

Hemitrichia clavata Rost.
Hemitrichia intorta Lister.
Hemitrichia Karstenii Lister.
Hemitrichia stipata Mass.

Order II. *Arcyriaceae*.

37. *Arcyria pucinea* Pers.
Arcyria stipata List.
Arcyria digitata McBr.
Arcyria albida Pers.
Arcyria incarnata Pers.
Arcyria nutans (Bull.) Grev.
Arcyria ferruginea Sant.
Arcyria flava Pers.
Arcyria insignis Kalchbr. and Cooke.
39. *Perichaena variabilis* Rost.
Perichaena chrysosperma List.

Order III. *Margaritaceae*.

41. *Dianema depressum* List.

Order IV. *Lycogalaceae*.

43. *Lycogala miniatum* Pers.
Lycogala exigium Morg.
Lycogala flavo fuscum Rost.

A STUDY OF THE HISTOLOGY OF THE WOOD OF CERTAIN SPECIES OF PINES.

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The conifers grow in thickness similarly to the dicotyledons, but their wood differs very considerably, particularly the secondary wood, in which wood vessels are entirely absent. In the first-year wood a few vessels are developed close to the pith, but the after-growth is composed entirely of tracheides. The tracheides are fibre-like elements with peculiar bordered pits, and are very similar in their appearance in the different species, and yet the wood, taken as a whole, differs very materially, varying from the very soft, light wood of the white pine to the hard, dense wood of the long-leaf pine.

In order to determine, if possible, what peculiarity of structure produced such variations in the wood, since the wood itself is formed entirely of similar elements, and there is not the chance for variations in structure that appear in the dicotyledonous wood, certain species of the pines were examined microscopically, by means of sections and by maceration of the wood, by the latter method separating the elements. Thirteen species were examined. The wood varied in age from seven years in *Pinus glabra* to over fifty years in *Pinus elliottii*. In order to compare



Pine Tracheides. X 145.

the elements in the different species, and also the spring and summer wood of the same species, camera lucida drawings were made of the tracheides. These were then measured, so as to determine the actual length, width, and the thickness of the walls of the spring and the summer woods.

The tables give the results of the measurements, the characteristics of the woods as obtained from sections studied with the microscope, and also the properties of the wood in bulk.

NAME.	LENGTH IN MM.		WIDTH IN μ .		RATIO BETWEEN LENGTH AND WIDTH.		THICKNESS OF WALLS IN μ .		RATIO BETWEEN WIDTH AND THICKNESS.	
	Spring.	Summer.	Spring.	Summer.	Spring.	Summer.	Spring.	Summer.	Spring.	Summer.
<i>Pinus strobus</i>	3,7000	3,6000	47.97	21.21	77.11	169.73	5.42	6.81	8.85	3.31
<i>Pinus monticola</i>	4,3330	4,9333	42.95	34.09	100.88	144.71	4.73	8.14	9.08	4.18
<i>Pinus flexilis</i>	2,7333	2,9250	34.09	15.90	80.17	183.96	5.68	6.25	6.00	2.54
<i>Pinus resinosa</i>	2,0250	2,0500	44.69	27.27	45.31	75.17	4.16	6.81	10.74	4.00
<i>Pinus torreyana</i>	3,5333	3,1333	41.66	32.57	84.81	96.20	7.19	11.55	5.78	2.81
<i>Pinus ponderosa</i>	3,2833	3,0222	48.48	35.22	67.72	85.80	3.78	10.03	12.82	3.51
<i>Pinus ponderosa scopulorum</i> .	3,2880	3,0000	25.37	18.18	129.60	164.40	2.46	3.97	10.31	4.57
<i>Pinus contorta</i>	2,9666	3,0333	49.62	35.60	59.78	85.20	4.92	9.46	10.08	3.85
<i>Pinus tedda</i>	6,4444	6,7250	56.06	33.33	114.95	201.77	4.54	10.60	12.35	3.14
<i>Pinus rigida</i>	2,4000	3,0583	42.80	32.95	56.07	92.81	3.03	9.46	14.12	3.48
<i>Pinus glabra</i>	2,2222	2,6055	46.96	26.13	47.32	99.71	4.54	9.84	10.34	2.65
<i>Pinus palustris</i>	4,4555	4,8533	43.56	40.90	102.28	118.66	6.43	13.63	6.77	3.00
<i>Pinus elliptii</i>	5,2590	4,9440	59.09	43.16	89.00	114.55	8.71	16.09	6.78	2.68

NAME.	Spring Wood.	Summer Wood.	Tyloses.	Resin Ducts.	Medullary Rays.
<i>Pinus strobus</i>	Nearly all	Thin ring, indistinct		Single, promiscuous	1 row of cells, obscure.
<i>Pinus monticola</i>	Nearly all	Thin ring, indistinct	Present ..	Single, pairs, promiscuous	1 row of cells, widens, then narrows, obscure.
<i>Pinus flexilis</i>	Large amount ..	Small amount, distinct ..	Present ..	Single, pairs, promiscuous	1 row of cells, rarely more, conspicuous.
<i>Pinus resinosa</i>	About $\frac{2}{3}$	About $\frac{1}{3}$, indistinct	Present ..	Single, promiscuous	1 row of cells, rarely 2 or 3, obscure.
<i>Pinus torreyana</i>	About $\frac{1}{2}$	About $\frac{1}{4}$, distinct	Present ..	Single, promiscuous	1 row of cells, rarely more, obscure.
<i>Pinus ponderosa</i>	Nearly all	Thin ring, indistinct		Single, pairs, in summer wood	1 row of cells, obscure.
<i>Pinus ponderosa scopulorum</i> ..	About $\frac{1}{4}$	About $\frac{3}{4}$, not dense		Single, pairs, in summer wood	1 row of cells, obscure.
<i>Pinus contorta</i>	About $\frac{2}{3}$	About $\frac{1}{3}$, distinct	Present ..	Single, pairs, promiscuous	1 row of cells, obscure.
<i>Pinus taeda</i>	About $\frac{1}{2}$	About $\frac{1}{3}$, distinct		Single, promiscuous	1 row of cells, rarely more, obscure.
<i>Pinus rigida</i>	About $\frac{3}{4}$	About $\frac{1}{4}$, indistinct		Single, in summer wood or close to it	1 row of cells, widen into more, obscure.
<i>Pinus glabra</i>	About $\frac{3}{4}$	About $\frac{1}{3}$, distinct		Single, promiscuous	1 row of cells, widen to 3 or 4, obscure.
<i>Pinus palustris</i>	About $\frac{2}{3}$	About $\frac{1}{3}$, distinct		Single, in summer wood, near spring	1 row of cells, rarely 2, obscure.
<i>Pinus eliottii</i>	About $\frac{1}{3}$	About $\frac{2}{3}$, distinct	Present ..	Single, in spring and early summer	1 row of cells, rarely more, conspicuous.

NAME.	Weight.	Strength.	Density.	Grain.
<i>Pinus strobus</i>	Light	Not strong	Soft	Straight, fine.
<i>Pinus monticola</i>	Light	Not strong	Soft, compact	Straight.
<i>Pinus flexilis</i>	Light	Not strong	Soft, compact	Close.
<i>Pinus resinosa</i>	Light	Moderately strong	Hard, compact	Coarse.
<i>Pinus torreyana</i>	Light	Not strong	Soft, compact	Rather close.
<i>Pinus ponderosa</i>	Heavy	Strong	Hard, compact	Not coarse.
<i>Pinus ponderosa scopulorum</i>	Light	Strong	Hard	Coarse.
<i>Pinus contorta</i>	Light	Not strong	Not hard	Very coarse.
<i>Pinus tedda</i>	Light	Not strong	Soft	Coarse.
<i>Pinus rigida</i>	Light	Not strong	Soft	Very coarse.
<i>Pinus glabra</i>	Light	Very strong	Very hard, compact	Coarse.
<i>Pinus palustris</i>	Heavy	Very strong	Very hard, compact	Coarse.
<i>Pinus elliotii</i>	Heavy	Very strong	Very hard, compact	Coarse.

NAME.	Color.		Quality.
	Heartwood.	Sapwood.	
<i>Pinus strobus</i>	Light brown or red	White	Good quality.
<i>Pinus monticola</i>	Light brown or red	Nearly white	Inferior quality, resembles <i>P. strobus</i> .
<i>Pinus flexilis</i>	Light yellow, red on exposure	Nearly white	Inferior quality.
<i>Pinus resinosa</i>	Yellow	Nearly yellow,	Tough, elastic, does not shrink, warp in seasoning.
<i>Pinus torreyana</i>	Light red	White	Brittle.
<i>Pinus ponderosa</i>	Light red	White	Brittle, not durable, vary considerably.
<i>Pinus ponderosa scopulorum</i>	Light red	White	Brittle, not durable, vary considerably.
<i>Pinus contorta</i>	Brown, reddish	Nearly white	Brittle.
<i>Pinus tedda</i>	Light brown	Orange to white	Brittle, not durable.
<i>Pinus rigida</i>	Reddish	Yellow or white	Rigid, durable.
<i>Pinus glabra</i>	Light brown	Nearly white	Brittle, not durable.
<i>Pinus palustris</i>	Light red or orange	Nearly white	Tough, durable.
<i>Pinus elliotii</i>	Dark orange	Light orange	Tough, durable.

In examining the figures obtained it is seen there are six species in which the spring wood tracheides are longer than those of the summer, while seven species have the summer tracheides the longer. The species in each group show variations in hardness and strength, so that taking the length of the tracheides as a factor by itself nothing can be deduced in regard to the quality of the wood, but taking the length and comparing it with the width of the cells, and again comparing the width and the thickness of walls together, and the amount of the spring and summer wood, the strength can be determined within limits in each species.

For instance, in *P. ponderosa scopulorum* the spring tracheides are 129.6 times as long as they are wide, and the summer tracheides 164.4 times their width, the thickness of their walls is not nearly as great as that of many of the others, but when the thickness is compared with the width of the cells, it is found to be fairly thick, and as about two-thirds of the annual ring is summer wood, we have an explanation of the strength of the wood.

Taking any of these factors alone, it does not mean anything, as the length of the elements may be very considerable, but the width may be also; then, again, the elements may have rather thin walls, if the thickness of the wall alone were considered. But when the size of the cell as a whole is taken into consideration along with the thickness, the proportion of wall may be greater than the figures representing the thickness indicate.

CONTRIBUTIONS TO THE FLORA OF INDIANA.

STANLEY COULTER.

The notes included in this contribution are based, partly, upon a critical study of certain species and partly upon reports and materials submitted by those interested in perfecting our knowledge of the flora of the State. They are presented in the hope that they may prove of interest and value to the botanical workers of the State.

Pinus Strobus L. White Pine.

From Mr. C. F. Very, of New Albany, I have received abundant specimens of the leaves and cones of this species with the following notes. The specimens are from trees planted by the father of Mr. Very some seventy years ago, and one of them is about sixty feet in height, with a