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THESIS

A Careful Comparison Of The
Three Native Pines of Michigan

W. R. Kedzie

1899

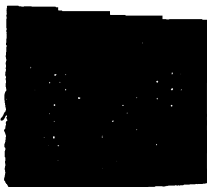
THESIS

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A CAREFUL COMPARISON
Of The Three Native Pines of Michigan.

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W. R. Kedzie
THESIS BY W. R. KEDZIE.

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MICHIGAN
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1899.

THESIS

The following Thesis, which is presented for the degree of Bachelor of Science, is designed to be a rather critical comparison of the three members of the genus Pinus (which comprises all the pines) which are indigenous to Michigan.

The three pines are:

- I. Pinus Strobus L., commonly called White Pine or Weymouth Pine.
- II. Pinus resinosa Ait., commonly called Red Pine, Canadian Pine, or Norway Pine.
- III. Pinus divaricata (Ait.) Sudw., commonly called Labrador Pine, Gray Pine, or Jack Pine. Synonyms:-
Pinus sylvestris var. divaricata Ait.
Pinus Banksiana Lamb.
Pinus divaricata Sudw.

The genus Pinus belongs to the sub-kingdom known as Spermatophyta or seed-bearing plants; the class Gymnospermae or seed-bearing plants in which the seeds are not contained in an enclosed ovary, but lie exposed upon an open scale or leaf; to the family Coniferae, being the only one under the class Gymnospermae; to the family Pinaceae "Fertile flowers in scaly aments becoming cones or berry-like, Ovules 2 or more at the base of each scale" (Gray), and to the tribe Abietinae or the Pine family proper.

This classification may best be shown thus:

Subkingdom Spermatophyta #
 Class Gymnospermae
 Family Coniferae
 Family Pinaceae
 Tribe Abietineae
 Genus Pinus.

Before beginning the comparison of the three species, it may be well to give their botanical characteristics, that we may become partly familiar with the subjects with which we have to deal. As there were no native trees--nor even trees growing in anything like natural conditions within my reach, it would be out of the question for me to attempt a botanical description, for I would have nothing but previous descriptions to build upon. Under the circumstances I can do no better than to quote some parts of the descriptions of Dr. Gray.

Pinus Strobus. "Leaves very slender, glaucous; sterile flowers oval, fertile catkins long-stalked, cylindrical; cones narrow, cylindrical, nodding, often curved; seed smooth; cotyledons 8-10."

Pinus divaricata. "Leaves short, oblique, divergent; cones conical, oblong, usually curved, smooth, the scales pointless."

Pinus resinosa. "Leaves in twos from long sheaths, elongated, dark green; cones ovate-conical, smooth, their scales slightly thickened, pointless; sterile flowers oblong-linear, subtended by about 6 involucreal scales which are early deciduous by an articulation above the base."

C R I T I C A L C O M P A R I S O N .

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The Tree.

SIZE (in Feet)

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Height	Maximum	Average.
Pinus Strobus	250	100-120.
Pinus resinosa	150	70-80
Pinus divaricata	100	20-30

Diameter

Pinus Strobus	10-1/2	3-4
Pinus resinosa	5	2-3
Pinus divaricata	3-1/2	1-2

Appearance.

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The Jack Pine (*Pinus divaricata*) is a low irregular shaped tree with straggling branches and gnarled trunk. It possesses a decidedly unkept appearance in consequence of its irregularity. The White Pine (*Pinus Strobus*) and Red Pine (*Pinus resinosa*) are both of erect habit, towering in the original forest far above their fellows with ~~x~~ spreading limbs forming an open top, but with the trunk practically free from branches. When growing in the open, however, the trunks are often covered entirely with graceful limbs, making a most desirable tree for ornamental purposes.

No. II.) The Jack pine is of no use for ornamental purposes unless the effect desired is that of wildness.

The common name of *Pinus divaricata* or "Scrub"

comes, I presume, from the scrubby habit of the tree; that of *Pinus Strobus*, or "White", from the peculiar whiteness of the wood; and that of *Pinus resinosa* or "Red" from the red color shown by the staminate catkins when in flower.

Bark.

The bark of the White pine when young is smooth, but as it becomes older, on the trunk especially, it is divided by shallow fissures, but does not become deeply furrowed till two feet or more in diameter. The Red pine never has bark as smooth as that of white, even when young, and as it becomes older it scales or flakes off and thus becomes particularly rough. The bark of the Jack pine is between that of the White and Red, never getting as smooth as the White, and ordinarily not as rough as the Red. The Red and Jack have bark of a reddish or brownish color, while that of the White varies from dark green to almost black.

Wood.

The wood of White pine is almost white, compact and rather soft, but exceedingly valuable for interior furnishing, where an easily worked yet strong and durable wood is desired. In Plate IV. figure B. is shown a tangential section, in figure E. a transverse section, and in figure H. a radial section. White pine weighs 24 pounds per cubic foot.

The wood of Red pine is light red or yellowish red not strong and slightly resinous. A cubic foot will weigh 6 pounds more than one of the White. It is valuable for lumber although it does not approach the value of the White

pine. In Plate IV., figure C. is shown a tangential section, figure F. a transverse section and figure I. a radial section.

The Jack pine is of no practical value as lumber because it rarely grows either large enough or straight enough to pay for the cutting. The wood is soft, weak and of a brownish color. A cubic foot will weigh 3 pounds more than the White. Its only practical value is for fire wood and even there, pine is never to be recommended where hard wood can be obtained, except for kindling. The tough little Jack pine is however of great value in protecting the weaker trees of red pine until they are large enough to care for themselves.

As will be seen in a comparison of the drawings on Plate IV., the cells of White pine are smaller in all particulars than either the other two. And the Red pine smaller than the Jack. The size of the bordered pits follows the same progression in regard to size. The only essential difference, aside from the size of the bordered pits and cells, is in the medullary rays, the cells of which in the Jack pine are large while in the other two they are much smaller. They are largest in the middle of the ray and taper toward the edges, making a cross section of the ray appear somewhat elliptical. (Plate IV., figure A.) In the White pine the cells are much smaller but the ray retains the elliptical cross section although not so marked as in the Jack. (Plate IV figure B.) The Red pine has little or none of the elliptical shape in the medullary ray, the cells being more nearly all

of a size and regular in shape. (Plate IV. figure C.) The shape of the cells in the cross section of the medullary rays also varies, the Jack pine having cells almost round, the White varying from round to elliptical and the Red quite a regular elliptical section.

Leaves.

ARRANGEMENT

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The leaves of the White pine are arranged in whorls of five upon a very short stem. (Plate I. figure F.a) The Red (Plate I. figure G.a) and Jack (Plate I. figure C.a) are both in whorls of two. The stem upon which the leaves are borne, however, is much longer in the Jack than the White, and in the White than in the Red.

LENGTH

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In determining the length of the leaves I selected specimens not only from trees growing on the college grounds but also from the college herbarium specimens, so the lengths given here are carefully obtained averages from many specimens years and localities.

Average Length in Centimeters.

<i>Pinus Strobus</i>	8.4
<i>Pinus resinosa</i>	12.8
<i>Pinus divaricata</i>	3.2

In the selection of these measurements I was careful to obtain as near typical leaves as possible.

SHAPE

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The White pine leaves being arranged in a whorl of five

must necessarily take on more or less of the triangular form, and in fact they are ordinarily supposed to be in that shape (as Plate I. figure Q). I have found no record of anything to the contrary, but careful work brought out a very unexpected discovery. Complete whorls of White pine leaves were tied with threads and carefully imbedded cross sections, instead of showing five perfect triangles, I found the leaves to be shaped as in Plate I. figure Q. The two leaves (1 and 2) are shaped much like two quarters of a pie. The axis of the plant is between the two upper corners of the leaves. Next from the two leaves at the axis comes a pair of leaves (3 and 4) which, instead of being essentially triangular, have four sides as is shown in the drawing. Leaf 5 which is the odd one is situated at the opposite side of the whorl from the axis and is much more broadly triangular. Thus in order to get the essential symmetry it is possible to imagine the whorl cut in the right way; that is through the axis, only as opposed to the erroneous idea all the leaves are alike. The leaves are rather coarsely serrate as is shown in V. The bract from which the whorl rises is quite well defined (Figure F.g) The mature leaves have no scales at their bases. The size and shape of the buds shown in B. their cross section in D.

The leaves of the Red pine are more or less semi-circular in shape as shown in R and R'. They are arranged in whorls of two with their edges toward the axis thus carrying

out the symmetry. They are enclosed at the base with the leaf scales (C.C). The bract from which the leaves rise is less prominent than in the White pine. The branches usually terminate in a single bud, although not always, differing here much from the White pine. The size and shape of the bud shown at H. its cross section at I. The serrations are shown at X.

The leaves of the Jack pine are in whorls of two like those of the Red, but are a great deal shorter than the Red. While essentially semi-circular in shape they are much thinner than the Red, and instead of the surface toward the other leaf being flat as in the case of the Red pine, it is slightly convex. To the base of the mature leaf are attached the remains of the leaf scales. The bract at their base has lost much of its prominence and is rather delicate and the leaves have some little stem of their own. The serrations are shown at W. The buds are shown at B. and their cross section at A. Their number is a medium between the Red and White. The buds A.B.; D.F.; and H.I.; are drawn natural size to show the relative size and shape. The relative size of the leaves in length is shown at C.G. and F. which are drawn natural size. The relative size of cross section is shown at Q', P' and R' all enlarged about five times.

Measurements of Buds:

Red 8 Millimeters wide at widest place.

"	15	"	"	long	"	Longest	"
White	3	"	"	wide	"	widest	"
"	10	"	"	long	"	longest	"
Jack	2	"	"	wide	"	widest	"
"	8	"	"	long	"	longest	"

S T O M A T A S.

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The stomata in the pine leaves are arranged in rows running the longest way of the leaf and each one in the bottom of a little pit. These rows of pits are shown for Jack pine in Plate I figure S., White in figure T. and Red in figure U. In each case a is the pit, b the surrounding cells and c the epidermal cells. These openings for the Jack pine are longer and more nearly circular, for the Red smaller and more nearly square and for the White more oblong and considerable smaller, when the epidermis is cut off it exposes the stoma which are very much alike except in the matter of size, the White (T') being smallest. Jack (S') next and Red (U') largest. The stomata in cross section are shown at M., Jack pine, N White pine and O Red Pine. In each case a is the pit, b the intercellular space, c the epidermis, e the guard cells and f the parenchyma. The Jack pine has 13 rows of stomata on the inner surface of the leaves while the Red has only 6. The White has 4 rows on each of the inner surfaces.

R E S I N D U C T S.

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The arrangement of the resin ducts is peculiar to each species. The Jack always has two ducts in each leaf, each duct situated near but not at the angle of the leaf, and surrounded on all sides by the parenchyma (Plate I, figure P, b, b) The duct, more enlarged, is shown at J., a being the duct, b

the surrounding cells and c, the parenchyma.

The ducts of the Red pine vary from 2-4 in each leaf usually however there are 3, two always on the inner surface and one or two on the opposite side of the leaf (R., b.b.b.). At L. the duct is shown more enlarged. a, the duct, b, and c, the surrounding cells, d, the parenchyma and e, the epidermis. At c, in U. is shown the epidermis with the duct just below it

Each leaf of the White pine has two ducts just below the epidermis (F" b.) on the outside, and some little way from the angle of the leaf. (Q. b.b.b. etc.). But the two odd leaves of the wood (Q. 3 and 4) each have an extra duct (C) situated almost in the angle toward the centre and toward the axis, but may be any where along the narrow edge of the leaf or even at the other corner. The duct enlarged is shown at K., a, being the duct, b, the surrounding cells, c, the epidermis and d, the parenchyma.

Fruit.

The fruit of the pines is a cone, "formed of the imbricated carpellary scales each in the axil of a persistent bract" and normally bearing at their bases two seeds, which when ripe and shed take with them a thin membrane from the surface of the scale, and which forms the wing. The cone of White pine is long and narrow (L. Plate IV) that of Red pine shorter and oval (J.) and Jack pine much smaller and curved more or less around the stem. (K.)

The cones of all pines are fertilized one spring and remain in a dormant condition until the next year when they

develops into the mature cones. When mature, the White pine sheds its seeds and drops the cones, at least by the next year, the Red may retain them for two or three years, and the Jack for fifteen or more, sometimes so long that the tree may grow around and nearly cover the cone.

Flowers.

The staminate flowers and pollen of the Red and Jack pine are shown on Plate II. The Red pine being large and coarse while the Jack is more delicate. I have ^{NOT} succeeded in obtaining the staminate flowers of the White pine in fresh conditions.

Seeds.

The seeds of White pine I found rather rare only finding a few mature seeds among many cones, a mature White pine seed is shown at F. 1., Plate III. and a wing with an immature seed, the way most commonly found at 2 in the same drawing. The seed is oval and pointed at the lower end.

A Red pine seed and wing are shown at 1. and 2. The seed is shorter, much broader and has an indentation more or less marked upon its side which is characteristic.

At D., and 2. is shown the seed and wing of Jack pine which is the smallest of them all. The seed is rather triangular, instead of oval. The wing is more nearly oval than that of the Red, but has much the same shape, although smaller.

Seedlings.

On Plate III. at a is shown three stages of the seedling of the Jack pine, 1, as it is just coming out of the ground, 2 when out and straightened up and 3 when it has thrown off the seed coat and exposes the five cotyledons, at B. is shown the same drawing for the Red pine, which in this case had six cotyledons. At c, is shown two drawings of the White pine having 9 cotyledons.

The cones of the Jack pine as previously stated, often stay on the trees for many years unopened. This is a protection of nature against forest fires. When a forest of Jack pines is burned the heat is often just intense enough to cause the old cones to open and seed their seed by the time it is by so each fire simply sows a crop of new pines, and as the Jack pine will fruit when only a few feet high, it may be seen that this pine is almost "fire proof". The young pines, too, serve as a protection to the more rapidly growing and valuable Red pine and is in this way perhaps of most value.

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While the pines, at one time were one of Michigan's most valuable products like many others, is almost or soon will be exhausted, the general sentiment now arising against total extinction will one day find fruit in the

partial re-establishment of Michigan's beautiful forests, especially in the almost barren plains of the north, fit only for the growing of pine trees.

I wish to acknowledge the valuable suggestions given me by Dr. Beal as I conducted the work of research for this thesis, and also the reference to the following books.

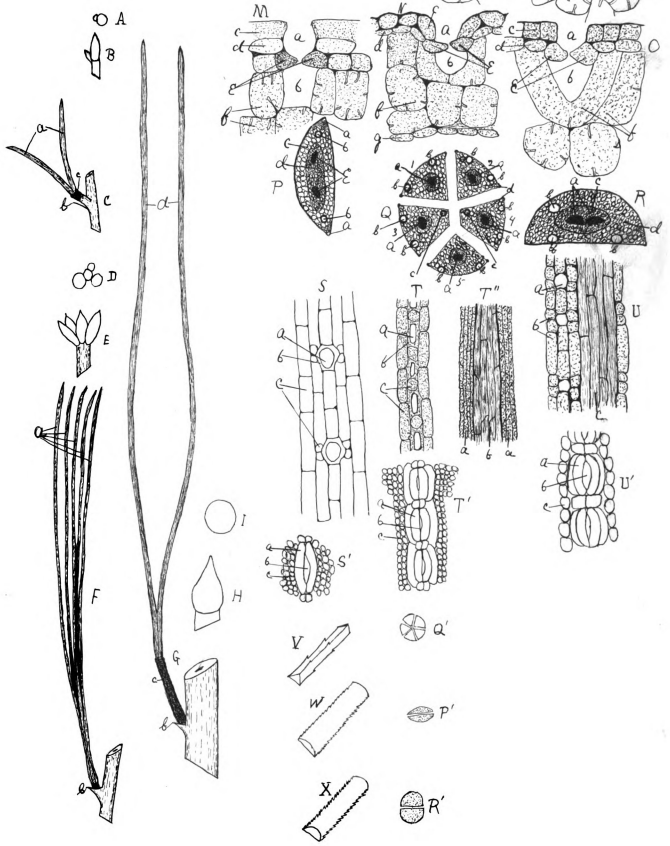
Sargent's Silva of North America,

Gray's Manual of Botany,

Britton and Brown's Illustrated Flora,

and slight reference to some other works.

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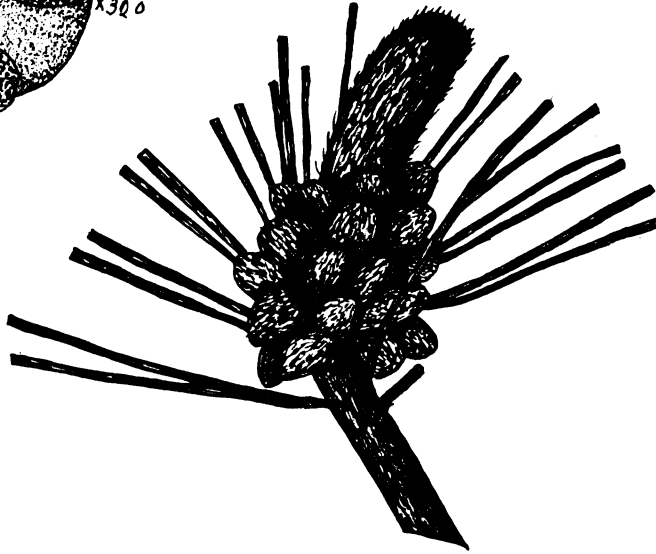
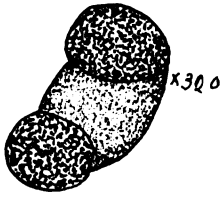
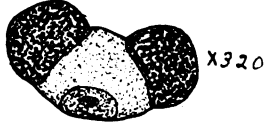
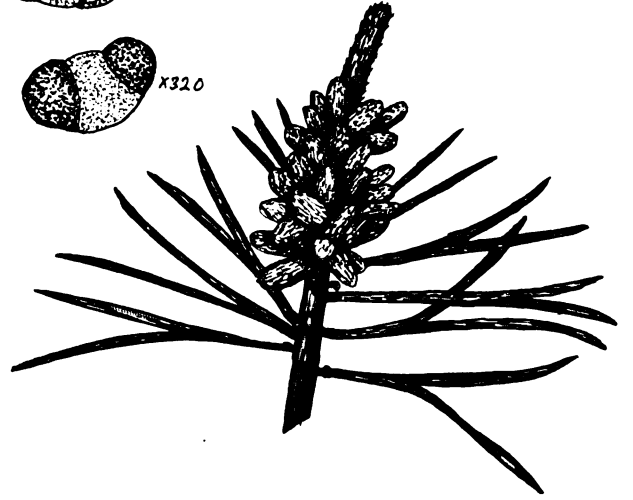
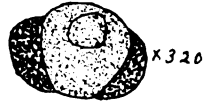
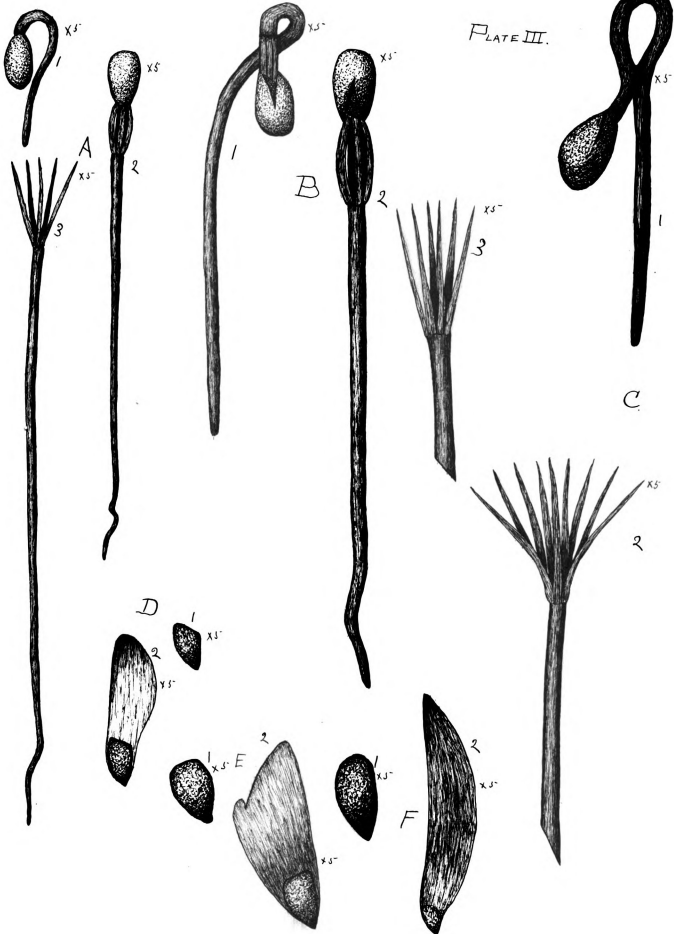
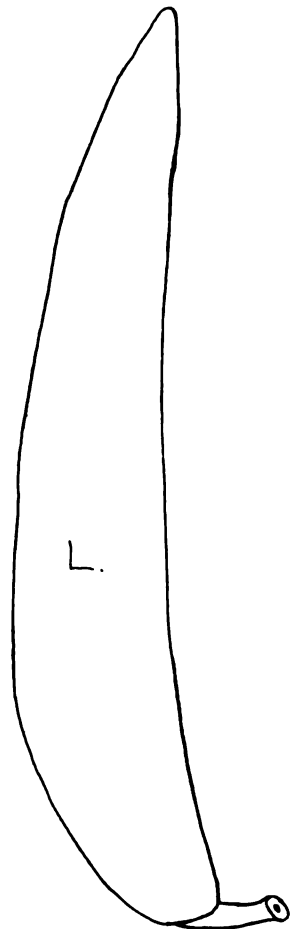
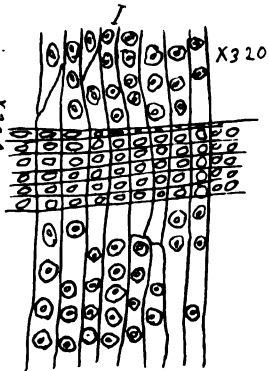
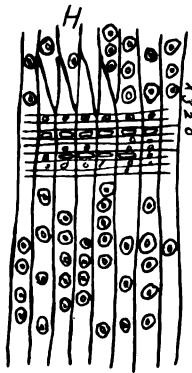
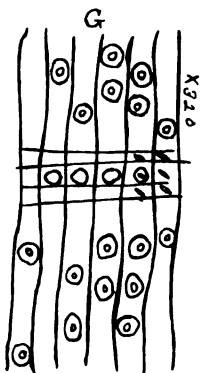
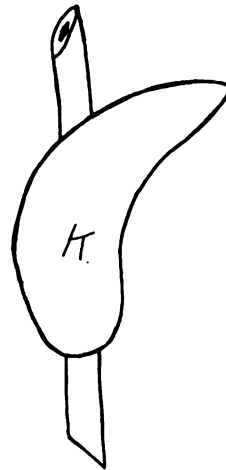
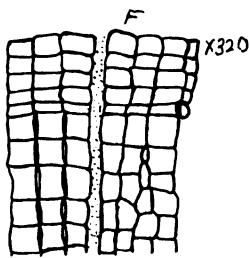
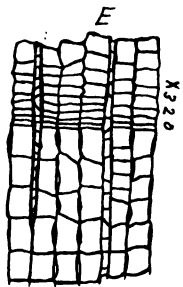
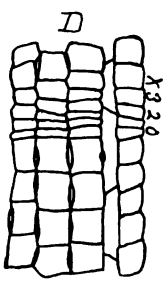
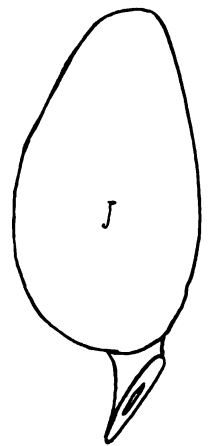
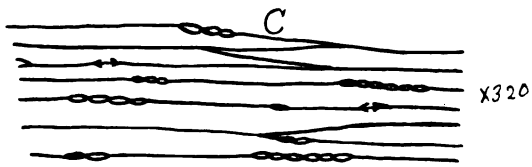
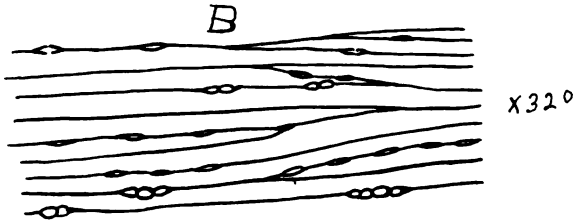
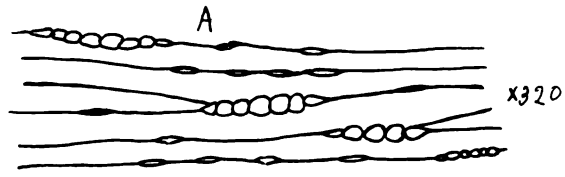


PLATE III.







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