Jap. I, p. 38; Hook. f. et Anders. in Hook. f. Fl. Brit. Ind. I, p. 159; Nyman, Consp. p. 66; Forbes et Hemsl. in Journ. Linn. Soc. XXIII, p. 48; Miyabe, in Mem. Bost. Soc. Nat. Hist. IV, p. 219; Henry, in Trans. As. Soc. Jap. XXIV, Suppl. p. 17; Dur. et Schinz, Consp. Fl. Afr. I, 2, p. 131; T. Ito et Matsumura, Tent. Fl. Lutch. p. 34.

Thlaspi Bursa-pastoris, Linn. Sp. Pl. ed. 1, p. 647; Thunb. Fl. Jap. p. 259; Lour. Fl. Cochinch. p. 395; Eng. Bot. t. 1485; Franch. Pl. David. I, p. 39.

薺 *Sei*, vulgo *Nadsuna*, Kæmpf. Amœn. p. 897.

Hab. in urbe Tshifu provinciæ Shantung, mense Aprilis anno 1898 (*Domina Yoshi Takagaki*, n. 545!): in colle Nan-shan, 29 Aprilis 1900, flor. cum fruct. mat. (*T. Takagaki*!).

RESEDACEÆ.

Reseda odorata, Linn.

Colitur in hortis collis Nansi-shan urbis Tshifu, 17 Octobris 1897, flor. cum fruct. (*Domina Yoshi Takagaki*, n. 297!)

Notes on Some Melampsoræ of Japan III. Japanese Species of Phacopsora.

By

N. Hiratsuka.

The genus *Phacopsora* was established by Dr. P. Dietel¹⁾ in 1895, by the revision of *Melampsora punctiformis* Barcl. et Diet. on *Galium Aparine* L. collected by A. Barclay in western Himalaya, Simla.

Its peculiarity is that the unicellular teleutospores are formed in many layers, instead of making a single layer as it is the case with other

1) P. Dietel, Drei neue Uredineengattungen: Masseella, Phakopsora und Schizospora. Berichte d. deutsch. botan. Gesellschaft. Heft 7. 1895.

Melampsora; the whole spores are united together into one body of lenticular shape from which the generic name was derived.

In Japan, notwithstanding of the common occurrence of *Galium Aparine* L., this parasite has not yet been observed.

In 1895, Mr. K. Sengoku collected a rust fungus on *Parthenocissus tricuspidata* Pl. at Komaba, Tokyo, and sent it to Prof. Miyabe of Sapporo; just then as I was studying on the *Melampsora* of Japan under his direction, I had a good opportunity to examine that specimen.

It had besides uredospores, unicellular teleutospores arranged in 3-4 layers, united together into one compact mass of somewhat lenticular shape.

This peculiarity, I thought, is quite sufficient to distinguish it from other known genera of *Melampsora*; but on account of the deficiency of the material, I was obliged to postpone my study on the subject for some other occasion.

During my stay at Hirosaki, Prov. Mutsu, in 1896, I was struck with a fungus attacking the leaves of *Ampelopsis heterophylla* Sieb. et Zucc. which was proved to be an allied form to one on *Parthenocissus*.

Further in 1897, I collected a similar parasite on *Vitis Coignetiae* Pull. and *Vitis vinifera* L. at Hirosaki and its vicinity, and at about the same time Mr. Takahashi at Morioka, Prov. Rikuchū on *Parthenocissus tricuspidata* Pl., *Ampelopsis heterophylla* Sieb. et Zucc., *Vitis Coignetiae* Pull. and *Vitis vinifera* L.; thus enriched us with the materials for the study of these interesting forms.

In 1898, Dietel¹⁾ published the results of his study on the Japanese *Uredineæ*, among which he described a new species of *Phacopsora* as *Phacopsora Ampelopsidis* Diet. et Syd. parasitic on *Ampelopsis leeooides* Pl. collected by Prof. Shirai, at Komaba, Tōkyō.

At my request Prof. Shirai kindly sent me the same specimen which he had formerly sent to Dr. P. Sydow of Berlin, with the remarks that the specimen he had sent him was *Ampelopsis heterophylla* Sieb. et Zucc. and not *Ampelopsis leeooides* Pl., which upon examination I found to be quite identical with the specimens in my possession and agrees exactly with the description made by Dietel.

Recently, Sydow²⁾ described one on *Parthenocissus tricuspidata* Pl. (= *Vitis inconstans* Miq.), collected by Mr. Shirai, as a new species under

1) P. Dietel, Einige Uredineen aus Ostasien. Hedwigia. Heft 4, 1898.

2) P. Sydow, Diagnosen neuer aus verschiedenen Gegenden stammender Pilze. Hedwigia. 1899. Beiblatt. P. 140.

the name of *Phacopsora Vitis* Syd. The characters by which it can be distinguished from *Ph. Ampelopsidis* Diet. et Syd., according to him, are as follows:—

(1) Uredospores elongated. (2) Teleutospores are not formed surrounding an uredosorus in group. (3) Size of teleutospores somewhat greater.

According to my study of the large number of the specimens, I came to the conclusion that there is no good reason to make two distinct species of *Phacopsora* parasitic on the related species of *Vitaceæ*.

In the present contribution one more species is added to the genus.

***Phacopsora Ampelopsidis* Diet. et Syd.**

Syn. *Ph. Vitis* Syd.

Uredo Vitis Diet. (non. III. Thümen).¹⁾

Pl. III. Fig. 1-9.

Uredospores.—Sori mostly hypophyllous, small, scattered or irregularly grouped, yellowish-orange, pseudoperidia none; paraphyses numerous around the sori and also intermixed, clavate or somewhat swollen at the top, 35-60 μ long; spores obovate or long elliptical, 18-26 μ long 12-15 μ broad, epispore colorless, finely echinulate, contents yellowish-orange.

Teleutospores.—Sori mostly hypophyllous, small, covered by the epidermis, separate or united together, formed either surrounding uredosori or independent of them, at first yellowish-brown, wax-like, at last dark-brown, 45-75 μ thick; spores in many layers (3-5, rarely 6), closely united together into one mass of somewhat lenticular shape, uppermost one elongated 15-30 μ long, 11-15 μ broad, others somewhat cubical, epispore brownish, smooth, sometimes uppermost ones slightly thicker walled at apex.

Hab. On *Ampelopsis heterophylla* Sieb. et Zucc. (*Nobudō*):

Hirosaki, Prov. Mutsu, Oct. 5, 1896, (II, III.), (N. Hiratsuka !);

Morioka, Prov. Rikuchū, Oct. 11, 1897, (II, III.), (Y. Takahashi !);

Ogikubo near Tokyo, Prov. Musashi, Oct. 8, 1899, (II, III.), (S. Kusano !);

Tokyo, Prov. Musashi, Nov. 16, 1891, (II, III.), (S. Shirai !).

On *Parthenocissus tricuspidata* Planch. (*Tsuta*):

Morioka, Prov. Rikuchū, Sept. 23, 1897, (II.), (Y. Takahashi !);

1) P. Dietel, Uredineæ Japonicæ. I. Engl. bot. Jahr. Bd. 28. Heft I, 1899.

Tokyo, Prov. Musashi, Oct. 15, 1895, (II, III.), (K. Sengoku !);
 Sept. 1899, (II, III.), (S. Kusano !), July 18, 1898, (II.), (T. Makino !).

On *Vitis Coignetiae* Pull. (*Yamabudō*) :

Minamitsugaru, Prov. Mutsu. Aug. 27, 1897, (II, III.), (N. Hiratsuka !);
 Hirosaki, Prov. Mutsu, Oct. 18, 1897, (II, III.), (N. Hiratsuka !);
 Morioka, Prov. Rikuchū, Oct. 5, 1897, (II, III.), (Y. Takahashi !).

On *Vitis flexuosa* Thunb. (*Sankakuzuru*) :

Mont. Takao, Prov. Musashi, Oct. 18, 1899, (II.), (S. Kusano !).

On *Vitis vinifera* L. (*Seiyōbudō*) :

Hirosaki, Prov. Mutsu, Sept. 13, 1898, (II.), (N. Hiratsuka !);
 Morioka, Prov. Rikuchū, Sept. 26, 1898, (II, III.), (Y. Takahashi !).

Remarks.—To settle the question whether the fungi attacking five different host plants belonging to Vitaceæ (*Ampelopsis heterophylla*, *Parthenocissus tricuspidata*, *Vitis Coignetiae*, *Vitis flexuosa* and *Vitis vinifera*) are of the same species or not, careful comparison was made between them.

They agree in main important points but with some minor variations which may be briefly stated as follows :

(1) As to the paraphyses in the uredosori, those on *Amp. heterophylla* and *Parth. tricuspidata* well agree in that they are clavate, curved, somewhat inflated at the top, stout, 30–45 μ in length, while those on *Vitis Coignetiae* and *V. vinifera*, somewhat elongated, slender, curved, 40–60 μ long. (Compare Fig. 4, 5, and 6).

(2) As to the uredospores there are following gradations :

Ampelopsis heterophylla S. et Z.

$$\left. \begin{array}{l} 18 \mu \times 15 \mu \\ 21 \mu \times 15 \mu \\ 24 \mu \times 15 \mu \end{array} \right\} 18-24 \mu \times 15 \mu.$$

Parthenocissus tricuspidata Pl.

$$\left. \begin{array}{l} 18 \mu \times 15 \mu \\ 22 \mu \times 15 \mu \\ 26 \mu \times 12 \mu \end{array} \right\} 18-26 \mu \times 12-15 \mu.$$

Vitis Coignetiae Pull.

$$\left. \begin{array}{l} 19 \mu \times 15 \mu \\ 22 \mu \times 12 \mu \\ 22 \mu \times 15 \mu \end{array} \right\} 19-22 \mu \times 12-15 \mu.$$

Vitis vinifera L.

$$\left. \begin{array}{l} 21 \mu \times 15 \mu \\ 24 \mu \times 15 \mu \\ 26 \mu \times 12 \mu \end{array} \right\} 21-26 \mu \times 12-15 \mu.$$

(3) As to the formation of the teleutospores:

In *Ampelopsis heterophylla*, teleutосori are formed mostly surrounding a single uredosorus, united together into one mass, but this character is not constant; in many cases we met with the teleutосori formed quite independent of the uredosori. In the case of *Parthenocissus tricuspidata*, teleutосori are formed separately, independent of the uredosorus, but we do not fail also to find some teleutосori which surrounding the uredosorus; which in *Vitis Coignetiae* and *V. vinifera*, it is intermediate, both cases occurring indiscriminately. Sometimes it happens that two or more groups of teleutосori unite into one larger patch including 2 or 3 uredosori among them.

These minor variations resulting from the difference of the host, I think, are not sufficient to distinguish species, it is rather proper to regard them as the forms of one species, *Phacopsora Ampelopsidis* Diet. et Syd. If we admit *Phacopsora Vitis* Syd. on *Parthenocissus* as a distinct species, we have also good reason to claim that one on wild and cultivated grapes is another independent species; but to confirm this fact more decidedly, we must refer to the infection experiments.

For the present, however, it is advisable to include these forms under one species rather than to split it into several species based on small differencee which in fact fade into each other by intermediate forms.

By the kindness of Mr. S. Kusano, I obtained a specimen of *Phacopsora* on *Vitis flexuosa* Thunb. The teleutосores are formed in minute punctiform, dark-brown or almost black spots, irregularly grouped together on the under surface of the leaf, quite independent of the uredosori. I failed to find out the uredo in the specimen, but from the nature of the teleutосores, I am inclined to think that it must also be included in the present species.

As regards the formation of the teleutосores, we agree with Dietel that they are not formed by transverse divisions of a tubular cell as it is the case with *Coleosporium*, but by the successive formation of spores from underlying hymenium; this fact may be proved when observed in the young stages.

In this connection, it may be added that the uredo attacking cultivated grapes in N. America which was described as *Uredo Vitis* by von Thümen,¹⁾ are quite different from the present species, although Dietel²⁾

1) Pilze des Weinstockes, p. 182. Saccardo, Syl. Fung. Vol. VII. p. 863.

2) l. c.

identified the uredo on *Parthenocissus tricuspidata*, collected by Mr. T. Makino.

I was kindly given the specimen of Uredo on *Parthenocissus tricuspidata* by Mr. T. Makino, which he had communicated to Prof. Dietel through Prof. Miyoshi, and which upon examination was proved to be the Uredo stage of the present species.

Phacopsora Ehretiae (Barcl.) Hiratsuka.

Syn. *Uredo Ehretiae* Barclay.¹⁾

Pl. III. Fig. 10-13.

Spermogonia applanata, amphigenous, maculi 3-5 mm. diam., orange color.

Uredospores. Sori amphigenous, accompanied by spermogonia or independent of them, small, roundish, separate, pseudoperidia and paraphyses absent, at first covered by the epidermis, at maturity rupturing it, orange color; spores long obovate or long elliptical, 22-23 μ long, 16-20 μ broad, usually 22 $\mu \times$ 17 μ , epispore brownish, distinctly echinulate, apex much thickened; contents orange color.

Teleutospores. Sori minute, compact, flat, hypophyllous, scattered forming groups, at first yellowish-brown at last dark-brown; spores are formed under the epidermis in 3-4 layers, closely united together, upper one somewhat cylindrical, 22-30 μ long, 12-15 μ broad, the rest cubical, 15-18 $\mu \times$ 12-15 μ ; epispore brownish, at apex slightly thickened, especially upper most ones.

Hab. On *Ehretia acuminata* R. Br. (*chishanoki*).

Shuri, Prov. Riukiu, Jan. 6, 1899, (II, III.).

April 18, 1899, (Spermogonia and II.) (N. Hiratsuka!);

May 6, 1900, (II.), (T. Maida!).

Remarks.—On the fully grown leaves, on January 6th, the teleutospores were developed abundantly, while the Uredo was very rare; the leaves attacked were discolored in its affected portion but caused no hypertrophy. On the same host, I found, on April 18th of the same year, newly formed leaves attacked by the same fungus; this time besides uredospores, spermogonia were developed. The part attacked swelled up many times thicker than the surrounding region, forming a distinct maculi of 3-5 mm. in diameter with orange yellow appearance.

1) Add. Ured. 228; Saccardo, Syl. Fung. Vol. XI, p. 225.

In cross-sections of the attacked portion, one may not fail to notice an enormous growth induced by the stimulation of the parasite on the young growing tissue; epidermal, pallisade and even spongy-parenchyma cells of this region become many times larger in diameter than the normal ones, filled with nutrient substances.

In the uredosori both pseudoperidia and paraphyses were absent. Uredospores long abovate or elliptical, its epispore somewhat brownish, at apex remarkably thickened, studded with acute spines; two germ-pores on the lateral wall may be observed.

Teleutospores are formed quite independent of the Uredo in small, flat sori, separate or grouped together on the under surface of the leaf; at first yellowish-brown wax-like becoming dark-brown at maturity. They are formed under the epidermis in 2-4 layers, closely united together into one mass which hardly separable by dissection. The cell-wall at its apex somewhat thickened, especially upper most ones; I have observed a single germ-pore at the upper corner of the spore, where the epispore especially thickened. I refer the present species to *Uredo Ehretiae* Barcl.¹⁾ on *Ehretia serrata* Roxb. (= *E. acuminata* R. Br.) collected by A. Barclay at Simla, Himachal Pradesh; I have no authentic specimen to compare, but his description agree so closely with mine that I do not hesitate to consider them to be identical.

It is interesting to know that the genus *Phacopsora*, so far as known at present, are all asiatic, its distribution extending from India to Northern Japan through Loochoo Islands.

Botanical Laboratory of
Sapporo Agr'l College, Japan.

June 6th, 1900.

1) l. c.

EXPLANATION OF FIGURES IN PLATE.

I. **Phacopsora Ampelopsidis** Diet. et Syd.

(Fig. 1-9; Zeiss 4×D.)

- Fig. 1, Uredospores on *Vitis vinifera* L.
Fig. 2, „ on *Parthenocissus tricuspidata* Pl.
Fig. 3, „ on *Ampelopsis heterophylla* S. et Z.
Fig. 4, Paraphyses in the Uredosori on *Vitis vinifera* L.
Fig. 5, „ „ on *Parthenocissus tricuspidata* Pl.
Fig. 6, „ „ on *Vitis Coignetiae* Pull,
Fig. 7, Vertical median section of teleutosorus on *Ampelopsis heterophyll*
S. et Z.
Fig. 8, Vertical median section of teleutosorus on *Parthenocissus tricuspi-*
data Pl.
Fig. 9, Teleutospores dissected, on *Ampelopsis heterophylla* S. et Z.

II. **Phacopsora Ehretiae** (Barel.) Hiratsuka.

(Fig. 10-13; Zeiss 4×D).

- Fig. 10, Uredospores; Fig. 11, 12, Vertical median sections of teleutosori;
Fig. 13, Teleutospores dissected. (Ep.=Edidermis; sp.=spores;
ge.=germpores).
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