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Botany. — "Exosporina Laricis OUD. — *A new microscopic fungus occurring on the Larch and very injurious to this tree.*" By Prof. C. A. J. A. OUDEMANS.

On June 11, 1903, Mr. C. A. G. BEINS collected on the estate "de Groote Bunte" at Nunspeet and sent to me a number of needles and twigs of the common Larch *(Larix decidua = Larix europaea)*, the former of which, although they belonged to recently grown dwarfshoots, had for the greater part a sickly appearance, and had exchanged their light-green colour for a light-brown one.

The question naturally arose: what could be the cause of this phenomenon, and whether a fungus might be at the root of it.

An investigation concerning this matter soon showed me that the twigs were normal, and consequently had not been visited by the to the Larch very injurious *Peziza (Dasyscypha) Willkommii*, but that the needles were spotted on both sides, but especially on the lower side, with very small black specks (Fig. 1).

These specks, spread at random, sometimes more, sometimes less numerous, mostly circular, had a diameter of 100—150 μ at the utmost, and most resembled *Leptostroma-* or *Leptothyrium*-specks, although a closer examination showed that they shared no property of any importance with these genera. They cohered firmly with the epiderm, and it soon appeared that they had not been hidden under it and gradually found an exit, but that they had existed from the beginning on the surface of the needles.

This result was not obtained by examining cross-sections, which the very minute specks did not allow to make, but by heating the needles for a few minutes in a ten percent solution of caustic potash, washing them, making them transparent with chloral-hydrate, and gently pressing them with a cover-slip. Under the microscope light-brown, wavy, occasionally bifurcated threads or ribbons of varying breadth were seen on the leaf, which in various places produced little disks, from which new threads were sent out in some other direction (Fig. 2).

The threads consisted of articulate hyphae and the disks of a small-celled parenchym. By pressing the latter more strongly and so dividing them into smaller fragments, it appeared that they were not flat but globular, and that they protruded like little cupolas above the epiderm to which they were firmly attached.

These fragments also gave an opportunity of gaining an idea about the internal structure, of the disks. From their small-celled tissue, namely, certain favoured hyphae had grown up in a close bunch, in such a way that their height increased regularly from the edge to the middle. These hyphae, by forming numerous partitions, had got an articulate appearance. On closer inspection the multicellular rods appeared, in a more mature state, to consist in the lower parts of cubical, in the higher ones of more rounded cells, and finally to become disintegrated, so that, on account of similar cases, there could be no doubt that the cast-off cells were the means of multiplication and had consequently to be considered as conidia.

These conidia, from which new infections may be expected, are mostly 5—6 μ high and 5 μ broad, have a light-brown colour and are perfectly smooth. By far the greater part of them are undivided; only a few show perpendicular or inclined partitions.

If we now ask what harm is done to *Larix decidua* by the above described fungus, the answer can only be that the stomata are blocked up and rendered useless by it; that the function of the leaves is interfered with, and that the chlorophyll is changed in such a manner, that its assimilative power is reduced, and that evaporation is in no small measure prevented. This is proved by the brownish colour of the leaves replacing the green one. In one and the same spiral of needles, such as are found with Larix, the morbid process proceeds from the outside to the interior, so that for a considerable period needles of two colours are observed on the rosettes.

As the needles fall off pretty soon, and lodge no mycelium threads which might have gone on to the twigs, it follows that, in order to prevent future damage to the trees, the fallen needles should be removed and burnt. Spraying might perhaps save attacked trees from further decay. For trees that are visited by the fungus, begin to languish, their growth is impeded, their resistance diminishes, and so they soon fall a victim to all sorts of Dematiaceae which give them a dirty blackish appearance.

The next question is: what place in the system the fungus ought to occupy, and what name has to be assigned to it.

To begin with, it undoubtedly belongs to the "Fungi imperfecti", lately entitled "Deuteromycetae" by SACCARDO (Syll. XIV, p. 4). Secondly we must exclude the *Sphaeropsideae*, which possess a perithecium, as well as the *Melanconieae*, the conidia of which, without being occluded in a perithecium, develop within parts of plants and rest on a stroma. Our fungus rather belongs to the third and last, at the same time the largest class of the Deuteromycetae, which have no perithecium and the conidia of which, produced on threads or hyphae, live either independent of each other, which is the general case, or are gathered in bundles, forming a so called "Coremium".

For the sake of brevity we shall state at once that our fungus belongs to the Tuberculariaceae, with coloured hyphae and conidia linked like a rosary, and that first CORDA (Icones Fung. I, p. 9 and fig. 148), and later SACCARDO (Syll IV, 757) assigned the generic name *Trimmatostroma* to a similar fungus.

The species, described and represented by the former, he called *Trimmatostroma Salicis*, after its host. Now it deserves notice that SACCARDO found a fungus on rose hips and first called it *Exosporium fructicola* (Fungi Italici, pl 40), which he later transplaced to *Trimmatostroma* and called *Tr. fructicola*: firstly because in the genus *Exosporium*, introduced by LINK and exemplified by *E. Tiliae* (plate 1, fig. 8 of his Observationes mycologicae), the conidia are not linked together, but adjacent, and secondly because in his opinion the structure of *Exosporium fructicola* did not agree with that of *Exosporium Tiliae*, but with that of *Trimmatostroma Salicis*.

Now our plate shows *Trimmatostroma Salicis* Corda (fig. E) as well as *Trimmatostroma fructicola* (fig. F), reproduced from the original drawings, in order to elucidate our conviction that between these two, points of difference are to be found rather than points of resemblance, and this to such an extent, that it seemed to us that *Trimmatostroma* had to be shifted again, this time to the genus *Exosporina*, introduced by us for *E. Laricis*, with which SACCARDO's fungus has the greatest resemblance.

The characteristics of the three repeatedly mentioned genera can now be summarised as follows·

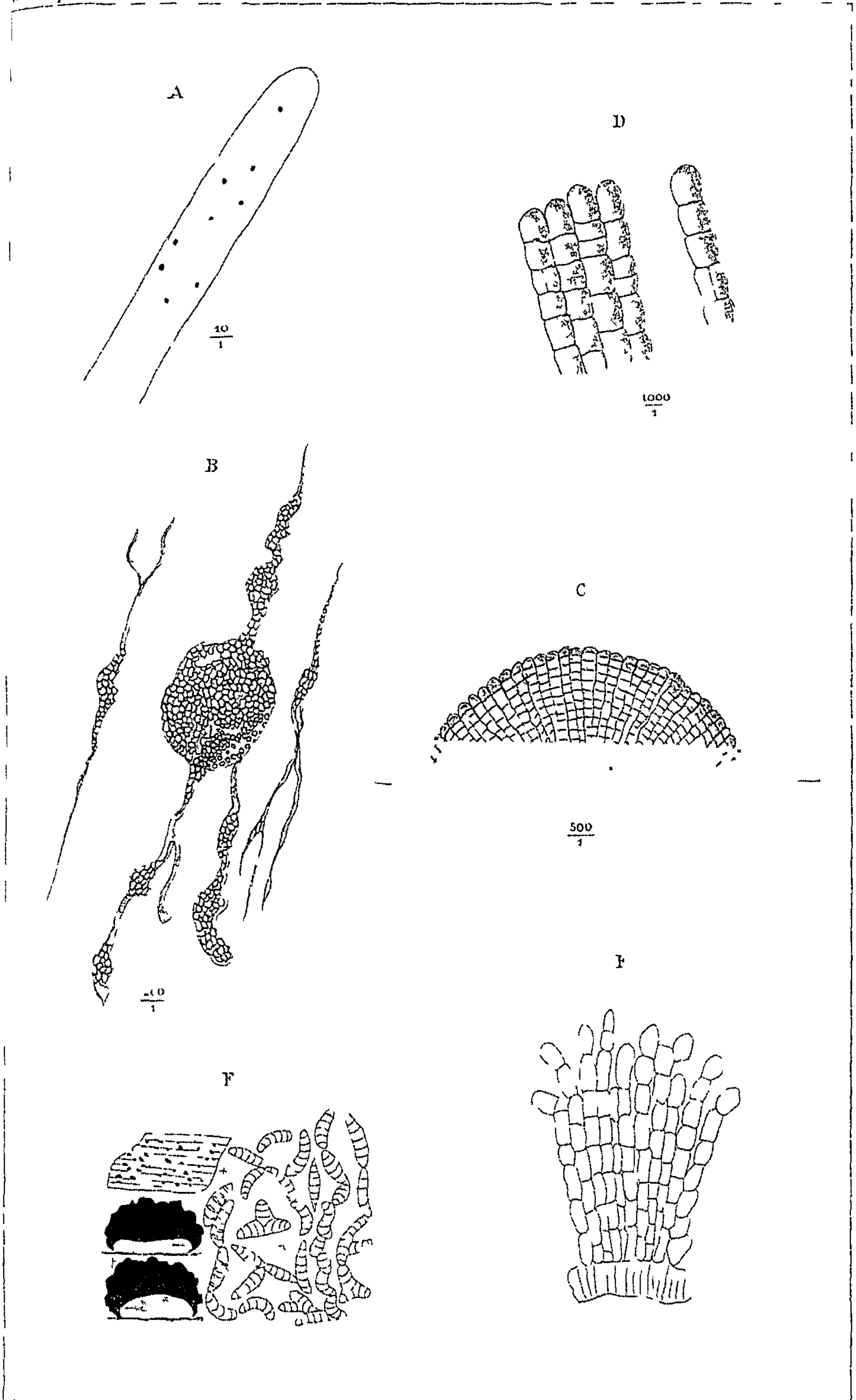
Exosporina — Conidia in strings, undivided, falling off singly. Stroma not or only slightly developed

Exosporium — Conidia consisting of two or more cells, not united to strings, forming a close assemblage on a stroma.

Trimmatostroma — Multicellular conidia, loosely cohering, forming a dense aggregate on a well developed stroma.

Of the genus *Trimmatostroma*, in CORDA's sense, only two species are known besides *Tr salicis*, viz *Tr. americana* Thum. Mycol. Univ N°. 793 (Sacc. Syll. IV, 757) on twigs of *Salix discolor*, and *Tr amentorum* Bresad. et Sacc., on female catkins of *Alnus incana*. A species described by DOHERTY under the name of *Tr abietina* (um?) (Botanical Gazette 1900, p 401, and Sacc. Syll. XVI, 1107) agrees more with a *Sporodesmium* according to the description, and is considered as such by SACCARDO. All these three fungi need not be considered here. We would only remark that *Trimmatostroma abietina*, which like our *Exosporina Laricis* occurs on the leaves of Conifera,

(Exosporma Laricis Oud.)



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causes great damage to plantations of *Abies balsamea* in the environs of Guelph in Ontario. Though it may be very probable that the fungus mentioned does not belong to the genus *Trimmatostroma*, yet it appears from DOHERTY's article that it greatly impedes the growth of the trees by choosing their needles as substrate. About the checking of the evil nothing is mentioned by DOHERTY, so that we cannot profit by advice from Ontario. No suffering trees were found at Nunspeet except at "de Groote Bunte".

EXOSPORINA OUD. n. g.

Fungi expositi vel endogeni, stromate nullo vel parum evoluto, conidiis in catenas stipatas digestis, singulatim secedentibus, homomorphis, continuis, coloratis.

E. Laricis OUD. — Stromatibus amphigenis, expositis, punctiformibus, nigris, catenas conidiorum longiusculas, in placentam convexam arcte condensatas, gerentibus; conidiis primo angulatis, denique globulosis, continuis, 5—6 $\times$ 5 μ, singulatim secedentibus, ferrugineis.

EXPLANATION OF THE PLATE.

Fig. A. Needle of *Larix decidua;* magnification 10 times; with the black spots of *Exosporina Laricis* OUD.

Fig. B. Hyphae or ribbons, extending over the leaf and in various places grown out to small-celled little disks, from which later the conidia, connected to strings, will arise Magn. $\frac{200}{1}$.

Fig. C. Ripe cushion of strings of conidia, as they would appear on a cross-section. Magn. $\frac{500}{1}$.

Fig. D. Part of such a cushion, enlarged $\frac{1000}{1}$. Each separate string shows a spherical top-cell.

Fig. E. CORDA's picture of *Trimmatostroma Salicis.*

Fig. F. SACCARDO's picture of *Exosporium fructicola.*

I am much indebted to Mr. C. J. KONING at Bussum, who has been kind enough to draw the plate for me.

Mathematics. — "PLUCKER's *numbers of a curve in S_n*" by Prof. P. H. SCHOUTE.

The PLÜCKER's numbers of a curve in the space S_n with n dimensions have been given for the first time by VERONESE (*Math. Annalen*, vol. 19, page 195), yet they have been seldom applied although dating from 1882. This is probably due to the more or less awkward

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