

some are globular, others either conical or oblong, those of the globular form predominating."

The wide soil range of the persimmon indicates that these differences may be dependent upon soil character, at least in large measure. A warm soil well exposed to the sun is best adapted to the persimmon, but it is found on almost any kind of soil from rich bottom land to the thin soil of hill tops. In Lawrence and Orange counties, according to Messrs. Troop and Hadley, it is found in great luxuriance in red clay soil areas, in lands exhausted by persistent cropping and which had been abandoned as worthless.

In this wide range of soil conditions it would seem possible to determine with some accuracy the effect of soil character upon this species.

I have called attention to these variations chiefly as an intimation that our forest flora is much less perfectly known than its importance merits, and in the hope that it will direct attention to the range of variation in these and other species.

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## SEEDLINGS OF CERTAIN NATIVE HERBACEOUS PLANTS.

BY STANLEY COULTER AND HERMAN B. DORNER.

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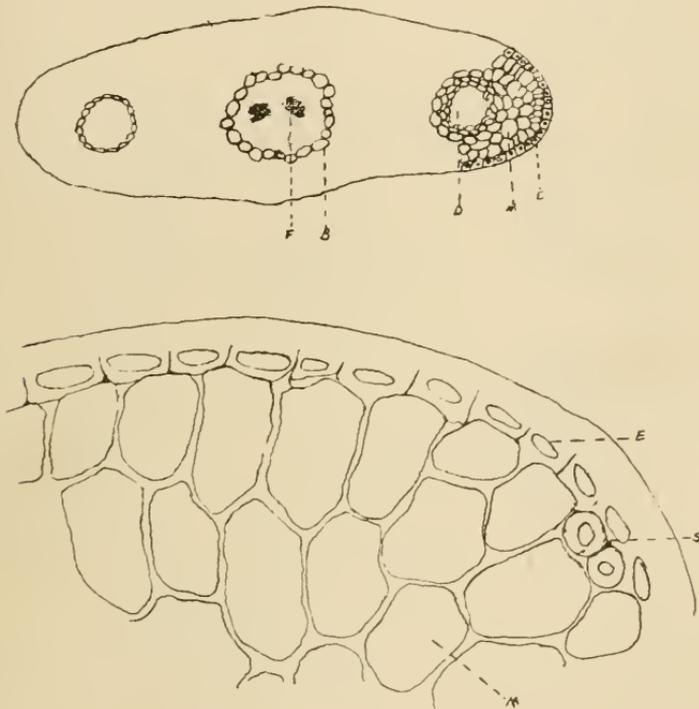
## THE RESIN DUCTS AND STRENGTHENING CELLS OF ABIES AND PICEA.

BY HERMAN B. DORNER.

Of recent years great strides have been made in systematic botany, especially in the line of adding new determinative features to classification. At the present time not only external features, but also internal structures are used for the determination of genera and species. This system of classification, according to internal structure, has best been carried out in the genus *Pinus*.

The first work done upon the pines with the internal structure in view,

was done by F. Thomas in 1865. Further study was made upon the subject by C. E. Bertrand in 1871-74 and W. B. McNab in 1875-77. However, the first man to study the subject closely was the late Dr. George Engelmann, whose name is more intimately associated with the conifers than that of any other man. His first work along this line was his "Synopsis of American Firs," which was published in 1878 in the Trans. St. Louis



ABIES BALSAMEA.

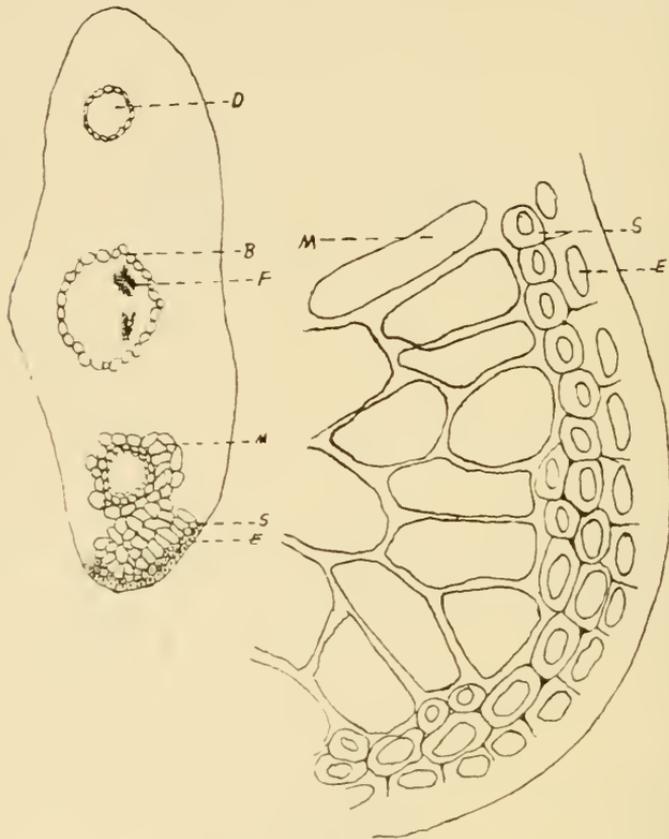
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|----------------------|--------------------|
| D Ducts.             | M Mesophyll.       |
| B Bundle sheath.     | E Epidermis.       |
| F Fibro-vas. bundle. | S Strength. cells. |

Acad. III, pp. 593-602. In 1880 there appeared in the same journal, IV, pp. 161-189, his "Revision of the Genus Pinus." However, in the second paper he merely used the internal structure to distinguish between the different subdivisions of the genus.

It is at this point that J. M. Coulter and J. N. Rose took up the work. Their idea was to apply the characters obtained not only to the subdi-

visions but to the species as well. The results of this work appeared in 1886 in the "Botanical Gazette," XI, pp. 256-262 and 302-309.

The object of their study was to determine whether the pines could be separated from one another by means of the structure of the foliage



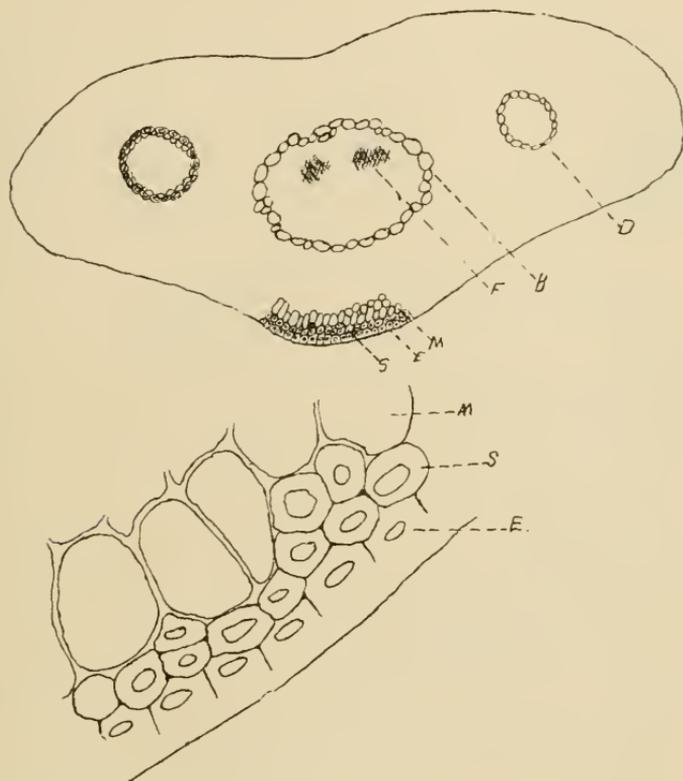
*ABIES FRASERI.*

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|----------------------|--------------------|
| D Ducts.             | M Mesophyll.       |
| B Bundle sheath.     | S Strength. cells. |
| F Fibro-vas. bundle. | E Epidermis.       |

leaf. The material used by them was gathered from as large a range as possible and thus have the material grown under as many conditions as possible. Their determinative features were based upon the number of fibro-vascular bundles, the position and kind of strengthening cells, the position of the stomata, the number and position of the ducts, thickness

of the walls of the bundle sheath, and the number of leaves in a fascicle. With these characters, which appeared to be permanent ones, a system of classification was formulated which was very useful in connection with the classification based upon external features.

Since this time comparatively little, if any, work has been done upon



ABIES SUBALPINA.

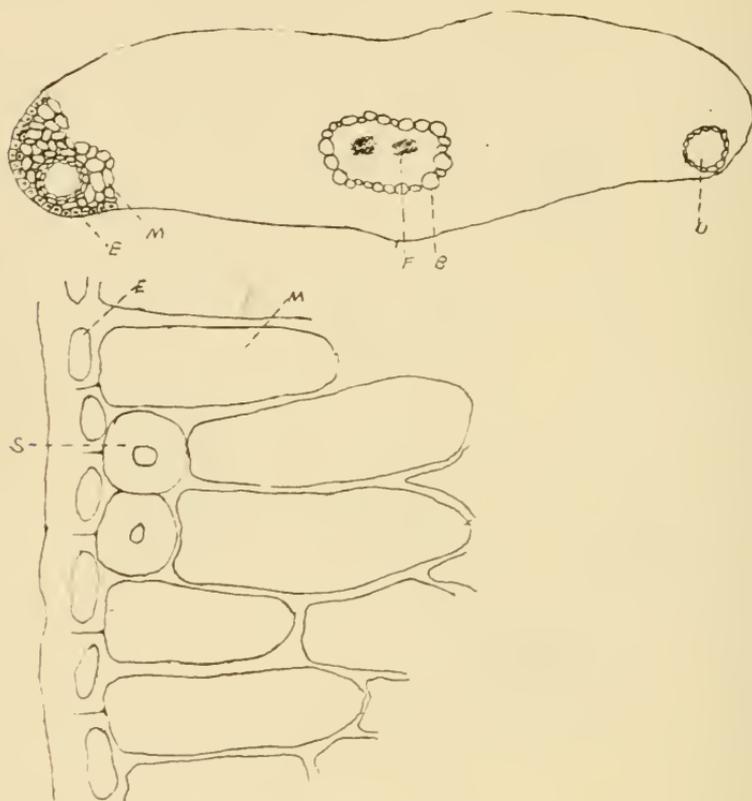
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| D Ducts.             | M Mesophyll.      |
| B Bundle sheath.     | E Epidermis.      |
| F Fibro-vas. bundle. | S Strength cells. |

the Coniferae in this line. It was with this same end in view that the study of the generæ *Abies* and *Picea* was taken up. The object here, as in the case of the *Pinus*, was to work out the characteristic features of the species of the two generæ and find their determinative value.

The material used was obtained of C. S. Sargent of the Arnold Ar-

boretum, and comprised only truly American species. The collection consisted of six species of *Abies* and five of *Picea*, all of the United States.

In preparing the leaves for study, transverse sections were made through the center of the leaf so as to avoid the danger of getting sections without the characteristic number of ducts or fibro-vascular bundles. Al-



ABIES GRANDIS.

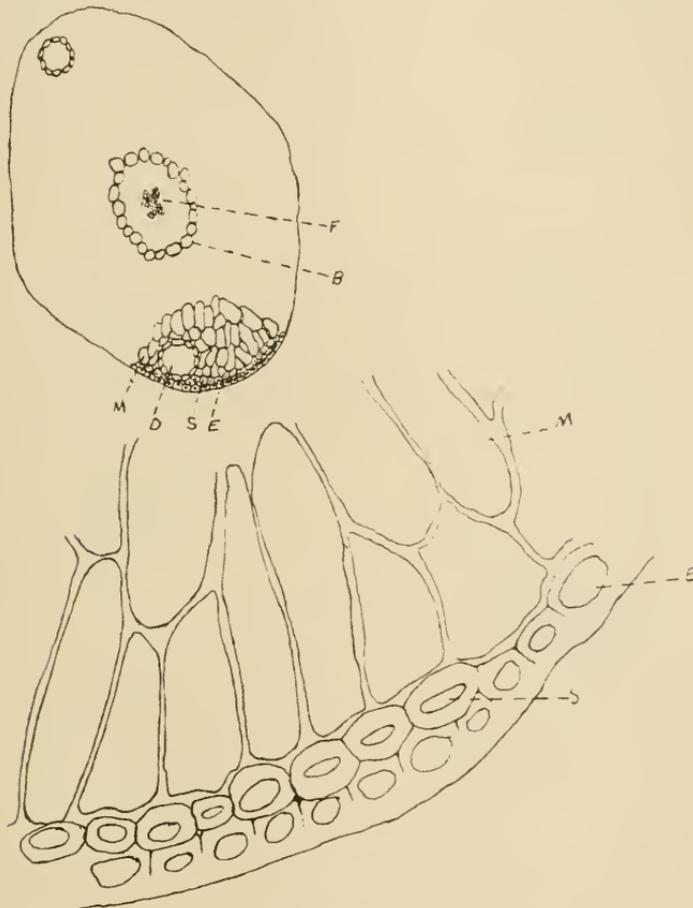
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|----------------------|--------------------|
| D Ducts.             | M Mesophyll.       |
| B Bundle sheath.     | E Epidermis.       |
| F Fibro-vas. bundle. | S Strength. cells. |

together, between five and six hundred specimens were studied. In this determination only features represented in these transverse sections were used.

In the genus *Abies* the leaf structure is essentially the same as that of the genus *Pinus*. The leaf, as a whole, is divided into three parts, the

*cortical*, or outer part, the *mesophyll*, or chlorophyll-bearing part, and the *fibro-vascular* region surrounded by its bundle sheath.

The *cortical* region is composed of an epidermis and a series of strengthening cells lying directly beneath. The epidermis is composed of

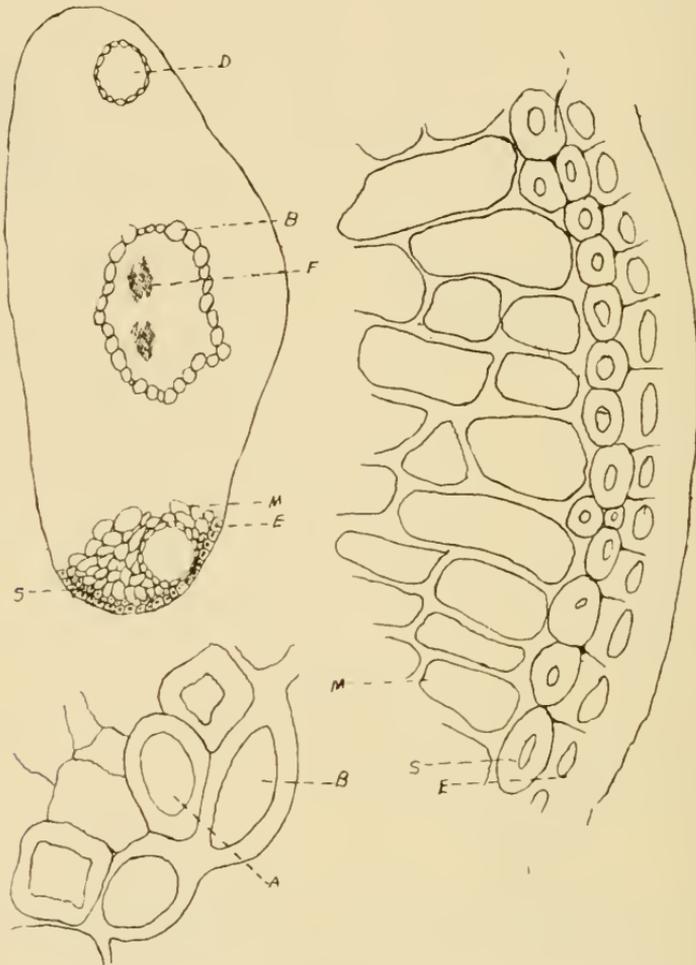


ABIES MAGNIFICA.

- |                      |                    |
|----------------------|--------------------|
| D Ducts.             | M Mesophyll.       |
| F Fibro-vas. bundle. | E Epidermis.       |
| B Bundle sheath.     | S Strength. cells. |

a single layer of thick-walled cells with a cuticle twice as thick as the lumen of the cell. This epidermis is broken by the openings of the stomata. These stomata are arranged in rows down the sides of the leaf

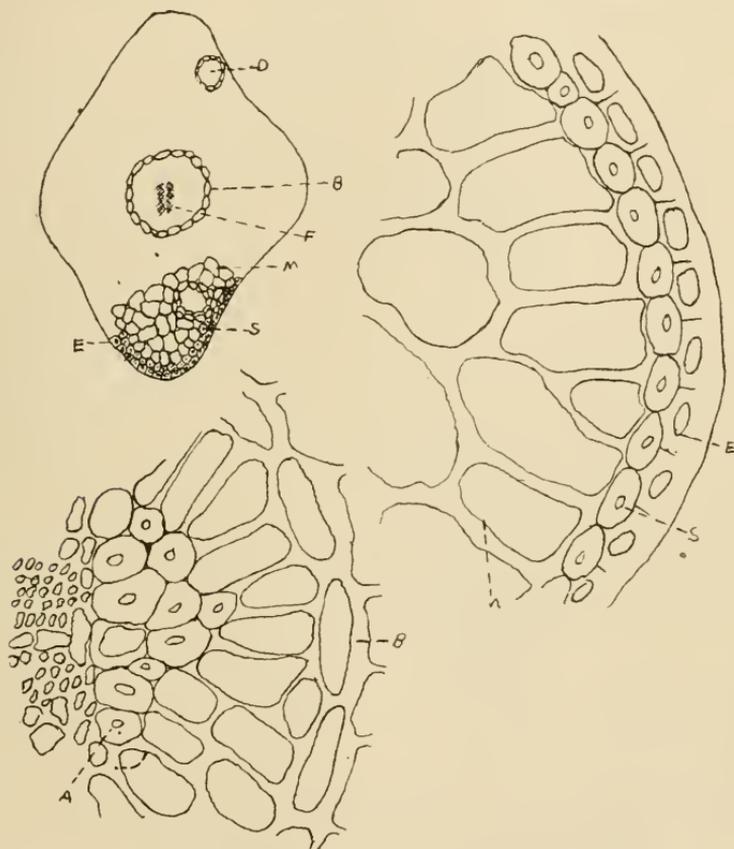
in the hollows between the angles. The strengthening cells are all thick walled and without content. For convenience these cells will be referred to as thin and thick walled but the terms are mere relative ones. The term strengthening cell, as here used, refers to these thick-walled cells wherever found.



ABIES CONCOLOR.

- |                                  |                    |
|----------------------------------|--------------------|
| D Ducts.                         | M Mesophyll.       |
| B Bundle sheath.                 | E Epidermis.       |
| F Fibro-vas. bundles.            | S Strength. cells. |
| A Strength. cells within sheath. |                    |

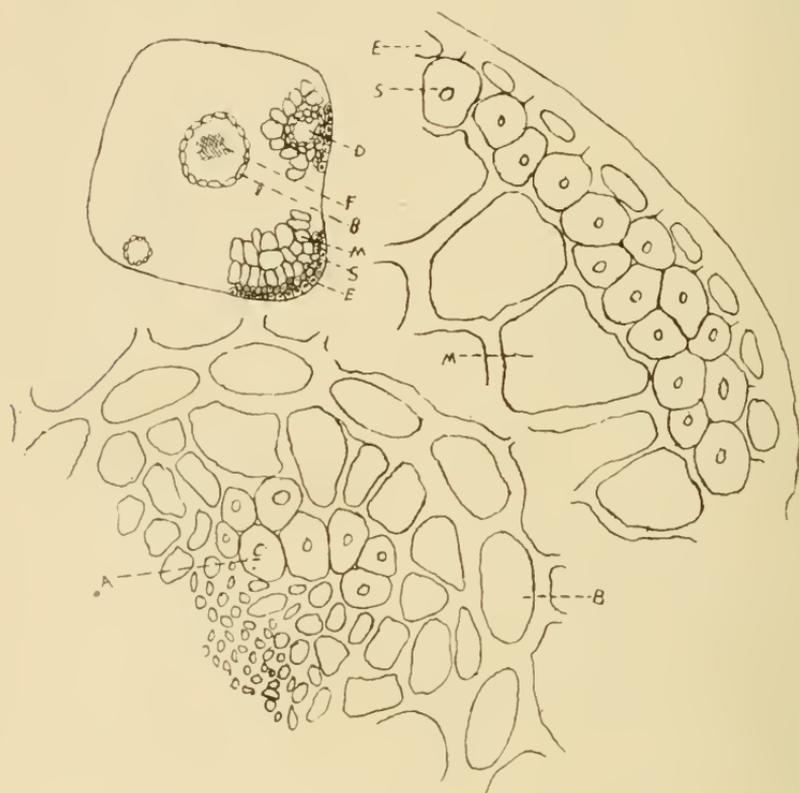
The *mesophyll* region is composed of chlorophyll-bearing, parenchyma cells. These cells differ from the corresponding ones of the pine, in that they do not show that characteristic infolding of the cell wall. The cell walls are smooth, more like the parenchyma of an ordinary leaf. It is within this region that the resin ducts occur. These ducts may be either *peripheral* when they lie directly under the epidermis, or *medial* when they lie entirely surrounded by the parenchyma. These lie parallel to the longer axis of the leaf and are surrounded by a series of strengthening cells. Lining the inside of the duct is a single layer of secretory cells.



PICEA MARIANA.

- |                                  |                    |
|----------------------------------|--------------------|
| D Ducts.                         | M Mesophyll.       |
| B Bundle sheath.                 | S Strength. cells. |
| F Fibro-vas. bundles.            | E Epidermis.       |
| A Strength. cells within sheath. |                    |

The *fibro-vascular* region lies in the center of the leaf and is surrounded by a somewhat imperfect bundle sheath. The sheath is composed of large and small cells intermingled. In the center lie the fibro-vascular bundles, which are two in number, with the exception of *Abies magnifica*, where the two seem to have merged into one. Strengthening cells sometimes appear within the bundle sheath and seem to be a constant feature in the species in which they occur.



PICEA RUBRA.

- |                                  |                  |
|----------------------------------|------------------|
| D Ducts.                         | E Epidermis.     |
| S Strength. cells.               | M Mesophyll.     |
| F Fibro-vas. bundle.             | B Bundle sheath. |
| A Strength. cells within sheath. |                  |

From the characteristics above mentioned the following synoptical arrangement of the genus has been arranged.

\*Ducts medial.

†Strengthening cells absent or few in number.

1. *Abies balsamea* (L.) Mill. Strengthening cells few in number or entirely absent, thin walled.

††Strengthening cells always present in considerable numbers.

2. *Abies Frascri* (Pursh.) Lindl. Strengthening cells in a continuous layer within the epidermis, sometimes doubling at the angles, especially the dorsal angles. Cells thin walled.

3. *Abies subalpina*, Engelmann. Strengthening cells mostly in the angles; in a single layer in the lateral angles and a double or triple row in dorsal angle, also occurring in groups between the angles.

\*\*Ducts peripheral.

†Strengthening cells few in number, occurring singly or in groups.

4. *Abies grandis*, Lindley. Strengthening cells occurring singly or in groups of from two to five, thick walled, sometimes occur within bundle sheath.

††Strengthening cells abundant in angles of the leaf in single or double rows.

5. *Abies magnifica*, Murray. Strengthening cells thick walled. The two vascular bundles merged into one.

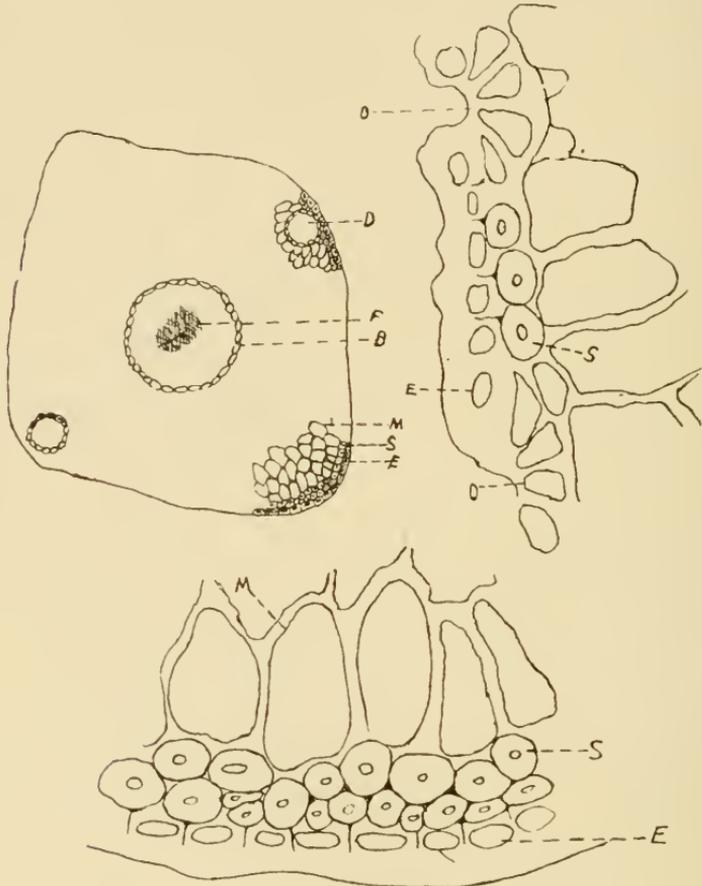
6. *Abies concolor*, Lindley and Gordon. Strengthening cells very thick walled, some present within the bundle sheath.

The structure of the leaf of the *Picea* is about the same as that of the *Abies*. The leaf, however, is of a different shape. In the cross section the *Abies* show a lateral axis very much longer than the dorsi-ventral axis. In the *Picea* the two axes are about equal. There are also other characteristic differences. The leaf, as in the *Abies*, is divided into *cortical*, *mesophyll* and *fibro-vascular* regions.

The *cortical* region. The epidermis is composed of thick-walled cells as in the *Abies*. The strengthening cells are arranged about the entire leaf, and like the epidermis, this layer is interrupted only by the stomata. The stomata here are also arranged in rows along the side of the leaf. Between the openings of the stomata the strengthening cells are much thinner walled than in the remainder of the leaf.

The *mesophyll* region is composed of wavy-margined, chlorophyll-bearing

ing. parenchyma cells. This region also contains the ducts, which vary from none to two in number. It appears as if the number of ducts should be two, if the leaf be bi-laterally symmetrical. However, in *Picea Canadensis* never more than one duct was found in a single leaf. Dissatisfied



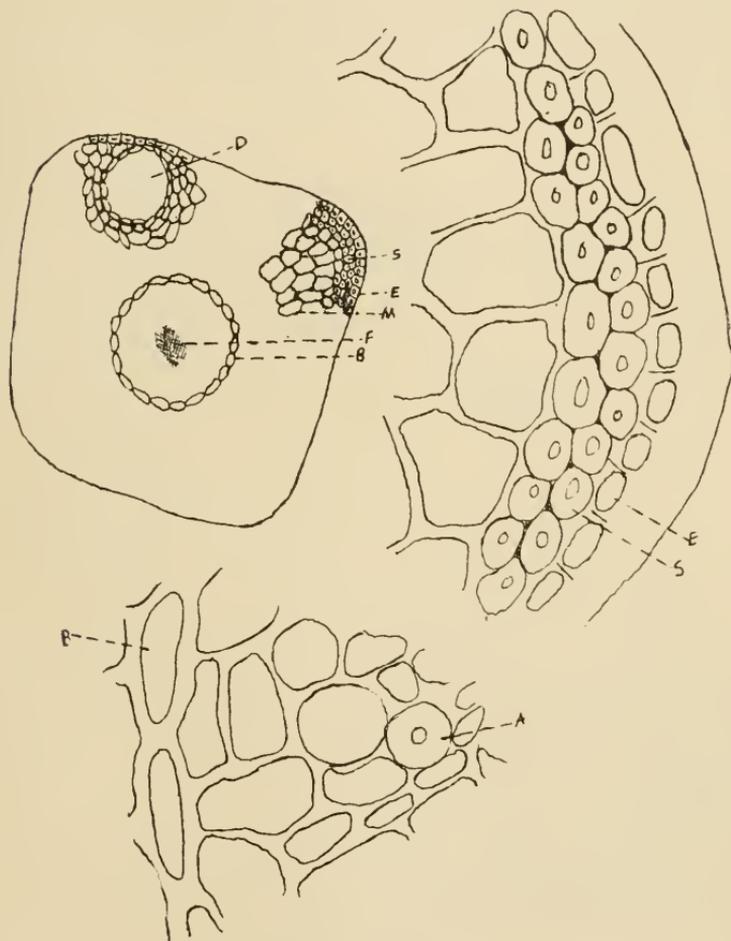
*PICEA PUNGENS.*

- |                      |                  |
|----------------------|------------------|
| D Ducts.             | E Epidermis.     |
| S Strength. cells.   | M Mesophyll.     |
| F Fibro-vas. bundle. | B Bundle sheath. |
| O Stomata.           |                  |

with this variation of the number of ducts, sections were made through the entire leaf. From these sections it was found that the duct did not extend the entire length of the leaf, but was somewhat spindle-shaped,

with the widest part in the center of the leaf and then gradually tapering to either end. This accounts, then, for the variation of the number of ducts. The ducts are all peripheral and are surrounded by a single layer of strengthening cells and lined by a layer of secretory cells.

The *fibro-vascular* region lies in the center of the leaf and is surrounded



PICRA ENGELMANNI.

- |                                |                  |
|--------------------------------|------------------|
| D Ducts.                       | E Epidermis.     |
| S Strength. cells.             | M Mesophyll.     |
| F Fibro-vas. bundle.           | B Bundle sheath. |
| A Strength cell within sheath. |                  |

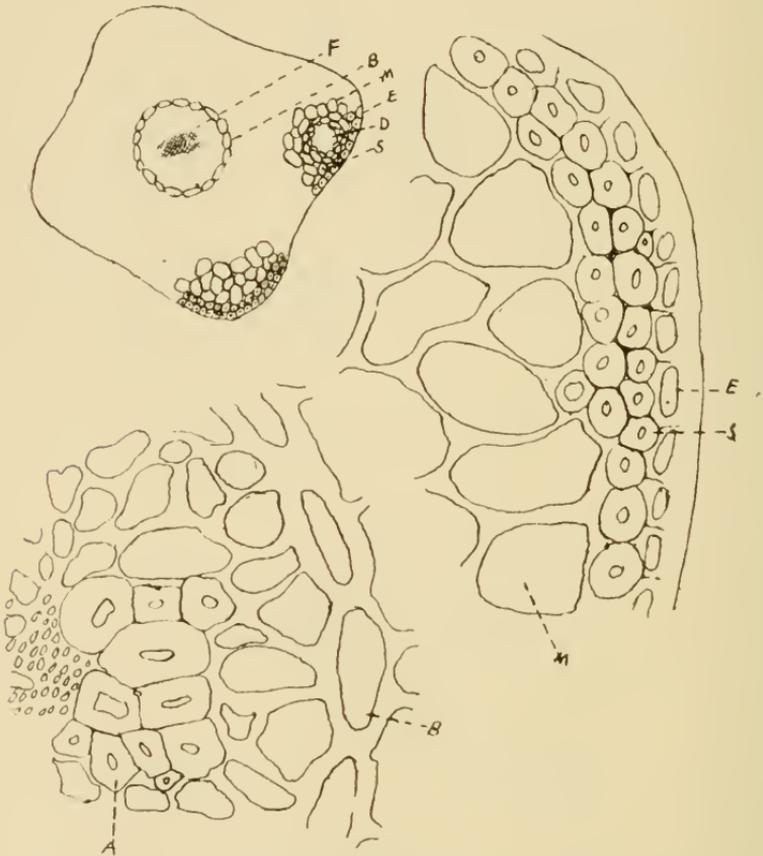
by a very regular bundle sheath. In all five species only one *fibro-vascular* bundle is present. Strengthening cells may or may not be present in this region, but when present are good determinative features.

From the data secured from the study of the *Picea*, the following arrangement has been made:

\*Ducts always *two*.

†Lateral axis much longer than dorsi-ventral axis.

1. *Picea Mariana* (Mill.) B. S. P. Strengthening cells in a single row, very thick walled, some occur within bundle sheath.



PICEA CANADENSIS (Alba).

D Ducts.

S Strength. cells.

F Fibro-vas. bundle.

A Strength. cells within sheath.

M Mesophyll.

E Epidermis.

B Bundle sheath.

†Lateral axis and dorsi-ventral axis about equal.

2. *Picea rubra* (Lamb.) Link. Strengthening cells very thick walled, occurring in a single row, sometimes doubled or tripled at the angles. Some strengthening cells occur within the sheath.

\*\*Ducts none to two.

3. *Picea pungens* Engelmann. Strengthening cells thick walled, some thick-walled cells occurring singly or in groups between the stomata, with tendency to double row at the angles.

4. *Picea Engelmanni* Engelmann. Strengthening cells in a single row, sometimes doubled at the angles; thick walled. A single cell sometimes occurs within the bundle sheath.

\*\*\*Ducts none to one.

5. *Picea Canadensis* (Will.) B. S. P. (=Picea alba Link.). Strengthening cells in a single row sometimes doubled at the angles; very thick walled; some occur within bundle sheath.

Although the above synoptical arrangements appear to be conclusive within themselves they are valuable only in conjunction with the external features.

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## A PROTEOLYTIC ENZYME OF YEAST.

BY KATHERINE E. GOLDEN.

### INTRODUCTION.

The enzymes are auxiliary substances which are formed where solid bodies are to be liquefied. They are peculiar in that they decompose complex substances without being affected themselves in any way by the action, and also that even in minute quantities they can produce very marked results. They are important in animal and plant metabolism and occur both in the cells and in solution in secretions of the cells. In the case of unicellular organisms, the metabolic processes are carried on throughout their entire substance, the food substance being absorbed into the cell, where the enzyme is formed and does its work. This, however, is not always the case, the enzyme sometimes being excreted, the work of absorption following its action. This latter process is peculiar to multicellular organisms, having certain parts differentiated for special work,