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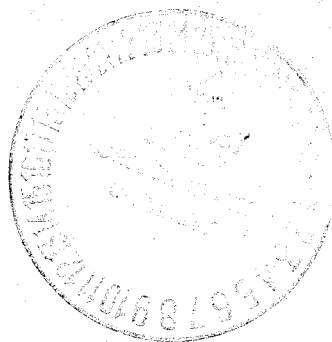
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Bibliography of Wood-Moisture Relationships

by

C. J. Kozlik

April 1960



**Forest Products Research
OREGON FOREST RESEARCH CENTER
Corvallis**

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OREGON FOREST RESEARCH CENTER

Two State programs of research are combined in the Oregon Forest Research Center to improve and expand values from timberlands of the State.

A team of forest scientists is investigating problems in forestry research of growing and protecting the crop, while wood scientists engaged in forest products research endeavor to make the most of the timber produced.

The current report stems from studies of forest products.

Purpose . . .

Fully utilize the resource by:

developing more by-products from mill and logging residues to use the material burned or left in the woods.

expanding markets for forest products through advanced treatments, improved drying, and new designs.

directing the prospective user's attention to available wood and bark supplies, and to species as yet not fully utilized.

creating new jobs and additional dollar returns by suggesting an increased variety of salable products. New products and growing values can offset rising costs.

Further the interests of forestry and forest products industries within the State.

Program . . .

Identify and develop uses for chemicals in wood and bark to provide markets for residues.

Improve pulping of residue materials.

Develop manufacturing techniques to improve products of wood industries.

Extend service life of wood products by improved preserving methods.

Develop and improve methods of seasoning wood to raise quality of wood products.

Create new uses and products for wood.

Evaluate mechanical properties of wood and wood-based materials and structures to increase and improve use of wood.

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INTRODUCTION

Water affects most properties of wood--color, plasticity, strength, durability. Perhaps most apparent, moisture causes shrinking and swelling of wood, and is responsible for costs of seasoning.

This bibliography was compiled to provide a general file of published information about wood-moisture relationships for use at the Oregon Forest Research Center. Because some publications listed undoubtedly are of interest to others, the bibliography has been published for limited distribution.

Most of the publications listed are printed in English, although some are in other languages. Many are available at the Forest Research Center or at the library of Oregon State College; those not at either agency are marked with asterisks. Publications are listed alphabetically by author in one of several groups. Groups are listed in the table of contents.

BIBLIOGRAPHY

1. Bibliography of Literature on Wood-Water Relationship and Relative Topics to 1948. C.S.I.R.O., Div. For. Prod., Australia. No. 35. 1949.

GENERAL

2. Desch, H. E. "Moisture in Wood." Wood, London, 13:12(347-348). 1948.
3. _____ . "The Moisture Relations of Wood." Wood, London, 14:11(350-352). 1949.
4. Espenas, L. D. Some Wood Moisture Relations. Report R1648, For. Prod. Lab., Forest Service, U.S. Dept. Agric. 9 pp. 1947.
5. *Gupta, H. K., and Rehman, M. A. "Shrinkage, Swelling, and Equilibrium Moisture Content of Wood, Their Importance in Seasoning, and a New Approach to the Problem of Ascertaining Dimensional Stability of Timber." Timber Dryers and Preserv. Assoc. India. J. 2:4(12-19). 1956.
6. Hawley, L. F. Wood-Liquid Relations. Tech. Bul. 248, U. S. Dept. Agric. 1931.
7. *Japing, H. W. "Wood and Moisture." Houthandel, 7(404-405). Feb. 12, 1955.
8. Koehler, A. "Importance of Moisture in Wood." Wood, Chicago, 6:1(36). 1951.
9. *Kollmann, F. "Baufeuchtigkeit und Holzfeuchtigkeit." Inform-Dienst Holz, Dusseld., 2(1-5). 1957.
10. *Maku, T. Studies on the Drying of Wood. Bul. 6, Wood Res., Kyoto, (51-70). 1951.

11. Nearn, W. T. Effect of Water Soluble Extractives on the Volumetric Shrinkage and Equilibrium Moisture Content of Eleven Tropical and Domestic Woods. Bul. 598, Pa. Agric. Expr. Sta. May, 1955.
12. Peck, E. C. The Sap or Moisture in Wood. Report D768 (Rev), For. Prod. Lab., Forest Service, U. S. Dept. Agric. 13 pp. 1953.
13. *Pot, H. F. "Wood and Moisture." Houthandel, 7(343-344). Dec. 28, 1954.
14. Rasmussen, E. F. Properties of Wood Related to Drying. Information on the Seasoning Characteristics of Wood Helpful in Understanding Kiln-drying Problems. Report R1900-1, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 70 pp. 1951.
15. Solvason, K. R. Moisture in Transient Heat Flow. Res. Paper 18, National Res. Council, Ottawa, Canada. 1955.
16. Stevens, W. C. "Factors Affecting the Drying of Wood." Timber Technol., 61:2165(124-126). 1953.
17. * _____, and Hodge, R. E. "Moisture Changes in Timber Exposed to Normal Weather Conditions." Timber News, 54(400-402). Nov., 1956.
18. "Structure in Relation to Properties." Rep. C.S.I.R.O., Australia. 1954.
19. Tieman, H. D. "The Drying of Frozen Wet Wood and the Peculiar Relation of Density to Crushing Strength." South. Lumberman, 169:2123(55-57). 1944.
20. "Wood-Water Relationships." Rep. For. Prod. Res. Bd., London, (11-12) 1949, (12-13) 1950, (50) 1951.

METHODS OF MOISTURE MEASUREMENT

21. Bosshard, H. H. "A New Method of Measuring Shrinkage Anisotropy in Wood." Naturwissenschaften., 43:3(54-55). 1956.
22. *Enchev, E. A. "Measuring Wood Moisture at the Point of Fiber Saturation." Vissh. Lesotekh. Inst. Nauch. Trudove, Sofia., 4(125-128). 1956.
23. *Gonet, B. "Analysis of Formulae for the Maximum Water Content of Wood." Sylwan, 100A:3(52-59). 1956.
24. Kajanne, P. "A Rapid Method for Moisture Determination." Paperi ja Puu, 39:8(391-398). 1957.
25. Kelsey, K. E., and R. S. T. Kingston. "An Investigation of Standard Methods for Determining the Shrinkage of Wood." J. For. Prod. Res. Soc., 3:4(49-53). 1953.
26. *Kuhne, H., and H. Strassler. "Uber die Bestimmung der Holzfeuchtigkeit." Schweizer Archiv, Solothurn, 18:8(264-275). 1952.
27. Melbourne, M. "The Measurement of Case Hardening." Timberman, 46:1(44-46). 1944.
28. Perry, T. D. "Is Percentage Best Basis for Expressing Moisture Content of Wood?" Canad. Woodworker, 49:10(64-65, 114). 1949.
29. Rishell, C. "Moisture Content Determination." Wood, Chicago, 5:1(22-23). 1950.
30. *Sergovskii, P. S. "Method of Calculating the Processes of Wood Seasoning and Conditioning." Lesn. Prom., 11:3(22-26). 1951.
31. *Taranenko, A. D. "Calculating the Moisture Changes of Linear Dimensions and Volume of Wood." Derev. lesohim. Prom., 1:7(3-9). 1952.
32. *Ugolev, B. N. "Method of Measuring Internal Stresses in Wood During Air Drying." Zavodskaya Laboratoriya, Moskow, 21:10(1224-1229). 1955.

MOISTURE CONTENT

33. Baur, J. "Neuzeitliche Bestimmung der Feuchtigkeit." Ost. Forst- u. Holzw. Wein, 8:9(225-227). 1953.
34. *Bisset, I. J. W. "Some Troubles Due to Changes in Moisture Content." For. Prod. News Lett. C.S.I.R.O., 158. November-December, 1947.
35. Buro, A., and G. Becker. "Effect of Moisture Content and Properties of, and Changes in, Coniferous Woods on the Diffusion of NaF in the Cell Wall." Holz Roh- u. Werkstoff, 14:10(388-403). 1956.
36. Control of Moisture Content and Shrinkage of Wood. Report R1903-7, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 40 pp. 1951.
37. *Egner, K. "Beitrage zur Kenntnis der Feuchtigkeitsbewegung im Holzern, vor allem im Fichtenholz wahrend der Trocknung unterhalb des Fasersattegungspunktes." Forschungsberichte Holz., 2. 1934.
38. *Ferris, D. W. "How to Control Moisture Content of Wood Going Into Production." Natl. Hardwood Mag., 22:21(30-32). March, 1947.
39. *Gobie, C. H. "Moisture Content: Theory and Application." T.D.A.Q. Rev., 4:3(16-19). 1954.
40. Jay, B. A. "Moisture Content." Wood, London, 20:11(449-451). 1955.
41. *Krpan, J. "Investigations About Moisture Content Equilibrium Between Air and Wood." Glasnik za Sumske Pokuse, 11(5-51). 1953.
42. *Kubler, H. Bisherige Studien uber die Holzfeuchtebewegung. Kritik und Konsequenzen. Diss. Math-Nat. Fak. Univ., Hamburg. 1956.
43. MacLean, J. D. Effect of Moisture Changes on the Shrinking, Swelling, Specific Gravity, Air or Void Space, Weight and Similar Properties of Wood. Report 1448 (Rev), For. Prod. Lab., Forest Service, U. S. Dept. Agric. 43 pp. 1952.

44. *Maku, T. "Relation Between the Moisture Content and Heat Conduction in Wood." J. Jap. For. Soc., 32(147). April 25, 1950.
45. Malmquist, L. "Observations on the Wood Moisture Content Hysteresis Above 100°C." Holz Roh- u. Werkstoff, 11:5(174-175). 1953. Translation 67 by Canada For. Prod. Lab. 1953.
46. Millett, R. S. "Variation in Moisture Content in Wood Exposed to Indoor Conditions." Timber Canada, 13:7(21-23, 34, 36). 1953.
47. Moisture Content Changes in Seasoned Lumber in Storage and in Transit. Bul. 102, Forestry Br., Dept. Resources Development, Canada. 1952.
48. "Moisture Content Distribution in Wood With One Face in Contact with Water." Rep. For. Prod. Res. Bd., London, (13). 1952.
49. *Moisture Content of Wood. Bul. 4, Aero. Res. Tech. Notes. 1943.
50. Peck, E. C. Moisture Content of Wood in Use. Report R1655, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 10 pp. 1955.
51. Pentoney, R. E. "Effect of Moisture Content and Grain Angle on the Internal Friction of Wood." Comp. Wood, 2(131-136). Nov., 1955.
52. Perry, T. D. "How to Solve Some of the Problems Encountered in Moisture Content." Wood Prod., 54:9(35-39). 1949.
53. Relation of Moisture Content and Drying Rate of Wood to Relative Humidity of Atmosphere. Report R509, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1941.
54. *Stanbury, G. R., R. H. Ewell, and R. F. Messing. "Studies in Wood Moisture Content." Rep. Brit. Intell. Obj. Sub-comm. No. B.I.O.S./J.A.P.P.R./1548.

FIBER-SATURATION POINT

55. Buckman, S. J., and L. W. Rees. Moisture Movement in Coniferous Wood Below the Fiber-Saturation Point. Tech. Bul. 108, Minn. Agric. Expr. Sta. 19 pp. 1935.
56. The Fiber Saturation Point of Wood. Tech. Note 252, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1944.
57. Krpan, J. "Investigations of the Fiber Saturation Point in Beech, Oak, Fir and Spruce Wood." Holz Roh- u. Werkstoff, 12:3(84-91). 1954. Translation 257 by For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1955.
58. Perem, E. "Determination of the Fiber Saturation Point of Wood by Centrifuging." J. For. Prod. Res. Soc., 4:4(77-81). 1954.
59. Rees, L. W., and S. J. Buckman. "Moisture Movement in Wood Above the Fiber Saturation Point." J. Agric. Research, 57(161-187). Aug. 1, 1938.
60. Wangaard, F. F. "A New Approach to the Determination of Fiber Saturation Point from Mechanical Tests." Forest Prod. J., 7:11(410-416). 1957.

EQUILIBRIUM MOISTURE CONTENT

61. Deery, H. L. Equilibrium Moisture Content of Salt-Treated Wood.
Tech. Pub. 58, N.Y. St. Coll. For. 1941.
62. *Enchev, E. A. Studies on the Equilibrium Moisture Content of Wood.
No. 3 (281-303), Nauč. Trud. lesoteh. Inst., Sofia. 1954.
63. *Grumach, M. The Equilibrium Moisture Content of Wood in Super-
heated Steam. C.S.I.R.O., Div. For. Prod., Australia.
64. Higgins, N. C. "The Equilibrium Moisture Content-Relative Humidity
Relationships of Selected Native and Foreign Woods." For. Prod.
J., 7:10(371-377). 1957.
65. Kauman, W. G. "Equilibrium Moisture Content Relations and Drying
Control in Superheated Steam Drying." For. Prod. J., 6:9(328-
332). 1956.
66. Spiller, D. "Effect of Heat Treatments on Equilibrium Moisture Con-
tent of Three New Zealand Grown Woods." Bul. 30, J. Sci. Technol.
(24-26). July, 1948.
67. Tieman, H. D. "The Hygroscopic Relations of Wood." Southern Lum-
berman, 173:2167(64-65). 1946.

SWELLING AND SHRINKAGE

68. *Barclay, R. M. "The Effect of the Middle Lamella and Anatomical Structure on the Tangential Shrinkage of Hardwoods." J. Oxf. Univ. For. Soc., 4:3(5-8). 1955.
69. *Barkas, W. W. Recent Work on the Moisture in Wood in Relation to Strength and Shrinkage. Special Rep. 4, C.S.I.R.O., Div. For. Prod., Australia. 1938.
70. _____ . "Sorption, Swelling and Elastic Constants of the Cell Wall Material in Wood." Trans. Faraday Soc., 42B(137-150). 1946.
71. * _____ . "The Swelling of Wood under Stress." Svensk Pappers-Tidning, Stockholm, 53:14(385-396), 53:15(431-439), 53:16(465-470), 53:17(509-597), and 53:18(543-550). 1950.
72. _____ . "Wood Water Relationships. IV. The Swelling and Shrinkage of Wood in Relation to its Mechanical Properties." Trans. Faraday Soc., 35(386-388). 1939.
73. _____ . "Wood Water Relationships. VI. The Influence of Ray Cells on the Shrinkage of Wood." Trans. Faraday Soc., 37 (535-547). 1941.
74. _____ . "Wood Water Relationships. VIII. Some Elastic Constants and Swelling Pressures of Natural Wood and of its Gel. Material." Trans. Faraday Soc., 38(447-462). 1942.
75. Bisset, I. J. W. "Why Does Wood Shrink?" For. Prod. News Lett., C.S.I.R.O., 184(5-6). Jan-Feb., 1951.
76. Bosshard, H. H. "On The Anisotropy of Wood Shrinkage." Holz Roh-u. Werkstoff, 14:8(285-295). 1956.
77. _____ . "The Influence of the Middle Lamella System on the Shrinkage of Wood." Comp. Wood, 4:1,2(17-22). 1957.
78. Browne, F. L. "Swelling of Springwood and Summerwood in Softwood." For. Prod. J., 7:11(416-424). 1957.

79. *Chalk, L. The Influence of Gross Anatomy on the Shrinkage of Wood. Sect. 13A, 8th Int. Bot. Congr., Paris. 1954.
80. *Chammamedow, K. M. Über die Gesetzmässigkeiten der Quellung von einigen Holzarten. Isvestija Akad. Nauk Aserbeidshanskoj SSR 6, (43-50). 1955.
81. Chudnoff, M. "The Effect of Zinc Chloride on Some Shrinkage Properties of Eucalyptus camaldulensis Wood." For. Res. Sta. Pap., Israel, 2(5-16). 1953. and For. Prod. J., 5:2(139-141). 1955.
82. Clegg, W. "The Effect and Control of Shrinkage during the Kiln-Drying of Species of the Genus Quercus." Timber Technol., 65:2222(623-636). 1957.
83. Cockrell, R. A. "Explanation of Longitudinal Shrinkage of Wood Based on Interconnected Chain Molecule Concept of Cell Wall Structure." Trans. Amer. Soc. Mech. Engrs., 69:8(931-935). 1947.
84. _____, "Further Observations on Longitudinal Shrinkage of Softwoods." Proc. For. Prod. Res. Soc., 3(455-459). 1949.
85. _____, "Influence of Fibril Angle on Longitudinal Shrinkage of Ponderosa Pine Wood." J. For., 44:11(876-878). 1946.
86. _____, "Shrinkage and Density of Ponderosa Pine Wood." J. For., 42(288-290). April, 1944.
87. *Desch, H. E. "Minimizing Shrinkage and Swelling in Wood." Wood, London, 4:1(19-21). 1939.
88. *Dienes, L. "The Process of Drying and the Law of Shrinking and Swelling of Hardwood Boards With Special References to the Drying of Oak." Faipar, Budapest, 2:2(36-41). 1952.
89. *Eklund, B. Undersokningar over krympnings-och svallningsforandringar hos borrhspan av tall och gran. Medd. fran Statens Skogsforskningsinstitut., Stockholm, 38:7(1-59). 1950-51.
90. *Enchev, E. A. "About the Shrinkage and Swelling of Wood." Bulgar. Akad. na Nauk. Inst. za Gorata Izv., 1(123-142). 1955.

91. Erickson, H. D. "Relation of Specific Gravity to Shrinkage and of These Factors to Growth in Yellow Poplar." J. Agric. Res., 78:5-6(103-127). 1949.
92. _____ . "Tangential Shrinkage of Serial Sections Within Annual Rings of Douglas fir (Pseudotsuga menziesii) and Western Red Cedar (Thuja plicata)." For. Prod. J., 5:8(241-250). 1955.
93. Fleischer, H. O. "Shrinkage and the Development of Defects in Veneer Drying." J. For. Prod. Res. Soc., 4:1(30-34). 1954.
94. Fountain, W. C., and F. W. Guernsey. "Some Variables Affecting the Shrinkage of Western Hemlock (Tsuga heterophylla)." For. Prod. J., 6:4(148-152). 1956.
95. *Frey-Wyssling, A. "The Anisotropy of Shrinkage on Transverse Wood Section." Holz, 3(43-45). 1940.
96. * _____ . "The Cause of Anisotropic Shrinkage of Wood." Holz, 3(349-353). 1940.
97. _____ . "Further Experiments on the Shrinkage Anisotropy of Wood." Holz Roh- u. Werkstoff, 6:7(197-198). 1943. Translation by C.S.I.R.O., Australia.
98. *Greengill, W. L. "Some Recent Investigations of the Shrinkage of Wood." Int. Rev. Timber Util., 2-3(52-53). 1939.
99. *Haden, R. V. "Shrinkage (of Wood and Type of Ray)." Rep. Imp. For. Inst., Oxford, 18 pp. 1953.
100. Hale, J. D. "The Anatomical Basis of Dimensional Changes of Wood in Response to Changes in Moisture Content." For. Prod. J., 7:4(140-144). 1957.
101. Hermann, _____, and C. A. Rasmussen. Shrinkage and Swelling of Ponderosa Pine. Tech. Bul. 1, Western Pine Assoc. 1935.
102. _____ and _____ . Shrinkage and Swelling of Idaho White Pine. Tech. Bul. 2, Western Pine Assoc. 1935.

103. Hermann, A., and C. A. Rasmussen. Shrinkage and Swelling of Sugar Pine. Tech. Bul. 3, Western Pine Assoc. 1935.
104. Huber, H. A. A Study of Across-the-Grain Shrinkage During Drying. No. 10, Mich. Wood Technol. 1956.
105. *Ivanou, Iu. M. "First Investigation of the Phenomenon of Wood Swelling by the Russian Physicist, Vasilii Petrou." Akad. Nauk SSSR. Inst. Lesa. Trudy, 9(229-235). 1953.
106. Johnston, D. D. "Effect of Mechanical Restraint During Drying on the Subsequent Distortion of Timber." Timber Technol., 65:2219 (453-455). 1957.
107. *Kadita, S., K. Nakato, and N. Kintaka. "On the Cause of the Anisotropic Shrinkage and Swelling of Wood. V. On the Relationships Between the Ray, Vessel and the Anisotropic Shrinkage." J. Jap. For. Soc., 37:4(153-156). 1955.
108. *_____, K. Nakato, and Y. Namiki. "The Cause of Anisotropic Shrinkage and Swelling of Wood. IV. The Relationship Between the Rays and Anisotropic Shrinkage." J. Jap. For. Soc., 35:2 (51-56). 1953.
109. *Kapur, S. N., and A. Rehman. Shrinkage Studies on Indian Woods. 1. Effect of High Temperatures on the Shrinkage and Moisture Equilibrium of Wood. Manager of Publications, Indian Forest Records, Utilization, Delhi, 1(1). 1936.
110. Keer, G. A. "Protection of Wood Against Moisture Changes." Wood, London, 21:4(130-131). 1956.
111. Kelsey, K. E. "The Shrinkage Intersection Point; its Significance and the Method of its Determination." For. Prod. J., 6:10(411-417). 1956.
112. *_____, and R. L. Steele. Shrinkage and Density Determinations. 2. Shrinkage and Density of Plantation Grown Pinus radiata. Progress rep. 2, T.P. 22, C.S.I.R.O., Div. For. Prod., Australia. 1956.

113. *Khanmamedov, K. M. "The Causes of Differences in the Radial and Tangential Shrinkage of the Wood." Akad. Nauk. Azerbaidzhansk SSR. Izv., 8(89-94). August, 1954.
114. *_____. "In Regard to Regularities of Wood Swelling of Certain Species." Akad. Nauk. Azerbaidzhansk SSR. Izv., 6(43-50). June, 1955.
115. *Kingston, R. S. T. "Sorpton and Swelling of Cellulosic Materials with Special Reference to Wood." Roy. Austral. Chem. Inst. J. Proc., 17(259-261). July, 1950.
116. *Kitamura, H. "Studies on the Shrinkage of Important Timbers. I. Abies firma Sieb. et Zucc. from Gunma Prefecture." J. Jap. Wood Res. Soc., 2:1(13-18). 1956.
117. *_____. "Studies on the Shrinkage of Important Timbers. II. Tsuga sieboldii Carr. from Gunma Prefecture." J. Jap. Wood Res. Soc., 2:2(55-59). 1956.
118. Koehler, A. "Effect of Heating Wet Wood in its Subsequent Dimensions." Proc. Amer. Wood Pres. Assoc., 29(376-388). 1933.
119. _____. Longitudinal Shrinkage of Wood. Report 1093, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 21 pp. 1946.
120. _____. "Longitudinal Shrinkage of Wood." Canad. Woodworker, 46:11(29, 32, 35-36, 39). 1946; and Wood, Chicago, (22-24, 40-42). Nov., 1946.
121. _____. "Report on Longitudinal Shrinkage of Wood." Canada Lumberman, 68:11(43-45, 94-95). 1948.
122. Kollmann, F. "Sorpton and Swelling of Wood." Naturwissenschaften, 32(121-139). April, June, 1944.
123. *Koning-Vrolijk, G. M. C. "Het krimpen van vers gekapt essenhout bij drogen." Tijdschr. Ned. Heidemaatsch., Arnhem, 67:6(144-146). 1956.
124. *Kubinsky, E. "Effect of Steaming on the Movement of Beech Wood." Drev. Výskum, 1:1-2(93-111). 1956.

125. Kuhne, H., and J. Vodoz. "Untersuchungen uber das Schwinden und Quellen einiger schweizerischer Holzer." Eidgenossische Materialprufungs und Versuchsanstalt f. Industrie, Bauwesen u. Gewerbe, Zurich, 179(29-44). 1951.
126. *Kumar, V. B. "Effects of Organic Liquids on the Strength and Swelling Anisotropies of Wood Across the Grain." Norsk Skogind., 9:7(243-248). 1955.
127. *_____. "Swelling Studies in Wood." Norsk Skogind., 117:7 (259-264, 266-268). 1957.
128. *Lawniczak, M., K. Nowak, and W. Dregier. "Studies on the Swelling of Microscopic Sections of Wood." Sylwan, 100A:3(89-96). 1956.
129. Lindsay, F. W., and L. Chalk. "The Influence of Rays on the Shrinkage of Wood." Forestry, 27:1(16-24). 1954.
130. Longitudinal Shrinkage of Wood. Tech. Note 234, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1942.
131. McIntosh, D. C. "Effect of Rays on Radial Shrinkage of Beech." For. Prod. J., 5:2(67-71). 1955.
132. _____. "Some Aspects of the Influence of Rays on the Shrinkage of Wood." J. For. Prod. Res. Soc., 4:2(39-42). 1954.
133. _____. "Transverse Shrinkage of Red Oak (Quercus rubra) and Beech (Fagus)." For. Prod. J., 7:3(114-120). 1957.
134. MacLean, J. D. Effect of Direction of Growth Rings on the Relative Amount of Shrinkage in Width and Thickness of Lumber and Effect of Radial and Tangential Shrinkage of Dimensions of Round Timbers. Report 1473, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 19 pp. 1945.
135. *Mahem, C. F. "Shrinkage of Wood." Timber Canada, 8:10(66-67, 72). 1948.
136. *Mariaux, A. Anisotropy of Transverse Shrinkage of Timber. Sect. 13A, 8th Int. Bot. Congr., Paris. 1954.

137. *Matsumoto, T. The Anisotropic Shrinkage of Wood. For. Bul. 26, Morioka College of Agric. Iwate Univ. (81-88). 1950.
138. Morschauser, C. R. The Effect of Rays on Differential Shrinkage. Univ. of Mich. Thesis. 1954.
139. _____. "The Effect of Rays on the Differential Shrinkage of Red Oak (Quercus rubra)."
J. For. Prod. Res. Soc., 4:10(280-282). 1954.
140. Moskaleva, V. E. Swelling of Micro-Sections of Natural and Compressed Pine Wood in Liquids of Different Polarity. Trud. Inst. Les., 9(121-126). 1933. Translation 98 by For. Prod. Lab., Div. Canada. 1956.
141. Newlin, J. A., and T. R. C. Wilson. The Relation of the Shrinkage and Strength Properties of Wood to its Specific Gravity. Bul. 676, U. S. Dept. Agric. 1919.
142. Nowak, A. "The Swelling Processes in Wood." Mitt. Ost. Ges. Holzforsch., 2:2(9-12). 1950. Translation by C.S.I.R.O., Div. For. Prod., Australia. 1951.
143. * _____. "Die Quellvorgänge im Holz." Internat. Holz, 41:8(9-12). 1950.
144. *Okusa, K., and S. Hayashi. "Shrinking and Swelling of Wood Under Stress. I. Compressive Stress." J. Jap. Wood Res. Soc., 2:1(5-7). 1956.
145. Paerels, F. "Arbeitsparendes Verfahren für die Messung der Dickenquellung." Holz Roh- u. Werkstoff, 15:9(367-370). 1957.
146. Paul, B. H. "Lengthwise Shrinkage in Ponderosa Pine." For. Prod. J., 7:11(408-410). 1957.
147. Peck, E. C. "How Wood Shrinks and Swells." For. Prod. J., 7:7(235-244). 1957.
148. _____. Shrinkage of Wood. Report 1650, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1947.

149. *Peck, E. C. "Shrinkage of Wood." Timber Plywood Ann., (274, 276, 278, 280). 1947-1948.
150. Pentoney, R. E. "Mechanisms Affecting Tangential vs. Radial Shrinkage." J. For. Prod. Res. Soc., 3:2(27-32, 86). 1953.
151. *Perkitny, T., J. Stefaniak, and A. Chudzinski. Kurczenie sie drewna po nawilzeniu i wysuszeniu w zaleznosci od cisnienia wywieranego na to drewno w stanie suchym. Prace Inst. Techn. Drewna, Poznan, 3:4(34-51). 1957.
152. *_____, J. Stefaniak, and Z. Rudnicki. Wplyw naprezen sciskajacych na pecznienie i kurczenie sie drewna. Prace Inst. Techn. Drewna, Poznan, 3:4(52-69). 1957.
153. Pillow, M. Y. "Variations in Longitudinal Shrinkage of Second-Growth Douglas-Fir." J. For., 47:5(383-391). 1949.
154. Preston, R. D. "Anisotropic Contraction of Wood and of its Constituent Cells." Forestry, 16(32-48). 1942.
155. *Rietz, R. C. "Moisture and Shrinkage Relationships in Wood." Proc., Cold Storage Locker Operators' Conf., Col. Agric., Univ. Wis., (46-51). 1939.
156. _____. "Moisture and Shrinkage Relationships in Wood; Wood Moves with Every Change in Surrounding Atmospheric Conditions-- Shrinkage Proportional to Moisture Losses Below Fiber Saturation Point." Canada Lumberman, 63:9(80-81). 1943.
157. Ritter, G. J., and R. L. Mitchell. "Fiber Studies Contributing to the Differential Shrinkage of Cellulose." Paper Ind., 33(1189-1193). Jan., 1952.
158. Saechtling, H., and H. Zocher. "Investigations of the Fine Structure of Wood. Part I. The Volume Swelling of Spruce Wood and Lignin in Various Liquids." Kolloid-Beih., 40(413). 1934. "Part II. The Vapor-Pressure Lowering of Various Liquids and Their Absorption by Wood and Lignin." Kolloid Zeitschrift, 72:3(336-345). 1935. Translation 3437 A and B, C. S. I. R. O., Australia. 1957.
159. *Sallenave, P. "Radial and Tangential Shrinkage of Wood." Bois For. Trop., 56(45-50). 1957.

160. *Schlumbom, F. Kontrollversuche zur Abhängigkeit der Maximalquellungszahlen von der Holzabmessung und der Temperatur. Dipl. Arb., Math-Naturw. Fak. Univ., Hamburg. 1956.
161. Schwartz, W. "Contributions to Knowledge of Wood as an Industrial Material. III. The Effects of Impregnation on the Swelling of Wood." Angew. Bot., 26:5(228-239). 1952.
162. Shrinkage. Rep. Imp. For. Inst. Oxf., (18-19). 1952.
163. Shrinkage of Wood. Report 1363, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 5 pp. 1941.
164. *The Shrinkage of Wood During Drying. Trade Circ. 23, C.S.I.R.O., Div. For. Prod., Australia. 1934.
165. "Shrinkage Tests." Rep. For. Prod. Res. Bd., London, (13, 14) 1952, and (10) 1954.
166. Shrinking and Swelling of Wood in Use. Report 736, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 17 pp. 1952.
167. Stamm, A. J. "Shrinkage and Swelling of Wood." Industr. Engng. Chem., 27(401-406). 1935.
168. _____, "Swelling of Wood and Fiberboards in Liquid Ammonia." For. Prod. J., 5:6(413-416). 1955.
169. _____, and W. K. Loughborough. "Thermodynamics of the Swelling of Wood." J. Phys. Chem., 39(121-132). 1935.
170. Stevens, W. C. "The Effect of Temperature and Drying Rate on the Shrinkage of Beech." Timber News, 60:2162(585-587). 1952, and Timber Technol., 61:2163(27-28). 1953.
171. _____. "The Shrinkage and Expansion of Wood." Forestry, 12:1(38-43). 1938.
172. _____. "The Shrinkage of Beech (Fagus) at High and Low Temperatures." Timber Technol., 61:2171(427-428). 1953.

173. *Stryla, S. Research on the Ratio of Total Volumetric Shrinkage to Specific Gravity at 0 Per Cent Moisture in the Wood of Pinus sylvestris. Roczn. Nauk, Rol., 41(230-245). 1937.
174. Suzuki, Y. "Shrinkage of Wood in Kiln Drying." J. Jap. Wood Res. Soc., 2:1(43-48). 1956.
175. Tarkow, H. "The Swelling and Shrinkage of Wood, Paper and Cotton Textiles and Their Control." Tappi, 32:5(203-211). 1949.
176. Terrell, B. Z. "Distribution of Tension Wood and its Relation to Longitudinal Shrinkage in Aspen." Report R1917, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1952, and Mater. Veg., 1(288-299). 1953.
177. Tieman, H. D. "How Does Wood Shrink? 1. Fundamental Principles." South. Lumberman, 175:2193(66, 68). 1947.
178. _____ "How Does Wood Shrink? 2. The Outward Swelling of a Block as Compared with the Swelling of Wood Substance." South. Lumberman, 175:2195(62, 64). 1947.
179. _____ "How Does Wood Shrink? 3. Some Practical Results." South. Lumberman, 175:2197(76, 78). 1947.
180. _____ "How Does Wood Shrink? 4. Sapwood and Heartwood. Evaporation Causes Tension." South. Lumberman, 175:2199(76). 1947.
181. _____ "How Does Wood Shrink? 5. Relative Differences Between Species." South. Lumberman, 176:2203(70, 72). 1948.
182. _____ "How Does Wood Shrink? 6. How Shrinkage Can Be Reduced and the Wood Stabilized." South. Lumberman, 176:2205(76, 78). 1948.
183. _____ "How Does Wood Shrink? 7. How Wood Can Be Stabilized (Continued)." South. Lumberman, 176:2207(80, 82). 1948.
184. *Trendelenburg, R. "On Moisture at Fiber Saturation Point, Shrinkage, and Specific Gravity Based on Volume When Green in Some Important Timbers." Holz, 2(12-17). 1939.

185. Ullrich, H. "Swelling of Wood as a Substance With an Ultra-Filtration Structure, in Relation to the Size and Structure of the Molecule of the Swelling Agent." Planta, 42:1-2(129-139). 1953.
186. Vintila, V. E. "Investigations Into Space Importance and Shrinkage of Early and Late Wood of Conifers." Holz Roh- u. Werkstoff, 2:10(345-357). 1939.
187. * _____ . "Research on Specific Gravity and Shrinkage of Springwood and Summerwood in Conifers." Holz, 2(345-347). 1939.
188. Vodoz, J. "The Shrinkage and Swelling of Wood." Schweiz. Z. Forstw., 104:10(508-517). 1953. Translation 74 by For. Prod. Lab., Div. Canada. 1954.
189. Vorreiter, L. "Constituents of Wood and Its Volume Swelling." Holz Roh- u. Werkstoff, 12:6(223-226). 1954.
190. _____ . "Swelling of Wood as a Function of a Number of Variable Factors, in Particular of Temperature and Wood Dimensions." Holz Roh- u. Werkstoff, 13:8(301-312). 1955. Translation 3059 by C.S.I.R.O., Australia. 1956.
191. *Walter, W. "Dimensional Changes of Beech Wood During Steaming." Holz-Zbl., 80(140). 1954.
192. *Wardrop, A. B., and H. E. Dadswell. "The Swelling Behavior of Conifer Tracheids and the Concept of a Skin Substance." Proc., Australia P. & P. Ind. Tech. Assoc., (4). 1950.

SWELLING PRESSURE

193. Barkas, W. W. "Wood-Water Relationships. V. The Hydrostatic Compressibility of the Wood Water Aggregate." Trans., Faraday Soc., 36(824-834). 1940.
194. Ivanov, Iu. M. On the Pressure of Wood Swelling. Akad. Nauk SSSR. Inst. Lesa. Trudy, 9(236-249). 1953. Translation 102, For. Prod. Lab., Canada. 1956.
195. _____ "Measurement of Swelling Pressure of Wood." Comp. Wood, 3:5-6(91-100). 1956.
196. *Perkitney, T. Investigations on the Swelling Pressure of Wood. Bul. 64, Prace Inst. bad. Leśn. 1951.

SEASONING STRESSES AND SETS

197. Asano, I. "Studies on Collapse in Wood." J. Jap. Wood Res. Soc., 2:3(104-107). 1956.
198. Baker, W. J. Drying Stresses in Lumber Seasoning. Report R1652, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 9 pp. 1950.
199. Churchill, J. W. "The Effect of Time, Temperature, and Relative Humidity on the Relief of Case Hardening Stresses." J. For. Prod. Res. Soc., 4:10(264-270). 1954.
200. *Collapse and the Reconditioning of Collapsed Timber. Trade Circ. 20, Austr. Council Sci. and Ind. Res. 1934.
201. The Detection and Relief of Case Hardening. Tech. Note 213 (Rev), For. Prod. Lab., Forest Service, U. S. Dept. Agric. Dec., 1952.
202. *Devine, J. "How to Eliminate Surface Checks; Effects of Low Humidity on Stain." Natl. Hardwood Mag., 23:7(43-45, 75). 1949.
203. Kauman, W. G. "Current Research on Collapse." For. Prod. News Lett., C.S.I.R.O., 221(1-2). 1956.
204. Loughborough, W. K. "Stresses and Detection of Case Hardening During Kiln Drying." Rep. For. Prod. Lab., Forest Service, U. S. Dept. Agric. Dec. 7, 1920.
205. McMillen, J. M. "Drying Stresses in Red Oak." For. Prod. J., 5:1(71-76). 1955.
206. _____ . "Drying Stresses in Red Oak: Effect of Temperature." For. Prod. J., 5:4(230-241). 1955.
207. Mottet, A. L. "Determination of Case Hardening in Kiln Dried Lumber." Timberman, 45:5(28-29). 1944.
208. Peck, R. E., R. T. Griffith, and R. K. Nagaraja. "Relative Magnitude of Surface and Internal Resistance in Drying." Industr. Engng. Chem., 44:3(664-669). 1952.

209. *Rasmussen, E. F., and G. Voorhies. The Relief of Case Hardening Stresses in Aircraft Lumber. Report R1371, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1943.
210. Rietz, R. C. What is the Cause of Case Hardening in Lumber and How Can it be Relieved. Report D1769-9, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1951.
211. *Suzuki, Y. "Elastic and Plastic Strains in Dried Lumber." Trans. 62nd Mtg. Jap. For. Soc., (217-219), 1953, and Rec. 4, Res. Fac. Agric., Univ. Tokyo. 1955.
212. Tieman, H. D. "Can Casehardening Cause Internal Honey Combing?" Natl. Hardwood Mag., 29:4(26-27, 41). 1955.
213. _____, "Effects Produced by the Removal of the Free Water from the Green Wood." South. Lumberman, 151:1909(37-39). 1935.
214. _____, "Honeycombing Collapse and Bottlenecked Checks." Natl. Hardwood Mag., 29:6(23-24). 1955.
215. _____, "The Kiln Drying of Lumber. Examples of 'Collapse' and its Defects." South. Lumberman, 179:2239(68, 70, 72, 74). 1949.
216. _____, "Significance of Inherent Stresses While Drying Lumber." South. Lumberman, 169:2129(259-260). 1944.
217. _____, "What is Collapse?" South. Lumberman, 155:1961 (183-185). 1937.
218. *Ugolev, B. N. "Residual Stresses in Wood and a Method of Removing Them." Derev. lesohim. Prom., 2:1(12-15). 1953.
219. Winkel, L. D. "Case Hardening Stress Relief of Ponderosa Pine." For. Prod. J., 6:3(124-128). 1956.

MOVEMENT OF LIQUIDS, GASES AND SOLIDS IN WOOD

220. Anderson, B. E., R. A. Gortner, and H. Schmitz. Factors Affecting the Decreasing Rate of Flow of Liquids Through Wood. Tech. Bul. 46, Minn. Agric. Exp. Sta. 1941.
221. *Artsikhovskaia, N. V. "Investigations of Moisture Conductivity of Wood." Akad. Nauk SSSR. Inst. Lesa. Trudy, 9(127-157). 1953.
222. *_____. "Investigation of Moisture Movement in Wood During the Process of Drying." Akad. Nauk SSSR. Inst. Lesa. Trudy, 9(158-185). 1953.
223. *Babbitt, J. D. "On the Diffusion of Adsorbed Gases Through Solids." Canad. J. Physics, 29(437-446). 1951.
224. Baker, W. J. How Wood Dries. Report R1642, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 8 pp. 1951.
225. Barkas, W. W. "Retention of Moisture by Wood." Nature, 130(699-700). 1932.
226. _____. The Swelling of Wood Under Stress; A Discussion of Its Hygroscopic, Elastic, and Plastic Properties. London, H. M. Stationery Office, 104 pp. illus. 1949.
227. _____. "Wood Water Relationships. IV. Molecular Sorption of Water by Sitka Spruce Wood." Proc., Physical Society, 49(237). 1937.
228. Bateman, E., J. P. Hohf, and A. J. Stamm. "Unidirectional Drying of Wood." Industr. Engng. Chem., 31(1150-1154). 1939.
229. Bazhenov, V. A. Water Permeability of Wood. Akad. Nauk SSSR. Inst. Lesa. Trudy, 9(186-204). 1953. Translation 99, by For. Prod. Lab., Div., Canada. 1956.
230. *_____. Pronizajemostj drevesiny shidkostjami i jeje praktitscheskoe snatschenie. Moskau, Isdat. A. N. SSSR. 1952.
231. *_____. Perviousness of Wood to Liquids. Akad. Nauk. SSSR. Inst. Lesa. Trudy, 4(154-167). 1949.

232. *Bazhenov, V. A., and V. E. Moskaleva. On Permeability of Sapwood and Heartwood of Pine Wood by Fluids and Possibilities of Adjusting it. Akad. Nauk SSSR. Inst. Lesa. Trudy, 9(204-215). 1953.
233. Beard, H. C., and R. Osgood. "Permeability of Wood and other Cellulose Products to Ethylene Oxide Gas." For. Prod. J., 7:8(265-266). 1957.
234. Becker, G., and K. Starfinger. "Investigations on the Uptake of Liquids by Wood When Immersed. I. Effect of the Duration of Immersion and of Repeated Immersion Treatment on the Liquid Uptake of Pine and Spruce Wood." Holz Roh- u. Werkstoff, 13:12(462-467). 1955.
235. Behr, E. A., D. R. Briggs, and F. H. Kaufert. "Diffusion of Dissolved Materials Through Wood." J. Phys. Chem., 57(476-480). April, 1953.
236. *Bogaty, H., K. S. Campbell, and W. D. Appel. "Einige Beobachtungen uber die Verdampfung von Wasser Aus Cellulose." Text. Res. J., 22(75). 1952.
237. Buckmann, S. J., H. Schmitz, and R. A. Gortner. "Certain Factors Influence the Movement of Liquids in Wood." J. Phys. Chem., 39(103-120). 1935.
238. Burr, H. K., and A. J. Stamm. Diffusion in Wood. Report R1674, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 28 pp. 1947.
239. *Buttner, E. E. "Hygroscopic Properties of Some Timbers." So. African Timber Trades J., 3:5(12-13), 3:6(9-10), 3:10(12-15), 3:12(10-11). 1949, and 4:6(10-11). 1950.
240. Christensen, G. N., and E. J. Williams. "A Quantitative Theory of Diffusion in Porous Media and its Application to Wood." Aust. J. appl. Sci., 2:4(411-429). 1951.
241. _____, and _____. "The Temperature Coefficient of Diffusion Through Wood." Aust. J. appl. Sci., 2:4(430-439). 1951.

242. Christensen, G. N., and E. J. Williams. "Ion Selection and Its Effect on the Diffusion of Electrolytes." Aust. J. appl. Sci., 2:4(440-453). 1951.
243. "Diffusion Studies." Rep. For. Prod. Australia, (41). 1948.
244. "Diffusion of Water Vapour Through Wood." Rep. For. Prod. Res. Bd., London, (12) 1949, (13-14) 1950, (50-51) 1951, (48-49) 1952, (50) 1953.
245. Dumanskii, A. V., and E. F. Nekryach. "Heat of Wetting and Bound Water." Kolloidnyi Zhurnal, 17:3(168-170). 1955. Translation 2964, For. Prod. Lab., Australia, 1955.
246. Erickson, H. D., H. Schmitz, and R. A. Gortner. "Directional Permeability of Seasoned Woods to Water and Some Factors Which Affect It." J. Agric. Res., 56:10(711-746). 1938.
247. *Grzeczynski, T. "Investigations Upon the Anisotropy of Hygroscopic Deflection in the Course of Seasoning of Wood." Sylwan, 100A:11 (76-96). 1956.
248. Hartman, Dick U. "The Permeability of Wood to Fluids Under Pressure. I. Permeability to Water." Forstwiss. Cbl., 73:1-2(40-63). 1954.
249. Hearmon, R. F. S., and J. N. Burcham. "The Specific Heat and Heat of Wetting of Wood." Chemistry and Industry, (807-808). 1956.
250. *Howe, H. A. "Summary of Movements with Moisture Change of Improved Woods." Wood, Selected Gov't. Res. Reports Bd., London, 8(85-95). 1952.
251. Jost, W. Diffusion in Solids, Liquids, Gases. Academic Press, Inc., N. Y. 1952.
252. *Kadita, S., and K. Nakato. Influences of Some Extracting Treatments on the Hygroscopicity of Wood. Bul. 2, Wood Res., Kyoto, (9-21). 1949.
253. Kelsey, K. E. "The Sorption of Water Vapor by Wood." Aust. J. appl. Sci., 8:1(42-54). 1957.

254. Kelsey, K. E., and L. N. Clarke. "Effect of Temperature and Initial Moisture Content on the Heat of Wetting of Wood." Nature, London, 176(83-84). July 9, 1955.
255. Konishi, Y., T. Kismima, and T. Yamamoto. Study on the Liquid Penetration Into Wood by Fluorescence. Bul. 11, Wood Res., Kyoto, (1-2). Aug., 1953. Translation 72, For. Prod. Lab., Div. Canada, 1954.
256. * _____, and T. Yamamoto. Calculations of the Capillary Diameter in Wood From the Liquid Absorption Data. Bul. 8, Wood Res., Kyoto, (68-73). March, 1952.
257. Krier, J. P. "How Liquids Move Through Woods." Frontiers of Plant Sci., 2:2(2). 1950.
258. *Krischer, O. "Heat, Fluid and Vapor Flow in the Drying of Porous Substances." Z. Ver. deut. Ing., Beiheft Folge 1(17-25). 1940.
259. Kroll, K. "Die Bewegung der Feuchtigkeit in Nadelholz während der Trucknung bei Temperaturen um 100°C. Zweiter Teil: Die besonderen Bewegungsvorgänge in Nadelholz." Holz Roh- u. Werkstoff, 9:6(216-224). 1951.
260. _____, and B. Hersfeld. "Movement of the Moisture of Softwood When Dried at Temperatures Around 100°C." Holz Roh- u. Werkstoff, 9:5(176-181), and 9:6(216-224). 1951. Translation 1818 by C.S.I.R.O., Australia. 1951.
261. Kubler, V. H. R. "Studies on the Movement of Moisture Through Wood." Holz Roh- u. Werkstoff, 15:11(453-468). 1957.
262. Ledoux, E. Vapor Adsorption. Chemical Publishing Co., Brooklyn, N. Y. 1945.
263. *Lhota, O. "Hygroscopicity of Wood and Its Importance in the Use of Parquet for Floors in Building Construction." Lesnická Práce, 27:3(65-79).
264. Lundegardh, H. "The Transport of Water in Wood." Arkiv. för Botanik, 2:3(89-119). 1955.

265. Luner, P. "The Effect of Pre-Treatment on Diffusion Through Wood." Pulp and Paper Magazine of Canada, 57:3(216-220). 1956.
266. McNabb, A., and W. B. Taylor. "Some Theory Relating to the Diffusion of Chemicals in Green Timber." N. Z. J. Sci. Technol., 35B:1(113-126). 1953.
267. *Martley, J. F. Moisture Movement Through Wood: The Steady State. Tech. Paper 2, Dept. Sci. Indus. Res., For. Prod. Res., London. 1926.
268. "Moisture Movement and Distribution in Wood." Rep. For. Prod. Res. Bd., London, (48-49). 1955.
269. *Moll, F. "Wood and Water: A Contribution to the Hygroscopic Equilibrium Between Wood and Water." Holztechnik, 28:10(204). 1948.
270. *Narayanamurti, D., and V. B. Kumar. "Diffusion of Organic Molecules Through Wood." J. Polymer Science, 10:6(515-524). 1953.
271. _____, V. Ranganathan, and R. S. Ratra. "Movements of Liquids Through Wood." Holz Roh- u. Werkstoff, 9:11(422-426). 1951.
272. *Nylinder, P. "Studies on Drying and Uptake of Water in Coniferous Round Timber." Norrlands SkógsvForb. Tidskr., 2(165-230). 1950.
273. Ogura, T. Study on the Mechanisms of the Wood Drying. 1. On the Relation Between the Evaporation - velocity, the Moisture-conductivity and the Thickness of the Wood. Bul. 42, Jap. Forest Exp. Sta., Meguro, Tokyo, (11-25). July, 1949.
274. *_____. On the Moisture-conductivity and the Diffusion-coefficient. Bul. 45, Jap. For. Exp. Sta., Meguro, Tokyo, (55-69). 1950.
275. *_____. On the Evaporating Rate of Moisture in Wood. Bul. 51, Jap. For. Exp. Sta., Meguro, Tokyo, (61-75). 1951.
276. *_____. On the Effects of Surrounding Conditions on Moisture Conductivity. Bul. 51, Jap. For. Exp. Sta., Meguro, Tokyo, (77-83). 1951.

277. *Ogura, T. The Relation Between the Diffusion Coefficient and the Moisture Content of Wood. Bul. 54, Jap. Exp. Sta., Meguro, Tokyo, (165-186). 1952.
278. * _____ . Effect of Temperature on the Moisture Conductivity in Wood and on the Strain Developed in Wood as It Dried. Bul. 77, Jap. For. Exp. Sta., Meguro, Tokyo, (35-68). 1955.
279. _____ , and K. Ohnuma. "The Experimental Formula for the Evaporation Rate of Moisture in Wood at the Constant Drying Period." J. Jap. For. Soc., Japan, 1:1(38-41). 1955.
Translation 304, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1956.
280. * _____ , and M. Umehara. "On The Effect of Temperature, Fibre-direction and Thickness of Board on the Diffusion Coefficient of Wood." J. Jap. Wood Res. Soc., 3:2(51-56). 1957.
281. Paranyi, N. I., and W. Rabinovitch. "Determination of Penetration Rate of Liquid Media in Wood Using a Quartz Spiral Balance. Part I. Water and an Air-dry Spruce Chip." Pulp and Paper Magazine of Canada, 56:3(163-170). 1955.
282. "Passage of Liquids Through Wood." Rep. For. Prod. Res. Bd., London, (20-21). 1950.
283. Paton, J. M., and R. F. S. Hearmon. "Effect of Exposure to Gamma-Rays on the Hygroscopicity of Sitka Spruce Wood." Nature, 180(651). Sept. 28, 1957.
284. "Permeability of Timber." Rep. For. Prod. Res. Bd., London, (30-31), 1955, and (30) 1956.
285. Pfalzner, P. M. "On the Flow of Gases and Water Vapour Through Wood." Canad. J. Res., 28A:4(389-410). 1950.
286. *Pidgeon, L. M., and O. Maass. Penetration of Water Vapor into Wood. McGill Univ. Lib., Montreal, Canada. 1931.
287. *Pitts, G. Y. "Moisture Absorption in Timbers: Woods Used in Store Construction." Mod. Refrig., 47(112-113). May 18, 1944.

288. Ripley-Duggan, B. A. "Adsorption of Barium Chloride, Sodium Chloride, and of Water." N. Z. J. Sci. Technol. B., 34(1-12). July, 1952.
289. Roberts, H. D. "The Moisture Content Distribution in Wood Used as a Partition Between Water and Air." Aust. Council Sci. and Ind. Res. J., 17:3(133-138). Aug., 1944.
290. Runkel, R. O. H. "Sorpton of Wood Fibres From the Morphological and Chemical Points of View." Holz Roh- u. Werkstoff, 12:6 (226-232). 1954. Translation 2530 by C.S.I.R.O., Australia. 1955.
291. _____, and M. Luthgens. Studies on the Sorption of the Wood Fibre--Second Communication. Translation 112 by For. Prod. Lab., Div., Canada. 1957.
292. *Sadoh, T., and S. Kadita. "Studies on the Relation Between Physical Properties and Chemical Components of Wood. 3. On the Moisture Adsorption of Hardwood Hemicellulose." J. Jap. Wood Res. Soc., 3:3(100-102). 1957.
293. * _____, and _____. "Studies on the Relation Between Physical Properties and Chemical Components of Wood. 2. On the Ability of Moisture Adsorption of Hemicellulose and Cellulose." J. Jap. Wood Res. Soc., 2:6(237-240). 1956.
294. *Samborski, M. R., G. T. Tsoumis, and F. F. Wangaard. "Moisture Absorption in Certain Tropical American Woods." Properties of Tropical Woods, Rep. 3, Yale School of Forestry. 1953.
295. *Screaton, R. M., and S. G. Mason. "Sorption of Alkali on Spruce Lignin, Holocellulose, and Wood." Svensk Pappidn., 60:10 (379-387). 1957.
296. Schniewind, A. P. "Sorption Hysteresis in Relation to Wood Thickness." For. Prod. J., 6:6(225-229). 1956.
297. *Schwabe, K., and B. Philipp. "Kinetics of Sorption of Vapours and Imbibition of Liquids by and Swelling of Cellulose." Holzforschung, Berlin, 8:1(1-2). 1954.

298. Sergovskii, P. S. "On the Mechanism of the Movement of Moisture in Wood During Convection-type Drying." Derev. lesohim. Prom., 3:4(3-8). 1954. Translation 2568 by C.S.I.R.O., Australia. 1955.
299. * _____ . "Moisture Conduction of Wood." Derev. Prom., 4:2(3-8). 1955.
300. Skaar, C. "Analysis of Methods for Determining the Coefficient of Moisture Diffusion in Wood." J. For. Prod. Res. Soc., 4:12 (403-410). 1954.
301. * _____ . The Moisture Diffusion Coefficient for Beech. Unpublished dissertation. Yale University. 1957.
302. * _____ . The Mechanism of Moisture Movement in Beech Below the Fiber Saturation Point. Unpublished report, Syracuse University, School of Forestry. 1958.
303. *Sorption Studies. Report 87-88, C.S.I.R.O., Australia. 1956.
304. Spalt, H. A. "The Sorption of Water Vapor by Domestic and Tropical Woods." For. Prod. J., 7:10(331-335). 1957.
305. Stamm, A. J. The Effect of Changes in the Equilibrium Relative Vapor Pressure Upon the Capillary Structure of Wood. Report R1075, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 1935.
306. _____ . Passage of Liquids, Vapors, and Dissolved Materials Through Soft Woods. Tech. Bul. 929, U. S. Dept. Agric. 1946.
307. _____ . "The Passage of Water Through the Capillary Structure of Wood." Discussions of the Faraday Soc., London, 3(264-273). 1948.
308. _____ , and H. Tarkow. "Penetration of Cellulose Fibers." J. Phys. Colloid Chem., (745-753). 1950.
309. _____ , and _____ . "Diffusion and Penetration Mechanism of Liquids into Wood." Pulp and Paper Magazine of Canada, 54:2(54-63). 1953.

310. Stamm, A. J., and L. A. Hansen. "Surface Bound Versus Capillary-Condensed Water in Wood." J. Phys. Chem., 42 (209-314). 1938.
311. Stevens, W. C. "The Removal of Moisture from Wood." Wood, London, 10:7(172-173). 1945.
312. _____, and D. D. Johnston. "Moisture Movement Through Wood." Wood, London, 19:10(400-407). 1954.
313. *Stillwell, S. T. C. Movement of Moisture With Reference to Timber Seasoning. Tech. Paper 1, For. Prod. Res. Bd., London.
314. Stone, J. E. "The effective Capillary Cross-Sectional Area of Wood as a Function of pH." Tappi, 40:7(539-541). 1957.
315. _____. "The Penetrability of Wood." Pulp and Paper Mag., Canada, 57:7(139-145). 1956.
316. _____, and C. Forderreuther. "Studies of Penetration and Diffusion into Wood." Tappi, 39:10(679-683). 1956.
317. Tieman, H. D. "How Wood Behaves in Drying." South. Lumberman, 167:2101(51-52). 1943.
318. _____. "Moisture Gradients." South. Lumberman, 167:2103 (53-54). 1943.
319. _____. "The Kiln Drying of Lumber--How Water Moves Through the Wood in Drying." South. Lumberman, 185:2311 (54-56). 1952.
320. _____. "Moisture Movement and Stresses." South. Lumberman, 168:2109(49-50). 1944.
321. _____. "Moisture Movement in Drying Wood." South. Lumberman, 171:2145(59-60). 1945.
322. _____. "Moisture Movements in Pervious and Impervious Wood." South. Lumberman, 168:2107(47-48). 1944.
323. _____. "More About Moisture Gradients; Sapwood and Heartwood." South. Lumberman, 167:2105(281-282). 1943.

324. Tieman, H. D. "Permeability of Wood to Air and Liquids: Soap Foam Tests." South. Lumberman, 17:2223. 1948.
325. Van Arsdel, W. "Approximate Diffusion Calculations for the Falling-Rate Phase of Drying." Trans. Amer. Institute Chem. Engng., 43:1(13-24). 1947.
326. *Watanabe, H., and K. Aso. "Studies on the Transmission of Gas Through Wood. 2. On the Relation Between Gas Pressure and Transmission Velocity of Gas Parallel to the Grain Through Sapwood and Heartwood of Sugi." J. Jap. Wood Res. Soc., 3:2(41-45). 1957.
327. *Yamada, T., and S. Kadita. Absorption of Water Vapor on Wood. Bul. 9, Wood Res., Kyoto, (42-62), 1952, and Bul. 11, (5-20) 1953.
328. *Youngs, R. L. Unsteady-State Moisture Movement in Wood. Unpublished report at Yale University, School of Forestry. 1954.

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329. *Armbruster, E. "The Effect of Impregnation on Moisture Absorption and Strength of Wood." Mitt. ost. Ges. Holzforsch., 1:2(16-20). 1949.
330. Clermont, L. P., and F. Bender. "The Effect of Swelling Agents and Catalysts on the Acetylation of Wood." For. Prod. J., 7:5(167-170). 1957.
331. *Falck, R. Treatment of Timber. Patent 156,284, Austria. June 10, 1939.
332. *Genel, S. V. "Reduction of Wood Hygroscopicity by Treatment with Aromatic Amines." Lesnaya Prom., 8:1(18-23). 1948.
Translation by For. Prod. Lab., Australia. 1949.
333. *Goto, T., and S. Kadita. Studies on Impregnated Woods. VII. Relation Between the Phenol to Formaldehyde Ratio and Dimensional Stability. Bul. 15, Wood Res., Kyoto, (24-37). 1955.
334. *_____, and _____. "Studies on Impregnated Woods. VIII. Relationship Between the Solvent and Dimensional Stability." J. Jap. Wood Res. Soc., 1:1(30-34). 1955.
335. *Hudson, Monie. Dimensional Stabilization of Wood by Treatment with Halogenated Ethers. Patent 2,726,169, U. S. Dec. 6, 1955.
336. Kenaga, D. L., R. C. Sproull, and J. Esslinger. "Preliminary Experiments on Dimensional Stabilization of Wood by Allylation." South. Lumberman, 180:2252(45, 48). 1950.
337. _____, and R. C. Sproull. "Further Experiments on Dimensional Stabilization of Wood by Allylation." J. For. Prod. Res. Soc., 1(28-32). 1951.
338. *Krzikalla, H., and O. Lissner. Impregnation of Wood with Ammoniacal Polycarboxylic Acids. Patent 2,768,910, U. S. Oct. 30, 1956.
339. *Kvalnes, H. M., and F. S. Chance. Urea-Formaldehyde Compositions. Patent 2,485,203, U. S. Oct. 18, 1949.

340. Millett, M. A., and A. J. Stamm. "Wood Treatment with Urea Resin-Forming Systems (Dimensional Stability)." Mod. Plastics, 24:2(150-153, 202, 204, 206). 1946.
341. *"Modified Wood." For. Res. India Burma, Pt. I (75-77). 1950-51, 1955.
342. *Narayanamurti, D., and B. K. Handa. "Acetylated Wood." Das Papier, 7(87-92). 1953.
343. Nayer, A. N., and R. L. Hossfeld. "Hydrogen Bonding and the Swelling of Wood in Various Organic Liquids." J. Amer. Chem. Soc., 71:8(2852-2855). 1949.
344. Risi, J., and D. F. Arseneau. "Dimensional Stabilization of Wood--by Acetylation." For. Prod. J., 7:6(210-213). 1957.
345. _____, and _____. "Dimensional Stabilization of Wood--by Crotonylation." For. Prod. J., 7:7(245-246). 1957.
346. _____, and _____. "Dimensional Stabilization of Wood--by Butylation." For. Prod. J., 7:8(261-265). 1957.
347. _____, and _____. "Dimensional Stabilization of Wood--by Allylation." For. Prod. J., 7:9(293-295). 1957.
348. *Samek, J. "Dimensional Stability of Wood Impregnated with Cresol-Formaldehyde Resin." Drev. Vyskum, 1:1-2(157-169). 1956.
349. Seborg, R. M., H. Tarkow, and A. J. Stamm. "Effect of Heat Upon the Dimensional Stabilization of Wood." J. For. Prod. Res. Soc., 3:3(59-67). 1953.
350. Stamm, A. J. Antishrink Treatment for Wood. Patent 2,296,316, U. S. Sept. 22, 1943.
351. _____. Stabilizing the Dimensions of Wood. U. S. Dept. Agric. Yearbook (807-809). 1950-51.
352. _____. "Dimensional Stabilization of Wood with Carbowaxes." For. Prod. J., 6:5(201-204). 1956.

353. Stamm, A. J., and L. A. Hansen. "Minimizing Wood Shrinkage and Swelling; Replacing Water in Wood with Nonvolatile Materials." Industr. and Engng. Chem., 27(1480-1484). Dec., 1935.
354. _____, and _____. "Minimizing Wood Shrinkage and Swelling." Industr. Engng. Chem., 29(831-833). 1937.
355. _____, and M. A. Millett. "Wood Treatment with Urea Resin-Forming Systems." Modern Plastics, 24:2(150-153, 202, 204, 206). 1946.
356. _____, and R. M. Seborg. Minimizing Wood Shrinkage and Swelling; Treating with Synthetic Resin-Forming Materials. Rep. R1110, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 20 pp. 1936.
357. _____, and H. Tarkow. "Dimensional Stabilization of Wood." J. Phys. and Colloid Chem., 51(493-505). 1947.
358. _____, and _____. "Wood, A Limited Swelling Gel." J. Phys. and Colloid Chem., 53:2(251-260). 1949.
359. _____, and _____. Method of Stabilizing Wood. Patent 2,572,020, U. S. October 23, 1951.
360. *Svit, N. P. Method of Producing Wood with Dimensional Stability and Resistance to High Temperatures. Patent No. 266,172, Switzerland. April 17, 1950.
361. Tarkow, H., and A. J. Stamm. "Effect of Formaldehyde Treatments upon the Dimensional Stabilization of Wood." J. For. Prod. Res. Soc., 3:2(33-37). 1953.
362. _____, A. J. Stamm, and E. C. O. Erickson. Acetylated Wood. Rep. 1593, For. Prod. Lab., Forest Service, U. S. Dept. Agric. 29 pp. 1946.
363. Upson, J. J. "Wood's Dimensional Stability Promoted by New Process." Wood and Wood Prod., 58:8(36, 38). 1953.
364. *Vinokurov, D. M. Variation in Swelling, Hygroscopicity and Chemical Composition of Wood Impregnated with Glucose During Heat and Pressure. Naucnye Trudy Ljvovskogo Lesotechniceskogo Institute No. 1 (90-103). 1954.

365. Wright, G. W. "Dimension Stabilizing Treatments for Timber."
For. Prod. News Lett., C.S.I.R.O., 230 (1-4). May, 1957.

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