A New Disease on the Larch in Scotland.

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With Plate XIII.

ON the 22nd May 1912, Mr. Donald Grant, forester to Sir John Stirling Maxwell on his estate of Fersit in Inverness-shire, sent to one of us specimens of *Larix europaea* with a fungus disease on the leaves, which, he remarked, bore a striking resemblance to the pine leaf rust, *Peridermium pini f. acicola.*

An examination of the specimens in the laboratory leads to the conclusion that fungus present must be provisionally included in *Peridermium*, a genus of the Uredineae, consisting of a number of species parasitic on Gymnosperms, of which only the aecidial stage is known. Klebahn,* in 1898, described a species of this genus parasitic on the larch, which he named *Aecidium* (*Peridermium*) *Laricis*,† and, although the form under discussion does not agree in all respects with Klebahn's description, the differences are too slight to justify the creation of a new species. In the same paper Klebahn shows that *Aecidium* (*Peridermium*) *Laricis* is the aecidial stage of *Melampsoridium betulinum.*

As the occurrence of *Peridermium Laricis* has not been previously recorded in Scotland, the following information may prove of value to those interested in forestry. In his observations

* Kulturversuche mit heteröcischen Rostpilzen. Bericht vii (1898). Zeitschr. f. Pflanzenkr., Bd. ix, 1899, p. 14.

† Arthur and Kern, in Bull. Torr. Bot. Club, vol. xxxiii, 1906, p. 403, definitely placed this species in the genus *Peridermium*; the fungus is therefore described as *Peridermium Laricis* (Kleb.), Arth. et Kern, by Saccardo in the Sylloge Fungorum, vol. xxi, 1912.

[Notes, R.B.G., Edin., No. XXXVI, March 1913.]

of the appearance of the fungus, Mr. Grant found that the larch was attacked early in the season, and that the fungus was fully developed on leaves when they were about three weeks old. It is interesting to note that, in his subsequent observations, he found the branches had shed their diseased leaves by 30th July, and, in consequence, no further material was available for examination. This would indicate that the stage of the fungus upon the larch runs a rapid course, and may thus account to some extent for the fact that it has previously escaped observation.*

The fungus is almost always found on the under surface of the leaves, but occasionally on the upper side. The aecidia are arranged in rows on one or both sides of the midrib, and are separated by short, irregular intervals (Figs. 1, 2, and 3, Pl. xiii). The number of aecidia on each leaf is variable, but usually 6–15. Each group of spores is enclosed by a delicate white protective covering, the pseudoperidium, which, at maturity, has the form of a cylinder, slightly flattened laterally and open at the upper end. The pseudoperidium varies from ·5–·7 mm. in height, ·5–·7 mm. long, and ·3–·4 mm. wide. In the earlier stages it is closed, and then the cylindrical part is terminated by a bluntly conical upper portion (long pointer, Fig. 1). The ripe aecidiospores are set free by the irregular rupture of the apex of the pseudoperidium, and, in consequence, after dehiscence has taken place, this is terminated by a ragged or lacerate margin (see short pointer, Fig. 1 and Fig. 4). Occasionally two adjacent pseudoperidia become partially or completely fused together (Fig. 2). The wall of the pseudoperidium is one cell in thickness, the cells being rhomboidal or polygonal in shape and the walls finely verrucose (Fig. 6). The numerous spores are orange-yellow in colour and rather irregular in shape, ellipsoidal or polyhedral, about 16–22 μ in length and 14–18 μ broad. The spore wall is evenly verrucose except a small area, which is smooth, and thinner than the remaining portions. Fig. 4 represents a spore in optical median section and Fig. 5 in surface view. It will be seen that the outer part of the wall consists of a number of rods of material placed perpendicularly to the surface (Fig. 4). Before dehiscence takes place the spores are found arranged in chains at the base of the pseudoperidium; when the latter ruptures they easily separate and escape from the opening at the upper end.

A fungus known as *Caeoma Laricis* bears a considerable resemblance to the form just described on the larch. *Caeoma*

* A re-examination of diseased larch leaves, sent by Mr. Murray, forester at Murthly, Perthshire, in June 1911, shows that the fungus present is an early condition of *Peridermium Laricis*.

Laricis produces orange-yellow spots on the leaves, but is at once distinguished from *Peridermium Laricis* by the entire absence of the pseudoperidium, as well as by differences in the sculpturing of the spore wall. *Caeoma Laricis* has been shown by Klebahn and others to be the aecidial stage of six different species of *Melampsora*, in which the uredospore and teleutospore stages occur on various species of *Populus* and *Salix*.

Although no definite record of the occurrence of *Peridermium Laricis* in Great Britain or Ireland has been made it is probable that Plowright,* in 1891, carried out experiments with this species. This investigator discovered a form of *Caeoma Laricis* near King's Lynn, the aecidiospores of which, when placed on *Betula alba*, caused infection, and, in course of time, the uredospore and teleutospore stages of *Melampsora betulina* were produced. A subsequent infection of *Larix europaea* by the germinating teleutospores produced spermogonia only.

Klebahn,† by infection experiments commenced in 1896 in the neighbourhood of Hamburg, conclusively proved that *Peridermium Laricis* is the aecidial condition of *Melampsora betulina*. In his earlier experiments spermogonia were formed on *Larix europaea* as the result of infection by teleutospores from the birch, but, in later investigations, aecidia only were produced.

Melampsora betulina differs from the remaining species of the genus in the presence of a pseudoperidium enclosing the uredospore sorus. Klebahn † has therefore instituted a new genus *Melampsoridium* for the reception of this species. The differences between the two genera are as follows :—

Melampsoridium : Aecidium of the *Peridermium* type. Uredospore sorus with a definite pseudoperidium.

Melampsora : Aecidium of the *Caeoma* type. Uredospore sorus surrounded by capitate hairs but without a definite pseudoperidium.

The teleutospore sorus is similar in each genus.

Arthur and Kern ‡ include *Peridermium Laricis* in their list of North American species since *Melampsoridium betulinum* is of common occurrence in that country ; the stage on the larch has not yet, however, been found in North America. Saccardo § records its occurrence in France and Germany.

The specimens of *Peridermium Laricis* obtained in Scotland differ in some respects from those described by Klebahn. Up to the present no spermogonia have been discovered ; it is possible,

* Einige Impfversuche mit Rostpilzen. Zeitschr. f. Pflanzenkr., Bd. i, 1891, p. 130.

† *Loc. cit.* and Kulturversuche mit Rostpilzen. Bericht viii (1899). Jahrb. f. Wiss. Bot., Bd. xxxiv, 1900, p. 347.

‡ *Loc. cit.*

§ Sylloge Fungorum, vol. xxi.

however, that these develop earlier than the aecidia, and have, in consequence, been overlooked. The colour of the pseudoperidium is described by Klebahn as bright red-orange ("hell rötlich-orange"). In the Scottish specimens, in the early stages before the pseudoperidium had opened, the colour was pale yellow, and, after dehiscence, it became white.

Considering the abundance of *Melampsoridium betulinum* in this country, it is a remarkable fact that *Peridermium Laricis* is of such rare occurrence. Its resemblance to *Caeoma Laricis* may, however, partly explain the absence of previous records. It is possible that *Melampsoridium betulinum* really consists of several physiological species, and that *Peridermium Laricis* is only one of its aecidial forms; this supposition may explain the absence of records from North America. At present no information is available on this point, but it is proposed to carry out infection experiments to throw light on this and other questions in connection with the life history of the fungus.

DESCRIPTION OF PLATE XIII.

All figures refer to *Peridermium Laricis*.

FIG. 1.—Photograph of twig of *Larix europaea* showing diseased leaves: (*a*) pseudoperidium showing lacerate margin (short pointer); (*b*) unopened pseudo-peridium (long pointer) (× 4).

FIG. 2.—Photograph of twig of *Larix europaea* showing diseased leaves: (*a*) fused pseudoperidia (× 4).

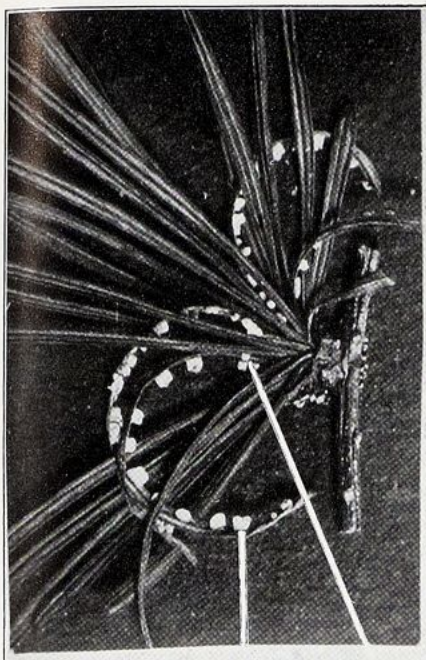
FIG. 3.—Photograph of twigs of *Larix europaea* showing diseased leaves (about natural size).

FIG. 4.—A pseudoperidium showing lacerate margin (× about 50).

FIG. 5.—Spore in surface view (× 1000).

FIG. 6.—Spore in optical median section (× 1000).

FIG. 7.—Part of pseudoperidium; the lower cells show the verrucose marking on the walls (× 220).



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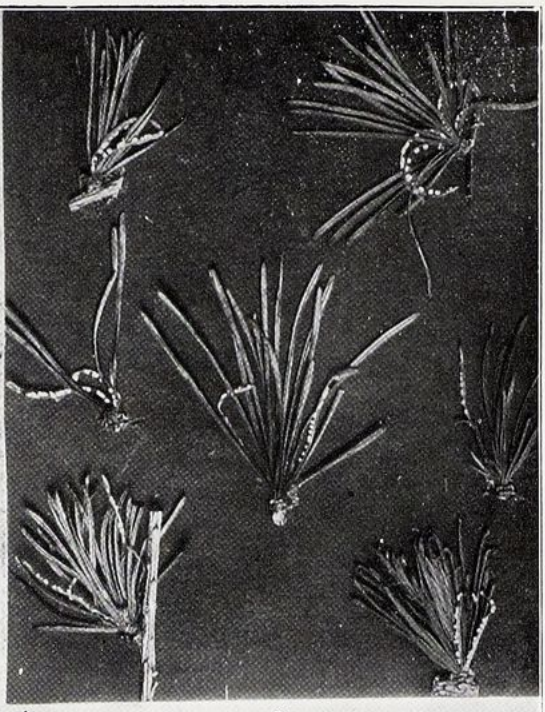

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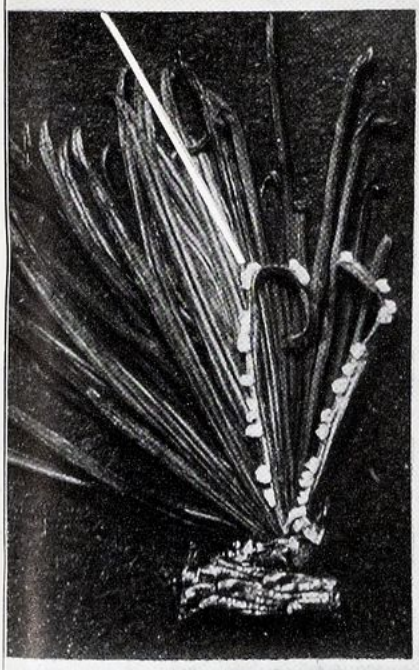

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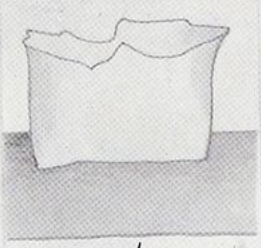

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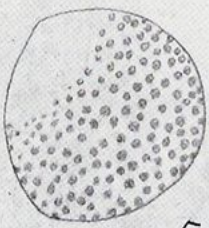

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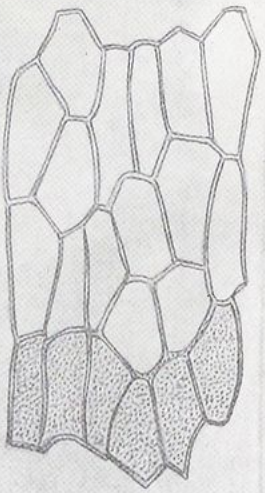

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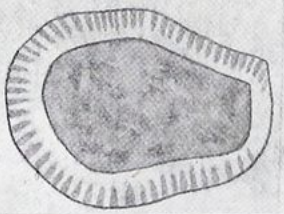

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PERIDERMIUM LARICIS, ARTH. ET KERN.