic on the Japanese species ot *Alnus* may be considered to belong the following four distinct species:—

1. *Melampsoridium Alni* (THÜM.) DIET.
   on *Alnus Maximowiczii*.
2. *Melampsoridium Hiratsukanum* S. ITÔ nov. sp.

on *Alnus hirsuta*.

3. *Melampsoridium Alni-firmæ* HIRATSUKA nov. sp.
on *Alnus firma* var. *Sieboldiana*.

4. *Melampsoridium Alni-pendulæ* HIRATSUKA nov. sp.
on *Alnus pendula*.

Key to the Japanese species of *Melampsoridium* on *Alnus*.

1. Long spined form (*Gymnothyrsus* form) (32.4–55.8 μ long).
Uredospores echinulate throughout, without a spineless portion.
Uredospores 21.6–34.2×10.4–15.2 μ.
1) *Melampsoridium Hiratsukanum* S. ITÔ.

2. Short spined form (*Alnobetula* form) (21.6–32.4 μ long).
Uredospores echinulate throughout, without a spineless portion.
Uredospores 34.2–46.8×12.8–20.0 μ.
2) *Melampsoridium Alni-firmæ* HIRATSUKA.
Uredospores with a spineless or smooth portion.
Uredospores 27.0–43.2×8.8–14.4 μ.
3) *Melampsoridium Alni-pendulæ* HIRATSUKA.
Uredospores 32.4–46.8×8.8–15.2 μ.
4) *Melampsoridium Alni* (THÜM.) DIET.

3. Descriptions of Melampsoridium parasitic on the Japanese species of Alnus.

1. Melampsoridium Alni (THÜM.) DIETEL

in Engl.-Prantl, Natürl. Pflanzenfam. I, 1. Abt.**, p, 551, 1900—SYD. Monogr. Ured. III, p. 430, p.p.—ARTH. in N. Amer. Fl. VII, p. 680, 1925, p.p.

Syn. *Melampsora Alni* THÜM. in Bull. Soc. Impér. Nat. Moscou, LIII, p. 226, 1878—SACC. Syll. VII, p. 595—TRANZSCH. in Script. Bot. Hort. Univ. Petropol. III, p. 139, 1891; IV, p. 301, 1895.

Uredosori hypophyllous, scattered or gregarious, minute, round, 0.18 to 0.4 mm in diameter, reddish yellow; pseudoperidia hemispherical, persistent, peridial cells polygonal, firm, ostiolar cells ovate-conical, extended into acute or acuminate conical spiny apex, 21.6–32.4 μ long; uredospores oblong-clavate or linear-oblong, 32.4–46.8 ×8.8–15.2 μ, epispore colourless, echinulate, rather thin, the thinnest at smooth apex; paraphyses rudimentary.

Teleutosori hypophyllous, minute, scattered or gregarious, 0.3–0.5 mm across, purplish or blackish brown; teleutospores subepidermal,

32.4—46.8×12.6—18.0 μ; epispore light yellowish brown, rather thin, smooth.

Hab. On leaves of *Alnus Maximowiczii* CALL. (=*A. viridis* DC. var. *sibirica* REGEL) (*Miyama-hannoki*).

Honshû:

Prov. Shimotsuke: Mt. Shirane (II, Aug. 7, 1900, G. Yamada & J. Hanzawa).

Hokkaidô:

Prov. Oshima: Ônuma (II, III, Oct. 29, 1922, Naohide Hiratsuka); Mt. Komagatake (II, III, Sept. 28, 1924, Naohide Hiratsuka).

Prov. Shiribeshi: Raiden-tôge (III, Oct. 5, 1901, G. Yamada).

Prov. Ishikari: Sapporo (II, III, Oct. 8, 1924; II, III, Oct. 9, 1924; II, III, Oct. 15, 1924, Naohide Hiratsuka); Yamahana (II, III, Oct. 25, 1924, Naohide Hiratsuka); Mt. Moiwa (II, III, Oct. 6, 1924, H. Takasugi); Makomanai (II, III, Oct. 23, 1924, Naohide Hiratsuka); Mt. Teine (II, III, Sept. 27, 1925; II, III, Oct. 19, 1924, Naohide Hiratsuka); Mt. Sapporo (II, III, Sept. 23, 1922, Naohide Hiratsuka).

Prov. Kitami: Oshidomari (Rishiri) (II, III, Oct. 10, 1923, K. Togashi); Kabuka (Rebun) (II, III, Oct. 12, 1923, K. Togashi).

Prov. Kushiro: Mt. Oakan (II, III, Sept. 10, 1925, Naohide Hiratsuka).

Saghalien:

Nayoro (II, III, Sept. 6, 1906, T. Miyake); Mt. Ushoro (II, III, Aug. 30, 1907, T. Miyake).

Distrib. Siberia and Japan.

Remarks: In 1925 and 1926, the writer inoculated the sporidia of the present fungus on the leaves of *Larix Kæmpferi* SARG. and succeeded in getting its æcidial stage, of which he will treat, together with the experimental results of the related species, in another paper.

2. **Melampsoridium Alni-pendulæ** HIRATSUKA nov. sp.

Soris uredosporiferis hypophyllis, maculis flavidis vel rufis, sparsis vel laxe aggregatis, minutis, rotundatis, 0.1—0.4 mm diam., aureis; pseudoperidio hemisphærico, ex cellulis minutis, cubicis, cellulis ostiolaribus acutato-productis, 21.6—32.4 μ longis; uredosporis oblongis vel clavatis, ad apicem levis, deorsum versus laxiuscule breviterque aculeatis, 27.0—43.2×8.8—14.4 μ, episporio hyalino; soris teleutosporiferis hypophyllis, subepidermicis, sparsis vel aggregatis,

minutis, rufo-brunneis vel atro-brunneis; teleutosporis prismaticis vel clavatis, levis, flavidis, 34.2−46.8×12.6−16.2 μ, episporio ca. 1.0 μ crasso.

Hab. On leaves of *Alnus pendula* MATSUM. (=*A. firma* SIEB. et ZUCC. var. *multinervis* REGEL) (*Hime-yashabushi*).

Honshû :

Prov. Yamashiro: Kyoto (II, III, Oct. 1, 1924, K. Togashi).

Prov. Mutsu: Sukayu (II, III, Sept. 26, 1926, S. Itô & Naohide Hiratsuka).

Hokkaidô :

Prov. Shiribeshi: Zenibako (II, III, Sept. 9, 1926, S. Iwadare; II, III, Oct. 10, 1926, Naohide Hiratsuka).

Distrib. Japan.

Remarks: This fungus is closely allied to *Melampsoridium Alni* (THÜM.) DIET., from which it differs by its shorter uredospores.

3. **Melampsoridium Alni-firmae** HIRATSUKA nov. sp.

Syn. *Melampsoridium Alni* SYD. (non DIETEL) in Monogr. Ured. III, p. 430, p.p.—ARTH. in N. Amer. Fl. VII, p. 680, 1925, p.p.

Soris uredosporiferis hypophyllis, maculis rufo-brunneis efformantibus in epiphyllo nervis limitatis, sparsis vel laxe aggregatis, minutis, rotundatis, flavo-brunneis; pseudoperidio hemisphærico, firmo, ex cellulis minutissimis, cubicis, levis, cellulis ostiolaribus acutato-productis, 21.6−30.6 μ longis; uredosporis oblongis vel ellipsoideis, ubique breviter echinulatis, 34.2−46.8×12.8−20.0 μ, episporio 1.5−2.0 μ crasso; teleutosporis adhuc ignotis.

Hab. On leaves of *Alnus firma* SIEB. et ZUCC. var. *Sieboldiana* WINKL. (*Yashabushi*).

Honshû :

Prov. Izu: Atami (II, Aug. 1, 1898, Y. Takahashi & Naoharu Hiratsuka).

Distrib. Japan.

Remarks: This is a remarkable species, differing from *Melampsoridium Alni* and *M. Alni-pendulae* in many important points, viz. in the larger size and thicker membrane of the uredospores which have echinulation over the whole surface.

4. **Melampsoridium Hiratsukanum** S. ITÔ nov. sp.

Syn. *Melampsora Alni* HIRATS. (non THÜMEN) in Bot. Mag.

Tokyo, XI, p. 46, tab. IV, fig. 4-11, 1897.

Melampsoridium Alni SYD. (non DIETEL) in Monogr. Ured. III, p. 430, p.p.—ARTH. in N. Amer. Fl. VII, p. 680, 1925, p.p.

M. Alni WILSON in Transact. Brit. Myc. Soc. IX, p. 140, 1923.

Soris uredosporiferis hypophyllis, maculas rubro-flavas in epiphyllo efformantibus nervis limitatis, sparsis vel aggregatis, minutis, rotundatis, 0.2—0.4 mm diam., aurantiaco-flavidis; pseudoperidio hemisphærico apice poro rotundo tandem rupto cinctis; peridio firmo, ex cellulis polygonalibus, minutis, levis, cellulis ostiolaribus longioribus 32.4—55.8 μ longis ad apicem longe acutato-productis composito; uredosporis globosis, subglobosis, ovatis vel ellipsoideis, ubique laxe breviterque echinulatis, 21.6—34.2×10.4—15.2 μ, episporio hyalino, ca. 1.0 μ crasso; paraphysibus rudimentariis, fusiformibus; soris teleutosporiferis hypophyllis, subepidermicis, sparsis vel aggregatis, minutis, primitio flavis, dein brunneis vel purpureo-brunneis, tandem atro-brunneis; teleutosporis prismaticis, flavis, 32.4—45.0×10.8—16.2 μ, episporio ca. 1.0 μ crasso.

Hab. On leaves of *Alnus hirsuta* TURCZ. (=*A. incana* WILLD. var. *hirsuta* SPACH.) (*Ke-yamahannoki*).

Honshû :

Prov. Rikuchû: Gosho-mura (II, III, Sept. 3, 1897, Y. Takahashi).

Shikoku :

Prov. Tosa: Joki-mura (II, Nov. 1903, T. Yoshinaga).

Hokkaidô :

Prov. Oshima: Mt. Komagatake (II, III, Sept. 28, 1924, Naohide Hiratsuka).

Prov. Iburi: Mt. Yoichi (II, July 22, 1923, Naohide Hiratsuka); Numanohata (II, III, Nov. 1, 1900, K. Miyabe & G. Yamada); Chitose (II. III, Sept. 19, 1926, Naohide Hiratsuka; II, III, Oct. 10, 1900, G. Yamada).

Prov. Shiribeshi: Zenibako (II, III, Oct. 6, 1895, K. Miyabe); Raiden-tôge (II, III, Oct. 5, 1901, G. Yamada).

Prov. Ishikari: Sapporo (II, III, Sept. 1898, J. Hanzawa; II, III, Sept. 21, 1900, Naoharu Hiratsuka; II, III, Oct. 9, 1924, Naohide Hiratsuka); Maruyama (II, Aug. 3, 1924; II, Aug. 17, 1924; II, Sept. 14, 1924; II, Sept. 16, 1922; II, III, Oct. 11, 1924, Naohide Hiratsuka); Mt. Moiwa (II, Aug. 29, 1924; II, Aug. 31, 1922, Naohide Hiratsuka); Makomanai (II, III, Oct. 23, 1924, Naohide Hiratsuka); Garugawa (II, III, Oct. 12, 1924, Naohide Hiratsuka;

II, III, Oct. 24, 1905, J. Hanzawa); Mt. Teine (II, Sept. 2, 1924, Naohide Hiratsuka); Jôzankei (III, Oct. 16, 1924, Naohide Hiratsuka); Mt. Sapporo (II, III, Sept. 28, 1922, Naohide Hiratsuka).

Prov. Teshio: Nayoro (II, III, Sept. 23, 1926, Naoharu Hiratsuka).

Prov. Hidaka: Mt. Apoi (II, Aug. 17, 1912, K. Kondô).

Prov. Kushiro: Pirikaneppu (Akan) (II, Sept. 9, 1925, Naohide Hiratsuka); Mt. Meaken (II, III, Sept. 14, 1925, Naohide Hiratsuka); Rubeshibe (Akan) (II, III, Sept. 8, 1925, Naohide Hiratsuka); Akubetsu (Akan) (II, III, Sept. 7, 1925, Naohide Hiratsuka); Shirikomabetsu (Akan) (II, III, Sept. 11, 1925, Naohide Hiratsuka); Onnemoshiri (Akan) (II, Aug. 19, 1926, Naohide Hiratsuka).

Saghalien:

Nayoro (II, III, Sept. 6, 1906, T. Miyake); Mt. Suzuya (II, July 27, 1907, T. Miyake).

Distrib. Japan, Europe and North America (?).

Remarks: The writer made successful inoculation experiments on the leaves of *Larix Kæmpferi* SARG. with the sporidia of the present fungus.

Melampsoridium parasitic on *Alnus incana* and *A. glutinosa* collected in Scotland was identified by WILSON[7] with a doubt with *Melampsoridium Alni* (THÜM.) DIET. According to him, the uredospores of his specimens are usually smaller than those of *Melampsoridium betulinum* KLEB. and are echinulate over the whole surface of the wall. These characters point out a close affinity of the Scottish species to our *Melampsoridium Hiratsukanum* S. ITÔ, rather than to *Melampsoridium Alni* (THÜM.) DIET. which has the largest uredospores with a smooth portion at the apex. Moreover, the fact that *Alnus incana* and *A. glutinosa* belong to the same section, *Gymnothyrsus*, as our host, proves beyond all doubt that the species under consideration is distributed to Europe and may possibly also to North America.

II. Thekopsora Parasitic on the Japanese Species of Prunus.

In their monograph, P. & H. SYDOW recorded nine species of *Thekopsora*, among which the species parasitic on *Prunus* is only one, *Thekopsora areolata* (FR.) P. MAGNUS. According to their record, this species occurs on three different species belonging to the section *Padus*; namely, *Prunus Padus*, *P. serotina* and *P. virginiana*.

In 1901, this fungus was first recorded by IDETA[40] from Japan, and after his record, it was also reported by SHIRAI[57], SYDOW[61], etc.

NAOHARU HIRATSUKA, my father, described in his graduation thesis presented to the Faculty of Sapporo Agricultural College in 1896 a new species, *Thekopsora Pseudo-Cerasi* which is parasitic on *Prunus serrulata* LINDL. var. *sachalinensis* MAK. (erroneously identified with *Prunus Pseudo-Cerasus* LINDL.), but the description has remained unpublished up to the present.

The writer has examined in addition to his own, a rich collection of the specimens of *Thekopsora* parasitic on the Japanese species of *Prunus*, preserved in the Herbarium of Hokkaidô Imperial University. After a careful examination, he has come to the conclusion that there are two distinct species of *Thekopsora* in our country.

The species of *Prunus* found to be affected by *Thekopsora* in Japan are four in number. They are *Prunus Padus* L., *P. Ssiori* FR. SCHM., *P. serrulata* LINDL. var. *sachalinensis* MAK. and *P. Cerasus* L. Among these four species, *Prunus Padus* and *P. Ssiori* belong to the subgenus *Padus* and other two, *Prunus serrulata* var. *sachalinensis* and *P. Cerasus* belong to the subgenus *Cerasus*.

1. Comparative study of Thekopsora on the different species of Prunus.

The writer used the following materials for the measurements of the spores of the fungi on different species of *Prunus*.

TABLE II.

Materials for the measurement of the spores on the different species of Prunus.

Host plant	Collector	Locality	Date	Stage of the fungus
Prunus Padus.	Y. Tokubuchi.	Maruyama near Sapporo.	13/XI, 1895	II, III.
P. Ssiori.	The writer.	Mt. Kuro-dake, (Ishikari).	12/IX, 1926	II, III.
P. serrulata, var. sachalinensis.	N. Hiratsuka.	Sapporo.	25/IX, 1896	II, III.
P. Cerasus.	The writer.	Sapporo (cult).	20/IX, 1922	II, III.

The writer made measurements of two hundred uredospores from each material and got the following results:—

TABLE III.

Showing the measurements of the uredospores of Thekopsora on four species of Prunus.

Host plant	Length (in μ)		Width (in μ)	
	Range	Majority	Range	Majority
Prunus Padus.	14.4–25.2	18.0	10.8–18.0	14.4
P. Ssiori.	14.4–23.4	18.0	10.8–18.0	14.4
P. serrulata var. sachalinensis.	19.8–30.6	25.2	12.6–18.0	16.2
P. Cerasus.	19.3–34.2	25.2	12.6–18.0	16.2

From the above table, we find that the fungi on four species of *Prunus* may be divided into two groups according to the size of the uredospores. One of them is composed of the first and second species belonging to the subgenus *Padus*, whose uredospores are very much smaller than those of the third and fourth species of the *Cerasus*-group. As to the position of the uredosori and the character of the pseudoperidia as well as the ostiolar cells there could not be found any remarkable difference between them.

As to the teleutospores, measurements were also made of fifty spores from material shown in Table II. The result is as follows:—

TABLE IV.

Showing the measurements of the teleutospores of Thekopsora on four species of Prunus.

Host plant	Height (in μ)	Diameter (in μ)
	Range	Range
Prunus Padus.	16.2–24.3	14.4–25.2
P. Ssiori.	16.2–23.4	13.5–27.0
P. serrulata var. sachalinensis.	23.4–28.8	16.2–27.0
P. Cerasus.	25.2–28.8	16.2–27.0

From the above table, we find that the teleutospores on the subgenus *Cerasus* are longer than those on the *Padus*-group. And the writer noticed that there is a remarkable difference between them, in the shape and the epispore of the teleutospores, namely, the teleutospores of the former are oblong to ovate, forming in the spacious epidermal cell without pressing one another, so they do not assume polygonal shape, aud its epispore is uniformly thin, while those of the latter are globose or subglobose, generally polygonal with pressing one another, and its epispore darker and slightly thickened at the apex.

2. The nomenclature and description of the fungi.

From the above mentioned facts, it is evident that *Thekopsora* on four different species of *Prunus* may be divided into two distinct species, that is the fungus on the subgenus *Cerasus* differs from one on the subgenus *Padus*. The latter is identical with *Thekopsora areolata* (FR.) P. MAGN., while the former with *Thekopsora Pseudo-Cerasi*, which was described by NAOHARU HIRATSUKA in his graduation thesis.

1. **Thekopsora areolata** (FR.) P. MAGNUS

in Sitzungsber. d. Ges. Naturf. Freunde zu Berlin, p. 58, 1875—SACC. Syll. VII, p. 764—SYD. Monogr. Ured. III, p. 459, 1915; Ann. Myc. XI, p. 110, 1913.

Syn. *Sclerotium areolatum* FR. Syst. Myc. II, p. 263, 1823.

Melampsora areolatum FR. Summa Veg. Scand. p. 482, 1849.

M. Padi WINT. in Pilze Deutschl. I, p. 244, 1881—PLOWR. Monogr. Ured. p. 246, 1889.

Pucciniastrum Padi DIET. in Engl.-Prantl, Natürl. Pflanzenfam. I, 1. Abt.**, p. 47, fig. 53, C-D, 1898—FISCH. Ured. Schw. p. 463, fig. 303, 1904—LIRO, Ured. Fenn. p. 503, 1908.

Thekopsora Padi KLEB. in Pringsh. Jahrb. f. wiss. Bot. XXXIV, p. 378, 1900.

Th. Padi GROVE, Brit. Rust Fungi, p. 368, fig. 276, 1913.

Th. Padi BUBÁK, Rostpilze Böhmens, p. 187, fig. 45, 1908.

Uredosori hypophyllous, minute, scattered or gregarious, on the violet or reddish brown coloured angular spots; pseudoperidia hemispherical, persistent; peridial cells polygonal, thin; ostiolar cells large, smooth; uredospores globose to ellipsoidal, 14.4—25.2×10.8—18.0 μ. commonly 18.0×14.4 μ; epispore colourless, finely echinulate.

Teleutosori amphigenous, mostly epiphyllous, intracellular, formed in the epidermal cells, at last forming dark-brown to black discoloration on the surface of the leaf; teleutospores globose, subglebose or ovate, somewhat polygonal, divided into 2 to 4 cells, 16.2—23.4 μ high, 13.5—27.0 μ in diameter; epispore smooth, yellowish brown, darker and generally slightly thickened at apex.

Hab. On leaves of *Prunus Padus* L. (*Yezo-no-uwamizuzakura*). *Hokkaidô:*

Prov. Ishikari: Sapporo (II, III, Oct. 14, 1913, K. Miyabe); Maruyama (II, III, Oct. 13, 1895, Y. Tokubuchi).

On leaves of *Prunus Ssiori* FR. SCHM. (*Shûri-zakura*). *Hokkaidô:*

Prov. Iburi: Chitose (II, III, Sept. 1, 1896, K. Miyabe; II, III, Oct. 12, 1900, G. Yamada).

Prov. Shiribeshi: Inaho-tôge (II, III, Oct. 7, 1901, G. Yamada).

Prov. Ishikari: Sapporo (III, Sept. 9, 1895, Naoharu Hiratsuka); II, III, Oct. 4, 1896, K. Miyabe; II, III, Oct. 10, 1895, K. Miyabe & Y. Tokubuchi); Maruyama (II, Oct. 4, 1895, K. Miyabe; III, Nov. 14, 1925, Naohide Hiratsuka); Mt. Moiwa (II, III, Aug. 26, 1896, K. Miyabe); Jôzankei (II, III, Oct. 17, 1909, M. Miura*); Mt. Kurodake (II, III, Sept. 13, 1926, Naohide Hiratsuka).

Prov. Kushiro: Mt. Meakan (II, III, Sept. 14, 1925, Naohide

* SYDOW[61] recorded *Prunus Padus* L. as its host plant, but, after the writer's examination of the original specimen, he found that this host plant is *Prunus Ssiori* FR. SCHM., not *P. Padus* L.

Hiratsuka).

Saghalien: Soroiyofuka (II, III, Sept. 26, 1907, T. Miyake).

Distrib. Europe, Manchuria and Japan.

Remarks: The genetic relation of this species has been experimentally demonstrated by KLEBAHN,[42, 43] TUBEUF[70] and FISCHER[33] in Europe. According to these authors, the æcidial stage of this fungus is *Aecidium strobilinum* REESS on the cone-scales of *Picea excelsa*.

In our country, old specimens on the fallen cones of *Picea Glehni* and *P. jezoënsis*, have been collected in different places of Hokkaidô, but as they are all completely devoid of the æcidiospores and pseudoperidial cells, it is appropriate here simply to mention the existence of a *Peridermium* on the cones of Glehn's and Yezo Spruce and to leave the affirmation of their genetic relation for a future study.

2. **Thekopsora Pseudo-Cerasi** HIRATSUKA nov. sp.

Soris uredosporiferis hypophyllis, maculis flavo-brunneis, sparsis vel aggregatis, minutis, 0.1—0.3 mm diam., diu epidermide tectis, tandem poro centrali apertis et pulverulentis; pseudoperidio hemisphærico, firmo, ex cellulis minutis cubicis, cellulis ostiolaribus vero tunica crassiori præditis; uredosporis ovatis, ellipsoideis vel oblongis, breviter echinulatis, 19.8—30.6×12.6—18.0 μ, episporio hyalino; soris teleutosporiferis amphigenis, plerumque epiphyllis, crustaceis, minutis usque majoribus confluentibusque, sæpe angulatis et nervulis limitatis, purpureo-brunneis vel castaneo-brunneis; teleutosporis intracellular, in cellulis epidermidis evolutis, ovatis vel oblongis, 2–4-cellularibus, flavidis vel pallide brunneolis, levis, 23.4—28.8 μ altis, 16.2—27.0 μ latis; episporio 1.0—1.5 μ crasso.

Hab. On leaves of *Prunus serrulata* LINDL. var. *sachalinensis* MAK. (*Yezo-yamazakura*).

Hokkaidô:

Prov. Ishikari: Sapporo (II, III, Sept. 25, 1896, Naoharu Hiratsuka; II, Sept. 1900, G. Yamada; II, III, Oct. 1896, Y. Tokubuchi; II, III, Oct. 21, 1899, K. Miyabe; II, III, Oct. 30, 1894, Y. Takahashi & Naoharu Hiratsuka).

On leaves of *Prunus Cerasus* L. (*Seiyô-mizakura*). (*Cult.*)

Hokkaidô:

Prov. Ishikari: Sapporo (II, III, Sept. 17, 1896; II, III, Sept. 10, 1895, K. Miyabe; II, III, Sept. 25, 1896, Naoharu Hiratsuka; II, III, Oct. 17, 1897, Y. Tokubuchi; II, III, Sept. 20, 1922, Nao-

hide Hiratsuka); Maruyama (II, III, Sept. 23, 1923, Naoharu & Naohide Hiratsuka; II, III, Oct. 30, 1920, Y. Homma); Kotoni (II, III, Sept. 16, 1896; II, III, Nov. 10, 1926, Naoharu Hiratsuka); Jôzankei (II, III, Sept. 23, 1925; II, III, Nov. 7, 1926, Naohide Hiratsuka).

III. Thekopsora on the Japanese Species of Ericaceæ.

In SYDOW's monograph,[62] four species of *Thekopsora* are described as parasitic on the Ericaceæ, namely, *Thekopsora Vacciniorum* KARST. (including *Th. myrtillina* KARST.), *Th. sparsa* (WINT.) P. MAGN., *Th. minima* (ARTH.) SYD. and *Th. Gaultheriæ* SYD. In 1916, CRUCHET[10] added a species of *Thekopsora* on *Calluna vulgaris* and *Erica ciliaris*, *Thekopsora Fischeri* CRUCH. Of these five species that have hitherto been known to the scientific world, only one species, *Thekopsora Vacciniorum* KARST. has been reported to belong to our mycological flora.

In 1905, P. HENNINGS[35] identified the uredostage of the rust fungus on *Vaccinium hirtum* THUNB. collected by T. YOSHINAGA on Mt. Eboshiwashio, Prov. Tosa with *Thekopsora Vacciniorum* KARST. Recently, TOGASHI[64] reported that he had collected this species on *Vaccinium Vitis-Idæa* L. at Momoiwa, Rebun Isl., Prov. Kitami.

The writer has been able to examine some valuable specimens of *Thekopsora* of the Japanese Ericaceæ, which are preserved in the Herbarium of the University, besides quite a large number of the specimens in his own collection. Among these specimens, the writer found growing on the Ericaceæ of our country, six different species of *Thekopsora* of which, three species, namely, *Thekopsora hakkodensis* ITÔ et HIRATSUKA, *Th. Menziesiæ* HIRATSUKA and *Th. Tripetaleiæ* HIRATSUKA are ascertained to be new to science, and two species, *Thekopsora sparsa* (WINT.) P. MAGN. and *Th. myrtillina* KARST. to be new additions to our flora.

Key to the Species of Thekopsora on the Japanese Ericaceæ.

1. Ostiolar cells of the pseudoperidia in uredosori smooth.
   Ostiolar cells large, 36.0−43.2×10.8−18.0 μ.
   1) *Thekopsora hakkôdensis* ITÔ et HIRATSUKA.
   Ostiolar cells small, 21.6−30.6×7.2−14.4 μ.
   Uredosori large, on Sect. *Vitis-Idæa*.
   2) *Thekopsora Vacciniorum* KARST.
   Uredosori small, on Sect. *Myrtillus*.
   3) *Thekopsora myrtillina* KARST.
2. Ostiolar cells of the pseudoperidia in uredosori echinulate.
   Ostiolar cells small, membrane almost uniformly thin, 7.2−18.0×7.2−10.8 μ.
   Uredospores 18.0−28.8×9.0−14.4 μ, on *Menziesia*.

4) *Thekopsora Menziesiæ* HIRATSUKA.
Uredospores 21.6−34.2×13.5−16.2 μ, on *Tripetaleia*.
5) *Thekopsora Tripetaleiæ* HIRATSUKA.
Ostiolar cells large, membrane extremely thick at the base.
Uredospores 28.8−50.4×18.0−23.4 μ.
6) *Thekopsora sparsa* (WINT.) P. MAGN.

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1. Thekopsora myrtillina KARSTEN

Myc. Fenn. IV, p. 59, 1879.

Syn. *Aecidium? Myrtilli* SCHUM. Enum. Pl. Sæll. II, p. 227, 1803.

Uredo pustulata var. *Vaccinii* ALB. et SCHW. Consp. Fung. Nisk. p. 126, 1805, p.p.

U. Vacciniorum DC. Fl. franç. VI, p. 85, 1815, p.p.-COOKE, Hand book of Brit. Fung. p. 527, 1871, p.p.

Melampsora Vaccinii WINT. in Pilze Deutschl. I, p. 244, 1881, p.p.

M. Vacciniorum SCHRÖT. Pilze Schles. I, p. 365, 1887, p.p.—PLOWR. Monogr. Ured. p. 246, 1889, p.p.

Pucciniastrum Myrtilli ARTH. in Résult. Sc. Congr, Bot. Vienne, p. 337, 1906; in N. Amer. Fl. VII, p. 109, 1907.

P. Vacciniorum DIET. in ENGL.-PRANTL, Natürl. Pflanzenfam. I, Abt. 1,** p. 47, 1897, p.p.—FISCH. Ured. Schw. p. 467, fig. 305, 1904, p.p.—TROTT. Fl. Ital. Crypt. Ured. p. 384, 1914, p.p.

P. Vacciniorum LAGERH. in Tromsö Mus. Aarsh. XVII, p. 93, 1895—LIRO, Ured. Fenn. p. 515, 1908, p.p.

Thekopsora Vacciniorum DE TONI (non KARSTEN) in SACC. Syll. VII, p. 765, p.p.—BUBÁK, Rostpilze Böhmens, p. 188, 1908, p.p. —GZ. FRAG. Fl. Ibér. Ured. II, p. 268, fig. 132, 1925, p.p.—GROVE, Brit. Rust Fungi, p. 371, fig. 277, 1913, p.p.—SYD. Monogr. Ured. III, p. 462, 1915, p.p.

Uredosori hypophyllous, scattered or gregarious, minute, 0.1 to 0.21 mm across, round, yellowish brown; pseudoperidia hemispherical, firm; peridial cells small, epispore thin; ostiolar cells oblong or clavate, 21.6−30.6×7.2−14.4 μ, smooth; uredospores globose, subglobose to ovate, 16.2−30.6×14.4−19.8 μ, sparsely echinulate.

Teleutosori hypophyllous, brown to reddish brown; teleutospores intracellular, in the epidermal cells, globose, subglobose to ellipsoidal, somewhat angular, 16.2−21.6 μ high, 13.5−23.4 μ in width, divided

into 2 to 4 cells; epispore smooth, uniformly thin, light yellow.

Hab. On leaves of *Vaccinium axillare* NAKAI (*Kuro-usugo*).

Honshû :

Prov. Mutsu: Mt. Hakkôda (II, Sept 27, 1926, S. Itô & Naohide Hiratsuka).

On leaves of *Vaccinium Buergeri* MIQ. (*Usunoki*).

Honshû :

Prov. Mutsu: Mt. Hakkôda (II, III, Sept. 27, 1926, S. Itô & Naohide Hiratsuka).

On leaves of *Vaccinium Chamissonis* BONG. (*Yezo-kurousugo*).

Hokkaidô :

Prov. Kushiro: Mt. Meakan (II, Aug. 22, 1926; II, Sept. 14, 1925, Naohide Hiratsuka); Mt. Oakan (II, III, Sept. 10, 1925, Naohide Hiratsuka).

On leaves of *Vaccinium hirtum* THUNB. (*Sunoki*).

Shikoku :

Prov. Tosa: Mt. Eboshiwashio (II, June, 1903, T. Yoshinaga).

On leaves of *Vaccinium uliginosum* L. (*Kuro-mamenoki*).

Hokkaidô ;

Prov. Ishikari: Kumonotaira (Taisetsu-zan) (II, Sept. 10, 1926, Naohide Hiratsuka).

Saghalien :

Shikka (II, Oct. 1925, S. Kagabayashi).

Distrib. Europe, North America and Japan.

Remarks: In Japan, this species occurs on the above mentioned five species of *Vaccinium*, belonging to Sect. *Myrtillus*. Its teleutospores were found only on *Vaccinium Chamissonis* and *V. Buergeri*.

The present species is easily distinguished from the related species, *Thekopsora Vacciniorum* KARST. by the much smaller size of its uredosori. CLINTON[8] was the first to show the æcidial stage of the present species to be formed on *Tsuga canadensis* in 1910, and in 1912, his statement was confirmed by FRASER.[27] But, in our country, inoculation experiments have not yet been made.

2. Thekopsora Vacciniorum KARSTEN

Myc. Fenn. IV, p. 58, 1879—BUBÁK, Rostpilze Böhmens, p. 188, 1908, p.p.—Gz. FRAG. Fl. Ibér. Ured. II, p. 132, 1925, p.p.—GROVE, Brit. Rust Fungi, p. 371, 1913, p.p.—SACC. Syll. VII, p. 765,

p.p.—Syd. Monogr. Ured. III, p. 462, 1915, p.p.

Syn. *Uredo pustulata* var. *Vaccinii* Alb. et Schw. Consp. Fung. Nisk. p. 126, 1805, p.p.

U. Vacciniorum DC. Fl. franç. VI, p. 85, 1815, p.p.-Cooke, Hand book of Brit. Fung. p. 527, 1871, p.p.

Melampsora Vaccinii Wint. in Pilze Deutschl. I, p. 244, 1881, p.p.

M. Vacciniorum Schröt. Pilze Schles. I, p. 365, 1887, p.p.—Plowr. Monogr. Ured. p. 246, 1889, p. p.

Pucciniastrum Vacciniorum Diet. in Engl.-Prantl, Natürl. Pflanzenfam. I, Abt. 1,** p. 47, 1897, p.p.—Fisch. Ured. Schw. p. 467, 1904, p.p.—Trott. Fl. Ital. Crypt. Ured. p. 384, 1914, p.p.

Uredosori hypophyllous, solitary or in small groups, minute, 0.21 to 0.55 mm across, brown to dark brown; pseudoperidia hemispherical, firm; peridial cells rather small, cubical; ostiolar cells oblong to clavate, 21.6−30.6×7.2−14.4 μ, smooth; uredospores subglobose, ellipsoidal to broadly obovate, 18.0−28.8×14.4−19.8 μ; epispore rather thin, echinulate; contents yellowish coloured.

Teleutospores unknown.

Hab. On leaves of *Vaccinium Vitis-Idæa* L. (*Kokemomo*).

Honshû:

Prov. Mutsu: Mt. Hakkôda (II, Sept. 27, 1926, S. Itô & Naohide Hiratsuka).

Hokkaidô:

Prov. Iburi: Noboribetsu (II, Oct. 12, 1923, T. Nakayama).

Prov. Ishikari: Mt. Sapporo (II, Sept. 23, 1922, Naohide Hiratsuka); Mt. Karanuma (II, Sept. 17, 1922, T. Asuha); Kumonotaira (Taisetsu-zan) (II, Sept. 11, 1926, Naohide Hiratsuka).

Prov. Kitami: Momoiwa (Rebun) (II, Oct. 12, 1923, K. Togashi).

Prov. Kushiro: Mt. Oakan (II, Aug. 21, 1926, Naohide Hiratsuka).

Distrib. Europe, Kamchatka and Japan.

Remarks: As far as can be ascertained by the writer, the teleutostage of this fungus on *Vaccinium Vitis-Idæa* has not been collected in any country.

3. **Thekopsora hakkôdensis** Itô et Hiratsuka nov. sp.

Soris uredosporiferis hypophyllis, sparsis vel aggregatis, minutis, rotundatis, 0.16−0.5 mm diam., brunneis, epidermide elevata diu

tectis, poro centrali tandem apertis, pseudoperidio firmo hemisphærico, ex cellulis minutis, cellulis ostiolaribus clavatis, 36.0—43.2×10.8—18.0 μ, levibus; uredosporis subglobosis, late ovatis vel ellipsoideis, echinulatis, 16.2—27.0×14.4—19.8 μ, episporio hyalino 1.0—2.0 μ crasso, paraphysibus rudimentariis; teleutosporis adhuc ignotis.

Hab. On leaves of *Leucothoe Grayana* MAXIM. (*Hanahirinoki*).

Honshû :

Prov. Mutsu: Mt. Hakkôda (II, Sept. 27, 1926, S. Itô & Naohide Hiratsuka).

Distrib. Japan.

Remarks: The present fungus is related to *Thekopsora myrtillina* and *Th. Vacciniorum*, and can be distinguished from them by its larger ostiolar cells. The teleutostage of this species is still unknown.

4. Thekopsora Menziesiæ HIRATSUKA nov. sp.

Soris uredosporiferis hypophyllis, sparsis vel aggregatis, minutis, rotundatis, 0.1—0.21 mm diam., aurantiacis, epidermide diu tectis, tandem poro centrali apertis et pulverulentis, pseudoperidio hemisphærico firmo, ex cellulis minutis, cellulis ostiolaribus subglobosis vel ellipsoideis, 7.2—18.0×7.2—10.8 μ, echinulatis; uredosporis ellipsoideis vel ovatis, 18.0—28.8×9.0—14.4 μ, episporio hyalino ca. 1.0—1.5 μ crasso; soris teleutosporiferis amphigenis, plerumque epiphyllis, rufo-brunneis; teleutosporis in cellullis epidermalibus evolutis, solitariis vel irregulariter aggregatis aut lateraliter conjuctis, globosis, subglobosis vel oblong-prismaticis, flavidis, levibus, 4–6-cellularibus (plerumque 4), 12.6—21.6 μ latis, 18.0—21.6 μ altis, episporio 1.0—1.5 μ crasso, poris germinationis conspicuis.

Hab. On leaves of *Menziesia pentandra* MAXIM. (*Ko-yōrakutsutsuji*).

Honshû :

Prov. Mutsu: Mt. Hakkôda (II, Sept. 27, 1926, S. Itô & Naohide Hiratsuka).

Hokkaidô :

Prov. Ishikari: Mt. Teine (II, Sept. 27, 1925, Naohide Hiratsuka).

Prov. Kushiro: Mt. Meakan (II, III, Sept. 15, 1925, Naohide Hiratsuka).

Distrib. Japan.

Remarks: The present fungus is closely allied to *Thekopsora Tripetaleiæ* HIRATSUKA, and can be easily distinguished from it by

the size of the uredospores as well as the characters of the teleutospores.

5. Thekopsora Tripetaleiae HIRATSUKA nov. sp.

Syn. *Uredo Tripetaleiæ* DIET. in Ann. Myc. XII, p. 85, 1914—SACC. Syll. XXIII, p. 926—SYD. Monogr. Ured. IV, p. 440, 1924.

Soris uredosporiferis hypophyllis, maculis indeterminatis fuscis vel atro-purpureis insidentibus, sparsis vel paucis laxe aggregatis, minutis, rotundatis, 0.1—0.24 mm diam., flavidis, pseudoperidio hemisphærico, ex cellulis minutis, cellulis ostiolaribus subglobosis vel ellipsoideis, minute echtnulaiis, 7.2—18.0×7.2—10.8 μ; uredosporis subglobosis, ellipsoideis vel oblongis, subtiliter denseque echinulatis, 18.0—34.2×13.5—16.2 μ, intus pallide flavidis, episporio hyalino, ca. 1.5 μ crasso; soris teleutosporiferis plerumque epiphyllis, rarius hypophyllis, minutis, sæpe angulatis et nervulis limitatis, usque flavo-brunneis; teleutosporis in cellulis epidermidis evolutis, solitariis vel pluribus lateraliter conjunctis et applanatis, globosis, subglobosis vel oblongis, 2-4-cellularibus, flavidis vel pallide flavo-brunneis, levibus, 16.2—19.8 μ altis, 12.6—19.8 μ latis, episporio ca. 1.5 μ crasso, poris germinationis inconspicuis.

Hab. On leaves of *Tripetaleia bracteata* MAXIM. (*Miyama-hotsutsuji*).

Honshû :

Prov. Shimotsuke: Mt. Shirai (II, Aug. 7, 1900, J. Hanzawa & G. Yamada).

Prov. Mutsu: Mt. Iwaki (II, Aug. 24, 1896, K. Kikuchi; II, Sept. 12, 1897, Naoharu Hiratsuka); Mt. Hakkôda (II, Sept. 27, 1926, S. Itô & Naohide Hiratsuka).

Hokkaidô :

Prov. Oshima: Ônuma (II, III, Oct. 29, 1922, Naohide Hiratsuka).

Prov. Ishikari: Mt. Kuro-dake (II, Sept. 12, 1926, Naohide Hiratsuka).

On leaves of *Tripetaleia paniculata* SIEB. et ZUCC. (*Hotsutsuji*).

Honshu :

Prov. Rikuchû: Mt. Iwate (II, Aug. 24, 1897, Y. Takahashi).

Hokkaidô :

Prov. Hidaka: Samani (II, April 29, 1900, T. Kawakami).

Distrib. Japan.

Remarks: It is very rare to find the teleutospore-stage of the

present species, most of the specimens we have examined being in the uredostage.

The writer combined the present fungus with *Uredo Tripetaleiæ* DIET.[22] on *Tripetaleia bracteata* MAXIM. collected by K. TAMURA at Mt. Fuji, Prov. Suruga. Although we have not been able to examine its authentic specimen for comparison, DIETEL's original description of the fungus coincides so exactly with our species that I do not hesitate to consider them to be identical.

6. **Thekopsora sparsa** (WINT.) P. MAGNUS

Pilze von Tirol, Vorarlberg und Liechtenstein, p. 118, 1905—Gz. FRAG. Fl. Ibêr. Ured, II, p. 269, fig. 133, 1925—SYD. Monogr. Ured. III, p. 464, tab. XX, fig. 162, 1915.

Syn. *Melampsora sparsa* WINT. in Pilze Deutschl. I, p. 245, 1881—SACC. Syll. VII, p. 593.

Pucciniastrum sparsum FISCH. Ured. Schw. p. 469, fig. 306, 1904—ARTH. in N. Amer. Fl. VII, p. 108, 1907—LIRO, Ured. Fenn. p. 520, 1908—TROTT. Fl. Ital. Crypt. Ured. p. 385, 1914.

Uredosori amphigenous, mostly epiphyllous, scattered or grouped, minute, 0.2 to 0.55 mm in diameter, round, yellow; pseudoperidia hemispherical, firm; peridial cells rather large, elongate vertically, gradually thickened below, smooth; ostiolar cells 32.4 to 51.0 μ high, coarsely to finely echinulate at the apex, greatly thickened below; uredospores ellipsoidal to clavate-oblong, $28.8-50.4\times18.0-23.4$ μ; epispore thin, sparsely echinulate, hyaline.

Hab. On leaves of *Arctous japonicus* NAKAI (*Kuma-kokemomo*). *Hokkaidô:*

Prov. Ishikari: Mt. Kuro-dake (Taisetsu-zan) (II, Sept. 11, 1926, Naohide Hiratsuka).

Distrib. Europe, North America and Japan.

Remarks: This specimen bears only the uredospores on it. Up to the present time, this species has not been recorded in our country. In 1916, FISCHER[25] first demonstrated experimentally that the æcidial stage of the present fungus occurs on the leaves of *Abies pectinata* LAM. et DC. in Europe.

IV. Notes on Some Species of Pucciniastrum in Japan.

About thirty years ago, NAOHARU HIRATSUKA[37, 38, 39] reported eight species of Melampsoraceæ from our country under the suject of "Notes on some Melampsoræ of Japan-I (1897), II (1898) & III (1900)." Among them, the following four species of *Pucciniastrum* were recorded: *Pucciniastrum Agrimoniæ* (DC.) HIRATSUKA (=*P. Agrimoniæ* (DIET.) TRANZSCH.), *P. Tiliæ* MIYABE, *P. styracinum* HIRATSUKA and *P. Miyabeanum* HIRATSUKA.

Afterwards, DIETEL reported the following seven species of this genus from Japan: *Pucciniastrum Castaneæ* DIET.,[16] *P. Coriariæ* DIET.,[13] *P. Corni* DIET.,[18] *P. Coryli* KOM.,[17] *P. Corchoropsidis* DIET.,[62] *P. Epilobii* OTTH[13] and *P. Potentillæ* KOM.[19] Among them, *Pucciniastrum Corchoropsidis* DIET. was first described by him as *Uredinopsis Corchoropsidis* DIET.,[21] but, later was transferred to the genus *Pucciniastrum*. In 1903, SYDOW[59] transferred *Uredo Boehmeriæ* DIET. to the genus *Pucciniastrum* and named it *Pucciniastrum Boehmeriæ* SYD.

The writer has collected and examined a large number of the specimens of *Pucciniastrum*. Besides them, the specimens preserved in the Herbarium of Hokkaidô Imperial University were also examined.

Among these specimens, there are three species considered as new additions to the mycological flora of our country, and one species as new to science. The species new to Japan are *Pucciniastrum Circaeæ* (THÜM.) SPEG., *P. Goodyeræ* ARTH. and *P. Pyrolæ* (KARST.) SCHRÖT. and the one new to science is *Pucciniastrum Hydrangeæ-petiolaridis* HIRATSUKA.

In this paper, the writer intends to report on these interesting species of *Pucciniastrum* in Japan.

1. Pucciniastrum Circaeæ (THÜM.) SPEGAZZINI

in Dec. Myc. Ital. No. 65, 1879—BUBÁK, Rostpilze Böhmens, p. 186, 1908—FISCH. Ured. Schw. p. 461, fig. 302, 1904—GROVE, Brit. Rust Fungi, p. 365, fig. 273, 1913—HARIOT, Urêd. p. 250, 1908—LIRO, Ured. Fenn. p. 511, 1908—SACC. Syll. VII, p. 763—SYD. Monogr. Ured. III, p. 445, Tab. XIX, fig. 160, 1915—TROTT. Fl. Ital. Crypt. Ured. p. 382, fig. 31, 1914.

Syn. *Uredo Circaeæ* SCHUM. Enum. Pl. Sæll. II, p. 228, 1803.
U. Circaeæ ALB. et SCHW. Consp. Fung. Nisk. p. 124, 1805.

Cæoma Onagarum Link in Spec. Pl. II, p. 29, 1825, p.p.
Melampsora Circaeæ Thüm. in Myc. univ. No. 447, 1876.
M. Circaeæ Wint. in Pilze Deutschl. I, p. 243, 1881—Plowr. Monogr. Ured. p. 245, 1889—Schröt. Pilze Schles. I, p. 364, 1887.

Uredosori mostly hypophyllous, minute, scattered or gregarious, 0.12 to 0.25 mm in diameter, sometimes confluent, yellow; pseudoperidia hemispherical, persistent, peridial cells polygonal, firm, ostiolar cells more or less larger, smooth; uredospores subglobose, ovate or ellipsoidal, 18.0—24.4×10.8—14.4 μ; epispore rather thin (1.0 to 0.15 μ thick), covered with scattered minute warts; germ-pores inconspicuous.

Teleutosori mostly hypophyllous, subepidermal, in groups; teleutospores globose, subglobose to ovate, somewhat angular or flattened at the side, divided longitudinally into 2 to 4 cells, 19.8—27.0×16.2—23.4 μ; epispore smooth, yellow.

Hab. On leaves of *Circæa alpina* L. (*Miyama-tanitade*).
Hokkaidô :

Prov. Ishikari: Mt. Kuro-dake (II, Aug. 4, 1925; II, Aug. 18, 1925; II, III, Sept. 12, 1926, Naohide Hiratsuka); Mt. Hakuun (II, Aug. 5, 1925, Naohide Hiratsuka).

Prov. Kushiro: Mt. Meakan (II, July 21, 1922, Naohide Hiratsuka).

Saghalien :

Makun-kotan (II, III, Sept. 15, 1906, T. Miyake).

On leaves of *Circæa cardiophylla* Mak. (*Ushitakisô*).
Hokkaidô :

Prov. Ishikari: Yuni (II, Sept. 9, 1899, G. Yamada).

On leaves of *Circæa erubescens* Fr. et Sav. (*Tanitade*).
Hokkaidô :

Prov. Iburi: Rebunge (II, July 25, 1897, G. Yamada).

Distrib. Europe, Siberia and Japan.

Remarks: This fungus is a new addition to the mycological flora of Japan. *Circæa cardiophylla* and *C. erubescens* seem to be the new host plants to the present species.

2. Pucciniastrum Goodyeræ Arthur

in N. Amer. Fl. VII, p. 105, 1907—Liro, Ured. Fenn. p. 501, 1908—Syd. Monogr. Ured. III, p. 456, 1915.

Hab. *Uredo Goodyeræ* TRANZSCH. in Trudi St. Petersb. Obhch. Est. Otd. Bot. XXIII, p. 28, 1893; in Hedw. XXXII, p. 240, 1893—SACC. Syll. XI, p. 227.

Uredosori amphigenous, mostly epiphyllous, scattered or gregarious, 0.2 to 0.4 mm across, yellowish orange, then pale yellow; psudoperidia hemispherical, firm, peridial cells rather large, thin; ostiolar cells 32.4—42.0 μ high, finely echinulate above; uredospores oblong, ovate or oblong-clavate, 23.4—34.2×16.2—20.7 μ; epispore finely echinulate, colourless; contents pale yellow; germ-pores inconspicuous. Teleutospores unknown.

Hab. On leaves of *Goodyera Maximowicziana* MAK. (*Akebono-shusuran*).

Hokkaidô:

Prov. Ishikari: Sôunbetsu (II, Aug. 4, 1925, Naohide Hiratsuka); Mt. Kuro-dake (II, Aug. 18, 1925, K. Miyabe & Naohide Hiratsuka).

Distrib. Europe, North America and Japan.

Remarks: The present fungus is a new addition to our flora and *Goodyera Maximowicziana* MAK. seems to be a new host plant to the fungus.

In 1893, TRANZSCHEL[33] described *Uredo Goodyeræ* on *Goodyera repens* R. BR. which was collected at Levashov near St. Petersburg, Russia. In 1907, ARTHUR[2] transferred this species to the genus *Pucciniastrum* by the character of its uredostage. Its teleutostage has not yet been collected in any country.

3. Pucciniastrum Hydrangeæ-petiolaridis HIRATSUKA nov. sp.

Soris uredosporiferis hypophyllis, maculis flavidis vel flavo-brunneolis insidentibus, sparsis vel laxe aggregatis, sæpe totam folii superficiem æque obtegentibus, minutis, rotundatis, 0.2—0.34 mm diam., diu epidermide tectis, tandem poro centrali apertis, pseudoperidio firmo, hemisphærico, ex cellulis cubicis, minutis, cellulis ostiolaribus levibus; uredosporis oblongis, ovatis vel oblongo-clavatis, tenuiter echinulatis, 21.6—36.0×14.4—21.6 μ, intus aurantiacis, episporio hyalino, 1.5—2.0 μ crasso; soris teleutosporiferis amphigenis, plerumque hypophyllis, subepidermalibus, minutis, pallide flavidis vel flavo-brunneis; teleutosporis intercellularibus solitariis vel irregulariter aggregatis, globosis, subglobosis vel oblongis, 2-4-cellularibus, pallide flavo-brunneis, levibus, 19.8—32.4×18.0—27.0 μ.

Hab. On leaves of *Hydrangea petiolaris* SIEB. et ZUCC. (=*H. scandens* MAXIM.) (*Tsuru-ajisai*).

Honshû:

Prov. Shimotsuke: Nikkô (III, Oct. 30, 1900, T. Nishida).

Prov. Mutsu: Sukayu (II, Sept. 26, 1926, S. Itô & Naohide Hiratsuka).

Hokkaidô:

Prov. Shiribeshi: Akaiwa (Otaru) (II, Aug. 7, 1924, Naohide Hiratsuka); Zenibako (II, Oct. 10, 1926, Naohide Hiratsuka).

Prov. Ishikari: Maruyama (II, June 7, 1921, Y. Homma; II, June 9, 1924; II, Aug. 19, 1924; II, Sept. 10, 1922; II, Sept. 23, 1923; II, Sept. 25, 1924; II, III, Oct. 21, 1924; III, Nov. 14, 1925, Naohide Hiratsuka); Mt. Moiwa (II, June 8, 1924; II, June 10, 1925; II, July 3, 1924; II, Aug. 13, 1924; II, Sept. 14, 1924; II, Oct. 3, 1924; III, Nov. 5, 1923, Naohide Hiratsuka); Mt. Teine (II, Sept. 9, 1921, Y. Homma; II, Sept. 27, 1925, Naohide Hiratsuka); Mt. Kuro-dake (II, Aug. 19, 1925, K. Miyabe & Naohide Hiratsuka).

Prov. Iburi: Rebunge-tôge (II, Aug. 17, 1890, K. Miyabe).

Distrib. Japan.

Remarks: This species differs distinctly from the American species, *Thekopsora Hydrangeæ* (FARL.) P. MAGN. They can be distinguished from each other by the following characters. The teleutosori of *Thekopsora Hydrangeæ* are mostly epiphyllous, while those of the present fungus are usually hypophyllous or occasionally epiphyllous. The teleutospores of the former are intracellular, but those of our fungus are intercellular. Our fungus is also distinguishable from the American fungus by the larger size of its uredospores.

4. **Pucciniastrum Pyrolæ** (KARST.) SCHRÖTER

in Jahresber. Schles. Ges. f. vaterl. Kultur, LVIII, p. 167, 1880—LIRO, Ured. Fenn. p. 513, 1908—SYD. Monogr. Ured. III, p. 455, 1915.

Syn. *Uredo Pirolæ* WINT. in Pilze Deutschl. I, p. 254, 1881—FISCH. Ured. Schw. p. 539, fig. 337, 1904—HARIOT, Uréd. p. 306, 1908.

U. Chimaphilæ PECK in Ann. Rep. N. Y. State Mus. XLVI, p. 33, 1893—SACC. Syll. XI, p. 226.

Thekopsora Pyrolæ KARST. Myc. Fenn. IV, p. 59, 1879—BUBÁK, Rostpilze Böhmens, p. 189, 1908—SACC. Syll. VII, p. 866.

Melampsora Pirolæ SCHRÖT. Pilze Schles. I, p. 366, 1887

—PLOWR. Monogr. Ured. p. 247, 1889.

Pucciniastrum Pirolæ DIET. in ENGL.-PRANTL, Natürl. Pflanzenfam. I, Abt. 1,** p. 47, 1897—ARTH. in N. Amer. Fl. VII, p. 108, 1907—GROVE, Brit. Rust Fungi, p. 367, fig. 275, 1913.

Uredosori hypophyllous, sometimes on petioles, generally in small groups, causing reddish or reddish-brown spots on the upper surface of the leaf; pseudoperidia persistent; peridial cells polygonal, hyaline; ostiolar cells large, sparsely echinulate at the apex; uredospores elongate-ellipsoidal or clavate, 23.4—39.6×12.6—18.0 μ; epispore with pointed warts, rather thick; contents yellow.

Hab. On leaves of *Chimaphila umbellata* NUTT. (*Ô-umegasasô*).

Hokkaidô :

Prov. Iburi: Numanohata (II, Oct. 17, 1926, Naohide Hiratsuka).

On leaves of *Pirola media* SW. (*Maruba-no-ichiyakusô*).

Honshû :

Prov. Rikuchû: Mt. Iwate (II, July 16, 1903, G. Yamada).

Kurile Isl. :

Etorofu (II, July 26, 1924, A. Abe).

On leaves of *Pirola minor* L. (*Yezo-ichiyakusô*).

Kurile Isl. :

Murakami-wan (Paramushiru) (II, July 23, 1920, Y. Kudô).

On leaves of *Pirola renifolia* MAXIM. (*Jinyô-ichiyakusô*).

Hokkaidô :

Prov. Oshima: Ônuma (II, May 30, 1925, Naohide Hiratsuka).

Prov. Ishikari: Jôzankei (II, Aug. 5, 1923, Naohru Hiratsuka); Mt. Sapporo (II, June 25, 1914, B. Ishida).

Prov. Hidaka: Mt. Apoi (II, Aug. 17, 1912, K. Kondô).

On leaves of *Pirola rotundifolia* L. var. *incarnata* DC. (*Beni-ichiyakusô*).

Hokkaidô :

Prov. Iburi: Numanohata (II, Oct. 17, 1926, Naohide Hiratsuka).

On leaves of *Pirola secunda* L. (*Yama-ichiyakusô*).

Hokkaidô :

Prov. Ishikari: Nopporo (II, June 16, 1923, Y. Homma); Mt. Teine (II, June 27, 1925, Naohide Hiratsuka); Jôzankei (II, Aug. 24, 1898, K. Miyabe).

Prov. Tokachi: Mt. Memoro (II, July 22, 1914, S. Nishida).

Prov. Kushiro: Mt. Meakan (II, July 19, 1921, K. Togashi; II, Sept. 14, 1925, Naohide Hiratsuka).

Distrib. Europe, Greenland, North America and Japan.

Remarks: In our country, there have been no records concerning the occurrence of *Pucciniastrum Pyrolæ* (KARST.) SCHRÖT. on any species of *Pirola* or *Chimaphila* up to this time. The æcidial and teleuto-generations have not yet been observed in our materials. But, the character of its uredospores coincides exactly to the description of the present species.

The uredospores on *Chimaphila umbellata* are somewhat larger than those on the species of *Pirola*, but the writer included it under the present species. Field observations show that the mycelium of this rust fungus can overwinter in the tissues of the host and produce uredosori early in the next spring.

V. Notes on Some Species of Chrysomyxa in Japan.

In 1900, P. HENNINGS[31] first recorded *Chrysomyxa Rhododendri* DE BARY from Japan based on the specimen of the æcidial stage on *Abies ajanensis* FISCH. (=*Picea jezoënsis* CARR.) collected by M. SHIRAI in Tokyo (?).

In the same year, DIETEL[13] described *Chrysomyxa expansa* on *Rhododendron Metternichii* SIEB. et. ZUCC. var *pentamerum* MAXIM. (=*Rh. pentamerum* (MAXIM.) MATUM. et NAKAI) collected by S. KUSANO at Nikkô, Prov. Shimotsuke.

In 1901, YOSHINAGA[73] reported *Chrysomyxa Rhododendri* DE BARY on *Rhododendron indicum* (L.) SW. var. *macranthum* MAXIM. from Prov. Tosa. In the next year, HENNINGS[33] also reported this fungus, which was collected by INOUYE (=YOSHINAGA) at Sakawa, Prov. Tosa.

In 1903, DIETEL[17] reported a new species, *Chrysomyxa Menziesiæ* DIET. on *Menziesia pentandra* MAXIM. based on the specimen collected by S. KUSANO at Nikkô, and two years later, he[19] also reported *Chrysomyxa Rhododendri* DE BARY on *Rhododendron indicum* (L.) SW. var *obtusum* MAXIM. (=*Rh. obtusum* (LINDL.) PLANCH.) which was collected by N. NAMBU in Tokyo.

In 1915, MIYABE[50] reported that *Chrysomyxa* on *Rhododendron brachycarpum* D. DON. and *Rh. chrysanthum* PALL. collected in Hokkaido, is identical with *Chrysomyxa expansa* DIET., and proved that its æcidial stage could be produced on the leaves of *Picea jezoënsis* CARR. by inoculating them with the sporidia from the teleutospores of the fungus on *Rhododendron brachycarpum*. He also stated that its æcidial stage is identical with *Peridermium Piceæ-hondoensis* DIET.[18] on *Picea hondoensis* MAYR. which was collected by S. KUSANO on Mt. Fuji, Prov. Suruga.

In 1924, TOGASHI[61] identified an æcidial stage of *Chrysomyxa* on *Picea Glehni* MASTERS collected by him at Otatomari, Rishiri Isl., Prov. Kitami, as *Chrysomyxa Rhododendri* DE BARY.

Besides the above mentioned species, SHIRAI[68] enumerated the following species, as occurring in Japan: *Chrysomyxa Abietis* (WALLR.) UNGER, *Ch. Ledi* DE BARY, *Ch. Pirolæ* ROSTR. and *Ch. Woroninii* TRANZSCH.

In the present paper, the writer intends to report the following unrecorded or uncommon species in our country: *Chrysomyxa Abietis* (WALLR.) UNGER, *Ch. Cassandræ* TRANZSCH., *Ch. Empetri* SCHRÖT.,

Ch. Ledi DE BARY, *Ch. ledicola* LAGERH. and *Ch. Pirolæ* ROSTR.

1. Chrysomyxa Abietis (WALLR.) UNGER

in Beitr. zur vergleich. Path. p. 24, 1840—BUBÁK, Rostpilze Böhmens, p. 174, 1908—FISCH. Ured. Schw. p. 429, 1904—LIRO, Ured. Fenn. p. 452, 1908—SACC. Syll. VII. p. 762—SCHRÖT. Pilze Schles. I, p. 372, 1887—SYD. Monogr. Ured. III, p. 519, 1915—TROTT. Fl. Ital. Crypt. Ured. p. 360, 1914—WEIR in Mycologia XV, p. 183, 1923—WINT. in Pilze Deutschl. I, p. 249, 1881.

Syn. *Blennoria Abietis* WALLR. in Allgem. Forst.-u. Jagdzeitg. XVII, p. 65, 1834.

Teleutosori hypophyllous, linear-oblong, single or coalescent, 0.5 to 12 mm long, 0.3 to 0.5 mm in width, about 0.5 mm high, waxy, reddish orange; teleutospores catenulate, 45.0—95.0 μ long, cylindrical, slightly enlarged above, 19.8—31.2×10.8—16.2 μ, yellow; epispore hyaline, smooth.

Hab. On leaves of *Picea Glehni* MASTERS (*Aka-ezomatsu*).
Hokkaidô:

Prov. Ishikari: Nopporo (III, March 5, 1918, Nishimura).

On leaves of *Picea jezoënsis* CARR. (*Yezo-matsu*).
Hokkaidô:

Prov. Iburi: Shimukappu-mura (III, June 8, 1922, N. Nagane); Lake-side of Shikotsu (III, June 5, 1927, T. Ishiyama, S. Iwadare & M. Nagai).

On leaves of *Picea excelsa* LINK (*Doitsu-tôhi*). (*Cult.*)
Hokkaidô:

Prov. Ishikari: Sapporo (III, May, 1924, S. Itô).

Distrib. Europe and Japan.

Remarks: The genus *Chrysomyxa* was established by UNGER in 1840 taking as its type species, *Chrysomyxa Abietis* (WALLR.) UNGER, an autoecious lepto-form having only the teleutostage in its life-history. In 1906, ARTHUR[1] restricted the generic character and separated those species having all spore-stages as a new genus *Melampsoropsis* (SCHRÖT.) ARTH. In the present paper, the writer has treated the genus *Chrysomyxa* in a broad sense. Of the hosts found in Hokkaidô, *Picea Glehni* MASTERS and *P. jezoënsis* CARR. are new to the present species.

It is easily distinguished from its related species, *Chrysomyxa Weirii* JACKSON by its wider and larger spores.

2. Chrysomyxa Cassandrae Tranzschel

in Trudi St. Petersb. Obshch. Est. Otd. Bot. XXIII, p. 28, 1893—Liro, Ured. Fenn. p. 465, 1908—Sacc. Syll. XVII, p. 397—Syd. Monogr. Ured. III, p. 513, 1915.

Syn. *Uredo Cassandræ* Peck et Clint. in Ann. Rept. N. Y. State Mus. XXX, p. 54, 1878—Sacc. Syll. VII, p. 844.

Cæoma Cassandræ Gobi in Script. Bot. Hort. Univ. Petropol. I, p. 177, 1886—Gobi & Tranzsch. in Script. Bot. Hort. Univ. Petropol. III, p. 113, 1891.

C. Cassandræ Rostr. in Meddel. Bot. For Kjöbenhavn II, p. 90, 1888.

Melampsoropsis Cassandræ Arth. in Résult. Sc. Congr. Bot. Vienne, p. 338, 1906; in N. Amer. Fl. VII, p. 119, 1907—Fraser in Mycologia III, p. 68, 1911; IV, p. 178, 1912.

Uredosori hypophyllous, generally grouped, minute, round, 0.2—0.5 mm across; pseudoperidia delicate, inconspicuous; uredospores catenulate, globose to ellipsoidal, 18.0—32.4×14.4—19.8 μ; epispore closely verrucose, rather thin, hyaline.

Hab. On leaves of *Chamædaphne calyculata* (L.) Moench. (=*Andromeda calyculata* L., *Cassandra calyculata* D. Don.) (*Horomui-tsutsuji, Yachi-tsutsuji*).

Hokkaidô:

Prov. Ishikari: Horomui (II, June 20, 1922, Naohide Hiratsuka).

Distrib. Europe, Siberia, Kamchatka, North America and Japan.

Remarks: This species is a new addition to our flora. The specimen collected by the writer has its uredostage only.

3. Chrysomyxa Empetri Schröter

in Krypt. Fl. Schles. III, 1, p. 372, 1887—Grove, Brit. Rust Fungi, p. 311, fig. 235, 1913—Liro, Ured. Fenn. p. 454, 1908—Plowr. Monogr. Ured. p. 253, 1889—Syd. Monogr. Ured. III, p. 515, 1915—Trott. Fl. Ital. Crypt. Ured. p. 360, 1914.

Syn. *Uredo Empetri* Pers. in Moug. et Nestl. Stirp. Crypt. vogeso-rhen. No. 391, 1812.

Cæoma Empetri Wint. in Pilze Deutschl. I, p. 257, 1881.

Erysibe Empetri Wallr. Fl. Crypt. Germ. II, p. 199, 1833.

Thekopsora Empetri Karst. in Bidr. Fin. Nat. Folk, XXXI, p. 143, 1879.

Chrysomyxa Empetri ROSTR. in Meddel. om Grönland, Kjöbenhavn, III, p. 536, 1888—BUBÁK, Rostpilze Böhmens, p. 173, 1908—FISCH. Ured. Schw. p. 557, 1904—SACC. Syll. VII, p. 762.

Melampsoropsis Empetri ARTH. in Résult. Sc. Congr. Bot. Vienne, p. 338, 1906; in N. Amer. Fl. VII, p. 118, 1907.

Uredosori hypophyllous, rarely epiphyllous, minute or medium size, sometimes arranged in lines parallel to the midrib, covered by the epidermis, soon naked at maturity, pulverulent, reddish yellow; uredospores in chains, globose to ellipsoid or sometimes polygonal, 25.2−36.0×18.0−27.0 μ; epispore densely verrucose, colourless; contents orange-yellow.

Hab. On leaves of *Empetrum nigrum* L. (*Gankôran*).

Hokkaidô:

Prov. Ishikari: Mt. Kuro-dake (II, July 28, 1926, S. Itô, Y. Homma & Naohide Hiratsuka).

Prov. Tokachi: Shikaribetsu-numa (II, July 7, 1925, Naohide Hiratsuka).

Prov. Kushiro: Mt. Meakan (II, July 19, 1921, K. Togashi); Mt. Oakan (II, Aug. 10, 1923, Naohide Hiratsuka).

Prov. Nemuro: Nemuro (II, July 12, 1925; II, July 19, 1924, Naohide Hiratsuka).

Distrib. Europe, North America and Japan.

Remarks: The present fungus is also new to Japan. The teleutogeneration has not yet been collected in our country.

4. Chrysomyxa Ledi DE BARY

in Bot. Zeitg. XXXVII, p. 809, tab. X, fig. 7-8, 1879—BUBÁK, Rostpilze Böhmens, p. 172, 1908—LIRO, Ured. Fenn. p. 459, 1908—SACC. Syll. VII, p. 760—SCHRÖT. Pilze Schles. I, p. 371, 1887—SYD. Monogr. Ured. III, p. 504—WINT. in Pilze Deutschl. I, p. 251, 1881.

Syn. *Aecidium abietinum* ALB. et SCHW. Consp. Fung. Nisk. p. 120, 1805, p.p.

Cæoma Ledi LINK in Spec. Pl. II, p. 15, 1825.

C. Ledi SCHLECHT. Fl. Berol. II, p. 122, 1824.

Erysibe Ledi WALLR. Crypt. Germ. II, p. 199, 1833.

Melampsoropsis Ledi ARTH. in Résult. Sc. Congr. Bot. Vienne, p. 338, 1906.

M. abietina ARTH. in N. Amer. Fl. VII, p. 119, 1907.

Pucciniastrum Ledi KARST. Myc. Fenn. IV, p. 57, 1879.

Uredosori hypophyllous, scattered or sometimes gregarious, minute, round, covered by the epidermis and a very delicate pseudoperidium, soon naked; uredospores globose, subglobose or ellipsoid, 19.8—28.8 ×14.4—23.4 μ; epispore densely verrucose, hyaline, rather thick.

Hab. On leaves of *Ledum palustre* L. var. *yesoense* NAKAI (*yezo-isotsutsuji*).

Hokkaidô:

Prov. Iburi: Noboribetsu (II, Sept. 3, 1910, K. Miyabe).

Prov. Ishikari: Horomui (II, June 14, 1925, Y. Homma & Naohide Hiratsuka; II, Sept. 10, 1923, Naohide Hiratsuka); Mt. Kuro-dake (II, Aug. 5, 1925, Naohide Hiratsuka).

Prov. Tokachi: Mt. Nupukaushi (II, June 6, 1925, Naohide Hiratsuka).

Prov. Kushiro: Mt. Meakan (II, July 19, 1921, K. Togashi).

Distrib. Europe, Siberia, North America and Japan.

Remarks: In Hokkaidô, the uredostage of the present fungus is not uncommon, but, its teleutostage has not yet been collected. The present species is easily distinguished from *Chrysomyxa ledicola* LAGERH. by the hypophyllous position of the uredosori.

5. **Chrysomyxa ledicola** LAGERHEIM

in Tromsö Mus. Aarsh. XVI, p. 119, 1893—SYD. Monogr. Ured. III, p. 507, 1915.

Syn. *Uredo ledicola* PECK in Ann. Rept. N. Y. State Mus. XXV, p. 90, 1873.

Puccinia Ledi BERK. et CURT. in Grev. III, p. 54, 1874.

Dicæoma Ledi KUNTZE in Rev. Gen. III, p. 469, 1898.

Melampsoropsis ledicola ARTH. in Résult. Sc. Congr. Bot. Vienne, p. 338, 1906; in N. Amer. Fl. VII, p. 119, 1907.

Uredosori epiphyllous, on yellow or yellowish-brown spots, minute, round or oblong, scattered or elongated, 0.24 to 0.5 mm in diameter, ruptured epidermis prominent; pseudoperidia delicate; uredospores in chains, globose, subglobose or ellipsoid, 23.4—34.2×18.0—23.4 μ; epispore 2.0—3.0 μ thick, densely verrucose.

Hab. On leaves of *Ledum palustre* L. var. *vulgare* LEDEB. (*Koba-no-isotsutsuji*).

Hokkaidô:

Prov. Ishikari: Mt. Hokkai-dake (II, Aug. 4, 1925, Naohide Hiratsuka); Mt. Kuro-dake (II, Aug. 4, 1925, Naohide Hiratsuka);

Kumonotaira (Taisetsu-zan) (II, July 28, 1926, S. Itô, Y. Homma, Naohide Hiratsuka, etc.).

Distrib. North America, Alaska, Kamchatka, Canada, Greenland and Japan.

Remarks: This is also one of the species newly added to our mycological flora, but, its teleutostage has not yet been collected in our country. The present fungus is one of the arctic and alpine species, and in Hokkaidô, it is very abundant on the alpine meadows of the Taisetsu-zan-range.

6. Chrysomyxa Pirolae Rostrup

in Bot. Centralbl. V, p. 127, 1881—Bubák, Rostpilze Böhmens, p. 173, 1908—Fisch. Ured. Schw. p. 429, fig. 327, 1904—Grove, Brit. Rust Fungi, p. 312, fig. 236, 237, 1913—Liro, Ured. Fenn. p. 456, 1908—Syd. Monogr. Ured. III, p. 516, 1915—Trott. Fl. Ital. Crypt. Ured. p. 358, 1914.

Syn. *Aecidium (?) Pirolæ* DC. Fl. franç. VI, p. 99, 1815.

Cæoma (Aecidium) Pyrolatum Schw. in Transact. Amer. Phil. Soc. II, 4, p. 294, 1832.

Uredo pirolata Körn. in Hedw. XVI, p. 28, 1877.

Chrysomyxa pirolatum Wint. in Pilze Deutschl. I, p. 250, 1881.

Melampsoropsis Pyrolæ Arth. in Résult. Sc. Congr. Bot. Vienne, p. 338, 1906; in N. Amer. Fl. VII, p. 118, 1907.

Uredosori hypophyllous, often covering the whole surface of the leaf uniformly, round, minute, surrounded by the epidermis and a delicate pseudoperidium, soon naked, yellow; uredospores in chains, globose or somewhat polygonal, 18.0−28.8×16.2−25.2 μ; epispore verrucose.

Teleutosori hypophyllous, evenly and closely scattered, minute, round up to 0.4 mm in diameter, flat, waxy; teleutospores mostly ellipsoidal, somewhat polygonal, 10.9−18.0×5.4−9.0 μ, in rows as much as 90 to 150 μ long; epispore colourless, smooth.

Hab. On leaves and petioles of *Pirola renifolia* Maxim. (*Jinyô-ichiyakusô*).

Hokkaidô:

Prov. Ishikari: Sapporo (II, III, May 6, 1890, K. Miyabe); Nopporo (II, III, May 8, 1920; II, III, May 18, 1922, K. Togashi; II, June 16, 1923, Y. Homma; II III, May 17, 1926; II, III, June

22, 1923, Naohide Hiratsuka).

Prov. Iburi: Lake-side of Shikotsu (II, III, June 5, 1927, T. Ishiyama, S. Iwadare & M. Nagai).

Distrib. Europe, Siberia, North America, Greenland and Japan.

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