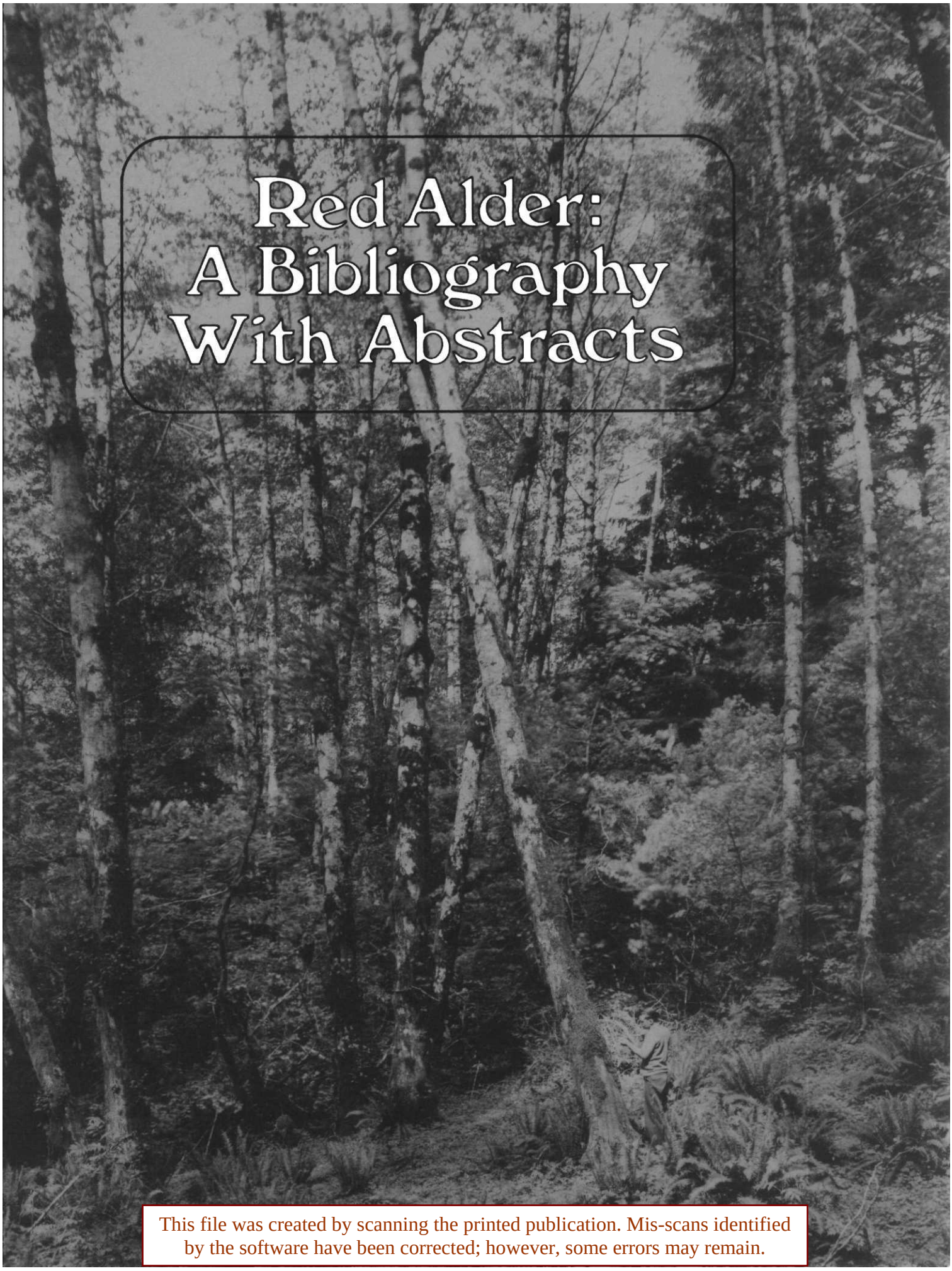

Red Alder: A Bibliography With Abstracts

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Cover photo:

A stand of red alder at Cascade Head Experimental Forest near Otis, Oregon. The trees are from **14** to 20 inches in diameter. *(U.S.* Forest Service *photo 325534)*

USDA Forest Service General Technical Report PNW-161

Red Alder: A Bibliography With Abstracts

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Abstract

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This bibliography lists 661 references to world literature through Hay 1978 containing information about red alder (Alnus rubra Bong.). Included are publications about its taxonomy, biology and silvics, chemical and physical information about its wood and fiber, studies on its nitrogen-fixing properties, and reports on industrial uses and economic considerations. Sources of cited publications are scientific journals, trade publications, special reports, and popular books. Abstracts or annotations are included for many references. Subject matter and author indexes are included.

Keywords: Red alder, Alnus rubra, bibliographies (forestry).

Introduction

This bibliography contains citations of literature containing information about red alder (Alnus rubra Bong.). It is the result of organizing references collected for several red alder projects and is offered as an aid to additional study on red alder.

Our search covered all index issues of Biological Abstracts, Chemical Abstracts, Forestry Abstracts, and Science Citation Index. We used computer bibliographic services to obtain citations from BIOSIS REVIEWS, CAB, CAIN, CHEHCON, PAPERCHEH, and CRIS data bases from the time of their establishment through May 1978. There were no articles about red alder in the journal Aliso. Bibliographies of most papers cited here were checked for articles not included in the above search procedure.

Our search was designed to exclude articles about individual fungi and diseases attacking red alder and about palynology, the study of pollen stratigraphy; however, some citations to both are included. Fungi and disease are adequately covered in the works of Browne (83), Hepting (237), Peace (445), and Shaw (511, 512, 513, 514), each of which provides further references to original papers. We include articles on red alder outside forestry to broaden the scope of usefulness and to increase the number of potential users.

Citations without abstracts or annotations are papers of lesser importance or papers not seen by us but authoritatively cited by others. These are included because of their potential value to readers. References are listed alphabetically by author. A subject matter index is included,

A copy of most cited works is on file at either the Forestry Sciences Laboratory, 3625 93rd Avenue S.W., Olympia, Washington 98502, or the Forest Land Hanagement Center, Department of Natural Resources, Olympia, Washington 98504. All are readily accessible in major libraries or through the USDA Forest Service WESTFORNET information system.

We will appreciate hearing of additional documents about red alder published before Hay 1978.

Acknowledgments

Thanks are extended to Boyd C. Wilson, Washington State Department of Natural Resources; Dean S. DeBell and Arland S. Harris, Forest Service, U.S. Department of Agriculture; John C. Gordon, Oregon State University, for permission to use their personal libraries; and to Shirley Beelik, Washington State Library, and Thelma Sameth, University of Washington Forestry Library, for their assistance. Special thanks to Dean S. DeBell and Constance A. Harrington for their help with the subject index.

ABBREVIATIONS	ABSTRACTOR
A	Author
BA	Biological Abstracts
BI	Biological Index
CFH	Charles F. Heebner
CA	Chemical Abstracts
FA	Forestry Abstracts
PO	Plant Breeding Abstracts
EO	Review of Applied Entomology, Series A
MO	Review of Plant Pathology
SO	Soils and Fertilizers
WO	Weed Abstracts

1. Abbe, Ernst C.
1935. Studies in the phylogeny of the Betulaceae. I. Floral and inflorescence anatomy and morphology. Bot. Gaz. 97(1):1–67.

"A study of the morphology and vascularization of the cymules and florets of 64 spp. and vars. of the Betulaceae from each of the genera and subgenera indicates the following: (1) The morphology and anatomy of the cymules and florets has been notably modified by dorsiventral or lateral concrescence, shortening of internodes, pressures within the ament, and reduction; (2) the bicarpellary ovaries owe their transverse or diagonal orientation to their derivation from the ancestral tri-carpellary ancestor, while the staminate florets in some spp. still are trimerous; (3) the full complement of bracts is present in the pistillate cymules of Carpinus, Ostryopsis, and Ostrya, the adaxial tertiary bract is lost from the staminate and pistillate cymules of most species of Alnus. Both adaxial and abaxial tertiary bracts have been lost from the staminate cymules of Betula, Corylus, Carpinus, Ostrya, and from the pistillate cymules of Betula. The secondary bracts have been lost, while the tertiary persist, in the pistillate cymules of Corylus. All bracts but the primary have been lost in the staminate cymules of Ostryopsis. (4) The staminate cymule is 3-flowered in all genera of the family. The pistillate cymule is 2-flowered by suppression of the secondary floret in all genera except Betula, in which all 3 florets are present. (5) The perigon is present in the pistillate florets of Carpinus, Ostrya, Corylus, Ostryopsis, and in the staminate florets of Alnus and Betula; it is obsolescent in the pistillate florets of Alnus and Betula; it is completely lost from the staminate florets of Carpinus, Corylus, and Ostryopsis. The ovary is inferior throughout the family." (BA)

2. Abbe, Ernst C.
1938. Studies in the phylogeny of the Betulaceae. II. Extremes in the range of variation of floral and inflorescence morphology. Bot. Gaz. 99(3):431–469.

"Cymules and florets whose complexity is greater or less than the average in the Betulaceae are described. The more complex cymules include: the secondary median floret in pistillate Alnus and Carpinus; adaxial quaternary florets in pistillate Alnus, and adaxial tertiary bracts in pistillate Alnus .... The more complex florets include the presence of tri-carpellary pistils in Alnus, Betula, and Ostryopsis; a hexamerous perigon and androecium in staminate Alnus and three ovule per carpel in Alnus ...." (BA)

3. Abrams, L., and Roxana S. Ferris.
1940. Illustrated flora of the Pacific States. Vol. 1. 538 p. Stanford Univ. Press, Stanford, Calif.

4. Akkermans, Antonius Dirk Louis.
1971. Nitrogen fixation and nodulation of Alnus and Hippophae under natural conditions. Ph. D. thesis. Univ. Leiden, The Netherlands. 85 p.

Detailed discussion of procedures and techniques for studying nitrogen fixation by alder in field and in laboratory. Covers both N-15 and acetylene-reduction methods. (CFH)

5. Alban, David H.
1969. The influence of western hemlock and western redcedar on soil properties. Soil Sci. Soc. Am. Proc. 33(3):453-457.

"Soils beneath very old western hemlock (Tsuga heterophylla (Raf.) Sarg.) and western redcedar (Thuja plicata Donn) trees at three sites on Washington and Idaho were compared. The sites differed in climate and parent materials, but were similar to the extent that western hemlock and western redcedar dominated the overstory. The A2-B2 sequences were generally more strongly developed under hemlock than under cedar. At two of the three sites considerable mixing of the organic and mineral soil horizons had occurred under cedar, but much less so under hemlock. Below the top 15 cm of mineral soil no large morphological differences were observed between profiles under cedar and hemlock. Soil pH, 'exchangeable' Ca, cation-exchange capacity, base saturation, and the total weight of organic horizons were greater under cedar than under hemlock. Soil N, C, Mg, and K were generally higher under cedar than under hemlock but the differences were not large. The differences between soil properties under hemlock and cedar, as well as the depth to which these differences occurred, varied from one property to another, and from site to site." (A)

6. Allan, G. G., C. S. Chopra, J. F. Friedhof, R. I Gara, M. W. Maggi, A. N. Neogi, S. C. Roberts, and R. M. Wilkins.
1973. Pesticides, pollution and polymers. Chem. Technol. 4(3):171-178.

"Ways of reducing pesticide applications using controlled release formulations, the chemistry of the controlled release from the polymeric matrix and the advantages and applications of polymerized controlled release pesticides are reviewed. In field trials, ester combinations of 2,4-DB with bark were synthesized; the polymerized pesticide resists oxidation in the soil to 2,4-D (which is more toxic to conifers than 2,4-DB) and had an extended duration of effectiveness. The polymerized 2,4-DB controlled Alnus rubra without harming Douglas-fir (Pseudotsuga menziesii)." (WO)

7. Allan, G. G., Astrid Lacitis, Fu-mei Liu, J-h Lee, and P. Hauranen.
1969. Fiber surface modification. Pt. II. Modification of ligniferous wood and bark fibers using a dichloro-s-triazine. Holzforschung 23(6):198-202.

"The application of the fundamentals of the reactive dye chemistry originally developed for textiles is proposed as a new general approach to the surface modification of wood fibers. The reactivities of a variety of lignaceous wood and bark fibers with a dihalogeno-s-triazine fiber reactive dye have been compared under conditions compatible with current board and paper manufacturing techniques. Differences in the extent of reaction are ascribed to the morphological characteristics of the fiber and to the type and amount of its lignin or phenolic group content. The dyed fibers contain a reactive monochloro-s-triazine moiety the chlorine atom of which however could not be displaced by either phenolate or thiophenolate anions. This inhibition of the chlorine displacement is attributed to a combination of steric effects due to the fiber mass and the electrokinetic repulsions occasioned by the sulfonic acid groups incidentally present as part of the structure of the reactive dye molecule.'' (A)

8. Allan, G. Graham, Chetan S. Chopra, and Robert M. Russell.
1972. Controlled release pesticides. Part 3. Selective suppression of weeds and deciduous brush in the presence of conifers. Int. Pest Control 14(2):15, 17-20.

"In the USA reafforestation with conifers is nationally retarded by the root competition offered by weeds and by the more rapidly growing deciduous brush and no satisfactory herbicide selectively toxic to these competitors has hitherto been developed. The synthesis of such a material has now been achieved by the chemical reaction of 2,4-DB with comminuted bark to afford a controlled release herbicide polymer combination. The macromolecular herbicide derivative at specific application levels did not damage Douglas-fir (Pseudotsuga menziesii) seedlings and yet had the capability of eradicating established western red alder (Alnus rubra) seedlings whilst simultaneously inhibiting weed seed germination and growth for an entire growing season. The selectivity observed is attributed to the release of 2,4-DB from combination with the bark polymers at a controlled rate which is sufficiently slow for its absorption by all plants to occur before enzymic degradation to the generally phytotoxic 2,4-D can take place in the soil." (WO)

9. Allison, G. W., and R. E. Breadon.
1960. Timber volume estimates from aerial photographs. B.C. For. Serv. For. Surv. Note 5, 25 p. Dep. Lands and For., Victoria, B.C.

10. Altmann, Th.
1940. Die erle als verwald. Forstarchiv 16 (6/7):92-93.

"Large areas of pine forest in the Nuremberg Reichswald were killed by the pine looper in the 1890's and the young stands established on the same areas were largely destroyed by Panalis flammea when about 30 years old. Pine monoculture accounts for the severity of the damage. To avoid such losses in the future, pine, spruce, and alder were mixed in the recent plantations. Both red and white alder grew vigorously on the coarse sandy soil where it was plowed deeply, limed, and cleared of competing vegetation. The alder created favorable conditions for the conifers, which promise to make a highly productive forest, resistant to insect attack. Black locust and Canadian poplar were also tried as nurse trees, but suffered from frost and drought. Birch was almost as good as alder, but was heavily browsed by deer." (BA)

11. Amchem Products, Inc.
1960. Amitrol, benzac, and combinations of both for control of woody plants. Tech. Serv. Data Sheet, Ambler H-79, 5 p.

"Presents a list, compiled from published and unpublished work, of wood plants susceptible (i.e., kill of 85% of the stem, with little or no regrowth after 2 growing seasons) to various rates of Amizol (90% active water-soluble formulation of amitrol), Benzac 1281 (2 lb./gal. triethylamine salt of 2,3,6-TBA) or a mixture of the two. Results from unpublished work were: Acer macrophyllum and Rubus spp. susceptible to Amizol 4 lb./100 gal.; R. spectabilis, Alnus rubra, A. macrophyllum, Salix spp., Tsuga heterophylla, and Abies grandis susceptible to Benzac 1281 4 lb./100 gal." (FA)

12. Amchem Products, Inc.
1962. Oil-soluble amines of 2,4-D and 2,4,5-T for the control of woody plants and broadleaf weeds. Tech. Serv. Data Sheet, Ambler E-162, 15 p.

"Volatility studies comparing various low-volatile ester, acid and water- and oil-soluble amine formulations of 2,4-D and 2,4,5-T are summarized, and methods of application to various weed and brush species used in comparisons of different oil-soluble and standard formulations of 2,4-D and/or 2,4,5-T and fenoprop are given. Tables give data of the degree of control of a wide range of different week, brush and tree species obtained by the use of the oil-soluble amine formulations. The tree and brush species included Sassafras albidum, Quercus borealis, Q. marilandica, Q. falcata, Q. stellata, Q. alba, Prunus serotina, Nyssa sylvatica, Liriodendron tulipifera, Acer rubrum, Robinia pseudoacacia, Fraxinus americana, Q. ilicifolia, Hamamelis virginiana, Rubus spp., Malus spp., Cornus florida, C. paniculata, Ulmus americana, Carya spp., Sambucus canadensis, Crataegus spp., Salix spp., Viburnum spp., Rhus glabra, Pinus ponderosa, Picea sitchensis, Populus sp., Pseudotsuga taxifolia, Tsuga heterophylla, Alnus rubra, Gualtheria shallon, Mahonia aquifolium, Ceanothus velutinus, Abies grandis, Rubus leucodermis, Rubus spectabilis, Liquidambar styraciflua and Tamarix pentandra. The results of volatility studies indicated that at high temperatures the oil-soluble amine formulations were considerably less volatile than the low-volatile esters, and were of about the same volatility as the water-soluble amines. In three trials in which low rates and spray volumes were used, the oil-soluble amines did not appear to be as effective as the low-volatile esters, and approximated to the water-soluble amines in effect. The reasons for this were not apparent. Against woody plants, the greater effectiveness of oil-soluble amines when concentrated around the root-collar zone, compared with applying them as stem-foliage sprays, was noted. It was concluded that the oil-soluble amines offer major advantages over water-soluble amines. They can be used in oil, oil/water, and water carriers, and, at high temperatures, the oil-soluble amines of phenoxy compounds can be expected to show only low volatility hazards, compared with standard formulations." (FA)

13. American Forestry Association.
1973. AFA's social register of big trees. Am. For. 79(4):21-74.

Largest red alder near Gardiner, Oregon, found by Francis Kimmey of Veneta, Oregon, is 15 feet in diameter at breast height, 99 feet high, with a spread of 76 feet. (CFH)

14. American Plywood Association.
1974. U.S. Product Standard PS 1-74 for construction and industrial plywood with typical APA grade-trademarks. 35 p. Prod. Stand. Sect., Natl. Bur. Stand., Tacoma, Wash.

Describes manufacturing standards for plywood. Red alder is acceptable and is interchangeable with all species within group 3. (CFH)

15. Andersen, H. E.
1955. Alder control on cutover areas. Alaska For. Res. Cent. Tech. Note 25, 1 p.

"Alder on a deep alluvial flat, logged in 1954, was treated by poisoning with NH_4 sulphamate, applied in cups at 8-in. intervals round the root collar

or, for smaller trees, by felling and poisoning the stumps. Treatment was on 22 June, and at the end of 2 months the cambium was dead in practically all trees. No viable seed was produced by the treated trees." (FA)

16. Anderson, B. G., and R. G. Frashour. 1954. Sticker stain in one-inch red alder lumber. For. Prod. Res. Soc. J. 4(3):133-135.

"Experiments showed that stain developing at sticker crossings in air-drying 1 inch Alnus rubra could be prevented by steaming the stickered lumber beforehand, and that this treatment also gave a desirable and uniform colour in the timber after final drying. Optimum treatment appeared to be 140° F. dry-bulb temperature and 4° F. wet-bulb depression and a minimum steaming time of about 18 hours. This method allows full advantage to be taken of air-drying during the summer without loss caused by stain or undesirable colour, and a reduction of 2-4 days in total kilning time." (FA)

17. Anderson, B. G., and R. G. Frashour. 1954. Sticker stain in one-inch red alder lumber. Rep. Oreg. For. Prod. Lab. D-3, 6 p.

"Experiments showed that stain developing at sticker crossings in air-drying 1-in. Alnus rubra could be prevented by steaming the stickered lumber beforehand, and that this treatment also gave a desirable and uniform colour in the timber after final drying. Optimum treatment appeared to be 140° F. dry-bulb temperature and 4° F. wet-bulb depression and a minimum steaming time of ca. 18 hr. This method allows full advantage to be taken of air-drying during the summer without loss caused by stain or undesirable colour, and a reduction of 2-4 days in total kilning time." (FA)

18. Andrews, H. J., and R. W. Cowlin. 1940, Forest resources of the Douglas-fir region. U.S. Dep. Agric. Misc. Publ. 389, 169 p. U.S. Gov. Print. Off., Washington, D. C.

Contains two red alder volume tables. (CFH)

19. Angulo, A. F., C. van Dijk, and A. Quispel. 1976. Symbiotic interactions in non-leguminous root nodules. In Symbiotic nitrogen fixation in plants, p. 475-483. P. S. Nutman, ed. Cambridge Univ. Press, England.

A general discussion of the biology of the alder root endophyte. The life cycle, probable method of infections, and techniques for cultivation of the root endophyte are covered. (CFH)

20. Apsey, T. Michael. 1961, An evaluation of crown widths of open-grown red alder as an aid to the prediction of growth and yield. B.S.F. thesis. Univ. B. C., Vancouver. 67 p.

"The growth and yield of Alnus rubra was studied, and crown-width/d.b.h. relationships were determined for both (1) open- and (2) close-grown trees. It was shown that, for both (1) and (2), most of the variation in crown width was accounted for by d.b.h., and a crown-width yield table was developed. Several multiple-regression equations were derived to provide estimates of radial growth, (a) 1-5 years ago, and (b) 6-10 years ago. It was found that for (1) most of the variation in radial growth (a) was accounted for by the variables total age and radial growth (b). For (2), however, most of the variation in radial growth (a) was accounted for by the variables d.b.h. and % live crown." (FA)

21. Arkwright, Peter.
1963. Know your timber. Woodworking Ind. 20(1-3):45, 89, 151.

"Rock elm (Ulmus thomasii); Opepe (Sarcocephalus diderrichii); and Western Red Alder (Alnus rubra)." (FA)

22. Atkinson, William A., and Willard I. Hamilton.
1978. The value of red alder as a source of nitrogen in Douglas-fir/alder mixed stands. **In** 'Utilization and management of alder, p. 337-351. David G. **Briggs**, Dean **s**. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Numerous studies of forest fertilization have demonstrated that Douglas-fir stands in the Pacific Northwest and British Columbia grow better when fertilized with nitrogen. Since the long-term outlook for fertilizer supply and cost is uncertain, foresters should be examining alternatives for maintaining and increasing forest productivity. Several nitrogen-supplying species of plants exist, of which red alder is the most interesting. Alder not only imparts significant amounts of nitrogen to the forest soil, but also is a tree of increasing value for wood products."

"This paper examines the economic value of alder both as a source of nitrogen and for its wood value. Three approaches are taken: (1) An economic analysis is made of existing research plot data on the Wind River Experimental Forest. Results are contrasted with the alternative of artificial fertilization. (2) Investigations of the nitrogen supplying capability of red alder reveal that relatively few alders are needed in order to supply Douglas-fir with its nitrogen needs. (3) A general model is proposed for evaluating alder's place in Douglas-fir forest management. Data requirements are identified.*' (A)

23. Atterbury, Toby.
1978. Alder characteristics as they affect utilization. **In** Utilization and management of alder, p. 71-81. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The utilization of red alder in the Pacific Northwest is tied to its location, yield, tree size, and wood properties. Up to the present time, conifers have been utilized and managed because they are more profitable. When the older stands of large conifers are harvested, alder may become fully utilized on its **own** merits." (A)

24. Baber,,A. A., and G. L. McCall.
1974. "Krenite" – a new brush control agent. West. Soc. Weed Sci. Proc. 27:4-5.

"Foliage sprays of Krenite (ammonium ethyl carbamoylphosphonate) made after the main flush of annual growth has hardened, eliminate unwanted brush without unsightly discoloration. Leaf fall of susceptible plants occurs normally in the autum but subsequent bud development is prevented or severely limited and stems and roots eventually die. Effective rates range from 4-8 lb/acre (aerial application) and from 2-6 lb/acre (ground application). Susceptible brush plants include Acer circinatum, Alnus rubra, Rubus spectabilis, Quercus spp., Eucalyptus spp., and Sequoia sempervirens. Herbaceous plants and broad-leaved evergreens are not affected." (WO)

25. Baird, P. K., J. S. Martin, and D. J. Fahey.
1955. Bond and magazine book papers and milk-carton paperboard from old-growth Douglas-fir and red alder pulps. USDA For. Serv. For. Prod. Lab. Rep. 2042, 13 p. Madison, Wis.

"Experimental processes tried at Madison point to the possibility of commercial application of Douglas-Fir bleached sulphate pulp, with or without Red-Alder pulp (groundwood, chemiground, or neutral sulphite)." (FA)

26. Baker, William J.
1951. Some factors involved in the promotion of alder-using industries in Tillamook, Oregon. Oreg. For. Prod. Lab. Spec. Rep. 1, 35 p. Sch. For., Oreg. State Coll. [Univ.], Corvallis.

27. Balci, A. N.
1964. Physical, chemical, and hydrological properties of certain western Washington forest floor types. Ph. D. thesis. Univ. Wash., Seattle. 206 p.

"Two major types--(a) mor, (b) duff mull--from 5 major areas of old-growth coniferous forests were studied. Distinct differences observed were: (1) Total weight and depth were greater for (a) then for (b). (2) Ignition losses of (a) were significantly greater, because (b) has a higher mineral dilution due to a gradual transition of the H layer to the A_1 horizon. (3) (a) had higher moisture constants and lower bulk densities then (b). (4) In the same rainfall conditions, the hydrograph for (a) had more gentle slopes on both ascending and recession periods; the shape of the hydrograph was affected by the depth of the forest floor. (5) Concentrations of N, P, and K were higher in (b), and total C, specific conductance, and C/N ratios in (a). These characteristics are believed to be indicative of differential decomposition rates, leaching of elements and age of forest floor. (6) (a) was more acid than (b). Rainfall of 15 cm/hour was transmitted at the same rate in (a) and (b), and both types had a higher effective saturation capacity at the steady-flow stage under 15 cm than under 2-3 cm rain/hour. In a study from October to May in (c) a young Red Alder stand and (d) Douglas Fir, the forest floor of (c) decomposed more rapidly and there were greater monthly fluctuations in the elemental composition of (c) leachates; (c) forest floors imparted a much darker colour to the natural waters than (d), but leachates of both were coloured far above permissible limits for domestic use. The pH of the surface water was low for (c), and leachates from (c) had higher concentrations of N, P, K, Ca, Mg and tannin and lignin compounds. The magnitude of elemental release from the forest floor of (c) was K > Ca > Mg > N > P, and that of leaching of nutrients beyond the 15-cm level was Ca > Mg > K > N > P." (FA)

28. Balci, A. N.
1973. Physical, chemical and hydrological properties of certain western Washington forest floor types. Istanbul Univ. Orman Fak. Yayin. 200, 159 p.

"The full version of work already noticed from a dissertation abstract on the characteristics of the forest floor under old-growth conifer stands and a 30-year-old Alnus rubra stand, and including a brief general review of the morphological classification and properties of forest floor and humus types." (FA)

29. Barber, Paul, Marvin Noble, and Juel Sheldon.
1978. Buyer's perspective on public agency timber sale procedures for alder. (Abstr.) **In** Utilization and management of alder, p. 83. David G. Briggs, Dean S. Debell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

30. Barrett, R. E.
1932. New coleoptera from California. Pan-Pac. Entomol. 8(4):171-172.

"Dendroides pacificus (p. 171), breeding in trunk of Alnus rubra, also inhabited by Platycerus oregonenis; Tamnochila sonorana (p. 171), under bark of Prosopis juliflora glandulosa; Aphodius sparsus ssp. shaldoni (p. 172), in nests of wood rat, Neotoma." (BA)

31. Becking, J. H.
1965. **In** vitro cultivation of alder root-nodule tissue containing the endophyte. Nature 207(4999):885-887.

"Though culture **in** vitro of root-nodule tissue containing the endophyte was successful, the main object of the **investigation**--culture of the effective **nodule**-endophyte of Alnus plutinosa in symbiosis with its host **in** vitro--was not achieved. The root-nodule tissue grown ~~in vitro~~ and containing its endophyte is a simpler system than that obtained in leguminous symbiosis." (FA)

32. Becking, J. H.
1966. Interactions nutritionelles plantes-actinomycetes. [Nutritional interactions between plants and actinomycetes.] Rapp. Gen. Ann. Inst. Pasteur (Paris) Suppl. 111:211-246. [In French. English summary.]

"The present report reviews the available information about non-leguminous plants which have the capacity to fix molecular nitrogen. Many unpublished results obtained by the author are included.

"An enumeration is given of the nodule-bearing non-leguminous plants, the nodule-bearing habits within each group, the cross-inoculation groups and the biological function of the root nodules.

"A brief survey is given of the biochemical characteristics of the root nodules, the nodule morphology and cytology. A morphological and cytological description of the endophyte is given. Experiments are described for the isolation of the endophyte with the aid of root-nodule tissue cultures." (A)

33. Becking, J. H.
1968. Nitrogen fixation by non-leguminous plants. Dutch Nitrogen Fert. Rev. 12:47-74.

34. Becking, J. H.
1970. Frankiaceae fam. nov. (Actinomycetales) with one new combination and six new species of the genus Frankia Brunchorst 1886, 174. Int. J. Syst. Bacteriol. 20(2): 201-220.

"The purpose of this publication is to propose a new taxonomic treatment of an important group of bacteria, which produce nodules on the roots of non-leguminous dicotyledons. The root nodule, product of the symbiosis of host and

bacteria, is able to fix atmospheric nitrogen. A single family, a single genus, and ten species are recognized." (A)

35. Becking, J. H.
1972. De betekensis van de rode els (Alnus rubra) voor de teelt van de douglasspar (Pseudotsuga menziesii). [The role of the red alder (Alnus rubra) in the cultivation of the Douglas-fir (Pseudotsuga menziesii.] Ned. Bosbouw Tijdschr. 44(5):132–137. [In Dutch.]

"Reviews experience in the USA and discusses the desirability of trials of mixtures of A. rubra and P. menziesii in Europe." (FA)

36 Behm, R. D.
1978. Developing new alder markers. In Utilization and management of alder, p. 157–161. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg,

"Attitude toward alder will play an important role in its future. Alder must be recognized as a species which produces a positive contribution to the local economy. The alder image can be improved by dropping the word 'red' from its name and by promoting it as an alternate to other woods rather than a cheap substitute. The attitude of prospective buyers of alder will improve as the local industry improves delivery, quality control, and promotional efforts." (A)

37. Bene, John.
1950. Douglas fir substitutes for the British Columbia plywood industry. B.C. Lumberman 34(8):49–50, 145.

"This paper...discusses the possibility of using Hemlock and Cedar and other conifers, tropical harwoods, and, in more detail, some West Coast hardwoods (Populus trichocarpa, Betula papyrifera var. occidentalis, Acer macrophyllum and Alnus rubra) for plywood. The importance of hardwoods in the veneer industry is emphasized. (FA)

38. Berg, Alan, and Allan Doerksen.
1975, Natural fertilization of a heavily thinned Douglas-fir stand by understory red alder. For. Res. Lab. Res. Note 56, 3 p. Oreg. State Univ., Corvallis.

"Describes the natural establishment of Alnus rubra under a 62-year-old Pseudotsuga menziesii stand in Oregon after a heavy thinning in 1955. Growth of the A. rubra understorey was rapid, but examination in 1972 showed that the overstorey canopy was closing and many of the understorey trees were dead. Soil analyses showed that a dense understory of A. rubra added ca. 780 lb total N/acre in the top 6 inches. It is suggested that A. rubra could be introduced either naturally or artificially to increase the N content of the soil in similar conditions." (FA)

39. Berg, Alan B., ed.
1972. Managing young forests in the Douglas-fir region. Vol. 3. Sch. For. Pap. 734, 224 p. Oreg. State Univ., Corvallis.

"These printed proceedings include 8 tech. repts. by different authors, descriptions of several field trips (to pulp and lumber cos., govt. forestry agencies, and the Willamette Natl. Forest), a banquet address on foresters' relations with the public and a final discn. session on the management of young timber stands. The tech. presentations dealt with management of Douglas-fir in Europe, the role of alder in improving soil fertility and growth of assocd. trees, regulation of soil organisms (control of Poria weirii) by red alder, economics and marketing of alder, admin. of thinning contracts and of partial-cut sales, econ. guides for intensive forest management, and foresters' approaches to the marking of trees for thinning. A good subject index is appended." (FA)

40. Bergman, Stuart I.
1949. Lengths of hardwood fibers and vessel segments: A statistical analysis of 49 hardwoods indigenous to the United States. Tappi 32(11):494-498.

"Up to 4 samples of each of 49 indigenous hardwoods were macerated and the lengths of fibres and vessel segments were measured. The results were tabulated, the woods being classified according to fibre and vessel-segment length. The results show that: (1) the difference between average lengths of fibre and vessel segments of 2 samples of the same species may be greater than the corresponding differences for 2 samples from different species; (2) wider sampling is necessary before a mean and standard deviation for lengths in a particular species can be obtained--samples from different parts of the same tree and from trees from varying sites and districts would be needed; (3) there is a high degree of positive correlation between the lengths of the fibres and those of the vessel segments." (FA)

41. Berntsen, Carl M.
1954. Some results of chemical debarking on Sitka spruce, western hemlock, and red alder. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Note 104, 7 p. Portland, Oreg.

"Out of 4 chemicals brushed on to b.h. band girdles in July-August, only undiluted Na arsenite gave 100% kill for Sitka and Hemlock (100 years old) within 2 months, bark being readily removable (except below the girdle) within 1 year. Alder bark, however, often remained tight. A basal spray of Alder with 2,4-D and 2,4,5-T (2%) in diesel oil killed several 30-year-old trees in 2 years and the others appeared to be dying." (FA)

42. Berntsen, Carl M.
1958. A look at red alder--pure, and in mixture with conifers. Soc. Am. For. Proc. 1958:157-158.

"Reports on test plots established in 1935-37 in mixed stands aged 8-12 years. In the control plots (1) there were ca. 3000 stemslacre; (2) was thinned to 2000 stems, and (3) to 733 stemslacre of pure Alder, and (4) to 1148 stemslacre of pure conifers (Sitka Spruce, Douglas Fir, and Western Hemlock). At 30 years, volumes and c.a.i. (in bd. ft.) were respectively: 2900 and 260 for (1), ca. 3300 and 260 for (2) and (3), and 4300 and 400 for (4)." (FA)

43. Berntsen, Carl M.
1961. Growth and development of red alder compared with conifers in 30-year-old stands. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Pap. 38, 20 p. Portland, Oreg.

Treatments were as follows: (1) pure alder, unthinned; (2) mixed alder-conifer, unthinned; (3) pure alder, thinned from an alder-conifer stand at age 11 years; and (4) pure conifer, thinned from an alder-conifer stand at age 8. Major results were: By age 29 years, the slow-starting pure conifer stand had about equaled the volume of the 32-year-old, unthinned, pure alder stand and had surpassed the yield of the thinned, pure alder and unthinned alder-conifer stands. Yield of the thinned, pure alder stand at age 31 was about 13 percent less than that of the unthinned, pure alder stand. Yield of the unthinned alder-conifer stand at age 29 was the lowest of all the experimental stands. (CFH)

44. Berntsen, Carl M.
1961. Pruning and epicormic branching in red alder. J. For. 59(9):675-676.

"Dissected trunk sections showed that pruning scars on trunks of red alder trees (Alnus rubra) healed rapidly, but formation of clear wood was limited by development of epicormic branches. Bud strands, originating in the leaf axil on the main stem elongated radially with each annual layer of wood. Bud-producing tissues at the terminal point of these strands gave rise to epicormic branch development in response to a certain physiological release triggered by the pruning treatment." (FA)

45. Berntsen, Carl M.
1962. A 20-year growth record for three stands of red alder. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Note 219, 9 p. Portland, Oreg.

"Compares with yield-table data the growth between the 21st and 41st years of natural stand viz. (a) two stands released from a light overstorey of Douglas Fir (by girdling), one only of which was then thinned, and (b) a pure Alder stand unthinned. The volume of (b)--4423 cu. ft./acre--at year 41 exceeded that of the tables. Thinning did not stimulate growth and it is considered that natural thinning could be relied upon in this intolerant species." (FA)

46. Besley, L.
1966. Importance, variation, and measurement of wood density and moisture. Woodland Res. Index Pulp and Pap. Res. Inst. Can. 182, 30 p.

"Reviews, in relation to the substitution of weight measurement for volume determination, some of the world literature on variation in wood density (w.d.) and moisture content (m.c.) found in pulpwood as delivered to mills, and as occurring between forest stands, trees species, individual trees of the same species, and various positions in the same tree. Values for 30 softwoods and 23 hardwoods, as reported by several investigators, are tabulated, including differences up the tree and radially, at the same height, across the sapwood and heartwood, and across the early and late wood of individual growth rings. The effects of season on m.c. in the standing tree, and of time since cutting on m.c. in the harvested tree or pulpwood, are also reported. Some methods and instruments now in use for measuring w.d. and m.c. are briefly discussed. Finally, a suggestion

is made for direct conversion, on a periodic basis, of the wet weight of rough wood to its ovendry equivalent in usable wood fibre, using the average ratios for different seasons in the year, and different drying periods, obtained from tests on sample disks, and thus avoiding the intermediate steps of separately determining bark weight, and basic density and m.c. of the wood." (FA)

47. Betts, H. S.
1960. American woods red alder. Am. Woods, 4 p. USDA For. Serv. Washington, D.C.

"Distribution and growth, supply, production, properties and uses of the following: ... Alnus rubra ... .*' (FA)

48. Bishop, Daniel H., Floyd A. Johnson, and George R. Staebler.
1958. Site curves for red alder. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Note 162, 7 p. Portland, Oreg.

"This preliminary report presents site-class curves (60 to 120 ft. by 20-ft. classes) for Alnus rubra, developed during yield-table construction and based on stem analyses of 43 trees from a representative spread of site conditions in W. Washington." (FA)

49. Bodig, J.
1965. The effect of anatomy on the initial stress-strain relationship in transverse compression. For. Prod. J. 15(5):197–202.

"Continuously recorded stress-strain curves and photographs taken simultaneously at differenct stages of compression of four species of different anatomical characteristics demonstrated the importance of anatomy and direction of loading in the determination of the stress-strain relationship of wood in transverse compression. Explanations and theories are given for the mechanisms of failures in radial and tangential cornpression, for the presence or absence of maximum stress points, and for the initial curvature of the stress-strain curves. The weak layer theory in radial compression and the spaced column behavior in tangential compression has been discussed and illustrated." (A)

50. Bollen, W. B., C. S. Chen, K. C. Lu, and Robert F. Tarrant.
1968. Effect of stemflow precipitation on chemical and microbiological soil properties beneath a single alder tree. In Biology of alder, p. 149–156. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. H. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Stemflow from a red alder trees had a substantially greater concentration of nitrogen and dissolved solids and slightly lower pH than gross rainfall. On a weight/area basis, however, the contribution of nutrient ions in stemflow was very small compared to that in gross rainfall or throughfall. No evidence was

found to indicate that enriched stemflow affected chemical and microbial properties of soil at a distance of only 2 feet from the stem. Results of this study support previous demonstration of a narrow absorption area about the tree stem as the total soil area affected by stemflow." (A)

51. Bollen, W. B., and K. C. Lu. 1957. Effect of Douglas-fir sawdust mulches and incorporations on soil microbial activities and plant growth. Soil Sci. Soc. Am. Proc. 21(1):35-41.

"Gives data on the decomposition rate, measured by CO_2 production in soil respiration tests, and other chemical data, including C/N ratios, for various organic materials used as mulches and fertilizers, relative figures for decomposition in one test being: wheat-straw 48, sawdust of Red Alder 40, of Ponderosa Pine, and Western Red Cedar 33, of Douglas Fir 30 and of Western Hemlock 27, Douglas Fir resin 30, and Douglas Fir bark, 26. Added N hastened decomposition of substances with a high C/N ratio, though it generally depressed cumulative evolution of CO_2.

"Owing to its low content in both N and available C, resulting in slow decomposition, Douglas Fir sawdust has a less depressive effect on plant growth through induced N deficiency than was commonly found in substances with high C/N ratios. At 10 tons/acre, it significantly increased first crop yields, though at 100 tons (a 5-in. layer) it depressed them. Ponderosa pine sawdust and Douglas Fir bark at 10 tons/acre depressed yields, but added N produced increases over untreated crops in all cases." (FA)

52. Bollen, W. B., and K. C. Lu. 1968. Nitrogen transformations in soils beneath red alder and conifers. In Biology of alder, p. 141-148. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Transformations of nitrogen in organic matter in the soil are essential to plant nutrition because nitrogen in the form of proteins and other organic compounds is not directly available. These compounds must undergo microbial decomposition to liberate nitrogen as ammonium (NH^+_4) and nitrate (NO^-_3), which can then be absorbed by plant roots.

"Nitrogen transformations, particularly nitrification, are rapid in soils under coastal Oregon stands of red alder (Alnus rubra Bong.); conifers--Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco), western hemlock (Tsuga heterophylla (Raf.) Sarg.) and Sitka spruce (Picea sitchensis (Bong.) Carr.); and mixed stands of alder and conifers. Nitrification is especially rapid in the F layer beneath alder stands despite a very low pH. These findings are from a study of contributions to the nitrogen economy by red alder conducted at Cascade Head Experimental Forest near Otis, Oregon." (A)

53. Bollen, W. B., and E. Wright. 1961. Microbes and nitrates in soils from virgin and young-growth forests (east and west of the Cascade Mountains and along the U.S. Pacific coast). Can. J. Microbiol. 7(5):785-792.

"Penicillium spp. predominated in samples of forest soils, except occasionally at depths of > 3 in., when Mucor and Aspergillus spp. were sometimes more abundant. Incubation for 30 days at 28° C and 50% moisture capacity frequently increased the % of Mucor as well as of Penicillum spp. Mucor spp. were consistently more predominant in soils associated with Alder than in other coastal soils. Mucor and Aspergillus spp. also appeared often in soil from stands of Ponderosa Pine growing E. of the Cascades. The greatest concentration of N as NO3 in unincubated soils was found in a young Red Alder stand. Samples of soil from stands of virgin coastal Redwood showed no NO_3-N. Soils from stands of virgin Sitka Spruce, however, showed considerable NO3 content, which increased markedly with incubation. With few exceptions, bacteria and actinomycetes were most numerous in the F soil horizon. Incubation greatly increased these populations in most soils." (FA)

54. Bollen, Walter B. 1953. Mulches and soil conditioners: Carbon and nitrogen in farm and forest products. J. Agric. and Food Chem. 1(5):379-381.

"The nitrogen content of organic matter used as mulches or soil conditioners not only influences rate and extent of their decomposition and humidification but also determines the available nitrogen released or required. Data on the carbon-nitrogen ratio of such materials are therefore essential for decomposition studies and for predicting additional nitrogen requirements for optimum microbial activitiy. Carbon-nitrogen values are also indicative of B.O.D. and pollutional potentials of organic wastes dumped into streams. Carbon-nitrogen values were determined for 55 agricultural and forest wastes used on soils in the Pacific Northwest. All coniferous wood wastes are similar in containing approximately 50% carbon and little nitrogen. Hay and straw average 45% carbon and also are low in nitrogen. Young plants and leguminous materials are higher in nitrogen, decompose readily, and liberate nitrogen in available form. Wood, straw, and similar residues of wide carbon-nitrogen ratio decompose slowly, demanding available nitrogen in inverse proportion to resistant components. With much lignocellulose and little water-soluble substance present, the carbon-nitrogen ratio is of secondary importance in controlling microbial decomposition." (A)

55. Bollen, Walter B., Chi-Sin Chen, Kuo C. Lu, and Robert F. Tarrant. 1967. Influence of red alder on fertility of forest soil: Microbial and chemical effects. Oreg. For. Res. Lab. Res. Bull. 12, 6 p. Oreg. State Univ., Corvallis.

"A detailed study of ways in which Alnus rubra contributes to the fertility of a forest soil. Microbial and chemical characteristics of the soil were determined at seasonal intervals from April 1962 to March 1963 in stands of (a) pure Alder, (b) pure conifers and (c) an Alder/conifer mixture, in Cascade Head Experimental Forest on the Oregon coast. Moulds were more numerous in the F layers than in the All horizon, and usually lowest under (b). Numbers of bacteria (including Streptomyces spp.) were high under (b) and low under (c), with peaks

in September in the F layers of (a) and (b); changes under (c) were mostly small. Streptomyces spp. (which produce antibiotics) were most prominent under (c) at all seasons; attention is drawn to the possible importance of this in relation to inhibition of fungal pathogens on conifer roots. The lowest pH values were usually found in soils under (a), and the highest in the F layer under (b). The pH of All horizons was generally higher than that of F layers and more variable seasonally, the highest values being recorded in July. Nitrate N and acidity were always higher under (c) than (b), indicating the greater probability of inhibition of root-rots and soil-borne diseases in (c). Exchangeable Ca was less abundant in soil under (a) and (c) than under (b). More litter, with a narrower C/N ratio, was contributed by (a), partly because of an abundant understorey. N transformations were vigorous in all the soils; total N was greater under (a) and (c) than under (b). A brief survey of the literature is given in the appendix." (FA)

56. Bond, G.
1955. An isotopic study on the fixation of nitrogen associated with nodulated plants of Alnus, Myrica, and Hippophae. J. Exp. Bot. 6(17):303-311.

57. Bond, G.
1956. Evidence for fixation of nitrogen by root nodules of alder (Alnus) under field conditions. New Phytol. 55(2):147-153.

Describes apparatus for determining N fixation of intact Alnus glutinosa root nodules in the field. Results show that field root nodules regularly fix nitrogen. (CFH)

58. Bond, G.
1864. Isotopic investigations of nitrogen fixation in non-legume root nodules. Nature, Lond. 204(4958):600-601.

"Earlier experiments showed that when 10% of N is present in the supplied atmosphere (total pressure 1 atm) fixation is detached nodules of Alnus, Casuarina, Myrica, and Hippophae is depressed if the % of O is > 20. In a further experiment with Casuarina nodules, the extent of this inhibition by O in the presence of increased gaseous N was investigated. Results with 10% N were similar to those already reported. With 30% N, the inhibitory effect of increasing O tension was considerably mitigated. This could be explained by competition between O and N at some stage in the fixation process. Other aspects under investigation are the N-fixing capacity of excised and of homogenized nodules, and the path of translocation of fixed N in the nodulated plant (it is tentatively suggested that this normally occurs through the xylem,, at least in Alnus and Hippophae)." (FA)

59. Bond, G.
1967. Fixation of nitrogen by higher plants other than legumes. Ann. Rev. Plant Physiol. 18:107-126.

Review of the taxonomy, cytology, and ecology of nitrogen-fixing root endophytes. Discusses practical and ecological aspects. Has separate sections on mycorrhizal plants and leaf bacteria. (CFH)

60. Bond, G.
1970. Fixation of nitrogen in non-legumes with Alnus-type root nodules. In Nitrogen nutrition of the plant, p. 1-8. E. A. Kirby, ed. Agric. Chem. Symp. Leeds 2. Waverly Press, Leeds Univ., England.

"Casuarina, Elaeagnus and other angiosperms possess root nodules inhabited either by Rhizobium or filamentous bacteria, these nodule types showing many physiological and biological resemblances. The **N-fixing** non-legumes, e.g. Alnus jorullensis, Dryas drummondii and Myrica cordifolia, are considered to be of great ecological and economic importance in providing N in regions occupied by natural vegetation." (FA)

61. Bond, G.
1971. Root-nodule formation in non-leguminous angiosperms. Plant and Soil Spec. Vol. 1971:317-324.

"Investigations in progress, as part of the IBP, have confirmed or established the fixation of N by a number of non-leguminous species, including Alnus jorullensis, Myrica cordifolia, and **M.** pilulifera. Information is given on diurnal variations in the rates of N fixation of some non-legumes, with the results of analyses of the amino-acid composition of the nodules.** (FA)

62. Bond, G.
1974. Root-nodule symbioses with actinomycete-like organisms. **In** The biology of nitrogen fixation, **p.** 342-378. **A.** Quispel, ed. North-Holland Publ. Co., Amsterdam.

Red alder is among the species discussed in relation to nitrogen fixation by root nodule endophytes. (CFH)

63. Bond., G.
1976. The results of the IBP survey of root-nodule formation in non-leguminous angiosperms. **In** Symbiotic nitrogen fixation in plants, p. 443-474. P. S. Nutman, ed. Cambridge Univ. Press, England.

Lists species of Alnus and other non-leguminous genera found to have root nodules in a worldwide survey in 1967. (CFH)

64. Bond, G., W. W. Fletcher, and T. P. Ferguson.
1954. The development and function of the root nodules of Alnus, Myrica, and Hippophae. Plant and Soil 5:309-323.

Report of work with Alnus glutinosa. In alnus, the optimum pH for growth of nodulated plants is lower than for nodule initiation. The effect of ammonium-nitrogen in the culture solution was to increase plant and nodule development, but the ratio of nodule weight to plant weight was decreased. (CFH)

65. Bongard, Heinrich Gustav.
1833. Observations sur la végétation de l'ile de Sitcha. Akad. Sci. St. Petersb. Mem. Sci. Math. Phys. Nat. Ser. 6 II:119-177.

The original description of red alder as a species. (CFH)

66. Borden, J. H., and W. F. Dean.
1971. Observations on Eriocampa ovata L. (Hymenoptera: Tenthredinidae) infesting red alder in southwestern British Columbia. J. Entomol. Soc. B. C. 68:26-28.

**Observationson the biology of Eriocampa ovata (L.) on Alnus rubra in British Columbia indicated that in this province, as in Quebec, the species is bivoltine and parthenogenetic and overwinters as a prepupa. In British Columbia, the first-instar larvae were found to emerge on the lower sides of the leaves and to pass through 6-7 instars rather than the 5-6 recorded in Quebec. It was noted that defoliation of the tree characteristically left only the midrib and main secondary veins and that in limited areas small trees might be completely defoliated." (EO)

67. Bornebusch, C. H.
1943. H. Forskellige Bladarters Forhold til Omsaetningen i Skovjord. [The influence of leaves of different species on decomposition in the forest soil.] (Abstr.) Forstl. Forsgsvaesen Dan. 16:265-272. [In Danish. German summary.]

68. Brackett, Michael.
1973. Notes on tarif tree volume computation. State Wash. Dep. Resour, Resour. Manage. Rep. 24, 26 p. Olympia, Wash.

69. Bramhall, G., Compiler.
1966. Wood marine piling symposium. II. Transcript of symposium held at the University of British Columbia on May 30, 1966. For. Prod. Lab. Inf. Rep. VP-X-9, 108 p. Vancouver, B. C.

"A collection of 9 papers, with discussion on each, comprising: Marine borers in B.C. coastal waters ...: Procurement and treatment of marine piling ...: Effect of incising on penetration of creosote in Western Hemlock piles ...; A comparison of the assay and multiple boring methods of inspecting Douglas Fir marine piling ...; Marine exposure tests of pressure-treated Douglas Fir and Southern Pine ...; Combination treatments for marine piles ..., Immersion studies on copper chrome arsenate (Boliden K-33 salts) in Pacific coast waters ... [tabulates and discusses results (generally promising) of trials of timber and poles of Alnus sp., ... at different localities along the coast]; Leaching rates and threshold values of wood preservatives in marine exposure blocks ...; and Problems and techniques in pile driving ..." (FA)

70. Brayshaw, T. C.
1960. Key to the native trees of Canada. Can. Dep. For. Bull. 125, 43 p.

"Includes (1) general key to the trees, (2) general key to deciduous trees in winter, (3) separate keys to the genera ... Alnus ... ." (FA)

71. Brayshaw, T. C.
1976. Catkin bearing plants (Amentiferae) of British Columbia. Occas. Pap. B. C. Prov. Mus. 18, 176 p. Victoria, B. C.

72. Briggs, David G., and James S. Bethel.
1978. The potential for integrated utilization of alder. In Utilization and management of alder, p. 163-173. David G. Briggs, Dean S. DeBell, and William A. Atkinson; compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"In attempting to evaluate utilization possibilities from forest stands, we are often confronted with an array of data that is either in the wrong units of measurement or has inappropriate utilization assumptions built in. Ecologists can often provide biomass data; but this is usually expressed in terms of total weights of crowns, stems, and roots with little regard to components useful to man. The foresters' tools are log rules, volume tables, and yield tables; but these are of limited value because they often incorporate fixed and somewhat arbitrary assumptions concerning product mix and manufacturing parameters.

What is needed is a method that views the stand in terms of its basic units, the trees, and on the basis of the sizes and shapes of trees can apply relevant manufacturing requirements to obtain estimates of product output. Such an approach is described and illustrated where an alder stand is being considered for conventional sawlogs and pulp, logs SHOLO and pulp, and a mixture of the two." (A)

73. Briggs, David G., James S. Bethel, and Gerard F. Schreuder.
1978. An approach for comparing the relative value of alder with other species from forest to end product. In Utilization and management of alder, p. 35-46. David G. Briggs, Dean S. DeBell, and W. A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Comparing alder as a renewable species with other species depends on a thorough analysis of a variety of technical and economic data from the system for growing trees through their end use. All too frequently, detail and components of the system are overlooked in policy analysis because a consistent and comprehensive format of appropriate data is not available.

"What is needed is a framework that incorporates diverse information on the technical, economic, labor, energy, and environmental aspects of production systems, captures those characteristics important to policy decisions, and thus facilitates the study of the role of alder as a source of materials in comparison to competing alternatives.

"This paper explains the Reference Haterials System (RMS) adapted by the National Academy of Sciences' Committee on Renewable Resources for Industrial Materials. RMS is suggested for use in examining the complex issues concerning alder management and utilization." (A)

74. Briggs, David G., Dean S. DeBell, and William A. Atkinson, Compilers. 1978. Utilization and management of alder. USDA For. Serv. Gen. Tech. Rep. PNW-70, 379 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Proceedings of a symposium held at Ocean Shores, Washington, April 25-27, 1977. Contributors are cited elsewhere in this bibliography. (CFH)

75. Brill, Winston J.
1977. Biological nitrogen fixation. Sci. Am. 236(3):68-81.

A popular account of the biology and chemistry of nitrogen fixation, (CFH)

76. British Columbia Department of Lands and Forests.
1953. Chemical treatment of standing trees as a method of debarking. In Report of the Forest Service 1952, p. 38-39. Victoria, B.C.

"Na_2HAsO_3 killed Tsuga heterophylla and Alnus rubra more quickly and easily than NH_4 sulphamate. Only Alder was killed by Esteron (2,4,5-T). Douglas Fir did not respond well to any of these chemicals. Loosening of the bark on the whole stem was found only on T. heterophylla after treatment with arsenite." (FA)

77. British Columbia Forest Service.
1947. Yield tables. 3d print. p. 42-43. Victoria B.C.

78. Brix, H.
1866. Errors in measurement of leaf water potential of some woody plants with the Schardakow dye method. Dep, For. Can. Publ. 1164, 11 p. Ottawa.

"The Schardakow dye method gives too low estimates of leaf water potentials for Douglas-fir, bigleaf maple, and'red alder. The total error could amount to -12.5, -6.5, and -5.0 atmospheres for turgid leaves of the three plants respectively. contamination of test solutions from cut cells is the major source of error, but solute uptake by the leaves from the test solutions contributes to the total error. By excluding the concentration changes occurring during the first one-half hour of tissue equilibration the total error could be reduced to -7.5, -2.4, and -1.6 atmospheres for the three plants. The error is most likely smaller for leaves having a lower water potential." (A)

79. Brockman, C. Frank.
1959. Red alder (Alnus rubra Bong.). Arbor. Bull. 22(2):50–51, 59. Arbor. Found., Seattle, Wash.

80. Brough, Sherman G.
1974. Tremella globospora, in the field and in culture. Can. J. Bot. 52(8):1853-1860.

"Tremella globospora Reid is described from 32 collections made in British Columbia. The fungus grows directly from within perithecia of species of Valsa and Diaporthe found, in this study, on hosts belonging to seven Angiosperm genera and three of Gymnosperm. Single-spore isolates were made from basidiocarps selected to represent as many variables as

possible; both colors (yellow and white) of the basidiocarp, proximity of position on a single twig versus considerable distance between sites, both genera of pyrenomycete host, four genera of seed plants, and collection dates from January to September. Compatibility tests indicated a single species with a modified tetrapolar mating system typical of the genus Tremella. Selected dikaryotic isolates were grown in laboratory culture on simple media, and fertile basidiocarps were produced. Variation in size, color, and consistency of basidiocarps in culture was compared with those in field collections. Clamp connections, branching from the clamp cell, and other microstructures produced in culture are also described. No reaction of T. plobospora to Valsa cultures or sterilized Valsa perithecia and extracts was observed." (A)

81. Brown, George W., and James T. Krygier.
1971. Clear-cut logging and sediment production in the Oregon Coast Range. Water Resour. Res. 7(5):1189-1198.

"Reports results of an ll-year study in three small catchments with Douglas Fir/Alder forest cover to determine the effect of road construction, clear felling and logging, and slash burning on sediment production. Road construction and slash burning caused substantial increases in sediment production during a 4-year period, whereas felling and yarding did not. Conclusions about the significance of all except very large changes in sediment production are limited because of annual variations within the between catchments." (FA)

82. Brown, K. J., and J. N. McGovern.
1953 High-yield cold soda pulps and products from several woods. Pap. Ind. 35(1):66-69.

"Hardwoods such as aspen (I), birch (II), red alder (III), sweet gum (IV), cottonwood (V), red (VI) and white oak (VII) and mixts. of III and VI or VII could be pulped by the 'cold soda process' (VIII) which entails steeping 1.5-2 hrs. at atm. pressure and room temp. with solns. contg. 20-100 g. NaOH/1., resulting in chem. consumption of 5-8% (on the dry-wood basis). Some hemicelluloses are lost, but there is little if any loss in lignin or a-cellulose. The softened chips are fiberized in an attrition mill. Yields range from 88 to 90% and the resulting pulps could be bleached satisfactorily to a brightness of 65-70%. Bleached pulps from I were apparently suitable for use in printing papers of the groundwood type (but further printing tests are required). Corrugating boards with high flat-crush-resistance could be made from I, III, and IV. At the same yield, I, II, III, and V pulps are stronger than those from IV, VI, and VII. Within limits of the process, the pulp strength increases with decreasing yield. The strength also increases as the pulps are processed to lower freeness. Bark adversely affects VIII and lowers pulp and board quality. Softwoods (like jack pine and hemlock) are not satisfactorily pulped by VIII." (FA)

83. Browne, F. G.
1968. Pests and diseases of forest plantation trees. 1,330 p.
Clarendon Press, Oxford.

Browne comprehensively describes animal pests, pathogenic viruses, bacteria, fungi, and higher plants found on forest plantation trees throughout the British Commonwealth. Species listing provides cross-reference to pests. No general index. Extensive bibliography. (CFH)

84. Browne, J. E.
1962. Standard cubic-foot volume tables for the commercial tree species of British Columbia, 1962. 107 p. B.C. For. Serv. For. Surv. and Inventory Div., Victoria, B.C.

85. Bruce, David, Robert O. Curtis, and Caryanne VanCoevering.
1968. Development of a system of taper and volume tables for red alder. For. Sci. 14(3):339–350.

"An estimating equation was derived for red alder (Alnus rubra Bong.), expressing ratio of squared upper stem d.i.b. to squared dbh outside bark as a function of dbh, total height, and the 3/2, 3rd, 32nd, and 40th powers of relative height, This equation formed the basis for a system of tables and equations which provides estimates of tree volume for various combinations of prodict units, utilization limits, and size classes of material. The methods used should also be applicable to other species.** (A)

86. Bryant, Ben S., and Judson Wonderly.
1964. An economic analysis of the hardwood industry of western Washington. 101 p. Inst. For. Prod., Univ. Wash., Seattle, and Bus. and Econ. Res. Div., Wash. State Dep. Commer. and Econ, Dev., Olympia.

A reprint of the master's thesis submitted by John H. Grovey (*). Discusses history and growth of hardwood lumber industry of western Washington. Includes various statistics on consumption prices and harvests. Compares physical properties and uses of Northwest hardwoods. (CFH)

87. Bublitz, Walter J., and Tommy D. Farr.
1971. Pulping characteristics of bigleaf maple (Acer macrophyllum Pursh.). Tappi 54(10):1716–1720.

"Bigleaf maple is a hardwood that grows prolifically in the coast range of the Pacific Northwest, and there is an estimated 3 billion board feet of this species growing in Oregon alone. The pulpwood potential of this species was investigated for four processes: kraft, Magnefite, semichemical, and refiner groundwood. Bleaching trials were conducted on the kraft, Magnefite, and ground wood pulps. Suitable quality unbleached pulps can be made in good yields by the kraft and Magnefite processes, and these pulps may be readily bleached to 70-80% brightness by standard bleaching techniques. With the exception of the refiner groundwood pulp, the strength properties of the bleached and unbleached pulps compare quite favorably with those of other hardwood market pulps. The refiner groundwood is weak and has low scattering power. The Concora crushing strength of NSSC pulp, however, is exceptionally high for the high yield of that pulp, which suggests that bigleaf maple would make an outstanding corrugating medium pulp.** [Tabular comparison with strength properties of other species including red alder.1 (A)

88. Calder, J. A., and Roy L. Taylor
1968. Flora of the Queen Charlotte Islands. Part 1. Systematics of the vascular plants. Can. Dep. Agric. Mon. 4, 658 p. Ottawa.

Ecology and distribution of red alder in the Queen Charlotte Islands is given. There also is an extensive discussion of botanical history, physiography, geology, climate, and plant communities. (CFH)

89. Calder, J. A., and Roy L. Taylor.
1968. Flora of the Queen Charlotte Islands. Part 2. Cytological aspects of the vascular plants. Can. Dep. Agric. Mon. 4, 148 p. Ottawa.

Chromosome number of five collections of red alder are reported as 2n=28. Methods and materials section describes field collection and laboratory determination of chromosome number. (CFH)

90. Callier, A.
1892. Über die in Schlesien vorkommenden Formen der Gattung Alnus. Jahresber. der Schlesischen Ges. fur Vaterl. Cult. 69(2):72-85.

91. Callier, A.
1904. Gattung Alnus. In Illustriertes Handbuch der Laubholzkunde Jena. C. K. Schneider, ed. Vol. 1, p. 119-136; Vol 2, p. 857-891.

92. Callier, A.
1911. Diagnoses formarum novarum generis Alnus. Fedde Repert. Spercierum Nov. Regni Veg. 248/250, X. Band, p. 225-237.

93. Callier, A.
1918. Alnus Formen der europaischen Herbarien und Garten. Mitt. Dtsch. Dendrol. Ges. 27:38-185.

94. Cameron, P. J., and W. G. Wellington.
1975. Effects of the plant growth regulator indolebutyric acid on the growth, development, and reproduction of the western tent caterpillar, Malacosoma californicum pluviale (Lepidoptera: Lasiocampidae). Can. Entomol. 107(12):1339-1342.

"In laboratory experiments in British Columbia, the synthetic plant-growth regulator indolebutyric acid added at 0.1 g/litre to the water in which was kept cut foliage of red alder (Alnus rubra) on which larvae of Malacosoma californicum pluviale (Dyar) were reared delayed pupation, caused a reduction in the weight of the pupae, and hindered the last larval moult. Larvae fed on treated foliage when very young gave rise to adults that produced more eggs and a higher proportion of viable ones than the untreated controls. Treatment of older larvae produced antigonadotrophic effects." (EO)

95. Carstensen, John P.
1961. Gluing characteristics of softwood veneers and secondary western hardwoods. For. Prod. J. 11(7):313-315.

"Discusses the modifications in formulations and techniques necessary when using protein or synthetic resin glues, normally formulated for Douglas-fir, for Western Pines, Sequoia, Western Red Cedar, Western Hemlock, Western Larch, Sitka Spruce, true Firs, Red Alder, Pacific Madrone and Tan Oak." (FA)

96. Chamberlain, Charles T.
1927. Observations on the treatment of hay fever in the Pacific Northwest: Fifty-three cases. Ann. Otol. Rhinol. Laryngol. 36:1083-1092.

"1. Approximately 95 per cent of all hay fever in Oregon is of the early or midsummer type, caused by the pollens of the grasses.

"2. The cutaneous or scratch method of testing patients for their pollen reactions is satisfactory if performed carefully and with uniform technic.

"3. The glycerin saturated sodium chlorid solution method of extracting pollens gives a more potent preparation, both for testing and for treatment, than the 12 per cent alcoholic normal saline extract.

4. More intensive treatment by use of more potent pollen extracts, giving of more frequent doses, and a larger final dose, gives better end results in hay fever treatments.

5. The combining of several pollens, especially is from different groups of plants, in a treatment preparation is not advisable, and may be a factor in failure to secure satisfactory results in some cases.

6. A thorough survey of the botanical flora of a locality must be made, and the hay fever plants, with their distribution and dates of pollination known, before one can hope to obtain the best possible results in hay fever work." (A)

97. Chambers, Charles J.
1974. Empirical yield tables for predominantly alder stands in western Washington. Wash. State Dep. Nat. Resour. DNR Rep. 31, 70 p. Olympia, Wash.

"Yield tables based on 174 permanent points located in Western Washington were developed for pure hardwood and mixed hardwood-conifer stands, using total age and 50-year site index curves. Density expressed as percent normal basal area (PNBA) was added to increase accuracy. It was concluded that there was no significant difference in cubic volume, top and stump (CVTS) between pure hardwood and mixed harwood-conifer stands on DNR lands in Western Washington. Pure, even-aged hardwood stand and stock tables, with volume by log position by DBH classes, were constructed, based on 36 hardwood points. Hardwood stands in this report are assumed to be predominantly alder stands." (A)

98. Chang, Ying-Pe, and Raymond L. Mitchell.
1855. Chemical composition of common North American pulpwood barks. Tappi 38(5):315-320.

"Components determined in 9 softwood and 15 hardwood barks were as follows: ash, extractives, 'lignin', methoxyl in 'lignin' and bark, and the amount and composition of the reducing sugars produced from extractive-free bark by 72% H_2SO_4. The hot-water extract was tested qualitatively for tannins by two methods. Solubility of bark in 1% NaOH and the amount of precipitate obtained by acidifying the alkaline extract were also determined. Heat of combustion values were measured for 8 softwood and 12 hardwood barks. Most of the barks contain relatively large amounts of ash, extractives, 'lignin' and material soluble in 1% NaOH. The high solubility in alkali, exceeding 50% for seven barks, suggests a potential means for utilizing these barks. Apparent trends in the relation of chemical composition to physical structure of bark are discussed briefly." (A)

99. Chen, Chi-Sin.
1965. Influence of interplanted and pure stands of red alder (Alnus rubra Bong.) on microbial and chemical characteristics of a coastal forest soil in the Douglas-fir region. Ph. D. thesis. Oreg. State Univ., Corvallis. **164** p.

"Gives the results of a study on the distribution of moulds and bacteria, pH Values, contents of **N,** sulphate, phosphate, and exchangeable H and cations, the degree of ammonification and nitrification, and the S-oxidizing power in the various horizons of soils under Alder, conifers, and mixed Alders and conifers, and the dry matter, NH_4-, NO_3- and Kjeldahl N in canopy rainfall and stem flow." (FA)

100. Cheng, Chi Shan.
1949. The soaking treatment of black cottonwood and red alder fence posts in pentachlorophenol. J. For. **47(8):651-652.**

"A report on investigations into cold- and hot-soaking preservative treatments of seasoned Black Cottonwood [Populus trichocarpa] and Red Alder [Alnus rubra]. Round posts can be successfully treated by soaking in unheated **5%** pentachlorophenol/diesel-oil solution, **so** long as the depth of the solution is not less than the height of treatment desired. Incising the posts doubled the depth of radial penetration in Red Alder and increased it by about **10%** in Black Cottonwood. A reduction in retention is possible in incised posts of these species because the uniform radial penetration obtained makes it unnecessary to rely on end penetration. **No** siginificant difference could be found between hot and cold-soaking." (FA)

101. Chow, S.
1972. Thermal reactions and industrial uses of bark, Wood and Fiber **4(3):130-138.**

"Demonstrates that phenols in Douglas Fir and Red Alder bark can be polymerized at temperatures above 200 deg. C. and describes how this reaction can be used to advantage in the production of material with high oil absorption (useful e.g. for cleaning up oil spills), or adhesive-free bark chipboards.

"Boards made in this way were equal in internal bond strength and bending strength to, and greater in dimensional stability than, corresponding bark boards manufactured at lower temperatures and containing **4.5% PF** adhesives." (FA)

102. Chow, S., and K. J. Pickles.
1971. Thermal softening and degradation of wood and bark. Wood and Fiber **3(3):166-178.**

"The thermal softening of powdered wood and bark of Pseudotsuga menziesii and Alnus rubra was studied over a range of moisture contents. Softening of oven-dry samples begins at **180"** C and ends at about **500"** C, with a maximum rate of softening at **380°C.** An increase in m.c. lowers the softening temperature owing to plasticization by moisture. The reactions occurring when wood and bark are heated above **180"** C were shown by differential thermal analysis, infra-red spectroscopy and X-ray diffraction to be of two types: depolymerization degradation of carbohydrates, and polymerization of extractives and lignin components. Differences in thermal behaviour of softwoods and hardwoods are noted. The experiments also included materials of two other conifers and two other hardwoods, but results are given in detail only for P. menziesii and **A. rubra."** (FA)

103. Clark, Donald H.
1955. Alder comes of age. Pac. Coast Hardwoods (Fall):6-7. Northwest Hardwood Assoc., Seattle, Wash.

Discussion of properties, uses, and future of red alder as a commercial species. (CFH)

104. Clark, Donald H.
1955. Forest industry survey of Lewis County, Washington. New Wood-Use Ser., Inst. For. Prod. Circ. 29, 33 p. Univ. Wash., Seattle.

In 1955, there was 98 million board feet of red alder in Lewis County, Washington. This was 58 percent of all hardwoods. (CFH)

105. Clark, Donald H.
1956. Alder forsakes Cinderella role. West. Conserv. J. 13(1):30–31, 51-52.

106. Clark, Donald H.
1956. Hardwood timber inventory of Snohomish County, Washington. Inst. For. Prod. Circ. 31, 13 p. Univ. Wash., Seattle.

Statistical data resulting from a field survey of various hardwood types in Snohomish County, Washington, USA, taken in the summer of 1955. Contains tables and charts of volumes of various species, mainly red alder. Makes recommendations for management, harvest, and marketing. (CFH)

107. Clark, Donald H.
1956. Hardwoods offer pulping resources. West. Conserv. J. 13(6):20–22.

Considers hardwoods and especially red alder as pulpwood. Discusses production methods, pulpwood specifications, measurement, and availability. (CFH)

108. Clark, Donald H.
1957. Developments in the use of red alder. For. Prod. J. 7(11):17A–20A.

"Pacific Coast red alder, a fast-growing, aggressive tree, is emerging from commercial obscurity into a position of distinct value in the forest products field. It has been added to softwoods as a desirable material for several types of paper. Increased utilization forecasts a future demand that may equal the available supply in Oregon, Washington, and British Columbia." (A)

109. Clark, J. B., and G. R. Lister,
1973. A comparative study of the photosynthetic action spectra for a deciduous and four coniferous trees. (Abstr.) Plant Physiol. 51(Suppl.):20.

110. Clark, John **B.**, and Geoffrey R. Lister.
1975. Photosynthetic action spectra of trees. **I.** Comparative photosynthetic action spectra of one deciduous and four coniferous tree species as related to the photorespiration and pigment complements. Plant Physiol. **55(2):401-406.**

"Describes laboratory studies in which measurements were made of the relative spectral photosynthetic activities of 2-to 3-year-old field-grown seedlings of ~~Alnus~~ ~~rubra~~ (a) Pseudotsuga menziesii (b), Picea sitchensis (c), *e.* pungens (d) and **P.** pungens var. hoopsii (e). Compared with the red peak of photosynthetic activity, the relative rates of net photosynthesis in blue light were highest for the dark-green broad leaf of (a), intermediate for the green needles of (b) and (c), and lowest for the blue-green and blue-white needles of (d) and (e) respectively. Leaf form per se was not responsible for these results. The differences were more subtle, resulting from the differential operation of various photosynthesis-screening mechanisms. It is concluded that the relatively high carotenoid/chlorophyll ratio of the 'green' conifers, as compared with (a), is responsible for their relatively lower photosynthetic activity in blue light as a result of absorption screening of the chlorophyll by the extra carotenoids. For the 'blue' conifers, the additional factor of leaf colour is also involved, which differentiates them from the 'green' conifers." (FA)

111. Clark, John B., and Geoffrey R. Lister.
1975. Photosynthetic action spectra of trees. II. The relationship of cuticle structure to the visible and ultraviolet spectral properties of needles from four coniferous species. Plant Physiol. **55(2):407-413.**

"The relative reflectance spectra of needles of (d) and (e) that had been wiped to remove the bluish coloration from the needle surfaces, were very similar to those for the normal 'green' foliage of (b) and (c). Scanning electron microscopy of surfaces of unwiped needles of (d) and (e) revealed a system of wax filaments whose complexity was correlated with the degree of ultraviolet and blue reflectance. It is concluded that both the bluish appearance (glaucous bloom) and the low relative efficiencies of blue light in photosynthesis of (d) and (e) result from the selectively enhanced reflection of blue light caused by the presence of wax deposits on the cuticle." **(FA)**

112. Clark, Robert **H.**, and Harold R. Offord.
1926. The tannin content of British Columbian Alnus rubra. Trans. Roy. Soc. Can. 20(Sect. **III):149-152.**

"Alder being immune to the attacks of the teredo this wood is extensively used for piling. The authors investigated the commercial possibility of extracting tannin from the remaining portions of the tree. Analyses showed a rise in the tannin content up to late fall when a sudden drop occurred after the sap ceased to flow. This variation is similar to that of the western hemlock. The minimum tannin content of **2.79** percent occurred in

January and the maximum of 6.60 percent in March. This does not warrant a commercial extraction at the present time." (CA)

113. Cole, Dale W., S. P. Gessel, and John Turner.
1978. Comparative mineral cycling in red alder and Douglas-fir. In Utilization and management of alder, p. 327-336. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers, USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"A comparative study of mineral cycling between second-growth forests of red alder (Alnus rubra) and Douglas-fir (Pseudotsuga menziesii) was made at the Thompson research site within the Cedar River watershed, western Washington. Both sites have similar histories and are adjoining on glacial drift material. The rate of elemental cycling is far faster in alder than in Douglas-fir. The red alder ecosystem is accumulating 85 kg ha^{-1} yr^{-1} more nitrogen than the Douglas-fir, apparently through biological fixation. Greater percentages of the nutrients are stored within the trees and understory vegetation in the alder ecosystem, but these nutrients remain within the foliage and forest floor two to five times longer in Douglas-fir than in alder. Nutrient leaching losses are slightly higher within the alder ecosystem. This study helps clarify the role of red alder in second-growth forests and provides insight into the management of this type of ecosystem. (A)

114. Cole, Dale W., and Stanley P. Gessel.
1968. Cedar River research. A program for studying the pathways, rates, and processes of elemental cycling in a forest ecosystem. Contrib. Inst. For. Prod. 4, 54 p. Seattle, Wash.

"Describes the experimental area and its vegetation (which includes three principal types of forest cover: a 35-year-old Douglas Fir plantation and natural stands of ca. 35-year-old Douglas Fir and of 21- to 28-year-old Alnus rubra), the field instrumentation, and the methods used for recording and analysing the data, and summarizes the results of studies undertaken so far on (1) mineral and water transfer under natural-ecosystem conditions and (2) the influence of altering the ecosystem on the rates of transfer." (FA)

115. Collingwood, G. H.
1945. Red alder (Alnus rubra Bong.). Am. For. 51(3):126-127.

General silvical characteristics of red alder. (CFH)

116. Collingwood, G. H. and Warren D. Brush.
1955. Red alder Alnus rubra Bong. In Knowing your trees. p. 174-175. Am. For. Assoc., Washington, D.C.

The red alder section is a reprint of an article appearing in Collingwood (115). Similar articles appear in the 1964 and 1974 editions of "Knowing your trees." (CFH)

117. Commonwealth Bureau of Soils.
1971. Bibliography on soil relationships, nutrition and fertilizer of alder (Alnus spp.). Ser. 1455, 13 p. Harpenden, England.

A collection of 49 literature citations with abstracts pertaining to the relationship between alder and soil fertility. Red alder is one of the species discussed. (CFH)

118. Cooke, William Bridge.
1956. The genus Phlebia.
Mycologia 48(3):386-405.

"A revision of the genus Phlebia based on 1560 collections in 25 herbaria is presented. The commonest spp., as indicated by synonymy and number of collections, are P. radiata and P. albida. Novelties based on morphological variation include Phlebia atkinsoniana from New York, P. argentinensis from Argentina, P. celtidis on Celtis from Idaho, P. cystidiata Jackson on Alnus rubra from California, P. subabida in Abies magnifica from California, P. canadensis on Acer, etc. from Ontario, and P. murrillii on Pinus from Florida. Five spp. were not available for study and 9 sp. previously assigned to Phlebia were excluded. The genus PHAEOPHLEBIA is proposed for P. strigoso-zonata (-Merulins strigoso-zonatus Schn.) which has 28 synonyms. Tendencies of development within the genus are noted, but it is suggested that when 78% of the spp. treated are represented by less than 5% of the specimens studied, conclusions are difficult to make." (BA)

119. Corliss, J. F., and C. T. Dyrness.
1965. A detailed soil-vegetation survey of the Alsea area in the Oregon Coast Range. In Forest-soil relationships in North America, p. 457-483. Chester T. Youngberg, ed. Oreg. State Univ. Press., Corvallis.

120. Cowan, I. M.
1945. The ecological relationships of the food of the Columbian black-tailed deer, Odocoileus hemionus columbianus (Richardson), in the coast forest region of southern Vancouver Island, British Columbia.
Ecol. Monogr. 15:109-139.

"The coast deer of British Columbia is primarily an inhabitant of pioneer forest communities. Logging may be directly responsible for producing improved conditions for this ungulate. Optimum conditions for coast deer occur where a rolling or broken terrain supports a diversified cower in which young second-growth forests predominate but where blocks of older timber are interspersed. Current reforestation practice with Douglas Fir (Pseudotsuga taxifolia) planted at approximately 1,200 per acre provides conditions under which maximum damage by deer can be expected. Where natural or artificial seeding gives rise to seedlings in excess of 12,000 per acre, deer damage is found to be unimportant.

"Examination of food plants in the field and in deer stomachs revealed that 67 per cent of the annual diet consisted of twigs and leaves of trees and shrubs (24 per cent conifer browse and 43 per cent deciduous browse). The most important woody species browsed in the Goldstream area were Douglas Fir (Pseudotsuga taxifolia), Alder (Alnus rubra), Willow (Salix sp.) and Cedar (Thuja plicata).

Browsing upon seedling and second-growth Douglas Fir was particularly severe on inferior forest sites. Two types of Douglas Fir (normal trees and yellow trees) were noted among the natural regeneation on southern Vancouver Island. The latter had a significantly lower palatability than the former. Since Western Hemlock (Tsuga heterophylla) is not browsed by deer, it is suggested that this species might be used for artificial reforestation in areas where deer are abundant.

"Tables are given showing the relative palatability to deer of plants found in southern Vancouver Island, and the extent to which species in the various communities are utilized--their abundance, period of availability, period of utilization, and importance as deer food. Douglas Fir (as represented by young trees) is the most important single food item in the diet of the Columbian black-tailed deer." (FA)

121. Cowlin, Robert W., and Robert M. Forster.
1965. The timber situation and outlook for northwest Oregon. USDA For. Ser. Resour. Bull. PNW-12, 56 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Contains volume and acreages for red alder in northwest Oregon. (CFH)

122. Crouch, Glenn L.
1966. Preferences of black-tailed deer for native forage and Douglas-fir seedlings. J. Wildl. Manage. 30(3):471-475.

"Choice of browse by Odocoileus hemionus columbianus in an enclosure carrying native vegetation and some planted Douglas Fir was closely related to the weather. Blackberry leaves were most highly preferred so long as they were available. Douglas Fir ranked higher in preference than most common woody plants, which included Alnus rubra, Corylus californica, and Acer circinatum." (FA)

123. Crouch, Glenn L.
1968. Clipping of woody plants by mountain beaver. J. Mammal. 49(1):151-152.

"Shrubs and small trees in areas occupied by Aplodontia rufa often have bushy, open, uneven crowns or atypical forms as a result of clipping of stems and branches. Acer circinatum was the most frequently clipped plant in 1963 on 110 plots; other species damaged included Alnus rubra, Acer macrophyllum, Corylus cornuta and Salix sp." (FA)

124. Curtis, Robert O., David Bruce, and Caryanne VanCoevering.
1968. Volume'and taper tables for red alder. USDA For. Serv. Res. Pap. PNW-56, 35 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Basic data used consisted of tree measurement data of Alnus rubra from Oregon, Washington and British Columbia, additional data from Washington and Oregon, and data for tables originally published in 1926; a total of 473 trees was available for analysis." (FA)

125. Curtis, Robert O., Donald J. DeMars, and Francis R. Herman. 1974. Which dependent variable in site index-height-age regressions? For. Sci. 20(1):74-87.

"Two regressions relating height and site index can be calculated from stem analysis data. Site index estimation curves obtained by regressing site index on height and age differ from height growth curves obtained by regressing height on site index and age. The first provide estimates of site index for stands of known present age and height, while the second provide estimates of expected height at different ages for stands of specified site index. The traditional type of height over age 'site index curve' does not provide optimum estimates of site index. Magnitude and practical importance of differences depend on the amount of unexplained variation present. Appropriate uses of the two systems of curves and some sources of bias are discussed." (A)

126. Dahms, W. G. 1958. Chemical control of brush and undesirable hardwoods on forest land of the Pacific Northwest. (Abstr.) Weed Soc. Am. 1958:29.

"An aerial foliage spray of 2,4-D or 2,4,5-T controlled Alnus rubra; some species of Arctostaphylos and Ceanothus were killed, others resprouted; Castanopsis chrysophylla, Quercus chrysolepis and Lithocarpus densiflorus were lightly damaged. A basal spray was most promising for Rubus spectabilis, and a dormant-season aerial spray for Acer circinatum; both species resprouted after foliage spraying." (FA)

127. Darlington, C. D., and A. P. Wylie. 1956. Chromosome atlas of flowering plants. 2d ed. p. 179-180. MacMillan Co., New York.

Red alder has 28 chromosomes (n=14). (CFH)

128. Daubenmire, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetational classification. Ecol. Monogr. 22:301-330.

129. Daubenmire, R. 1969. Ecologic plant geography of the Pacific Northwest.. Madrono 20(3):111-128.

"The purpose of this phytogeographic sketch is to provide an introduction to the natural vegetation of the Pacific Northwest for the use of botanists from other areas who will be attending the XI International Botanical Congress in Seattle in 1969. Attention will be centered on the State of Washington, with secondary emphasis on the adjoining areas. If my friends in British Columbia feel that I have slighted their Province, this is more a consequence of maps terminating at the international border than of any intent of mine to confine attention to the 'Pacific Northwest*--a nationalistic and ambiguous though useful term, which I shall not try to define!

"The visitor, like some of use who reside here, may be appalled by the scarcity of natural vegetation in a region which was opened up by white explorers as late as 1805 (the Lewis and Clark expidition). Nevertheless the account is centered on remnants of natural vegetation with the intent of helping the visitor recognize some of the common types and see how they fit into a regional pattern." (A)

130. Davis, E. M.
1960. Machining properties of red alder and bigleaf maple. Wood-Worker, Indianapolis 78(11):10–25.

"Gives brief results of recent U.S. planning, shaping, turning, boring, and mortising tests with Alnus rubra and Acer macrophyllum." (FA)

131. Davis, E. M.
1962. Machining and related characteristics of United States hardwoods. U.S. Dep. Agric. Tech. Bull. 1267, 68 p. Washington, D.C.

Discusses and presents tables of response of various woods to planing, shaping, turning, boring, mortising, sanding, steam binding, nail and screw splitting, specific gravity, annual rings per inch, cross grain, shrinkage, warp, and changes of color. (CFH)

132. Davis, Margaret Bryan.
1973. Pollen evidence of changing land use around the shores of Lake Washington, Northwest Sci. 47(3):133–148.

"Pollen diagrams from near-surface sediments in Lake Washington record changes in the vegetation around the lake since the mid-19th century. The primeval conifer forests produced a pollen assemblage dominated by pollen from Douglas-fir, cedar, and hemlock, with minor amounts of pollen from pine, fir and spruce. Sediments 30-45 cm beneath the surface were deposited during the early years of settlement around Lake Washington between 1860 and 1890. They record minor changes in the vegetation as limited areas were logged. Douglas-fir was the major species cut at the time. Alder pollen reflects the first sharp increase in alder trees as succession took place on disturbed sites. A much greater increase of alder followed the intensive logging operations of the 1880's. The growth of Seattle and the cutting of second-growth forests in recent years have reduced the amount of locally produced alder pollen. The changes that served as culture indicators in the pollen diagram from Lake Washington are interesting from the theoretical point of view. In Washington, the logging horizon is conspicuous because the conifers, which in this case are poor pollen producers, are temporarily replaced by a successional species (red alder) that is a heavy pollen producer." (BA)

133. Dayton, William A.
1931. Important western browse plants. U.S. Dep. Agric. Misc. Publ. 101, 214 p. Washington, D.C.

134. DeBell, D. S.
1971. Progress report on red alder study. 6 p. Cent. Res., Crown Zellerbach Corp., Camas, Wash.

135. DeBell, Dean S.
1972. Potential productivity of dense, young thickets of red alder. For. Res. Note 2, 7 p. Crown Zellerbach Corp., Camas, Wash.

"Total above-ground production was evaluated in 28 natural alder thickets, aged 1 to 14 years. On a per acre basis, mean annual production varied from 3 to more than 20 tons of green wood per acre. Such yields warrant preliminary trials of short-rotation cultural systems with red alder." (A)

136. DeBell, Dean S.
1975. Short-rotation culture of hardwoods in the Pacific Northwest. Iowa State J. Res. 49(3):345-352.

"In the late 1960's, innovatiwe ideas on silage wood were published. Since then, interest has been generated in short-rotation culture of hardwoods in the Pacific Northwest, and has been accompa-. nied by experimentation attempting to increase yields from this type of culture. Major factors included in programming the experiments were suitable sites; relative productivity of black cottonwood and alder; cultural practices including weed control, fertilization, and organic amendments and irrigation; and kraft pulping of juvenile hardwoods." (A)

137. DeBell, Dean s., Robert F. Strand, and Donald L. Reukema.
1978. Short-rotation production of red alder: Some options for future forest management. **In** Utilization and management of alder, p. 231-244. David. G. Briggs, Dean s. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Many options are awailable to foresters who may want to consider management of red alder (Alnus rubra Bong.). Four options are discussed in this paper--a coppice system and three high forest systems: pulpwood log, saw-log and peeler, and pulpwood log and saw-log production. Coppice can be grown on 4- to 6-year rotations and pulpwood logs can be produced in 10 to 15 years on most sites. Estimated yields (per acre per year) of these options are about double those obtained in natural stands. Saw logs and peelers can probably be grown in 28 to 37 years, and yields are estimated to be about 40 percent higher than those listed in normal yield tables for well-stocked stands." (A)

138. DeBell, Dean S., and Boyd C. Wilson.
1978. Natural variation in red alder. **In** Utilization and management of alder, p. 193-208. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"An 8-year-old provenance trial examined racial variation among 10 sources of red alder from Alaska, British Columbia, Washington, Oregon and Idaho. The fastest growing sources are from northwestern Washington, and Oregon also grew well. The slowest growers were from Juneau, Alaska, and Sandpoint, Idaho--they also have the greatest frost resistance.

"A study of phenotypic variation between and within eight stands was conducted in a small area west of Olympia, Washington. Although the stands were selected to cover the range in site conditions occurring in the area, only crown width index, branching character-. istics, and bark thickness showed significant variation between stands. Variation from tree to tree within stands, however, was substantial for all traits.

"The results of these studies suggest that individual tree selection will be a useful approach in alder improvement programs and that such programs can encompass rather large areas (or breeding zones.") (A)

139. DeFreitas, Amantino R., and Harvey D. Erickson.
1969. Propagation of molds on red alder roundwood--their effect on oil soak treatments. For. Prod. J. 19(10):45-52.

"Growth of four fungi including Trichoderma sp., Fusarium sp., Gliocladium roseum, and Chaetomeum cochliodes was satisfactory on the wood only when a flouride salt was present. Concentrations of 1.5 to 3.0 percent were near optimum. Other additives tried were not helpful. Trichoderma sp. was the dominant fungus from a mixture inoculation. Light steaming caused only a short-term growth advantage. Good fungal growth produced twice the oil absorption of non-infected wood. Trichoderma was usually the best. Leaving inner bark on before inoculation caused no real decrease in oil absorption after 4 weeks of fungal growth. It seems unnecessary to remove the inner bark before inoculation, Exploratory tests indicated vacuum impregnation was much more effective than cold soak. The hyphae traveled through all types of cells in the wood and even pierced fiber walls." (A)

140. DeFreitas, Amantino Ramos.
1966. Stimulation of several mold growths on red alder and their effects on cold-soak treatment. M.F. thesis. Coll. For. Resour., Univ. Wash., Seattle. 91 p.

141. DeMoisy, Ralph G.
1952. Progress report on chemical debarking. Inst. For. Prod. Circ. 19, 4 p. Univ. Wash., Seattle.

"Several methods of girdling the trees and applying Na_2HAsO_3 solution for barking pulpwood species have been tested. Western Hemlock, Firs, Black Cottonwood and Western Red Cedar have been successfully treated. Results for Douglas Fir are disappointing. Bark separation tests with Red Alder are incomplete, but no separation had occurred after 160 days. Future plans are discussed, and additional information is given on crew organization and treating techniques, safety precautions and patent rights." (FA)

142. Detling, LeRoy E.
1968. Historical background of the flora of the Pacific Northwest. Univ. Oreg. Mus. Nat. Hist. Bull. 13, 57 p. Eugene, Oreg.

"The modern flora of the Pacific Northwest is characterized by associations which show affinities to floras now occupying widely separated areas (Eurasia, South and Central America) and to floras shown by paleo-botanical evidence to have occupied all these areas, but particularly the American West. Distinct distribution patterns, both in time and space, manifest themselves. These patterns are and have been influenced by topographic and climatic changes from the Cretaceous to the present. Three principal sources of associations are evident: evolution in situ; northern regions as shown in the Arcto-Tertiary Geoflora; western Mexico and the southwestern United States as shown in the Nadro-Tertiary Geoflora." (A)

143. Diehl, William W.
1955. Valsaria megalospora on red alder. Plant Dis. Rep. 39(4):334.

144. Dimock, Edward J., II, Enoch Bell, and Robert M. Randall.
1976. Converting brush and hardwood to conifers on high sites in western Washington and Oregon--progress, policy, success and costs. USDA For. Ser. Res. Pap. PNW-213, 16 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Evaluates opportunities, techniques, success and cost of brushland reclamation efforts for almost a 20-year period. Among newer techniques, slash-and-burn and spray-and-burn are consistently more successful--and more economical per established conifer--than multiple-spray conversions." (A)

145. Dixon, D.
1961. These are the champs. *Am.* For. 67(1):40-46, 48-50.

146. Dobie, J.
1966. Product yield and value, financial rotations and biological relationships of good site Douglas fir. M.F. thesis. Univ. B. C., Vancouver. 141 p.

"Quantity and value of the assortment yield of four natural stands (age 63-145) of Douglas Fir in British Columbia were analysed, using linear programme techniques to determine the optimum assortment yields from each stand. Financial rotations at two levels of established costs and three interest rates were examined, and mathematical models of the relationship between tree value, tree volume, and biological variables are presented. It was found that the new value per cu. ft. of tree increased with tree size and that, at the level of costs and values used, it is more profitable to produce piling from small logs and plywood from large trees rather than lumber. Optimum conversion returned for all stands was 5 cents/cu. ft. greater than the lumber conversion return. Financial rotations at 3% compound interest on establishment costs and on the value of growing stock are 60-70 years for these sites. Many biological variables were found to be correlated with tree value and volume. Combinations of d.b.h., butt-log grade, and crown class were the best 2- or 3-variable models for value prediction; tree d.b.h. and D^2H gave similar estimates of bd. ft. and cu. ft. volumes." (FA)

147. Doran, Samuel M., Joseph Buhaly, and Loren Curry.
1971, Red alder costs and returns for western Washington. Coop. Ext. Serv., Coll. Agric., Wash. State Univ. Study EM 3461, 33 p. Pullman, Wash.

"Describes a study to determine the income and costs normally associated with the production of Alnus rubra timber in western Washington, and to determine the age (for most sites, ca. 50 years) at which it should be harvested for maximum profit." (FA)

148. Douglas, David.
1959. Journal kept by David Douglas during his travels in North America 1823-1827. 364 p. Antiquarian Press Ltd., New York.

Douglas first collected red alder (plant collection #11) on April 8, 1825, on the north shore of the Columbia River at Cape Disappointment. His journal reveals: "(11) Alnus s~.: a tree 50 to 70 feet high; may prove A. glutinosa; its size occasioned by the richness of the soil and finer climate; most places on the Columbia; April." (CFH)

149. Douglas-fir Second-Growth Management Committee.
1947. Management of second-growth forests in the Douglas-fir region. 151 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Report deals with regeneration and management of Douglas-fir in the Pacific Northwest, with red alder considered mainly as a competing species; however, there is a short discussion of red alder management. (CFH)

150. Dreyer, H. V.
1928. Skyldes rodellens sygelighed froets proveniens? [Is the sickliness of red alder due to the source of the seed?] Dan. Skovforen. Tidsskr. 13:229-376.

"Investigations confirm the belief that the sickliness of alder in Denmark is due to the kind of seed and its origin. Native seed produced healthy individuals, but imported seed produced sickly trees. Alder is very valuable as an advance crop in improving the condition of the soil because of its nitrogen-fixing capacity. It should be planted especially on lands which are not suitable for ash." (BA)

151. Driver, Charles H.
1978. Red alder management and diseases. In Utilization and management of alder, p. 271-272. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Ser. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Relatively little is specifically known about diseases of red alder with respect to management. The status of reports in the literature concerning the subject is outlined. Research remains to be conducted on the part played by diseases of this species in respect to management." (A)

152. Duffield, John W.
1956. Damage to western Washington forests from November 1955 cold wave. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Note 129, 8 p. Portland, Oreg.

A survey of the damage, with maps showing location and relative severity of damage. (CFH)

153. Eklundh, C.
1944. Report on alder, ash and elm. In Arsberattelse over Foreningens for vaxtforadling av skogsträd verksamhet under ar 1943. [Annual report on the work of the Association for Forest Tree Breeding during the year 1943.] Sven. Papp Tidn. 47, 38 p. [Suppl.] [In Swedish.]

"In spring 1943, bottle grafting of Alder species was carried out for the first time, and gave 25 per cent success. Alnus elutinosa was used as stock for scions of A. glutinosa, A. incana, A. cordata, A. subcordata, A. rubra, A. hirsuta, and some Danish material. The method used with promising results in Denmark for maintaining a 'live seed store' for valuable hybrid seed was tried, grafting A. cordata scions 10-15 cm. long in older stands of A. plutinosa in which trees about 15 cm. in diameter had been cut to breast height for use as stocks.

"Crosses were made with the bottle grafts, grown in the illuminated greenhouse, of &. glutinosa with &. cordata,

A. incana or A. rubra and of A. subcordata with A. glutinosa or A. cordata. Some fruits were obtained and the seed will be sown in spring 1944.

"In the vegetative propagation experiments about 10 plus-variants selected from two-year-old plants with the greatest average increment were planted and layered, the branches undergoing treatment with hormone paste or strangulation to induce the formation of adventitious roots. Good results were obtained.

"One- and two-year-old colchicine-treated Alders were grown on in pots to obtain early flowering, or raised in the arboretum, where some of the plants were strangulated. Investigation of the stomata and chromosome number in these supposedly mixoploid plants showed that the root-tip cells were predominantly diploid, whereas the variation in the size of stomata suggested that the shoot system had retained its mixoploid character to a greater extent. It is hoped, by vegetative propagation, to obtain pure tetraploids from some buds of these plants." (FA)

154. Erickson, Harvey D.
1957. Wood supply and production of the pulp industry in the State of Washington. New Wood-Use Ser., Inst. For. Prod. Circ. 32, 38 p. Univ. Wash., Seattle.

Red alder is growing in importance as a pulp species. It presently ranks number four in pulp volume, comprising 31 percent of total. (CFH)

155. Erickson, Harvey D., and Amantino R. DeFreitas.
1971. Influence of various molds and seasoning on vacuum light-oil treatment of round red alder (Alnus rubra Bong.). For Prod. J. 21(4):53-58.

"Vacuum treatment for 45 or 75 min. of specimens incubated for 4-6 weeks after inoculation with one of four fungi (Trichoderma harzianum, Gliocladium roseum, Chaetomium cochlioides or Fusarium sp.) gave greater retentions and penetrations of PCP in light oil than did similar treatment of uninoculated controls that had been barked and stored green for 4 or 6 weeks. There was little difference in the effect of the different fungi. Absorptions about equal to those for vacuum treatment after incubation with the fungi were obtained in wood barked immediately after cutting and then dried. A modified hot-and-cold treatment of wood after incubation with Trichoderma was less effective than vacuum treatment. Vacuum treatment of wood after 18 days' laboratory storage before barking and drying gave retentions little better than a cold-soak treatment of wood incubated with Fusarium, which was the poorest of all treatments." (FA)

156. Esau, Katherine, and Vernon I. Cheadle.
1955. Significance of cell divisions in differentiating secondary phloem. Acta Bot. Neerl. 4(3):348-357.

"With regard to the frequency of anticlinal divisions in the phloem initials the 77 general investigated by the authors fall into 3 groups: (1) anticlinal divisions none or infrequent

(Acer, Rhus, Berberis, Celastrus, Alnus, Quercus, Aesculus, Jaglans, Lardizabala, Gymnocladus, Fraxinus, Pyrus, Prunus, Populus, Tilia); (2a) anticlinal divisions common and mainly transverse or slightly oblique (Buxus, Viburnum, Weigelia, Cercidiphyllum, Clethra, Cornus, Rhododendron, Azara, Hypericum, Paulownia, Ailanthus): and (2b) anticlinal divisions common and mainly vertical or strongly oblique (Annona, Asimia, Michelia, Paeonia, and all 9 genera of Lauraceae used in this study). The derivatives of these divisions consist either of sieve elements with their companion cells and parenchyma cells. Frequently the divisions result in sieve elements shorter than their mother cells." (BA)

157. Eslyn, W. E., T. K. Kirk, and M. J. Effland.
1975. Changes in the chemical composition of wood caused by six soft-rot fungi. Phytopathology 65(4):473-476.

"Outer-xylem blocks of Alnus rubra, Populus balsamifera and Pinus monticola were exposed to six soft-rot fungi isolated from pulp-chip storage piles, viz. Graphium sp., Monodictys sp., Papulospora sp., Paecilomyces sp., Thielavia terrestris and Allescheria sp. Samples of wood at different weight losses were analysed for lignin and polysaccharides (flucan, xylan and mannan). Polysaccharides were depleted faster than lignin in Alder and Poplar. Lignin was depleted by all the fungi. Graphium sp. appeared to increase the mannan content of Alder. Pine was not decayed significantly by Graphium sp., Monodictys sp. and Allescheria sp.; the other fungi caused small weight losses. In Pine, lignin was depleted faster than polysaccharides by Paecilomyces and T. terrestris." (FA)

158. Espenas, Leif D.
1951. The seasoning of Oregon hardwoods. Oreg. For. Prod. Lab. Inf. Circ. 6, 35 p. Corvallis, Oreg.

"Kiln schedules for green stock are given for: Red Alder, Cottonwood, Oregon Ash, Oregon Maple, Myrtle (California Laurel), and Madrone. Kiln schedules for air-dried stock are given or suggested for Tan Oak, Chinquapin, California Black Oak, and Oregon White Oak." (FA)

159. Espenas, Leif D.
1971. Shrinkage of Douglas-fir, western hemlock and red alder as affected by drying conditions. For. Prod. J. 21(6):44-46.

When specimens were dried at temperatures from 90 to 230°F to give equilibrium moisture contents (EMC) of 6, 9 or 12% (6% only at 230°C), moisture content after equilibrating at room temperature decreased with increasing drying temperature. Shrinkage increased with increasing drying temperature and was greatest for the highest EMC. Compared with shrinkage at 90°C, shrinkage at 215" was greater by 33% tangentially and 51% radially for Douglas Fir, 65 and 82% respectively for Hemlock, and over 100% for Alder when EMC was 12% throughout; at 6% EMC, the corresponding figures were 30 and 33%, 17 and 18%, and 41 and 49%. Increase in shrinkage could not be accounted for by differences in EMC. Temperature effects were greater above than below 150°C." (FA)

160. Evans, Harold J., and Mark Kliewer. 1964. Vitamin B_{12} compounds in relation to the requirements of colbalt for higher plants and nitrogen-fixing organisms. Ann. N.Y. Acad. Sci. 112:735-755.

Red alder root nodules show nine cobamide coenzyme content of 24-62 micromoles per gram of fresh tissue. That is among the highest of 15 species reported. The role of cobamide coenzymes in nitrogen-fixing organisms is discussed. There is insufficient evidence to determine whether the function of B_{12}-coenzymes in N-fixing organisms is different from that in those that do not fix nitrogen. (CFH)

161. Evans, R. S. 1974. Energy plantations--should we grow trees for power-plant fuel? West. For. Prod. Lab. Inf. Rep. VP-X-129, 15 p. Vancouver, B.C.

"Examines the prospects of operating a power station using as fuel tree crops grown on a sustained-yield basis in North America. It is calculated that for most regions of North America the outlook is not promising, the land area required to sustain a 150 Mw power unit being from 240 to more than 100 sq. miles, depending on the species. Conditions in the Pacific north-west are more favourable, especially for Red Alder (Alnus rubra), the growth rate of which is such that a power plant of this size might be sustained by a plantation of 65 sq. miles. Economic considerations and the use of fertilizers are not taken into account." (FA)

162. Faegri, Knut. 1968. A note on the maritime forest limit in south-east Alaska. Arbok Univ. Bergen (Mat.-Naturvitensk. Ser.) 1968(5), 20 p.

"On the Alaskan coast near Juneau, in a region of virgin (Picea sitchensis)/ Psuga heterophylla climax forest, a narrow belt of Alder fringes the conifer forest towards the beaches, but is absent from the most exposed situations, presumably because of wind; on part of this Alder-free stretch conifers form the extreme limit of the vegetation, but on the headlands small meadows lie between the bare rocks and the forest edge, carrying a few very unstunted Sitka Spruce. Pollen analysis and radio carbon dating suggest that these meadows are of comparatively recent origin (formed perhaps ca. 2500 years ago) and that there have also been fairly recent changes in forest composition from Alnus/ Pinus to spruce, possibly owing to increased winds. The findings suggest that, under purely natural conditions, there might also be a very narrow unforested belt on very exposed sites in Western Norway." **(CA)**

163. Faurot, James L. 1957. An economic analysis of red alder pulpwood logging methods in western Washington. M.F. thesis. Coll. For. Resour., Univ. Wash., Seattle. 56 p.

Small scale logging costs of red alder pulpwood are analyzed. Bucking, yarding, loading, and hauling factors are considered. The most economical operations are with a three-person crew cutting 16-foot logs and hauling them less than 50 miles. Alder pulpwood production is concluded to be economically marginal. (CFH)

164. Fay, Ginny, Polly Hessing, Karen Jacobsen, and Karen Oakley. 1975. Alder-cedar forest. Am. Birds 29(3):764.

Results of 24th winter bird population census. Done in an alder-cedar forest in Thurston County, Washington, U.S.A. Relative tree frequency was 57 percent red alder. Twenty species of birds were observed at rate of 857 birds per square kilometer. (CFH)

165. Fay, Ginny, Polly Hessing, Karen Jacobsen, and Karen Oakley. 1975, Douglas-fir forest. Am. Birds 29(3):764-765.

Results of the 24th winter bird population census. Done in a Douglas-fir forest in Thurston County, Washington, U.S.A. Red alder comprised 12.8 percent of tree species. Seventeen species of birds observed at rate of 888 birds per square kilometer. (CFH)

166. Feddern, Edward T. 1978. Harvesting of red alder. In Utilization and management of alder, p. 61-69. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The harvesting and marketing of red alder from the Oregon Coastal Counties requires a company to address itself to several major concerns before entering a major program.

"A few of these would be the availability of an efficient contracting force, manpower, harvesting equipment, labor and overhead costs, and the availability of a continuing market. Also, operating seasons in relationship with inventory control, lack of demand for all log grades, sizes and species, capabilities of sawmills to market residuals and adequate log storage facilities." (A)

167. Field, Nancy, and David A. Manuwal. 1973. Clearcut in Douglas-fir forest. Am. Birds 27(6):1003-1004.

Results of a bird census on a clearcut in a Douglas-fir forest in the Cedar River watershed, King County, Washington. Regeneration was occurring with red alder equaling 11.6 percent of the stand. Ten species were observed at a density of 561 birds per square kilometer. (CFH)

168. Finnis, J. M. 1964. Chemical frill treatment of alder. West. Weed Control Conf. Res. Progr. Rep. 1964:47.

"Alnus rubra, treated in late Aug. with dicamba at 4 lb./gal. undiluted with an aqueous solution of NH_4 sulphamate at 1 lb. in 1 pint water applied to axe cuts spaced 4 in. apart around the stems, died by late Oct." (FA)

169. Finnis, J. M. 1970. "Brown and burn" as a means of site preparation. West. Soc. Weed Sci. Proc. 23:47.

"The dense understorey remaining after logging Alder (Alnus rubra) stands (in coastal Washington) can be desiccated with dinoseb at 1 gal in 9 gal water/acre and ignited in one mass by 7 cans of jellied petrol/acre joined by primacord; the resulting series of flash fires gives a clean burn and facilitates planting." (FA)

170. Fonda, R. W.
1974. Forest succession in relation to river terrace development in Olympic National Park, Washington. Ecology 55(5):927-942.

"The floodway zone of the Hoh River exhibits four terrace levels of different ages, formed by erosional activity of the river on valley fills. The vegetation in this valley is in a long-term seral sequence as shown by the zonal pattern in relation to aging and development of these land surfaces. Succession starts on gravel bars, which are dominated by Alnus rubra and Salix scouleriana. The following sequential forest communities, and associated ages of land surfaces, are found: Alnus rubra on alder flats (80-100 yr); Picea sitchensis-Acer macrophyllum-Populus trichocarpa on first terraces (400 yr); Picea sitchensis-Tsuga heterophylla on second terraces (750 yr); and Tsuga heterophylla on third terraces. The latter represents the climax community for the river terrace sere, and it occurs on surfaces exposed by retreating Pleistocene alpine glaciers. The first three terraces are derived from Neoglacial alluvial fills.

"There is strong correlation among zonation patterns, forest succession, age of terraces, soil moisture, and soil profile development. Available soil moisture is an important factor governing the zonal sequence. The younger land surfaces are significantly drier than the older terraces. Plants on alder flats and first terraces must withstand greater moisture stress than those of second and third terraces. As the land surface ages, the soil profile develops; deeper, more mature soils are found away from the river.

"The term 'Olympic rain forest' is inappropriately applied to this vegetation; 'temperature moist coniferous forest' is more appropriate not only for forests in the Hoh Valley, but also for the rest of the Olympic Mountains and vegetation along the northern Pacific coast." (A)

171. Fontnoire, Jean.
1974. Les aunes. [The alders.] La Fôret Privée Fr. 97:21-37. [In French.]

172. Forbes, Reginald D., Ed.
1955. Forestry handbook. 1,174 p. Ronald Press Co., New York.

Contains a red alder volume table. (CFH)

173. Forest Club, University of British Columbia.
1959. Forestry handbook for British Columbia. 2d ed. 800 p. Vancouver, B.C.

Compilation of useful forestry data tables and information, much of it pertaining to red alder. (CFH)

174. Forest Industries.
1972. New drive behind red alder. For. Ind. 99(11):41.

"Red alder, for many years simply tolerated by land managers, had found increasing favor with furniture and novelty manufacturers. Production of red alder lumber in Washington and Oregon rose 50 million bd ft between 1960 and 1970, from 200 million to 250 million. Though utilized since the late 1800's, the species did not really get going until

after WW II. Four factors were the key to broader use: Technological advances in alder pulping, gradual decline in quality in other hardwoods on a national scale; expansion of nearby markets; and promotion efforts by an organization of Northwest hardwood producers and landowners.

"Red alder makes up about 70% of total volume of three principal hardwoods in coastal Oregon and Washington, followed by bigleaf maple and cottonwood. USFS data show that about 892,000 acres of commercial forest land in the two states are predominantly alder stands.

"Prior to WW 11, much alder was sold on a rough, green, mill-run basis and a bad reputation resulted. Production since then has been more rigid, in mills equipped to accurately saw, kiln, dry, and surface the lumber to specification.

Seldom growing at elevations above 2,500 feet, alder often forms pure stands of up to several hundred acres. It does best along streams and bottom lands. In such stands, the timber may be clear-boled for 50-60% of its height. Heights of 65-100 feet are normal, though some reach 130 feet. Diameter ranges are from 18 to 24 in., with a maximum of about 34 in.

"About 18.6 billion bd ft of alder is available in commercially operable stands, nearly all west of the Cascades and about 65% on private land." (A)

175. Forest Record, Forestry Commission, London, United Kingdom, 1970. Trials of species on peats: Alder. For. Res. For. Comm., London Rep. 1969/70:51-52.

"Trees in a single plot of Oregon Alder (Alnus rubra) on a deep infertile peat in Sutherland have reached a height of ca. 2 m. in two seasons after planting and fertilizing with P and K. A subsequent review of information on this and other Alnus spp. indicated, however, that although several species make rapid initial growth on acid peats, a characteristic deterioration takes place after 10-15 years, probably owing to lack of P and K. Further work on the nutrition of A. rubra has been planned." (FA)

176. Horristall, Floyd F., and S. P. Gessel. 1953. Soil properties related to forest cover type and productivity on the Lee Forest, Snohomish County, Washington. Soil Sci. Soc. Am. Proc, 19(3):384-389.

"Mechanical and chemical properties of the forest floor and soil, and soil moisture content were examined for 5 plots stocked respectively with Pseudotsuga taxifolia, Tsuga heterophylla, Thuja plicata and Alnus rubra, for each of which site class, number of trees, b.a., and volume and growth per acre were determined. Depth of hardpan layer was an important criterion for productivity rating. The dominating influence seemed to be soil drainage." (FA)

177. Fowells, H. A. 1965. Red alder (Alnus rubra Bong.). In Silvics of forest trees of the United States, p. 83-88. U.S. Dep. Agric. Agric. Handb. 271. Washington, D.C.

"A description of the silvical characteristics of red alder."

178. Franklin, Jerry F., and C. T. Dyrness.
1969. Vegetation of Oregon and Washington. USDA For. Serv. Res, Pap. PNW-80, 216 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Describes and illustrates major vegetational types found in Oregon and Washington including forest types, steppe and shrub-steppe communities, and subalpine mosiacs. Successional and environmental relationships of the communities are discussed. An extensive bibliography directs the reader to more detailed sources." (A)

179. Franklin, Jerry F., and C. T. Dyrness.
1973. Natural vegetation of Oregon and Washington. USDA For. Serv. Gen. Tech. Rep. PNW-8, 417 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Major vegetational units of Oregon and Washington and their environmental relationships are described and illustrated. After an initial consideration of the vegetation components in the two States, major geographic areas and vegetation zones are detailed. Descriptions of each vegetation zone include composition and succession, as well as discussion of variations associated with environmental gradients. Three chapters treat the forested zones found in the two States. Major emphasis is on the distinctive mesic temperate forest found in western Washington and northwestern Oregon. The interior valley forests, shrub lands, and prairies found between the Coast and Cascade Ranges in western Oregon are treated in a single chapter as are subalpine and alpine mosiacs of tree-dominated and meadow communities. Unusual habitats, such as areas of recent vulcanism, serpentines, and ocean strand, are individually described. Soils, geology, and climate are considered in broad outline in an early chapter and in greater detail within discussions of individual geographic areas and vegetation zones. Appendices are included for definition of the various soil types, scientific and common plant names, and a subject index. An extensive bibliography is included to direct the reader to other references." (A)

180. Franklin, Jerry F., C. T. Dyrness, Duane G. Moore, and Robert F. Tarrant.
1968. Chemical soil properties under coastal Oregon stands of alder and conifers. In Biology of alder, p. 157-172. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Chemical soil properties were compared under (1) adjacent 40-year-old red alder (Alnus rubra), conifer (mainly Douglas-fir (Pseudotsuga menziesii)), and mixed stands and (2) adjacent 30-year-old alder and conifer stands growing on the Oregon coast. Soils on all sites were Astoria-like Sols Bruns Acides developed primarily from Eocene siltstone. Organic matter, total nitrogen, and acidity were significantly greater in A horizons under alder and mixed stands. In All horizons of the older stands, organic content under alder average one-third greater than conifer (39 vs. 29 percent), nitrogen one-third greater (0.8 vs. 0.6 percent), and pH one unit lower (4.3 vs. 5.3). A horizons under conifer stands average three times richer in bases than those under alder stands. Similar differences, but of a much smaller magnitude, were observed in the B

horizons. Observed effects of alder on acidity and base content disagree with the generally held concept of hardwoods as base conservers. These effects may indicate greater production of acid decomposition products in the organic- and nitrogen-richer alder soils." (A)

181. Franklin, Jerry F., and Anna A. Pechanec.
1968. Comparison of vegetation in adjacent alder, conifer, and mixed alder-conifer communities. I. Understory vegetation and stand structure. In Biology of alder, p. 37-43. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Vegetational analyses of adjacent 40-year-old coastal Oregon stands of red alder, conifers, and mixed alder-conifer showed marked differences in coverage and richness of understory. Shrubby species were confined mainly to the pure alder stand, where they formed a dense layer. Herbaceous plants were best developed in the alder mixed stands and ground-dwelling cryptogams in the mixed and conifer stands, Differences in canopy density, and, perhaps, in nutrition probably accounted for most of the contrasts. Although current regeneration of trees was uniformly absent, suppressed Sitka spruce saplings persisting in the alder and mixed stands could, by responding to future release, partially replace a deteriorating alder overstory." (A)

182. Friedman, Janet Patterson.
1975. The prehistoric uses of wood at the Ozette archaeological site. Ph. D. thesis. Wash. State Univ., Pullman. 262 p.

"As a result of the remarkable preservation situation available at the Ozette Archaeological Site in Northwestern Washington State, working in wood, generally considered the major technological component of Northwest Coast culture, can be studied in an archaeological context. The current study deals with the identification of wood species utilized in the manufacture of specific categories of wooden artifacts by these aboriginal people. Evidence indicates that they selectively utilized a wide range of available woods, choosing the species with mechanical and other properties best suited to the needs posed by a particular type of artifact. They were well aware of the potentialities of their environment, and utilized it knowledgeably." (A)

183. Fritz, Emanuel.
1945. Twenty years' growth on a redwood sample plot. J. For. 43(1):30-36.

"A 1-acre sample plot of 85-yr.-old Sequoia sempervirens on a high site 1, on which growth data haxe been recorded for 20 yrs., shows the phenomenal yield of 223,034 board ft., not including an additional 21,400 board ft. accretion on 5 old-growth residual redwoods and a small amt. of Alnus oregona. During the decade when the stand was betw. 65 and 75 yrs. old, the periodic annual growth exceeded 5,000 bd. ft. per acre." (BA)

184. Froidevaux, Lucien.
1973. The ectomycorrhizal association, Alnus rubra + Lactarius obscuratus. Can. J. For. Res. 3(4):601-603.

"A laboratory study was made of samples of roots of A. rubra and sporocarps of L. obscuratus both collected in the Coast Ranges of western Oregon. The mycorrhizal association was confirmed by comparing the mycorrhizal mantle with the mycellium at the base of the stipe of the sporocarp for morphology, reaction to chemical reagents, and autofluorescence in long-wave ultraviolet light.** (FA)

185. Froidevaux, Lucien.
1975. Aureobasidium pullulans (de Bary) Arnaud: An associate of Alnus rubra and Lactarius obscuratus mycorrhizae. Eur. J. for. Pathol. 5(2):124-127.

"A. pullulans was isolated from 50% of A. rubra and L. obscuratus mycorrhizae collected in western Oregon in Nov. 1972. In laboratory tests, A. pullulans had an inhibitory effect on the growth of the root pathogen Fusarium oxysporum." (FA)

186. Furlow, John Jacob.
1974. A systematic study of the American species of Alnus (Betulaceae). Ph. D. thesis. Mich. State Univ., Lansing. 503 p.

"The genus Alnus consists of about 20 species of shrubs and trees, mainly of the Northern Hemisphere, but extending below the Equator into South America along the Andes. Although a wide array of studies of the genus during the past 70 years have produced an abundance of new data, and this period has seen the development of different philosophies concerning taxa in general, there has been no comprehensive revisionary effort in that time. Consequently current treatments of Alnus suffer from a lack of up-to-date information and unified taxonomic concepts. The species are often variable, and this had led to both widespread confusion in the treatment of taxa and a proliferation of infraspecific and specific names. In addition, where the geographical ranges of taxa overlap, the plants appear to hybridize readily, adding to the problems of identification and classification.

"From the results of the palynological, anatomical, chemosystematic, and numerical taxonomic studies, as well as ordinary observation, it is seen that the American taxa of Alnus group into three major clusters, which are treated as subgenera (Alnus, Alnobetula, and Clethropsis). Four taxa are regarded as conspecific with Eurasian Alnus incana subsp. rugosa, A. incana subsp. tenuifolia, A. viridis subsp. crispa, and A. viridis subsp. sinuata). The Latin American taxa are shown to comprise two species, Alnus acuminata and A. jorullensis, each of which is subdivided into two varieties (A. acuminata var. acuminata and A. acuminata var glabrata on the one hand, and A. jorullensis var. jorullensis and A. jorullensis var firmifolia on the other).

"Subgenera Clethropsis and Alnobetula are represented by single species in America (Alnus maritima and A. viridis, respectively). Subgenus Alnus is composed of two or more less distinct groups of taxa, one represented by the shrubby northern A. incana and A. serrulata, and the other by the Latin American species and the large tree species of the northern and central sections of the western part of the continent (Alnus rubra, A. rhombifolia, and A. oblongifolia). The latter group is regarded as the most primitive segment of the genus in the New World." (A)

187. Fye, Calvin G., and David G. Briggs.
1978. A comparison of lumber grading rules for alder and competing species. In Utilization and management of alder, p. 85-92. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"This paper contains a comparison of lumber grading rules and practices for red alder and competing species in the hardwood lumber trade such as birch, yellow poplar, soft maple, and black cherry." (A)

188. Gara, R. I., and L. L. Jaeck.
1978. Insect pests of red alder: Potential problems. In Utilization and management of alder, p. 265–269. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Although insect problems of red alder receive little attention at present, concern about insect damage will increase with increasing value and management of the species. Tent caterpillars and sawflies appear to offer the most serious threats to intensive management; defoliation by these insects could lead to drastic reductions in growth of heavily infested stands. Chrysomelid beetles, such as the alder flea beetle, can also be destructive as both larval and adult stages defoliate alder. Bark beetle populations are normally low and damage is limited; however, increased harvest, if accompanied by large amounts of logging slash, could result in population build-up and subsequent attack and mortality of trees in residual stands. Ambrosia beetles attack down logs and can degrade lumber unless removal and utilization proceeds promptly after felling." (A)

189. Garman, E. H.
1953. Pocket guide to the trees and shrubs of British Columbia. B.C. For. Serv. Publ. B. 28, 102 p. Victoria, B.C.

190. Gerhards, C. C.
1964. Limited evaluation of physical and mechanical properties of Nepal alder grown in Hawaii. USDA For. Serv. Res, Note, FPL-036, 4 p. For. Prod. Lab., Madison, Wis.

"Hawaii-grown Alnus nepalensis, tested for (a) shrinkage, (b) bending strength, and (c) hardness, was found to equal samples from Bengal in (b), and to exceed them in (a) and (c). Its modulus of elasticity (m.e.) was lower. It was harder than U.S.-grown Populus tremuloides and Pinus ponderosa, but softer than Alnus rubra. It was comparable to P. tremuloides in (b), but lower in m.e. Values for (a) in the radial and tangential directions were lower than in A. rubra and only slightly greater than in P. tremuloides and Pinus ponderosa." (FA)

191. Gessel, S. P., T. N. Stoate, and K. J. Turnbull.
1965. The growth behavior of Douglas-fir with nitrogenous fertilizer in western Washington. Coll. For. Resour. Bull. 1, 204 p. Univ. Wash., Seattle.

"A very detailed report (119 tables, 28 graphs, 17 maps) of the lay-out and results to date (1962) of long-term study, initiated 15 years previously, to investigate the effects of artificial fertilizers on immature Douglas Fir in western Washington. N has been the one actively simulating element so far discovered; its effects on crown size, height, diameter, volume, foliage, and soil are dealt with. No attempt has been made to determine the forms and amounts of N required to produce any effect, or the economics of fertilizing. An important interaction between weight of fertilizer and site quality resulted in greater additional gross increment per unit N on poor than on good quality classes." (FA)

192. Gessel, S. P., T. N. Stoate, and K. J. Turnbull.
1969. The growth behavior of Douglas-fir with nitrogenous fertilizer in western Washington. The second report. Univ. Wash. Inst. For. Prod. Contrib. 7, 119 p. Seattle, Wash.

A highly variable, improved growth rate differing between locations generally results from the application of nitrogen fertilizer to second-growth Douglas-fir forests. The reason for the variation is unknown. (CFH)

193. Gessel, S. P., and J. Turner.
1974. Litter production by red alder in western Washington. For. Sci. 20(4):325-330.

"Litter production was measured with four 45.7^2 cm traps per stand for 8 to 9 years in seven 30-year-old red alder (Alnus rubra Bong.) stands. Production between years did not differ significantly except for one in which buds and twigs were severely damaged by frost the previous November. The wetness of the summer in a given year affected timing and amplitude of the annual production peak. Annual nitrogen return was from 80 to 200 $kg\ ha^{-1}\ yr^{-1}$." (A)

194. Gessel, S. P., and John Turner.
1973. Litter production by stands of red alder in western Washington. Coniferous For. Biome Intern. Rep. 57, 6 p. Univ. Wash., Seattle.

195. Gessel, Stanley P., Kenneth J. Turnbull, and F. Todd Tremblay.
1960. How to fertilize trees and measure response. 67 p. Natl. Plant Food Inst., Washington, D.C.

Gives a site index curve for red alder. (CFH)

196. Glendenning, R.
1928. An interesting Myzocallis (Homoptera, Aphididae). Entomol. Soc. B.C. Proc. 1928(25):18-20.

"M. alni DeGeer was found by the author on 2 widely separated host plants, native alder (Alnus oregona) and wild strawberry (Fragaria glauca)." (BA)

197. Glennie, Douglas W., and John S. Mothershead.
1964. Chemical structure of lignin sulfonates. I. Preparation of lignin sulfonates from red alder. Tappi 47(6):356-360.

"Hardwood lignin was treated under moderate conditions so as to prepare lignin sulfonates for isolating and identifying monomeric and dimeric components. A 17.3-lb. sample of extractive-free wood chips from the outer 10-year growth of a red alder bolt was cooked with aqueous sodium bisulfite in three separate and successive stages of increasing temperature. Pulp of wood quality was obtained in 49.9% yield with a calculated removal of lignin of 86.7%. Comparison of the ultraviolet absorption characteristics for vinylvanillyl and vinylsyringyl sulfonates indicated that for every two guaiacyl units there were present about three syringyl units in red alder lignin sulfonates. Similarly, one unit in three was estimated to contain a free phenolic hydroxyl group. Since lignin sulfonates obtained in the first bisulfite cooking state were prepared under moderate conditions for sulfonation and came by diffusion from extractive-free chips from uniform wood of recent growth, they were considered a suitable source for isolation of derivatives with low molecular weights that resemble protolignin in red alder." (A)

198. Gordon, John C.
1978. Biological components of alder yield improvement. In Utilization and management of alder, p. 321-325. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Although alder has not been extensively used in intensive forestry, its potential is great. Two species, Alnus rubra Bong. and Alnus elutinosa (L.) Gaertn., are particularly promising because of their growth habit, characteristics, and having been studied more than other alders. The concept of ideal plant type, or ideotype, is useful in determining the yield potential and the need for improvement in specific characteristics of crop plants.

When alders are compared to an ideotype for maximum yield of fiber, they fit well--sapid juvenile growth, ease of vegetative propagation, crown shape, growing season utilization, nitrogen fixation, microbiological relations, genetic variation, and early flowering are all positive. Characteristics with poorer fit are water relations, unit-leaf-area rate of photosynthesis, fecundity, and wood properties. These, however, are susceptible to some genetic and cultural improvement. Recent studies have shown, for example, that photosynthetic capacity and the ability to fix atmospheric nitrogen are closely related but that considerable genetic variation exists in both characteristics." (A)

199. Gordon, John C., and Richard B. Hall.
1978. Alder research outside the Northwest: A brief overview. In Utilization and management of alder, p. 47-53. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp, Stn., Portland, Oreg.

"Over the past century Europeans have done much cultural and physiological research on Alnus plutinosa. Black alder has also been studied and used extensively in Europe and the Eastern United States for land reclamation. Most physiological research on black alder has been related to its capability to fix nitrogen symbiotically, although some data on photo-synthesis and translocation are available. Other European alder species that have received attention are Alnus incana and Alnus cordata. The Netherlands, Germany, Sweden, Finland, and Great Britain have alder genetics or tree improvement programs at one or more locations. Most of the cultural studies have had as their objective the increased use of black alder as an intercrop or rotation crop with conifers or poplars. In Great Britain there is renewed research interest in Alnus rubra, as a windbreak species for the protection of conifer plantations, and as an amenity tree."(A)

200. Graf, Phillip Edward.
1974. Successional stages of red alder in Bonner County, Idaho. M.S. thesis. Univ. Idaho, Moscow. 146 p.

"In northern Idaho seral populations of Alnus rubra are disjunct from the major populations located west of the Cascade-Sierra axis. My objective was to provide a synecological description of plant communities associated with Alnus rubra, especially the seral stages which are dominated by Alnus rubra, and the resulting climax association which lacks Alnus rubra. Thus, a study of Alnus rubra habitats around Lake Pend Oreille showed that both Thuja plicata and Tsuga heterophylla are climax dominants. All of the Alnus rubra successional stages sampled are on potential Tsuga heterophylla climax sites. The understory is dominated by the Pachistima myrsinites vascular union, with a dominance of Polystichum munitum beneath the successional stands of Alnus rubra. Early successional stages are dominated by pure Alnus rubra. Early successional stages are dominated by pure Alnus rubra. Potential climax plants are soon established beneath the Alnus overstory. Later in the sere, Tsuga heterophylla gradually overtops Alnus rubra, and near climax only dead Alnus rubra individuals are present in the stand. In contrast to the Lake Pend Oreille area, other areas, with disjunct populations, further south in northern Idaho were not glaciated. This has resulted in less disjuncts and endemics occupying the Lake Pend Oreille area." (A)

201. Graham, R. D.
1954. Vapor drying of western woods. Oreg. For. Prod. Lab. Rep. D-2, 11 p. Oreg. State Univ., Corvallis.

"Detailed results for Douglas Fir (1-, 2-, and 4-in.) and Western Hemlock (2-in.) and preliminary results for Redwood., Pacific madrone, Red Alder and Ponderosa Pine are tabulated." (FA)

202. Graham, Robert D., and Donald J. Hiller.
1963. Service life of treated and untreated fence posts: 1963 progress report on the post farm. Oreg. For. Prod. Lab. Prog. Rep. 13, 24 p. Oreg. State Univ., Corvallis.

Information on the expected useful life of fenceposts. Red alder is one of the species evaluated. Similar information can be found in earlier reports in this series. (CFH)

203. Gram, K., C. Muhle Larsen, C. Syrach Larsen, and M. Westergaard.
1941. Contributions to the cytogenetics of forest trees. II. Alnus studies. K. Vet. Hojsk. Arsskr. 1941:44-58. Denmark, Copenhagen.

"Alnus elutinosa, A. incana, A. hirsuta, A. tenuifolia, A. tenuifolia var. occidentalis, A. rubra, and A. cordata had 2n = 28 chromosomes. Trees cultivated under the names A. subcordata, A. japonica, and A. orientalis had 2n = 42, and in one individual of A. subcordata 2n = 56. Meiosis was regular in the diploids, very irregular in the triploids, and regular--apart from the formation of some few tetrasomes--in the tetraploid A. subcordata. The triploids are regarded as hybrids between diploid and tetraploid species, and triploids cultivated in various botanical gardens under species names are evidently spontaneous hybrids grown under the name of the mother tree. According to other authors, A. japonica and forms of A. glutinosa are also tetraploid, as is A. subcordata X A. glutinosa (A. spaethii). Experimentally produced hybrids are listed. (FA)

204. Gramovsky, A, A.
1928. A review of myzocallis species inhabiting Alnus, with description of a new species (Homoptera, Aphiidae). Ann. Entomol. Soc. Am. 21(4):546-565.

"Keys to 4 spp. of Myzocallis inhabiting Alnus, alate and apterous viviparous and apterous oviparous ♀♀, and alate ♂♂. Redescriptions of M. alni, alate* and apterous * viviparous ♀♀, apterous oviparous ♀ *, alate ♂ * which is known in America only from Illinois, Oregon, and British Columbia, M. alnifoliae, the same stages*, on Alnus incana, A. rubra, A. rugosa, and A. serrulata in eastern United States; M. rhombifoliae (p. 555), same states*, from Alnus rhombifolia and A. incana, Wisconsin (type) and California; M. pseudoalni, alate viviparous ♀ *." (BA)

205. Gratkowski, H., D. Hopkins, and P. Lauterbach.
1973. The Pacific coast and northern Rocky Mountain region. J. For. 71(3):138-143.

Discusses brush control in the Pacific coast and Rocky Mountain areas. (CFH)

206. Graves, Henry S.
1912. Red alder. Alnus oregona Nutt. U.S. Dep. Agric. Silvical Leafl. 53, 4 p.

207. Gregson, P. G.
1948. The management and utilization of red alder. B.S.F. thesis. Univ. B.C., Vancouver. 59 p.

208. Grobey, John Henry.
1964. An economic analysis of the hardwood industry of western Washington. M.F. thesis. Univ. Wash., Seattle. 101 p.

Although part of the national hardwood industry, the hardwood industry of Washington is considered on a regional basis. Growth is expected but at present it is underutilized. Important reasons are interaction with other segments of the local timber industry, imperfections in the competitive behavior of resource markets, and certain institutional factors. (CFH)

209. Grondal, Bror L.
1918. Seattle shoe factory utilizes red alder. West Coast Lumberman 34(398):21.

Describes a manufacturing process which uses seasoned red alder as soles for wooden shoes. (CFH)

210. Grondal, Bror L.
1956. New process barks alder. Pulp and Pap. 30(3):125-126.

Alder bark is almost completely cooked away in the pulping process, yielding little pulp but requiring additional cooking liquid and decreasing digester capacity. Fresh green chips will float in water while bark particles sink. Chips with adhering bark will either float or sink depending on the amount of bark present. A proposed cleanup scheme involves screening to remove fines, rolling to loosen bark, and finally, a flotation to separate chip and bark. (CFH)

211. Grondal, Bror L., and Piotr Zenczak.
1949. Prolysis of wood: Recent developments. Trend Eng. Univ. Wash. 1(2):23-25. Seattle, Wash.

"Describes small-scale prolysis experiments carried out for checking claims put forward by Slavyansky. Attempts at improving the process of distilling the wood, while immersed in kerosene, under different temperatures and pressures, resulted in obtaining a high proportion of soluble tar and of acetic acid. Experiments were carried out with Douglas Fir heartwood in the form of large and small blocks and sawdust, and with Red Alder blocks. Kerosene losses were negligible. The charcoal obtained presents a very extended interior surface area." (FA)

212. Gunther, Erna.
1945. Ethnobotany of western Washington. Univ. Wash. Publ. Anthropol., 61 p. Seattle.

Uses of plants by native Americans. (CFH)

213. Haard, Richard T.
1971. The periodicity of spore release from a conifer, a liverwort, and a bracket fungus. Northwest Sci. 45(3):183-187.

"Two Kramer-Collins air samplers were used to observe hourly pollen release from a tree of Tsuga heterophylla in Mt. Baker National Forest, Wash., at 3500 ft alt. for 10 days in May, 1968. Well defined peaks in pollen release, coinciding with the lowest daily r.h. (29-43%) were noted on May 9, 10 and 11. Thuja plicata and Alnus rubra, growing at ca. 500 ft alt. in the same county, showed similar

patterns of pollen release. At the Mt. Baker site, parallel observations were made on spore release from a liverwort and from the fungus Ganoderma applanatum; the patterns for these differed inter se and from the pattern of pollen release in T. heterophylla." (FA)

214. Haddock, Philip G.
1949. A problem child reforms: New perspectives in the management of red alder. For. Club. Q. 22(2):9–15. Univ. Wash., Seattle.

"A review of the existing literature on the management and utilization of Alnus rubra in the Pacific Northwest, where it is the most plentiful and useful hardwood species." (FA)

215. Hagman, M.
1975. Incompatibility in forest trees. R. Soc. London Proc. B. 188, p. 313-326.

"Despite the great importance for forest tree breeding, very limited knowledge is yet available about the breeding systems of forest trees. Where incompatibility has been studied in the hardwoods; patterns have been observed which confirm the general rules detected for other angiosperms. Self- and interspecific incompatibility at the level of pollen tube growth has been reported for example in Betula and Alnus. In Alnus one case of unilateral interspecific incompatibility has been found. Self-incompatibility has, so far, not been reported from the conifers. Interspecific incompatibility in the form of the arrestment of the pollen tube growth in the nucellus tissue has been observed in Picea and is particularly clear in Pinus crosses between the subgenera Haploxylon and Diploxylon, but also within the Diploxylon-group. The nature of the incompatibility mechanism is still unknown, but serological differences related to the behaviour in the crosses had been detected in birch and pine pollen. It is suggested that the complex polysaccharidic composition of the cell walls and membranes might form a specific stereochemical basis for the incompatibility reaction. The presence of a combination of self-pollination, polyembryony and genetic load is discussed as an alternative mechanism favouring outbreeding in the Gymnosperms." (A)

216. Hagman, Max.
1967. Genetic mechanisms affecting inbreeding and outbreeding in forest trees; their significance for micro-evolution of forest tree species. Int. Union. For. Res. Organ. 14th Congr. Proc., Munich, Pt. III, Sect. 22, p. 346–365.

"Reviews past sudies on incompatibility in plants in general and forest species in particular. The author has observed that self-incompatibility in some species of Betula and Alnus is due to a retardation in the growth of the pollen tube. The influence of these factors in the micro-evolution of species is discussed." (FA)

217. Hall, J. Alfred.
1969. The pulp and paper industry and the Northwest. 61 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Discusses red alder as an unused or a little-used species in the pulp and paper industry. (CFH)

218. Hall, J. Alfred.
1970. Wood, pulp and paper, and people in the Northwest. 34 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Discusses alder as an unused or a little-used species in the pulp and paper industry. (CFH)

219. Hall, John W.
1950. The comparative anatomy of the Betulaceae. Am. J. Bot. 37(8):662.

"Anatomical evidence indicates that the Betulaceae are not primitive, but are moderately specialized. The trends of specialization are: in the Butuleae, from Alnus (scalariform perforation plates with numerous narrow bars; opposite and alternate intervascular pitting) to Betula (reduction in the number of bars and widening of the bars in the perforation plates; exclusively alternate intervascular pitting); thence in the tribe Coryleae to Corylus and Ostryopsis (spiral thickenings in the vessels; fibre-tracheids exclusively; reduced number of wide bars in the scalariform perforation plates; heterogeneous rays) to Carpinus (marked tendency toward simple perforations; homogeneous rays) and to the most advanced genus, Ostrya (simple perforations; homogeneous rays etc.)." (FA)

220. Hall, John W.
1952. The comparative anatomy and phylogeny of the Butlaceae. Bot. Gaz. 113(3):235-270.

Twenty-four species of Alnus were studied. Only three of the four sections of the genus are represented. The wood anatomy of the Betulaceae was studied comparatively to establish the phylogenetic position of the family. The Betulaceae is more primitive than the Coryleae. Alnus is less specialized than Betula. (CFH)

221. Hamilton, J. K., and N. S. Thompson.
1958. A comparison of the carbohydrates of hardwoods and softwoods. Pulp & Pap. Nag. Can. 59(10):233-241.

"Holocelluloses have been prepd. from a no. of hardwoods and softwoods by the chlorite method and, in certain instances, by a new milder method employing ClO_2 buffered to pH 7. Western red alder has been shown to contain a glucomannan (I) with glucose:mannose = 2:3. The isolation and identification of cryst. **O-α-4-O-methylglucuronopyranosyl-(1→2)-O-β-D-xylopyranosyl-(1→4)-D-**xylopyranosyl-trihydrate indicates that the 4-O-methylglucurono-xylan (II) of this wood is similar to that from other hardwoods. The results of pretreatment and high-strength NaOH extns. of various holocelluloses indicate that most of the hemicelluloses are not chemically combined with the cellulose of either type of wood. Though the cellulose of the hardwoods and softwoods are similar in phys. and chem. properties, it would appear that their noncellulosic polysaccharides have several differences. Hardwoods contain 20-30% hemicelluloses, consisting mostly of II with a high ratio of D-xylose (II) to 4-O-methyl-D-glucuronic acid (IV) and small amts. of glucose, arabinose, and mannose which last appears to be assocd. with a highly inaccessible I. Softwoods contain 15-20% hemicelluloses consisting mostly of a difficulty extractable I, small amts. of 4-O-methylglucuronoaraboxylan having a lower ratio of III to IV, and to a lesser but significant extent sol. I, galactoglucomannans, and arabogalac-

tans. Traces of rhamnose and glucuronic acid occur in both hardwoods and softwoods." (BA)

222. Hamilton, J. K., and N. S. Thompson.
1959. A comparison of the carbohydrates of hardwoods and softwoods. Tappi 42(9)752–760.

"Compares the hemicellulose of hardwoods (mainly Alnus rubra, Arbutus menziesii, Liquidambar styraciflua, Nyssa aquatica and N. sylvatica), and of softwoods (Tsuga heterophylla, Thuja plicata, Pinus elliottii, P. palustris, etc.), and presents detailed tabulated results of research on the behavior of hemicelluloses during various pulping processes. These results indicate that the residual extraction-resistant sugars which remain associated with the cellulose as shown by hydrolysis, are not part of the cellulose but are due to inaccessible or highly insoluble polymers intimately associated with it." (FA)

223. Hansen, Everett.
1975. Phellinus (Poria) weirii root rot in Douglas-fir-alder stands 10-17 years old. USDA For. Serv. Res. Note PNW-250, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Red alder growing in even-aged mixture with Douglas-fir did not reduce initial losses to Phellinus weirii 10- to 17-year-old Douglas-fir plantations. The ability of alder to reduce later losses from lateral spread within the stand was not examined. P. weirii is creating openings in these young stands with 3 percent of the trees already dead in one case. The symptoms and distinguishing features of P. weirii infection on young trees are described." (A)

224. Hansmann, Eugene W., and Harry K. Phinney.
1973. Effects of logging on periphyton in coastal streams of Oregon. Ecology 54(1):194–199.

"Describes part of a study on small catchments, comparing the effects of clear felling and patch logging on the water quality and biological resources of small coastal streams. The overstorey on the catchments consisted mainly of Pseudotsuga menziesii and Alnus rubra." (FA)

225. Harger, J. R. E.
1973. Damage to vegetation by chlorine gas. Int. J. Environ. Stud. 4:93–108.

"The effects of chlorine gas emanating from a factory in causing damage to foliage were tested on Malus fusca, Populus trichocarpa, Rubus spectabilis, Alnus rubra and Sambucus racemosa var. arborescens. S. racemosa was the most suceptible species. (FA)

226. Harrar, E. S.
1958. Hough's encyclopaedia of American woods. Vol. 2, 223 p. Robert Speller & Suns, New York.

Volume 2 of 16 volumes on properties and uses of American woods. Includes botanical description of trees, leaves, flowers, and fruits. Gross diagnostic features, microscopy, and tables of physical properties of wood are presented. An accompanying atlas volume includes thin section samples of wood in radial, tangential, and transverse cuts. (CFH)

227. Harris, Arland S., and Wilbur A. Farr.
1974. The forest ecosystem of southeast Alaska. 7. Forest ecology and timber management. USDA For. Serv. Gen. Tech. Rep. PNW-25, 109 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Large-scale use of the timber resource of southeast Alaska began in 1953 after long efforts to establish a timber industry. Development and present status of the industry and present management of the timber resource are summarized, stressing the biological basis for timber management activities in southeast Alaska today. Ecological and silvicultural considerations related to timber harvest, reforestation, and stand development are discussed.

"Published and unpublished information are brought together. Current management practices are discussed as a basis for better understanding of how this information can be helpful in managing the timber resource and to point out where research is needed." (A)

228. Harris, K. F.
1950. Growing good quality second growth alder. B.C. Lumberman 34(7):41, 109-110, 112.

Suggests modifications of European silvicultural techniques that may be applicable to intensive management of red alder. Gives estimates, in time per acre, of various silvicultural treatments. (CFH)

229. Hartman, David A., William A. Atkinson, Ben S. Bryant, and Richard O. Woodfin.
1975. Conversion factors for the Pacific Northwest forest industry: Converting forest growth to forest products. 112 p. Inst. For. Prod., Coll. For. Resour., Univ. Wash., Seattle.

A collection of tables of wood yield expressed in cubic measurements. English and metric units are presented. (CFH)

230. Hatton, J. V., and K. Hunt.
1977. Physical properties of softwood and hardwood kraft pulps as a function of bulk. Tappi 60(10):145-147.

"Data presented substantiate earlier findings that bulk (specific volume) can be used in place of the Canadian standard freeness (CSF) test to characterize pulp physical properties. Linear regression equations were found for kraft pulps of balsam fir, tamarack, red alder, beech, yellow birch, and maple, which correlate wide ranges of bulk with CSF values for burst factor, breaking length, and tear factor. It was observed that quadratic equations would fit the data slightly better. Areas of caution are indicated which should be considered before replacing CSF tests by bulk determinations."(FA)

231. Hatton, John V.
1976. The potential of process control in kraft pulping of hardwoods relative to softwoods. Tappi 59(8):48-50.

"Application of three-equation sets of general form $(Y, P, K) = A - B [(\log H)(EA)^n]$, to kraft pulping data from three softwood species--alpine fir, balsam fir, and Douglas fir--and four

hardwood species--beech, hard maple, red alder, and yellow birch--revealed that in hardwood kraft pulping, process control will be more difficult to achieve than for softwoods under normal operating conditions. In these equation sets, the three output variables--total pulp yield (Y), screened-pulp permanganate number (P), and screened-pulp kappa (K)--are related to the two major kraft pulping input variables of H-factor (H) and effective alkali applied (EA). A consistent behaviorial pattern observed within the three-equation sets for softwoods, pulped under a variety of kraft processing conditions, is confirmed by relatively high values of r^2, a measure of the goodness of fit of the derived equations with the experimental data. Thus, process control for kraft mill processing of softwoods should be relatively straightforward. For hardwoods, however, with their more variable chemical composition, less consistency is observed within the three-equation sets, and the derived equations do not fit the experimental data as well as for the softwoods." (A)

232. Hawkes, Carl.
1953. Planes release tree plantation. J. For. 51(5):345-348.

"Describes successful operations in Oregon for the release of 10-year-old conifer plantations from Red Alder by spraying from the air with 2,4-D at the rate/acre of 2 lb. acid equivalent mixed with 8 gal. water and 2 oz. sticker-spreader. Cost of spraying 1000 acres was $5-15/acre. Alder was killed, Willow discouraged, and little damage done to the other trees and shrubs." (FA)

233. Hawley, L. F., and Louise E. Wise.
1926. The chemistry of wood. 334 p. Chem. Cat. Co., Inc., New York.

Tables an volume and analysis of red alder. (CFH)

234. Hayes, James.
1948. Utilizing hardwoods from the farm. 27th Annu. Wash. State For. Conf. Proc., p. 20-22. Seattle, Wash.

235. Heebink, T. B.
1965. Suitability of seven west coast species for pallets. USDA For. Serv. Res. Pap. FPL-22, 16 p. For. Prod. Lab., Madison, Wis.

"Describes tests of different types of pallet made from (1) Pseudotsuga taxifolia, (2) Tsuga heterophylla, (3) Lithocarpus densiflorus,, (4) Larix occidentalis, (5) Pinus ponderosa, (6) Populus trichocarpa and (7) Alnus rubra, for resistance to (a) bending under load, (b) distortion when dropped on a corner, and (c) damage when thrown about in a revolving drum. The performance of (2) was as good as (1) throughout, that of (5), (6), and (7) was as good as (1) for (b) and (c) but inferior for (a), and (3) and (4) were inferior to (1) in all respects. Comparative tests of pallets of (1), (2) and (7) made from dry and green lumber were inconclusive." (FA)

236. Henderson, J. A.
1970, Biomass and composition of the understory vegetation in some Alnus rubra stands in western Oregon. H.S. thesis. Oreg. State Univ., Corvallis. 64 p.

237. Hepting, George H.
1971. Diseases of forest and shade trees of the United States. U.S. Dep. Agric. Agric. Handb. 386, 658 p. Washington, D.C.

This book discusses the pathology of trees native to the United States and of many species introduced for shade and ornamental purposes. It describes the main characteristics of a tree and its pathogens, then lists materials and references helpful to a person diagnosing diseases of a species. (CFH)

238. Herfeld, H., and E. Zieger.
1951. Fichten-, Kiefern- und Erlenzapfen als Gerbmaterialien. [Spruce, pine, and alder cones as tanning materials.] Gesammelte Abh. Dtsch. Lederinst., Freiberg, Germany, No. 6, p. 65-75.

**Resultsof an investigation into the tannin content of Spruce cones, both fallen and gathered from the trees; various portions of Spruce cones and Pine and Alder cones; with tables on results of extraction of Spruce and Alder cones, and of compatibility tests of Spruce-cone extracts with vegetable and synthetic tanstuffs. In this respect Pine cones were found to be of little value, but cones of Spruce and Alder (Alnus glutinosa, A,. incana, A,. rubra) could be advantageously used in the tanning industry." (FA)

239. Hetherington, J. C.
1964. Brush control in coastal British Columbia. B.C. For. Serv. Res. Note 38, ***56*** p. Vancouver.

Asummary of the principles of chemical, mechanical, and biological methods of brush control and the results of a study based on the examination of a large number of commercial and experimental brush-control projects in British Columbia. The control of Alnus rubra, Acer macrophyllum, A,. circinatum, Rubus spectabilis, Pterdium aquilinum, and gaultheria shallon by chemical means is discussed. Mechanical removal of brush by bulldozer, by girdling, and by cutting, and the silvicultural characteristics of tree species planted in brush areas are also considered. When possible, costs are given for all treatments. (FA)

240. Heusser, C. J.
1969. Modern pollen spectra from the Olympic Peninsula, Washington. Bull. Torrey Bot. Club 96(4):407-417.

"In samples from 52 sites in different sectors and altitudinal zones between sea-level forest and alpine tundra, pollen of Tsuga heterophylla and Alnus rubra was dominant. Extra-zonal pollen constituted part of the deposits. Variation within a zone was due to disturbance such as logging, fire, etc. The value of the data for interpreting N. Pacific Pleistocene pollen profiles is discussed." (FA)

241. Heusser, C. J.
1974. Quaternary vegetation climate and glaciation of the Hoh River Valley, Washington. Geol. Soc. Am. Bull. 85(10):1547-1560.

"The Hoh River valley, on the west side of the Olympic Peninsula, is about 90 km long and is one of the major valleys originating in the interior Olympic Mountains [USA]. Pollen stratigraphy and ^{14}C chronology of 3 bog cores in the lower Hoh valley show tundra at low elevations from 18,8000±800 yr B.P. until about 10,000 yr B.P. Holocene-vegetation is portrayed by 3 pollen assemblages: Pinus-Alnus-Picea-Pseudotsuga-Pterdium (10,000 to 8000 yr B.P.), Picea-Tsuga- Alnus-Pseudotsuga-Pterdium (8000 to 3000 yr B.P.) and Tusuga-Thuja-Abies (3000 to 0 yr B.P.). The sequence implies a climatic trend from a cool and relatively humid climate in the beginning, to increasing warmth, then maximum warmth and lower humidity, and finally to a cooler and quite humid climate at the close. The sequence also reflects the gradual replacement of open, successional forest communities by a late Holocene-age closed rain forest. Pollen influx is low, generally less than 1500 grains cm^{-2} yr^{-1}, except around 8000 yr. B.P., when values exceeded 5000 cm^{-2} yr^{-1}. Traces of tephra from the eruption of Mount Mazama, found in 1 bog section, mark an extreme Pacific continental limit for this ejectamenta. Refugia on the Olympic Peninsula contained the stock from which major migrations of plants northwestward along the north Pacific coast took place toward the close of Fraser Glaciation and during Holocene time." (BA)

242. Heusser, Calvin J.
1960. Late-Pleistocene environments of north Pacific North America. Am. Geogr. Soc. Spec. Publ. 35, 308 p.

A comprehensive discussion of the vegetation, environment, and chronology of the Pacific coast of North America from the late Pleistocene (about 14,000 years ago) to the present. Red alder was an important successional component of the region during this period. (CFH)

243. Heusser, Calvin J.
1973. Environmental sequence following the Fraser advance of the Juan de Fuca lobe, Washington. Quat. Res. 3(2):284-306.

"Stratigraphic palynology and radiocarbon chronology of two bogs and a lake on the northwestern Olympic Peninsula serve to record the environmental sequence post-dating the Fraser maximum of the Juan de Fuca lobe. Wastage of the lobe in the terminal area began before 14,4602200 BP. Differential downwasting followed, and the last remnants of dead ice probably disappeared some time before 9,380±180 BP. Ablation margine became sufficiently thick in the course of wastage for a vegetation cover to become established. Arboreal remains of this cover, found buried in til, date between 12,020±210 and 13,380±250 BP.

"Communities of Pinus contorta first succeeded on deglaciated surfaces during the Vashon Stade. Environmental conditions were comparable to those prevailing in the modern subalpine forest, and average July temperature stood near 12°C. Later, during the Everson Interstade (11,000-13,000 BP.), Alnus and Picea multiplied as temperature increased possibly to as much as 14°. During the Sumas Stade (10,000-11,000 BP.), temperature was again ca. 12°C, the cooler climate halting wastage and the spread

of Alnus and enabling communities of Picea, Tsuga heterophylla, and T. mertensiana to temporarily achieve stability.

"Postglacial environments through the Hypsithermal (ca. 3,000 BP) were dominated principally by Alnus. Alnus, succeeded in turn by Picea, invaded the landscape, following the recession of alpine glaciers and the rise in elevation of the snowline. For a time, as suggested by a peak of Pseudotsuga, temperature may have reached close to 17° and annual precipitation less than 760 mm. Arboreal communities were relatively open while light-requiring Pteridium remained conspicuous in the record. After 3000 BP during Neoglaciation, climate became sufficiently cool and moist to favor the development of extensive, closed communities of Tsuga, Picea, Thuja, and other hygrophilous species." (A)

244. Hewitt, E. J., and G. Bond.
1966. The cobalt requirements of non-legume root nodule plants. J. Exp. Bot. 17(52):480-491.

"Experiments with Casuarina cunninghamiana, Myrica gale and Alnus plutinosa confirmed the necessity of Co for proper growth of nodulated plants. Under the conditions of the experiment, marked N-deficiency symptoms appeared during the second growth season when Co was not supplied. The need for Co appears to be confined to the nodules. The relationship between the presence of Co, vitamin B_{12} analogues, and the growth of the endophyte and fixation of atmospheric N is discussed." (FA)

245. Hildenbrand, Homer.
1972. Economics and marketing of alder. In Managing young forests in the Douglas-fir region, Vol. 3, p. 53-61. Alan B. Berg, ed. Sch. For., Oreg. State Univ., Corvallis.

246. Hill, Fred J.
1978. Trends and technologies in southern hardwood sawmills. In Utilization and management of alder, p. 111-121. David G. Briggs, Dean S. DeBell, William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"This paper examines several hardwood sawmills ranging in capacity from 5 MM bd. ft. to 40 MM bd. ft. annually, and discusses the relative capital costs, operating costs, and characteristics of each facility. The paper further related hardwood sawmill design to the characteristics of the hardwood sawtimber resource in the Eastern United States and explores the major industry concerns of (1) lack of growth in hardwood lumber production, (2) reduction in log size and quality, and (3) shifts in end-use markets. The uncertain supply of hardwood logs from small private ownership, the lack of market growth, and the variable earnings history of hardwood operations have discouraged most large corporate investment to date." (A)

247. Hillstrom, William A.
1974. Chip debarking of several western species. USDA For. Serv. Res. Note NC-164, 4 p. North Cent. For. Exp. Stn., St. Paul, Minn.

"Compares procedures for removing bark from chips by compression rolls followed by 'drubbing' (tumbling and beating) the

material and then screening with or without an initial pre-steaming of the chips. Tests with four species are reported, using chips from various parts of the trees, including branches and foliage. Best bark removal was obtained with Alnus rubra (90%), followed by Tsuga heterophylla and Acer macrophyllum (60-75%); results with Pseudotsuga menziesii were slightly poorer. Pre-steaming made little difference to bark removal, but the 'drubbing' led to appreciable losses of wood fibre in P. menziesii and A. macrophyllum. After screening, and rejection of the fines, most residual bark was found in the smallest (3/16 in screen) chip material." (FA)

248. Hitchcock, C. Leo, and Arthur Cronquist.
1973. Flora of the Pacific Northwest. 730 p. Univ. Wash. Press, Seattle.

249. Hitchcock, C. Leo, Arthur Cronquist, Marion Ownbey, and J. W. Thompson.
1964. Vascular plants of the Pacific Northwest. Part 2. 597 p. Univ. Wash. Press, Seattle.

A major taxonomic reference to Pacific Northwest plants in five volumes; red alder is described in volume 11. (CFH)

250. Hosie, R. C.
1973. Native trees of Canada. 380 p. Can. For. Sesv., Ottawa.

Red alder is one of the species discussed in a nontechnical manner. Range map and photos included. Volume contains summer and winter keys to native Canadian trees. (CFH)

251. Hoyer, Gerald, Walter Fergerson, Michael Newton, and David R. M. Scott.
1978. A comparison of red alder, Douglas-fir, and western hemlock productivities as related to site--a panel discussion. & Utilization and management of alder, p. 175-182. David G. Briggs, Dean S. DeBell, William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

252. Hoyer, Gerald E.
1966, Tarif access tables for the Pacific Northwest--a compilation. 118 p. Wash. State Dep. Nat. Resour., Olympia.

253. Hrutfiord, B. F.
1878. Red alder as a pulpwood species. In Utilization and management of alder, p. 135-138. David G. Briggs, Dean S. DeBell, William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"In this paper I discuss the use of alder as a pulpwood species. Today most alder pulpwood is procured as roundwood. Debarking of small and frequently crooked logs and storage are indicated as problems. Chips are rarely stored more than a month as they color rapidly and strength and yield losses occur. Use of alder in a number of pulping processes is discussed. Alder is suggested as the best prospect for whole tree chipping in the Northwest." (A)

254. Huffman, J. G., W. D. Kitts, and C. R. Krishnamurti.
1971. Effects of alkali treatment and gamma irradiation on the chemical composition and *in vitro* rumen digestibility of certain species of wood. Can. J. Anim. Sci. 51(2):457-464.

"Changes in the chemical composition *in vitro* rumen digestibility of alder (*Alnus rubra*), Douglas-fir (*Pseudotsuga menziesii*), poplar (*Populus tremuloides*), and sludge (a by-product of the pulping process made up of silver fir and hemlock residues) were studied after treatment with NaOH and gamma irradiation. Treatment with alkali increased the percentage of cellulose and acid detergent fiber (ADF) in all species of wood studied, whereas the average acid detergent lignin (ADL) content was not affected. Alkali treatment increased the *in vitro* dry matter disappearance (DMD) of alder and poplar, and increased the *in vitro* cellulose digestion of alder, poplar and sludge. Samples of the 4 species of wood that were exposed to 1×10^8 or 2×10^8 rads of gamma irradiation were lower in cellulose, ADF and ADL content than the untreated samples, or those exposed to 1×10^6 or 1×10^7 rads. *In vitro* DMD, cellulose digestion and volatile fatty acid production were higher in samples of all 4 species exposed to 1×10^8 or 2×10^8 rads, than in untreated samples, or in those exposed to 1×10^6 or 1×10^7 rads." **(BA)**

255. Hughes, D. R., S. P. Gessel, and R. B. Walker.
1968. Red alder deficiency symptoms and fertilizer trials. *In* Biology of alder, p. 225-237. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

256. Hughes, Dallas Robert.
1967. Red alder deficiency symptoms and fertilizer trials. M.F. thesis. Univ. Wash., Seattle. 144 p.

Presents deficiency guidelines for N, P, K, Ca, and Mg developed in red alder seedlings growing in sand medium. Foliar percentages of these elements were determined as aids in diagnosing deficiencies. Module frequency was higher in low N treatments. Deficiency symptoms are illustrated with color photographs. Fertilizer studies were conducted with seedlings growing in soil. (CFH)

257. Hunt, Ian Sinclair.
1957. Las propiedades y usos de la madera de Alnus. [Properties and uses of alder wood.] Inst. For. Lat. Am. Bol. 23, p. 29-42. Merida, Venezuela. [In Spanish. English summary.]

"Available data on the properties and uses of the wood of the commercially important species of Alnus are discussed and summarized.

"The commercial uses are governed by the natural occurrence of the species; apparently there have been no large scale planting of exotic species of Alnus, with the exception of A. Nepalensis in Hawaii.

"The indigenous species in commercial use are A. rubra in Canada and the U.S.A., A. glutinosa in England and Europe, A. incana in Western and Central Europe, A. nepalensis in India, and A. jorullensis in South America.

"A comparison is made of those physical and mechanical properties which have been reported. There are some gaps in these data, particularly for A. jorullensis. It is noted that the lowest test figures are shared by A. nepalensis and A. jorullensis, and the highest by A. glutinosa and A. rubra.

"The literature cited gives some indication of the extent of the knowledge of the properties and applications of the wood of Alnus in the various countries in which the different species occur.

"Taking into account the present use of Alnus wood in North America, England and Europe, the uses to which the wood of A. jorullensis could be put to the greatest advantage in the future in South America would be: preservative treated telephone and electricity poles, treated fence posts, treated mine props, treated wood for rural buildings, boxes and cases, patches and match boxes, turned to novelty goods, and pulp and paper." (A)

258. Hunt, K., and J. V. Hatton. 1976. Increased pulp production by use of hardwoods in softwood kraft mills. Pulp & Pap. Can. 77(12):119-123.

"The kraft pulping of single softwood-single hardwood mixtures of white spruce, western hemlock, or jack pine containing up to 28% by weight of red alder, yellow birch, or trembling aspen is examined in detail. Single hardwood-single softwood mixtures cook more rapidly to a target permanganate number, and give higher pulp yields and equivalent pulp quality compared with a softwood cooks alone under the same conditions. Mixed pulps also beat faster. There are no technical limitations to the use of small amounts of hardwoods with softwoods to produce unbleached or bleached market pulps. In addition to increased pulp production, other benefits exist." (A)

259. Hyttinen, A., and E. R. Schafer. 1955. Grinding pretreated hardwoods: Experiments on quaking aspen, sweetgum, red alder, black tupelo, sugar maple, red oak and cottonwood. Pulp and Pap. Mag. Can. 56(12):140-148.

"Increasing the severity of the pretreatment with neutral Na_2SO_3 increased the strength and density of the pulp but decreased the brightness and opacity of its papers. The chemigroundwood pulp could probably be used for the same purposes as the neutral sulphite semichemical pulps. The darker pulps were easily brightened with $Ca(OCl)_2$. These chemigroundwood pulps may possibly provide entire or part substitutes for mechanical softwood pulps in newsprint and bood and towelling papers, and also in mixtures with mechanical hardwood pulps, a substitute for softwood groundwood. Details of the properties of the pulps, of test sheets, and of experiments in paper-making, are given for Populus tremuloides, Liquidambar styraciflua, Alnus rubra, Nyssa sylvatica, Acer saccharum, Quercus sp., and Populus sp." (FA)

260. Hyttinen, A., and E. R. Schafer.
1955. Grinding pretreated hardwoods: Experiments on quaking aspen, sweetgum, red alder, black tupelo, sugar maple, red oak, and cottonwood. USDA For. Serv. For. Prod. Lab. Rep. 2015, 12 p. Madison, Wis.

"Experiments were made with Populus tremuloides, Liquidambar styraciflua, Alnus rubra, Myssa sylvatica, Acer saccharum and Quercus sp. The effects of different pretreatment with neutral sulphite solutions are described and tabulated. The results, in addition to the easy bleaching, point to the possibility of substituting semichemical hardwood pulp in part or whole, for mechanical softwood pulp for a variety of uses." (FA)

261. Irgens-Holler, H.
1960. Automatic control of photoperiod. Ecology 41(1):222-223.

"Describes methods used at Corvallis, Oregon, for the automatic control of photoperiod in greenhouse studies on Pseudotsuga taxifolia and Alnus sp. The plants are grown in separate compartments of growth chambers. These can be covered or uncovered as required by a means of a small motor, controlled by an electric time switch (wiring system shown), which moves a light-proof canvas belt, mounted on rollers, in either direction. Fluorescent lamps are fitted in the compartments and can be used either to supplement daylight or to give long-day treatment when the chambers are covered. Temperature in the greenhouse is only partially controlled, but is kept constant in all compartments even though under varying light treatments." (FA)

262. Isaac, Leo A.
1939. Reforestation by broadcast seeding with small-seeded species. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Notes 27, p. 9-10. Portland, Oreg.

"Although there was wide variation in the results from these tests with seed of Sitka Spruce, Western Red Cedar, Western Hemlock, and Red Alder, it appears that satisfactory regeneration can be obtained by broadcast seeding at the rate of one or two pounds per acre, as long as the seeding is done within two years after slash burning. If postponed longer there is a considerable falling off in initial germination and in survival." (FA)

263. Ivan Bloch and Associates (Industrial Consultants, Portland, Oreg.).
1964. Western markets for red alder from specified counties in Oregon and Washington: A preliminary and partial examination prepared for the U.S. Area Redevelopment Administration. 56 p. Portland, Oreg.

264. Jackson, H. S., and Elizabeth Ruth Dearden.
1949. Studies of Canadian Thelephoraceae. III. Some new species from British Columbia. Can. J. Res., Sec. C., Bot. Sci. 27(4):147-156.

"Descrs. of Peniophora resinosa, on Picea sitchensis; P. unica, on Abies lasiocarpa; P. inusitata, on Populus trichocarpa; P. phlebioides and Corticium testatum, on Pseudotsuga taxifolia; C. praeteritum, on Alnus rubra; C. separatum, on Abies grandis; C. guaesitum, on Pseudotsuga taxifolia; C. propinquum, on Thuja plicata." (BA)

265. Jain, M. C., and T. R. Seshadri.
1971. Triterpenoids from Alnus rubra. Indian J. Chem. 9(9):1026-1027.

"Taraxerone, lupeol and betulin occur as major components and lupenone, taraxerol, ß-sitosterol and the somewhat rare compounds taraxeryl acetate and glutenone occur as the minor components in the bark of A. rubra. Except taraxerol and taraxerone, the other six have been isolated for the first time from A. rubra. The acetone and alcohol extracts contain glucose, xylose and arabinose as free sugars and fairly good amounts of leucocyanidin." (A)

266. Jaretzky, R.
1930. Zur Zytologie der Fagales. Planta 10:120-137.

267. Jenkins, J. H., and F. W. Guernsey.
1954. The kiln-drying of British Columbia lumber. For. Prod. Lab. Can. Bull. 111, 79 p. Vancouver, B.C.

Comprehensive presentation of the general principles of kiln-drying; gives details for kiln-drying the chief commercial lumber species of British Columbia. (CFH)

268. Jepson, Willis Linn.
1909. A. rubra Bong. In A flora of California, p. 347-349. Cunningham, Curtis, and Welch, San Francisco, Calif.

Describes alder and gives it range and uses in California. (CFH)

269. Jepson, Willis Linn.
1824. A. rubra Nutt. In A flora of the economic plants of California for agricultural students, p. 70-71. Assoc. Stud. Store, Berkeley, Calif.

Describes alder and gives it range and uses in California. (CFH)

270. Johnson, Floyd A.
1955. Volume tables for Pacific Northwest trees (a compilation). U.S. Dep. Agric. Agric. Handb. 92, 112 p.

"Gives tables (cu. ft. and bd. ft.) for Pinus ponderosa, Pseudotsuga taxifolia, Tsuga heterophylla, Picea sitchensis, Abies amabilis, Pinus contorta, Alnus rubra, Larix occidentalis, Abies concolor, A. grandis', Chamaecyparis lawsoniana, Pinus monticola, P. lambertiana, Thuja plicata, Libocedrus decurrens, Abies procera, Picea engelmannii and Populus trichocarpa." (FA)

271. Johnson, Floyd A., R. M. Kallander, and Paul G. Lauterbach.
1949. Volume tables for red alder. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Notes 55, 10 p. Portland, Oreg.

"The tables are based on figures from Oregon, Washington, and British Columbia." (FA)

272. Johnson, Floyd A., and Norman P. Worthington.
1963. Procedure for developing a site index estimating system from stern analysis data. USDA For. Serv. Res. Pap. PNW-7, 10 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The procedure presented in this report has been applied successfully to three tree species. It is simple, direct, and apparently statistically sound. Perhaps others, faced with the problem of developing site curves from stem data, will find it useful.** (FA)

273. Johnson, Frederic D.
1968. Disjunct populations of red alder in Idaho. In Biology of alder, p. 1-8. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Alnus rubra Bong., red alder, has been collected in several areas in northern Idaho. This is the eastern limit of the species and appears to be a definite disjunct of the Pacific coastal distribution. Development is centered in three main areas and is shown on range maps around Lake Pend Oreille, Bonner Co., lower Selway-Lochsa Rivers, Idaho Co., and North Fork Clearwater River, Clearwater Co. All of these areas are in the western redcedar-western hemlock vegetational zone; observations on ecological associations are made. Probable hybridization with other alders is reported.** (A)

274. Johnson, Frederic D.
1968. Taxonomy and distribution of northwestern alders. In Biology of alder, p. 9-22. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Synonymy, morphological features, and distribution of the four northwestern North American species of Alnus - A. rhombifolia, A. rubra, A. tenuifolia, and A. sinuata - are outlined. Included are distribution maps, a synoptic view of vegetative characteristics, and photos of buds and leaves.** (A)

275. Johnson, Herman M.
1917. Alnus oregona: Its value as a forest type on the Siuslaw National Forest. J. For. 15(8)981-987.

"Although the Oregon alder has been commonly considered a weed tree and in many respects undesirable, this study has shown that it has been and is yet of great value to the Siuslaw National Forest. Its function as a nurse crop to the more valuable Douglas-fir is making possible the restoration of the valuable timber which once covered this region. It is revivifying the depleted soil, making possible the prosperous communities scattered along the coast. Its presence has made impossible the extensive fires which formerly devastated this region. Lastly, its value as a commercial product is being realized, and it may be expected that in the near future it will develop an industry of considerable extent." (A)

276. Johnson, Herman M., Edward J. Hanzlik, and William H. Gibbons. 1926. Red alder of the Pacific Northwest. Its utilization, with notes on growth and management. U.S. Dep. Agric. Dep. Bull. 1437, 46 p. Washington, D.C.

"Alnus oregona is the most abundant and commercially the most important hardwood in Oregon and Washington. It is found along the Pacific Coast from southern California to southeastern Alaska, rarely more than 40-50 miles inland. It occurs at the lower altitudes in pure stands in rather small units, also in mixed stands with Douglas fir, western hemlock, western red cedar, and Sitka spruce. Other hardwoods associating with alder are bigleaf maple, black cottonwood, Oregon ash, cascara, and Pacific dogwood. The merchantable stand is estimated at 750 million board ft. in Oregon and 360 million in Washington. The wood is moderately light, even-grained and soft in texture, and compared with oak is moderately weak. It weighs 46 lbs. per cu. ft. when green and 27 lbs. when kiln-dried to 8% moisture. It is not naturally durable but presents no special difficulties in seasoning. About 13-1/2 million board feet was cut in 1923, or only 0.2% of the total cut of hardwood lumber in the U.S.A. Of this, 12 million ft. was used in the manufacture of furniture. Other products were wooden ware and novelties, veneer fixtures, brush and broom handles, and general mill work. Experiments have indicated that it is suitable for pulping by the soda process. Considerable quantities of round wood are used in making charcoal for gun powder. Red alder grows fairly rapidly for 50-60 yrs. Trees at 50 yrs. of age average 16.0 in. in diam., 97.5 ft. tall, and contain 52 cu. ft. (335 board ft.). In 50 yrs., pure alder stands can be expected to yield 15-40 M board ft. to the acre. The bulletin contains volume tables for alder (in board ft. and cu. ft.) and concludes with a classified list of present and possible uses of the wood; and a directory of producers of alder logs, lumber, and other alder products in Oregon and Washington." (BA)

277. Johnson, R. L. 1978. Hardwood culture in the Eastern United States. In Utilization and management of alder, p. 55-59. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Many hardwood plantations are being established in the East. Populus deltoides, Platanus occidentalis, Liquidamba styraciflua, and Juglans nigra are the species that have been planted and studied most." (A)

278. Johnsson, Helge. 1951. Lovtrad in Svensk Vaxtiforadling. Natur och Kultur, P. 795-799. [In Swedish.]

279. Johnsson, Helge, and Aake Ljunger. 1959. Betula, Alnus, Fagus, Quercus, Fraxinus, Castanea, Juglans. Handb. der Pflanzenzuecht. Vol. 6. 2d ed. p. 806-818. [In German]

280. Jones, George Neville.
1936. A botanical survey of the Olympic Peninsula, Washington. Univ. Wash. Publ. Biol., Vol. 5, 286 p. Seattle, Wash.

A discussion of the botanical features of the Olympic Peninsula based on 10 years of field experience and a compilation of literature through 1935. The zonal distribution and geographical relationships of the vegetation and history of botanical exploration are discussed. Keys to families and species are included. Red alder is a component of the Douglas-fir subclimax within the transition zone. (CFH)

281. Jones, J. R. I. L.
1943. Some food plants of Lepidopterous larvae. List 9. Entomol. Soc. B.C. Proc. 40:27.

"The list includes Acronicta (Apatela) funeralis on Willow (Salix scouleriana and some ornamental species) and Carolina Poplar; A. illita on Quercus robur and Alnus rubra; A. distans dolorosa on Alnus rubra; Halisidota maculata anguilfera on Salix hookeriana and S. scouleriana; Hyphantria textor on Salix lasiandra; Malacosom[a] disstria erosa on Alnus rubra; M. pluvialis on Prunus emarginata; Nadata gibbosa oregonensis on Castanea sp.; Phoesia portlandia on Salix lasiandra, S. hookeriana, S. scouleriana, Populus trichocarpa and P. tremuloides, Pseudothyatira cymatophoroides on Crataegus oxyacantha, Scoliopteryx libatrix on Salix lasiandra, S. scouleriana, Populus trichocarpa and Lombardy Poplar, and Schizura unicornis on Crataegus oxyacantha." (FA)

282. Karchesy, Joseph J., Hurray L. Laver, Douglas F. Barofsky, and Elisabeth Barofsky.
1974. Structure of oregonin, a natural diarylheptanoid xyloside. J. Chem. Soc. Chem. Commun. 1974(16):649-650.

"The structure of oregonin, 3-$(HO)_2C_6H_3(CH_2)_2COCH_2CH(OR)(CH_2)_2C_6H_3(OH)_2$-3,4 (R-xylosyl), a diaryl-heptanoid xyloside extd. from Alnus rubra, was detd. from chem. and spectral data." (BA)

283. Karchesy, Joseph J., Patricia M. Loveland, Murray L. Laver, Douglas F. Barofsky, and Elisabeth Barofsky.
1976. Condensed tannins from the barks of Alnus rubra and Pseudotsuga menziesii. Phytochemistry 15(12):2009-2010.

Describes isolation and identification of condensed tannins from red alder and Douglas-fir barks. (CFH)

284. Karchesy, Joseph John.
1975. Polyphenols of red alder: Chemistry of the staining phenomenon. Ph. D. thesis. Oreg. State Univ., Corvallis. 112 p.

"A cold-acetone extract of bark from Alnus rubra yielded a condensed tannin fraction that did not contribute to the staining phenomenon, and a diarylhepta-noid xyloside, to which the name oregonin is given. Oregonin was implicated in the staining phenomenon through its ability to form orange-red colours. Spectral data and physical constants are given for the condensed tannin fraction, for oregonin and for seven derivatives and related synthetic products.

285. Keller, E. L., J. S. Martin, and R. M. Kingsbury.
1956. Semichemical pulping characteristics of Pacific coast red alder, Douglas-fir, western redcedar, and western hemlock. USDA For. Serv. For. Prod. Lab. Rep. 1912, 25 p. Madison, Wis.

286. Kellman, M. C.
1970. The viable seed content of some forest soil in coastal British Columbia. Can. J. Bot. 48(7):1383-1385.

"The upper 10 cm of surface soil and litter beneath a coniferous forest in coastal British Columbia was found to contain over 1000 viable seeds per square meter. Alnus rubra Bong. made up 68.9% of all viable seed, although 18 other species, mainly weedy and secondary types, were recorded." (A)

287. Kellman, M. C.
1972. Erratum: The viable seed content of some forest soil in coastal British Columbia. Can. J. Bot. 50(7):1639.

"A corrective note, reidentifying as Betula papyrifera var. commutata the species previously identified as Alnus rubra." (FA)

288. Kenady, Reid M.
1978. Regeneration of red alder. In Utilization and management of alder, p. 183-191. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"This paper brings together information regarding regeneration of red alder (Alnus rubra Bong.) from published and unpublished sources. Based on this evidence, red alder does not appear to be a difficult species to regenerate, either naturally or artifically. This should come as no surprise to Pacific Northwest foresters. Red alder reaches sexual maturity at around age 10 and produces large quantities of seed annually, with bumper crops about every 4 years. Natural regeneration occurs in open, disturbed areas where mineral soil is exposed. Seedlings may reach 3 feet in height the first year, and grow to 15 feet in 5 years. Alder seedlings have been successfully grown in both bare root and container nursery systems. Stratification of seed does not appear to be essential for reasonable levels of germination. Plantations of red alder have done well where reported. Coppicing of young alder is possible and offers an alternative fiber production system." (A)

289. Kennedy, R. W., and G. K. Elliot.
1957. Spiral grain in red alder. For. Chron. 33(3):238-251.

"The occurrence and severity of spiral grain in Alnus rubra was investigated on two sites, one poor and one medium-good. The changing spiral was measured at breast height and at 10-ft. intervals above ground level. No straight-grained tree was found on either site, and it is concluded that the feature is genetically controlled, though the amount of spirality is affected by growth rate. Individual trees vary greatly, but the general spiral pattern is the same--an initial right spiral, followed by an increasing left spiral. The possibility of controlling growth rate so as to have as little spiral as possible in the outer wood of the tree, is discussed." (FA)

290. Kennedy, R. W., and G. Ifju.
1962. Applications of microtensile testing to thin wood sections.
Tappi 45(9):725–733.

"Describes three applications of microtensile testing: (1) a wood-quality evaluation of Douglas Fir; (2) a test of the effect of incipient decay, using 4 woods and 4 fungi; (3) a comparison of wood decay and dilute-acid hydrolysis. The strength differences noted in (1) were correlated with other chemical, physical, and anatomical properties of the wood. The 16 fungus/wood species combinations tested in (2) were ranked in order of progressively greater strength loss per unit weight loss into: (i) all species (Alnus rubra, Betula papyrifera, Tsuga heterophylla, and Abies sp.) decayed by Polystictus versicolor (a); (ii) all species decayed by Stereum sanguinolentum (b) and the conifers of Poria monticola (c) and Lentinus lepideus (d): (iii) the hardwoods by (c) and (d). Contents of holo- and a-cellulose determined for the decayed woods indicated a far greater reduction in degree of polymerization in woods rotted by (c) and (d) than in woods decayed to comparable weight losses by (a) and (b). The residual tenacity and holo-cellulose content of acid-treated woods were similar to those decayed by (a) to equivalent weight losses. The mechanical and chemical effects of (c) and (d), particularly on the hardwoods, were distinct from those of weak acid hydrolysis, which proceeded in a more heterogeneous fashion through selective removal of the hemicelluloses, and consequent retention of the more resistant a-cellulose." (FA)

291. King, A. D., Jr., W. L. Stanley, L. Jurd, and F. P. Boyle.
1971. Wood chip microbiological control with sulfur dioxide. Tappi 54(2):262.

"Small scale experiments with Alder chips treated with SO_2 gas to give uptakes of 0.1, 0.5 and 1% by weight and stored for 3 months at 22° C. indicate that chips can be effectively sterilized by treatment with 0.5 or 1% SO_2. The ability of SO_2 to sterilize as well as to bleach suggests that the possibility of using it economically in chip storage should be studied more intensively."(FA)

292. King, David G., Al Grass, and Ken Summers.
1973. Observations on the dipper in the Skagit Valley of British Columbia. Murrelet 54(2):16–19.

Discusses the distribution and number of the dipper (Cinclus mexicana) in the lower Skagit Valley in souther British Columbia in winter 1970. Red Alder is a major component of the streamside banks. (CFH)

293. Kirsch, R. K.
1959. Effect of saw dust mulches. I. Soil properties. Oreg. Agric. Exp. Stn. Tech. Bull. 49, 16 p.

"When Douglas Fir sawdust was applied with or without fertilizers as a mulch or soil amendment, strawberries became infested with red-stele disease. Soil samples were taken after rotovating all plots, and sweet corn was planted to determine residual effects. The results of analyses are presented. A further study of the effect of Douglas Fir and Alder sawdust on certain physical soil properties is summarized." (FA)

294. Kitts, W. D., C. K. Krishnamurti, J. A. Shelford, and J. G. Huffman. 1969. Use of wood and woody by-products as a source of energy in beef cattle rations. Adv. Chem. Ser. 95:279–297.

"The incorporation of sawdust in beef cattle rations has been investigated using three approaches. In vivo feeding trials with growing beef cattle indicate that there was no appreciable differences in the daily weight gain of steer when alder sawdust was substituted for hay in their rations. When hemlock sawdust, subjected to gamma radiation up to a maximum of 1.46×10^8 radiation, was used as a substrate for in vitro rumen fermentation, percentage dry matter disappearance and cellulose digestion showed a steady increase with increasing irradiation levels. The amount of reducing sugars formed from irradiated sawdust by incubation with cell-free extracts of rumen micro-organisms followed the same patterns as the in vitro fermentation tests." (A)

295. Kliewer, Mark, and Harold J. Evans. 1962. B_{12} coenzyme content of the nodules from legumes, alder, and Rhizobium meliloti. Nature (London) 194(4823):108–109.

Describes procedure and gives results of extractions of B_{12} coenzymes from root nodules. (CFH)

296. Kliewer, Mark, and Harold J. Evans. 1962. Physiological studies on the B_{12} coenzyme content of nodules from legumes and alder of Rhizobium species. (Abstr.) In Proceedings of the plant physiology meetings, 1962. Plant Physiol. 37(Suppl.):6–7.

297. Kliewer, Mark, and Harold J. Evans. 1963. Cobamide coenzyme contents of soybean nodules and nitrogen-fixing bacteria in relation to physiological conditions. Plant Physiol. 38:99–104.

"Nodules showed a gradual increase in the content of the vitamin B_{12} coenzyme (I) with age up to flowering, and then a decline. The increase in I was paralled by an increase in hemoglobin. There was a wide range in I concn. in 5 species of Rhizobium, but only small differences between effective strains of the same species. Ineffective and parasitic strains of R. meliloti and R. japonicum contained less I than the effective strains. I in these species was markedly increased with increasing Co in the medium, and one was present when Co was lacking. Azotobacter vinelandii required only 0.001 p.p.b. for normal growth, and more Co was required when N_2 was the source of N than when NH_3 was the source." (CA)

298. Klfewer, Mark, and Harold J. Evans. 1963. Identification of cobamide coenzyme in nodules of symbionts and isolation of the vitamin B_{12} coenzyme from Rhizobium meliloti. Plant Physiol. 38':55-59.

"Appreciable amts. of cobamide coenzyme (I) were found in the nodules of legumes (alfalfa, soybean, pea, bean, and red clover) and also in those of the non-legumes Alnus rubra and Ceanothus velutinus. R. meliloti was grown on a large scale and I was isolated in a highly purified form. From spectral properties chromatographic behavior, and biol. activity it was concluded that I was (5,6-dimethylbenzimidazolyl) combamide." (CA)

299. Knutsen, Stanley Kenneth.
1965. Hydrologic processes in thirty- to thirty-five-year-old stands of Douglas-fir and alder in western Washington. M. F. thesis. Coll. For. Resour., Univ. Wash., Seattle. 167 p.

Interception of rainfall for the period January 1 to August 31, 1964, was 10 percent for alder and 15 percent for Douglas-fir. Interception was seasonal; 9 percent in January-March and 13 percent in July and August for red alder. Corresponding values for Douglas-fir are 14 and 21 percent. Stemflow was less in summer than winter, amounting to 2.7 percent of rainfall in alder and 7 percent in Douglas-fir. Other hydrologic measurements are available. (CFH)

300. Kohnke, Helmut.
1941. The black alder as a pioneer tree on sand dunes and eroded land. J. For. 39(3):333-334.

301. Kozak, A., and J. H. G. Smith.
1966. Critical analysis of multivariate techniques for estimating tree taper suggests that simpler methods are best. For. Chron. 42(43):458-463.

"Trials of multivariate and other methods for analysis of tree taper are described. It is concluded that use of simple functions, sorting and graphical methods is adequate for many uses in operations and research." (A)

302. Kozlik, C. J.
1967. Establishing color in red alder lumber. Oreg. For. Prod. Lab. Rep. D-8, 11 p. Corvallis, Oreg.

"Steaming Alnus rubra lumber at 212" F and 100% r.h., for $\geq$ 4 hr. before air- or kiln-drying, eliminated sticker stain, prevented mottling, and produced a uniform colour ranging from white (sapwood) to ivory (heartwood). Steaming air-dried lumber at 212" F and 100% r.h. for 4-24 hr. eliminated previous sticker stain and gave a uniform, colour with insufficient mottling to cause degrade, but the boards lacked lustre. Forced-air drying of lower grades of lumber was uneconomic in the prevailing weather conditions; drying cost was $5.06/1000 bd. ft., and additional kiln drying was required." (FA)

303. Kozlik, Charles J.
1962. Seasoning red alder lumber. Oreg. For. Prod. Lab. Rep. D-6, 20 p. Corvallis, Oreg.

"Tests were made on red alder lumber to study the effects on drying time and degrade of various dry-bulb temperatures, equilibrium moisture content (e.m.c.) conditions, air velocities, and periods of fan-reversal, pre-streaming, and conditioning. Treatments were judged favourable if they led to reduction of drying time without excessive increase in degrade. A schedule is detailed for drying 1-in. lumber in ca. 85 hr.; 1-1/4-in. lumber can be dried under the same conditions (though more time is needed), but 1-1/2-in. lumber should be dried by less severe conditions to avoid excessive degrade." (FA)

304. Kozlik, Charles J.
1978. Stabilizing color and drying red alder. In Utilization and management of alder', p. 93-101. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., .Portland, Oreg.

"A honey-brown color is established without difficulty in drying freshly sawed red alder lumber, but a reddish-tan to reddish-brown color required dry-bulb temperatures about 185" F at 92-percent relative humidity or higher. A white or ivory color is obtained by steaming freshly saw or partially air-dried lumber at 212" F and 100-percent relative humidity. The white color may be retained with air drying, but a honey-brown to reddish-brown color requires kiln krying immediately after setting the color. Kiln-drying practices depend on kiln capacity, boiler capacity, availability of logs, log storage, and customer specifications. Initial dry-bulb temperatures range from 150° to 190" F, and drying times for 4/4 lumber vary from 4 to 6 days. Equalizing for uniformity of final moisture content and conditioning to remove drying stresses for remanufacturing are important steps in drying for both producer and customer." (A)

305. Krueger, Kenneth W., and Robert H. Ruth.
1968. Photosynthesis of red alder, Douglas-fir, Sitka spruce, and western hemlock seedlings. (Abstr.) In Biology of alder, p. 239. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"More rapid growth by red alder seedlings than by associated coastal conifers creates interest in their comparative photosynthetic behavior. Seedlings of the four species, previously grown under light and heavy shade, were brought to the laboratory at intervals during their second growing season for measurement of photosynthetic rate by infrared CO_2 analysis at five light intensities.

"Photosynthetic rates expressed on a leaf-area basis did not differ greatly between species up to saturating light intensities for the conifers. The conifers, especially western hemlock, reached maximum rates at lower light intensities than did alder. Growing the four species under heavy shade tended to decrease species differences in photosynthetic rates.

"The distribution of plant weight between photosynthetic and nonphotosynthetic tissue was generally similar for all species. Alder produced more leaf area per unit weight of leaf, however. In the dark, respiration rate per gram of top was highest for alder.

"Greater capacity to utilize high light intensities for photosynthesis combined with more area per unit weight of leaf and greater total leaf area per seedling may contribute substantially to alder's faster growth in high light situations. (A)

306. Krueger, Kenneth W., and Robert H. Ruth.
1969. Comparative photosynthesis of red alder, Douglas-fir, Sitka spruce, and western hemlock seedlings. Can J. Bot. 47(4):519–527.

"More rapid growth by red alder than by coastal conifer species may be explained by alder's greater foliage surface per unit foliage weight, greater total foliage area per seedling, and higher photosynthetic rate at high light intensities. Net photosynthetic rates per unit foliage ares were similar for red alder and the three conifers up to saturating light intensity for the conifers. Relative weight of photosynthetic and nonphotosynthetic tissue was also similar for the four species. Average maximum photosynthetic rates measured for these conifers are comparable to reported rates for woody broad-leaved species." (A)

307 Kuntze, Otto.
1891. Revisio generum plantarum. Wurzburg. p. 638-640.

308 Kurth, E. F.
1950. The chemical analysis of western woods. Part 111. Tappi 33(10):507–508.

"Four species of western hardwoods (Acer macrophyllum, Alnus rubra, Lithocarpus densiflorus, and Castanopsis chrysophylla) and 4 species of western softwoods (Pinus contorta var. latifolia, Chamaecyparis nootkatensis, Abies prandis, and Abies procera) have been analysed for ether, alcohol and water extractives, holocellulose, lignin, methoxyl group, acetyl group, and ash content." (FA)

309. Kurth, E. F., and Edwin L. Becker.
1953. The chemical nature of the extractives from red alder. Tappi 36(10):461–466.

"The bark of Alnus rubra has been found to contain 24.0% of extractives, its wood 8.6%. The main white colouring matters in the bark are alnulin and protalnulin; the red colouring matters are a phenolic xyloside, phlobatannin, a tannin-carbohydrate complex, and phlobaphene. The tannin contents are 4.2% in the bark and 0.74% in the wood." (FA)

310. Lai, Yuan-Zong.
1966. A study of the peracetic acid oxidation of Douglas-fir and red alder woodmeal. M.S.F. thesis. Univ. Wash., Seattle. 58 p.

Peracetic acid oxidation of Douglas-fir and red alder woodmeal results in the formation of a water-soluble lignin product. Yields are approximately 20 percent of the dry wood material. Red alder woodmeal is more easily attacked by peracetic acid. The analytical composition of Douglas-fir peracetic acid lignin is similar to that of red alder lignin.

An electrophilic aromatic substitution can explain the oxidation of lignin by peracetic acid. Guaiacyl and syringyl units, with a free phenolic hydroxyl group, are converted to muconic acid structure. The etherified units proceed to the formation of 1:4-benzoquinone, and by further oxidation of this to the fumaric acid derivative. Peracetic acid lignin still contains some undegraded aromatic rings.

Yields of periodote lignin for Douglas-fir and red alder preparation were approximately 22 percent on the basis of dry wood material, and about 88 percent of the lignin initially present

in wood. Red alder periodote lignin is more easily attacked by peracetic acid than that of Douglas-fir lignin. (CFH)

311. L'Allemand, Gordon.
1965. Red alder is a preferred species. Woodworking Dig. 67(4):34-38.

"Briefly discusses the physical, mechanical and working properties of Alnus rubra and compares it with other hardwoods as a furniture timber." (FA)

312. Lanner, Ronald M.
1964. Adventitious rooting - a response to Hawaii's environment. USDA For. Serv. Res. Note PSW-54, 3 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

"In the very humid climate of Hawaii, adventitious roots have been noted on the stems or branches of the following exotics, which in their own habitats rarely, if ever, form them: Eucalyptus robusta, Melaleuca leucadendron, Cryptomeria japonica, Alnus nepalensis, A. rubra, Fraxinus uhdei, Casuarina cunninghamiana, and C. littoralis." (FA)

313. Lanner, Ronald M.
1964. Clones of Nepal alder in Hawaii. J. For. 62(9):636-637.

"Observations in a 26-year plantation of Alnus nepalensis which suffered heavy losses from wind revealed that epicormic shoots had grown vertically from wind-thrown trees and put out adventitious roots, giving rise to clonal groups." (FA)

314. Larsen, Lee E.
1967. Current work on the new Soderhamn chippers. Tappi 50(2):61A-64A.

"The method of chip preparation has a great effect on the quality of the pulp produced. Recent developments in chipper design tend to minimize chip damage and contribute to improved sulfite pulp strength. Laboratory results obtained on chips produced from two new chippers, the Soderhamn Drum chipper and the H-P chipper, are compared with the results of chips produced by the conventional disk chipper." (A)

315. Larson, Don.
1976. Nitrogen-fixing shrubs: An answer to the world's firewood shortage? Futurist 10(2):74-77.

"The growing scarcity of firewood in the world's under-developed countries could be eliminated in five to 15 years if nitrogen-fixing shrubs were planted in wastelands that cannot now support trees or crops. These plants have their own built-in supply of nitrogen and can survive in sterile, barren lands where nearly all other plants perish. In addition, such super-hardy plants would check wind and water erosion, reduce runoff, and replenish the fertility of long-impoverished soils." (A)

316. Larson, William H.
1951. Forest roadside control of alder and willow. J. For. 49(10):705-707.

"A standard tank truck with Griswold 1-in. fog nozzle and 6-ft. applicator was used for spraying roadside brush in Douglas Fir forest, consisting mainly of Willow and Red Alder. Of the various concentrations of Na salt of 2,4-D tried, it was found that the 500 p.p.m. solution was satisfactory. For a 500-gal. charge of this solution, 2-1/2 lb. of 'Special Mix' and 1-1/4 lb. of 82% 2,4-D (costing $4.00 together) were used. Best results were obtained between mid-Xay and June. Total costs vary with local conditions, accessibility and water etc., but it is estimated that in the experiment the cost was $11.90 per mile sprayed, exclusive of travel to and from the job, broken hose etc. Observations of treated strips 2 years after treatment showed that they were still substantially free from regrowth." (FA)

317. Laundrie, J. F.
1959. Continuous cold soda pulping of west coast red alder, tanoak, madrone, and bigleaf maple. USDA For. Serv. For. Prod. Lab. Rep. 2162, 12 p. Madison, Wis.

318. Lawton, Donald M.
1972. Alder challenges established hardwoods. Woodworking & Furniture Dig. 74(2):28-30.

Red alder is gaining an ever-increasing share of U.S. and Canadian furniture manufacturing markets. Alder production in Oregon and Washington in 1970 was over 250 million board feet, an increase of 25 percent since 1960. Includes a brief description of red alder properties and case histories of use by various manufacturers throughout the United States. (CFH)

319. Leech, H. E.
1942. Hemichroa crocea Fourcroy. Entomol. Soc. B.C. Proc. 39:35.

"Larvae of this sawfly were taken on Alnus sp. at Gleneden, near Salmon Arm, June 1941. In Br. Columbia it was previously known only from the lower Fraser Valley." (BA)

320. Leney, L., A. Jackson, and H. D. Erickson.
1978. Properties of red alder (Alnus rubra Bong.) and its comparison to other hardwoods. In Utilization and management of alder, p. 25-33. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Red alder is compared with several common commercial hardwoods of the United States. The objective is to show that alder is suitable for many products for which other hardwoods of similar structure and specific gravity are used. One advantage of alder is its uniform color of both heartwood and sapwood. A limited test of alder specific gravity showed a range of 0.33 to 0.48 and no correlation with growth rate. Tension wood is shown not to be a problem in alder and not easy to detect. Growth stresses are believed to be more of a problem, causing the splitting of logs and warpage of lumber." (A)

321. Leonard, O. A., Summarizer.
1961. Undesireable woody plants. Res. Progr. Rep. West. Weed Control Conf. 1961:16-26.

"Alnus rubra--A 1/1 mixture of 2,4,5-T + 2,4-D in diesel oil, applied basally during the growing season, gave effective and economic defoliation of stems of 2.5 in. d.b.h., but dormant-season applications have satisfactory defoliation only of trees < 1 in. in d.b.h. and were more effective on dry than on wet tree stems." (FA)

322. Lettman, Gary James.
1977. The role of red alder in forest management in Washington. M.S. thesis. Wash. State. Univ., Pullman. 36 p.

"An analytical model was developed to help the owner of forest land in Washington determine if it would benefit him to consider red alder as part of his management regime. Relevant economic and environmental considerations were examined in a survey of the literature. During the course of the study personnel associated with the Northwest Hardwood Association, and spokesmen for several private industrial timberland owners and manufacturers of hardwood lumber were interviewed.

"Alder was found to be a potentially valuable tool in forest management in Washington. Evaluation of economic trends and recent advances in knowledge of the biology of alder indicated that alder could be used in many situations to increase forest productivity and to help produce a maximum sum of values from our forest land resource." (A)

323. Lewis, Meriwether, and William Clark.
1905. Original journals of the Lewis and Clark Expedition 1804-1806, in 7 volumes and an atlas. Ruben Gold Thwaites, ed. Dodd Mead and Co, New York.

On October 30, 1805, near the Big Rapid of the Columbia River (The Dalles), Clark, describing vegetation, writes "...and a timber resembling the beach in bark but different in the leaf which is Smaller and the tree Smaller." The editor identifies it as red alder. Later both men describe it in detail in their journal entry of February 9, 1906, calling it black alder; they mention it occasionally thereafter. (CFH)

324. Li, C. Y.
1974. Phenolic compounds in understory species of alder, conifer, and mixed alder-conifer stands of coastal Oregon. Lloydia 37(4):603-607.

"Phenolic compounds in hydrolysates and neutral extracts of leaves of understory vegetation in stands of red alder (Alnus rubra Bong.), conifer, and mixed alder-conifers near coastal Oregon were determined by two dimensional thin-layer chromatography coupled with different spraying reagents. p-Coumaric, p-hydroxybenzoic, and vanillic acids occurred in all species except Galium triflorum, which lacked p-hydroxybenzoic acid. Ferulic acid occurred in about two-thirds of the species. Protocatechuic and caffeic acids occurred sporadically among the species. Gentisic and syringic acids occurred in Stachys mexicana, Menziesia ferruginea, and Ceanothus velutinus. Acer circinatum contained syringic acid. C. velutinus leaves also contained phloroglucinol. Root nodules of alder and roots of

Ceanothus were additionally extracted. The belowground parts of these species more resembled each other in content of phenolic compounds than they resembled leaves of their own respective species." (A)

325. Li, C. Y., K. C. Lu, E. E. Nelson, W. B. Bollen, and J. M. Trappe. 1969. Effect of phenolic and other compounds on growth of Poria weirii in vitro. Microbios, Cambridge 3:305-311.

"Growth of the two isolates tested was strongly inhibited in media containing coumarin, 4-hydroxycoumarin or 7-hydroxycoumarin at concentrations of 0.5 and 2.0 mM and by o-catechol, salicylic acid, benzoic acid, ferulic acid, o-coumaric acid, and phenylacetic acid at 2.0 mM. Other compounds, including three known to occur in Alnus rubra or other Alders, viz. caffeic, chlorogenic and gentisic acids, inhibited only one of the isolates; still others, including some also found in Alders, had no effect or stimulated growth. Ferulic acid was the only compound reported from Pseudotsuga menziesii and Tsuga heterophylla that inhibited P. weireii in vitro. The possible role of such compounds as factors in the resistance of trees to P. weirii is discussed." (FA)

326. Li, C. Y., K. C. Lu, J. M. Trappe, and W. B. Bollen. 1967. Selective nitrogen assimilation by Poria weirii. Nature 213(5078):814.

"Experiments were designed to determine (a) the relative growth of P. weirii when supplied with N equivalents in nitrate, ammonium, or amino forms, and (b) whether P. weirii produces nitrate reductase. It was found that this fungus did not use nitrate as an N source but grew well with ammonium or amino N. Its behaviour in culture was markedly similar to that reported for Armillaria mellea, another serious destroyer of tree roots. Moreover, cell-free extracts of P. weirii completely lacked nitrate reductase activity. These findings are discussed in relation to the fact that soil under stands of Alnus rubra in mixture with conifers has been found to be markedly higher in nitrate N than soil under an adjacent stands of pure conifers. It is suggested, tentatively, that A. rubra mixed with conifers has a potential value for the biological control of P. weirii and probably other pathogens on many sites of the Douglas Fir region." (FA)

327. Li, C. Y., K. C. Lu, J. M. Trappe, and W. B. Bollen. 1968. Enzyme nitrate reductase of some parasitic fungi. USDA For. Serv. Res. Note PNW-79, 4 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Eight parasitic fungi, Fusarium avenaceum, F. oxysporum, Gliocladium roseum, Phytophtora cinnamomi, Pythium debaryanum, Poria weirii, Trichothecium roseum, and Verticillium alboatrum, were grown in liquid culture to determine the ability of each to produce nitrate reductase, an enzyme necessary to convert nitrate nitrogens into the more easily used ammonium form." (A)

328. Li, C. Y., K. C. Lu, J. N. Trappe, and W. B. Bollen.
1968. Enzyme systems of red alder and Douglas-fir in relation to infection by Poria weirii. In Biology of alder, p. 241-250. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"~~Poria weirii~~ hyphae secreted compounds, presumably phenoloxidases, that resulted in oxidation of catechol, DL-dopa, and hydroquinone but not P-cresol. Phenoloxidases with similar activity were found in red alder leaves but were lacking in Douglas-fir leaves. Leaves of both alder and Douglas-fir showed peroxidase activity, but at much higher levels in alder than in fir. Alder leaves were able to reduce nitrate nitrogen, presumably through presence of nitrate reductase, whereas leaves of Douglas-fir lacked apparent nitrate-reducing ability.

"These preliminary studies will be followed by studies on wood and roots of alder and Douglas-fir. If, as is likely, the phenols and phenoloxidase system in red alder leaves are also present in roots, a reason for alder's resistance to Poria weirii can be hypothesized. On penetration by the fungus, the o-dihydric phenols in alder tissue would be oxidized into fungitoxic compounds through the catalytic action of the phenoloxidases. These compounds, deposited about the periphery of the initial infection, would inhibit further spread of the fungus. Peroxidase activity, too, might contribute to resistance. Nitrate reductase activity assumes possible importance in that Poria weirii cannot reduce nitrate, whereas many of its antagonists can. Thus, the high nitrate levels in stands containing alder are not directly usable by P. weirii but permit buildup of high populations of antagonists." (A)

329. Li, C. Y., K. C. Lu, J. M. Trappe, and W. B. Bollen.
1970. Inhibition of Poria weirii and Fomes annosus by linoleic acid. For. Sci. 16(3):329-330.

"The K salt of linoleic acid inhibited growth in cultures of P. weirii linearly up to a concentration of 1.0 mg./ml. of acid in the medium. Growth became negligible when the concentration was increased from 0.75 to $\geq$ 1.0 mg./ml. F. annosus. grew moderately well at all concentrations tested, but inhibition increased with increase of the linoleic acid Concentration. Results suggest that the linoleic acid produced by Alnus rubra is an important factor in its resistance to infection by P. weirii and may reduce the longevity of the fungus in soil. beneath the trees. A similarly strong inhibition of F. annosus in nature seems less likely on the basis of present data." (FA)

330. Li, C. Y., K. C. Lu, J. M. Trappe, and W. B. Bollen.
1970. Separation of phenolic compounds in alkali hydrolysates of a forest soil by thin-layer chromatography. Can. J. Soil Sci. 50(3):458-460.

"Describes the extraction and separation by thin-layer chromatography of phenolic compounds in a soil extract from beneath a tree of Alnus rubra at Cascade Head Experimental Forest, Oregon." (FA)

331. Li, C. **Y.,** K. C. Lu, J. M. Trappe, and W. B. Bollen.
1972. Nitrate-reducing capacity of roots and nodules of Alnus rubra and roots of Pseudotsuga menziesii. Plant and Soil **37(2):409-414.**

"Nitrate was reduced by root segments of **A.** rubra and (more than twice as quickly) by root nodules. Root segments of **P.** menziesii failed to reduce nitrate in spite of treatments designed to induce such activity. The reported favourable response by P. menziesii to nitrate fertilizer may be ascribed either to microbial assimilation to nitrate ions with subsequent liberation of ammonium in the soil, or to nitrate assimilation by fungi that form mycorrhizae with Douglas Fir roots." (FA)

332. Li, **C.** Y., K. C. Lu, J. M. Trappe, and W. B. Bollen.
1972. Poria weirii-inhibiting and other phenolic compounds in roots of red alder and Douglas-fir. Microbios **5(17):65-68.**

"A thin-layer chromatographic study revealed the presence of phenolic compounds in bound forms only. Acid hydrolysates yielded vanillic acid from both species (ca. twice as much in the susceptible Douglas Fir as in the resistant Red Alder), and syringic acid from Alder only. Alkaline Hydrolysates yielded syringic, ferulic and p-coumaric acids in Red Alder, and vanillic, p-hydroxybenzoic and p-coumaric acids in Douglas Fir. Of these, ferulic, syringic, and vanillic acids have been shown to inhibit growth of the pathogen in vitro. Further research is needed to elucidate resistance mechanisms." (FA)

333. Li, Ching-Yan.
1969. Biological influence **of** red alder on Poria weirii and other root rot pathogens. Ph. D. thesis. Oreg. State Univ., Corvallis. **104 p.**

"Subjects covered include: the ability of **P.** weirii to use different N sources; the populations of bacteria, fungi and Streptomyces antagonistic to P. weirii in soils under Red Alder and Alder/conifer stands; temperature and pH requirements of P. weirii; the oxidative enzymes of **P.** weirii and leaves and roots of Red Alder and Douglas Fir; the effect of phenolic compounds on isolates of **P.** weirii; the tannins and ferulic, vanillic and caffeic acids in roots, leaves, litter and soil of Red Alder and Douglas Fir; soil tannins under Alder and conifers; and the characteristics of a compound, inhibitory to **P.** weirii, extracted from leaves of Red Alder but absent from Douglas Fir." (FA)

334. Lines, **R.**
1976. Alnus rubra. **In** Report on forest research, Forestry Commission, ended for year **1976** in March, **p.** 16. Edinburgh, U.K.

"Experiments were planted in early 1976 with nine provenances of Alnus rubra and one of Alnus sinuata at Shin Forest (Highland Region) and Keilder Forest (Northumberland). Apart from the Alaskan provenance, all grew well in their second year in the nursery, and autumn shoot die-back was minimal, even on the Californian origin. Bacterial nodules had already formed on their roots." (A)

335. Little, Elbert L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dep. Agric. Agric. Handb. 41, 472 p. Washington, D.C.

336. Little, Gene R.
1978. Supply of western alder stumpage, its quantity and quality, and trends in alder stumpage prices and product markets for the State of Washington. In Utilization and management of alder, p. 9-23, David G. Briggs, Dean S, DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"There is a sufficient supply of alder for the foreseeable future. Most alder is in private ownership. There will be a tremendous surplus (four times the current harvest) during the 1980's and 1990's. The opportunities for price improvement don't look promising, so we do not see why anyone would intentionally grow alder. To create a favorable climate for the alder industry, attitudes about this species must changes." (A)

337. Ljunger, Aake.
1959. Al-och alforadling. [Alder and alder breeding.] Skogen 46(5):115–117. [In Swedish.]

"Discusses the two species found in Sweden, their ecology and silvicultural importance and the occurrence of hybrids, and presents figures from breeding experiments showing in graphs the superior height growth of A. rubra X A. elutinosa compared with A. plutinosa during the first 7 years and probable futuro developments, concluding that the hybrid will reach a height of 20 m. at 22-24 years and A. glutinosa at 40." (FA)

338. Lloyd, W. J.
1949. Results of thinning a young alder stand. U.S. Dep. Agric. Soil Conserv. Serv., Pac. Reg. Tech. Note 8, 2 p. Portland, Oreg.

339. Lloyd, W. J.
1952. Alder thinning, second progress report. U.S. Dep. Agric. Soil Conserv. Serv., Pac. Reg. Tech. Note 29, 2 p. Portland, Oreg.

340. Lloyd, William J.
1955. Alder thinning-progress report. U.S. Dep. Agric. Soil Conserv. Serv., West Area Woodland Conserv. Tech. Note 3, 6 p. Portland, Oreg.

341. Lowe, Daphyne P.
1969. Check list and host index of bacteria, fungi, and mistletoes of British Columbia. Dep. Fish. and For., Inf. Rep. BC-X-32, 392 'p. Victoria, B.C.

Cross-indexed listing of British Columbia host genera and their attacking pathogens and saprogens. (CFH)

342. Lu, K. C., C. S. Chen, and W. B. Bollen.
1968. Comparison of microbial populations between red alder and conifer soils. In Biology of alder, p. 173-178. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Seasonal populations of molds and bacteria in the F layer and All soil horizon from stands of pure conifers, pure red alder, and conifer-alder mixtures near the Oregon coast were compared by dilution plating techniques. All organisms were generally more numerous in the F layer than in the All horizon. On this very moist site, populations of molds were lowest in spring, when the soil was extremely wet. In the F layer, Streptomyces species, of particular interest due to their possible antagonism against root pathogens, consistently comprised a higher proportion of the total bacterial population of the mixed stand than of either pure alder or pure conifer stands." (A)

343. Lumberman.
1955. Alder assumes importance and is discussed by foresters at 34th Washington State Forestry Conference. Lumberman 82(13):87, 129.

"Summarizes very briefly papers and discussion on uses of Red Alder [Alnus rubra] for pulping, timber and panelling, its seasoning, logging methods, natural regeneration, increment, epicormic branches and their effect on quality, soil relations, and rotation." (FA)

344. Lumberman
1957. Alder logs find use in plugging newsprint rolls. Lumberman 84(7):46.

"Although many substitutes have been tried, the old standby--the wooden plug--remains today the most efficient and economical means of preventing newsprint rolls from collapsing or crushing on the core. This article tells how they are made from alder by a new company in British Columbia." (A)

345. Lutz, J. F.
1972. Veneer species that grow in the United States. USDA For. Serv. Res. Pap. FPL-167, 127 p. For. Prod. Lab., Madison, Wis.

"Describes properties of 156 U.S. tree species that affect their manufacture and use as veneer or products made from veneer. Each species is rated for use in the general categories of construction plywood, decorative face veneer, inner plies of decorative panels, or container veneer and plywood." (A)

346. Lyons, C. P.
1969. Trees, shrubs, and flowers to know in British Columbia. 2d ed. 194 p. J. M. Dent & Sons (Can.) Ltd., Toronto and Vancouver.

347. McCartney, William D., Robert F. Scharpf, and Frank G. Hawksworth. 1973. Additional hosts of Viscum album, European mistletoe, in California. Plant Dis. Rep. 57(10):904.

"Reports Alnus rubra, Populus fremontii, and Salix lasiandra as new hosts native to California. On the basis of inoculation tests, Populus tremuloides was also found to be susceptible. Ten other trees listed are ornamentals." (FA)

348. MacConnell, J. T. 1959. The oxygen factor in the development of function of the root nodules of alder. Ann. Bot. (London) N.S. 23(90):261–268.

The number of nodules of Alnus plutinosa growing in solution was reduced as the percent of oxygen in aerating gas was decreased. The nodulated plant was sensitive to oxygen reduction. It is concluded that oxygen supply is of special importance in the development and function of alder root nodules.(CFH)

349. McGovern, J. N., and G. H. McGregor. 1944. Sulfite pulp production: Some factors pertinent to meeting war born shortages. Pulp and Pap. Mag. Can. 45:74–81.

"The prospect of a serious shortage of sulphite pulp in 1944 prompted the Forest Products Laboratory, Madison, to survey ways and means of increasing pulp production under existing conditions. It is suggested that the less common pulpwood species together with logging, sawmill, and veneer-mill wastes be utilized to the full extent of their availability; that advantage be taken of dense woods giving high yield per volume; that the pulping process be conducted in conformity with principles resulting in maximum production; and that fibre losses from chip preparation and pulp treatment and bleaching be minimised. The paper discusses briefly the pulping procedures applicable to species less commonly used for sulphite pulping, including Aspen, Cottonwood, Birch, Maple, Gum, Beech, Northern Pines, Tamarack, Western Pine, Larch, Douglas Fir, Southern Pine, Western Red Cedar, Sitka Spruce, and Alder, and examines in detail the sulphite process variables affecting pulp production. General observations are made on methods of reducing fibre losses due to different causes." (FA)

350. McGovern, J. N., J. S. Martin, and R. M. Kingsbury. 1951. Semichemical pulping characteristics of Pacific coast red alder, Douglas-fir, western redcedar, and western hemlock. U.S. For. Prod. Lab. Rep. R1912, 10 p. Madison, Wis.

"The alder gave neutral sulphite pulps suitable for container boards and bleached-paper products. Pulps made from Western Red Cedar and Western Hemlock had considerable promise for use in paper-board, that made from Douglas Fir somewhat less promise. Sulphate semichemical pulps made from Alder and old-growth Douglas Fir had lower chemical requirements, lower bursting strength and higher folding endurance than their neutral counterparts. Strong, bleached, neutral sulphite pulps can be produced in yields of 55% from Alder and 50% from second-growth Douglas Fir." (FA)

351. McGuane, Harry.
1978. Alder as a wood for veneer and plywood. (Abstr.) In Utilization and management of alder, p. 133. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The oral presentation described the process of manufacturing alder veneer in a facility equipped with the only hardwood lathe in the West. The hardwood lathe is equippd with a fixed nose bar which is capable of achieving higher peeling pressures than conifer lathes equipped with a roller bar. The capability of achieving higher pressures is important in controlling the roughness, depth of checks, and thickness of the veneer. The end product is a dry veneer that is 1/24 inch in thickness. The majority of this veneer is used in the manufacture of quarter inch plywood wall paneling.

"The market for alder veneer and its future are uncertain. Production of alder veneer has been low, and logs are frequently knotty so recovery of higher grades is difficult and costly. A large fraction is, therefore, a lower quality veneer which enters a very competitive market with surplus low quality veneers from other species. Style changes in the panelling industry and lack of familiarity with alder are other problems." (A)

352. McKelvey, Susan Delano.
1955. Botanical exploration of the Trans-Mississippi West 1790-1850. 1144 p. Arnold Arbor. Harvard Univ., Jamaica Plain, Mass.

Contains excerpts from original journals and edited journals of early botanists who collected plants in the Pacific Northwest. An alder was seen at Monterey Bay in 1791 by the Melaspina expedition. Red alder was collected by Archibald Menzies in 1792 at Port Discovery, Washington, by Lewis and Clark in 1805 near the Dalls, Oregon, and by Douglas in 1825 at the mouth of the Columbia River. Nuttall describes red alder after collecting it in 1834. (CFH)

353. McLaughlin, Willard T., and Robert L. Brown.
1942. Controlling coastal sand dunes in the Pacific Northwest. U.S. Dep. Agric. Circ. 660, 46 p. Washington, D.C.

"An account of methods employed in arresting sand dunes at the mouth of the Columbia River, Oregon. ...The first stage in reclamation is the planting of sand-binding beachgrass, but final control requires the use of shrubs and trees, which may be introduced only after the initial stabilization has been accomplished. Scotch Broom (Cytisus scoparius (L.) Link) is the shrub most commonly employed for this purpose. The only native tree species used extensively in dune-control plantings is Shore Pine (Pinus contorta Loud.). The Pine is usually planted towards the inside of the dune where greatest height is needed, the Broom being planted on the outside where there is no heavy shade. Being a legume, the Broom builds up the nitrogen content of the soil while acting as a windbreak for the young Pines. Other trees used in the later stages of dune-reclamation include the introduced species Pinus pinaster, P. sylvestris, P. pungens, P. nigra, and Alnus plutinosa, (FA)

Red alder does not afford much winter protection and is useful only in damp areas. (CFH)

354. McMinn, Howard E., and Evelyn Maino.
1937. An illustrated manual of Pacific coast trees. 409 p. Univ. Calif. Press, Berkeley.

Red alder is identified as Alnus oregona. (CFH)

355. McMunn, H. I.
1956. Developing new uses for alder. Pac. Coast Hardwoods, March, p. 8–9. Northwest Hardwoods Assoc., Seattle, Wash.

Early efforts of one timber company to develop new products and sales of red alder. (CFH)

356. McNair, Cliff, Jr.
1973. Port Gamble turns to alder operations. Bremerton Sun, March 29, 1973, p. 1, col. 5-6; p. 2, col. 4–5.

357. McPherson, W. E.
1956. Wholesaling of Northwest hardwoods. Pac. Coast Hardwoods, March, p. 6-7. Northwest Hardwoods Assoc., Seattle, Wash.

358. McVean, D. N.
1953. Regional variation of Alnus glutinosa (L.) Gaertn. in Britain. Watsonia 3(1):26–32.

"Data from 18 populations show that Alder in Britain exhibits clinal variations in some features of its morphology and physiology, and that these variations tend to take place along the main climatic gradient S.E.–N.W. The fact that no similar morphological gradients could be established altitudinally supports the theory that the differences are genotypic." (FA)

359. McVean, D. N.
1955. Ecology of Alnus glutinosa (L.) Gaertn. I. Fruit formation. J. Ecol. 43(1):46–60.

"The extent to which fruiting periodicity occurs in the Alder is described. Dates are given for the stages of fruit development, and the vulnerability of the ♂ nuclei in the extended period of 4-5 months between pollination and fertilization is stressed. Empty seeds are the result of fertilization failure rather than abortion. East Anglian Alders are shown to be completely self-sterile, and this, rather than frost damage to flowers, is regarded as a possible reason for low seed viability in certain years. High winds at the time of flowering are the most likely cause of low fertility in exposed populations and of the decreased % of embryo formation with increased altitude. Even in good seed years, embryos are not formed at altitudes above 300 m." (A)

360. McVean, D. N.
1955. Ecology of Alnus glutinosa (L.) Gaertn. II. Seed distribution and germination. J. Ecol. 43(1):61–71.

"Running water and wind-drift over standing water are shown to be the chief agents of dispersal, with important effects on seedling establishment and the form of populations. There is considerable variation (0–80%) in the viability of the seed set, and low viability is almost wholly due to the failure of embryo formation. Optimum

germination takes place at about 26" C and is independent of light, normal temperature fluctuations, and pH of the substrate. High *o* tension and humidity in the surrounding air are necessary for satisfactory germination. Cold treatment of damp seeds at 0-4" C for at least 6 weeks reduces the minimum germination temperature from 10 to 7° C; this has important ecological implications. The course of germination is described for laboratory and field seedlings. An important feature is the relative weakness of the radicle elongation and the liability of the radicle to suffer damage by low temperatures and incipient drying in the early stages of germination. This partly explains the hydrophytic behaviour of the species." (A)

361. McVean, D. N.
1956. Ecology of Alnus glutinosa (L.) Gaertn. 111. Seedling establishment. J. Ecol. 44(1):195-218.

"Experiments on the relations of seedlings to soil moisture are described, Betula pubescens being used for comparison: (1) Seedling establishment in waterlogged soil. (2) Effect of waterlogging at various developmental stages. (3) Establishment at various heights above a constant water-table. (4) Effect of periodic drying of the soil. It is concluded that in regions of low rainfall (*50-65* cm.) Alder seedlings will only establish themselves where the surface soil falls within the capillary fringe of the water-table, so that it remains constantly moist for 20-30 days in spring (March-Hay). Heavier rainfall and a cover of vegetation modify this picture. The Alder seedling is better adapted to establishment in very wet and waterlogged soils than is the Birch, and pure stands of Alder can be obtained from mixed sowings by appropriate treatment. It is also more resistant to complete inundation at all stages of development. A water-table at a depth of 10-30 cm. is optimal for early Alder establishment, but subsequent growth is best on drier sites. The Birch seedling is better adapted to establishment in habitats subject to periodic drying out, and pure stands of Birch can thus be obtained by flooding. The different buoyancies of the seed, the different susceptibilities of the radicles to drying out, and the different ratios of shoot to root development are all concerned in this.

"The growth of seedlings on different soils is described, and establishment found to be satisfactory on all except acid peats and highly calcareous soils. Pure fen peat appears to lack some factor, present in mineral soil, necessary for the optimum development of the seedlings. An experiment on the addition of various fertilizers to the peat indicated that the phosphate radical is largely concerned. Development of nodules and mycorrhiza is found to have little effect on establishment except perhaps on the most infertile sands. Field and pot experiments on light intensity and root competition are described. It is concluded that low light intensity, supplemented by insect attack, flooding etc. is a frequent cause of regeneration failure in woods and thick herbaceous vegetation. Root competition appears to be of greatest importance in the drier grass turfs. The significance of these factors in natural population structures and succession is briefly discussed." (A)

362. McVean, D. N.
1956. Ecology of Alnus glutinosa (L.) Gaertn. IV. Root system. J. Ecol. 44(1):219–225.

"Analysis of the gas contained in Alder roots from below the soil water-table is described and the results shown to be comparable with those obtained by other workers on the submerged parts of herbaceous aquatics. The gas is largely contained in the xylem elements as in the genus Aeschynomene. The structure of the water lenticles on stems, roots and nodules is described and the suggestion made that they may play an important part in the root aeration mechanism of the species when growing on water-logged sites. Root-cutting experiments to test the importance of different parts of the root system in the water supply of the tree have shown that the deep tap roots may well account for the success of established Alder on sites of deep water-table. The importance of the surface system (with its nodules and mycorrhiza) in the nutrition of the tree on infertile soils was also demonstrated by this method." (FA)

363. McVean, D. N.
1956, Ecology of Alnus glutinosa (L.) Gaertn. V. Notes on some British alder populations. J. Ecol. 44(2):321–330.

"Describes Alder populations in the New Forest, Norfolk, N. Wales, Sutherland and Invernessshire. The details of floristics and succession are discussed. The Alderwood flora is influenced by the composition of the vegetation it had succeeded; 50% of Alderwood species are from fen and marsh associations and only 5% are woodland species. Alder communities are most distinct on wet sites rich in bases (the relationship of soil water and base content to subordinate species is tabulated); on drier and less basic soils they merge with Oak, Ash, and Birch communities. The Alder colonizes hydroseres particularly quickly when fen successions have been deflected by mowing or grazing, but it does not invade grassland. It is suggested that the conditions required for a climax Alder carr are enough light and enough surface above water to permit regeneration from seed; it is unlikely that the community could be perpetuated by vegetative regeneration alone." (FA)

364. McVean, D. N.
1956. Ecology of Alnus glutinosa (L.) Gaertn. VI. Post-glacial history. J. Ecol. 44(3):331–333.

"Briefly discusses salient features in the European history of the Alder. Autecological studies indicate that the sudden increase of Alder pollen in the Late Boreal period was brought about by (1) a rise in the sea-level producing higher water-tables and initiating hydroseres, (2) and increased evaporation/precipitation ratio leading to a moist soil surface in spring which enabled the Alder to spread from one fen to another, and (3) climatic or biotic factors destroying the existing vegetation. Some evidence of recent climatic change in the British Isles, indicated by the structure and reproduction of hill Alder woods in the north and west, is presented." (FA)

365. Maas, E. F., and R. M. Adamson.
1972. Resistance of sawdusts, peats, and bark to decomposition in the presence of soil and nutrient solution. Soil Sci. Soc. Am. Proc. 36(5):769-772.

"Decomposition of organic growing media such as sawdust, bark or peat can have undesireable effects in the greenhouse culture of tomatoes. In this study the influence of (a) particle size of the medium, (b) nutrient additions (N, P, and K), and (c) an admixture of soil, was investigated by measuring weight losses in Alnus rubra sawdust, Pseudotsuga menziesii sawdust and bark, and three types of peat. The effect of (a) was small; (b) significantly increased decomposition of the sawdusts but had less effect on the bark; and (c) greatly increased decomposition in all the media." (FA)

366. Mackintosh, Anne H., and G. Bond.
1970. Diversity in the nodular endophytes of Alnus and Myrica. Phyton 27(1):79-90.

"In the genera Alnus and Myrica respectively 17 and 12 unusual combinations of nodule endophytes and host species have been studied for symbiotic performance. In Alnus 9 of these combinations resulted in satisfactory symbioses, but in Myrica only one. It is concluded that the Alnus endophyte exists in a number of forms, each able to symbiose with a restricted number of unusual host species, but that in Myrica the endophytes show little or no such ability. Geographical distribution and taxonomic affinity of host species provide a rational basis for some of the findings." (A)

367. Madison, Robert W.
1957. A guide to the Cascade Head Experimental Forest. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn., 13 p. Portland, Oreg.

"Describes the experimental forest, its purposes and administration, and the research projects in progress." (A)

368. Madison, Robert W., and Robert H. Ruth.
1962. Basal spraying of red alder. Weeds 10(4):324-325.

"Red alder (Alnus rubra) was readily killed by growing-season treatments with a 1 to 1 mixture of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) in diesel oil. Except for l-inch-diameter trees, it was resistant to dormant-season treatments. Treatments applied during moderate rain were less effective than during rain-free periods.** (BA)

369. Maloney, T. M.
1978. Alder: One of tomorrow's important structural raw materials? In Utilization and management of alder, p. 125-132. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

**Alderis a lightweight, fast-growing species ideally suited for composition board and composite materials. Studies indicate that there will be a shortage of conventional raw material for plywood building materials in the Pacific Northwest. The composite panel made of veneer faces and a particleboard core offers a

building panel that can possibly use alder for core. Plywood plants can maintain or increase their production rate using particleboard cores, thus avoiding problems associated with shortages of conventional veneer.

"Demonstration alder flakeboards (a type of particleboard) showed excellent modulus of rupture, modulus of elasticity, and internal bond properties which exceeded those in competitive flake-type boards. Indications are that alder merits serious consideration as a raw material for structural panel materials (composition board and composites)." (A)

370. Manolis, B.
1975. Coastal mixed forest. Am. Birds 29(3):767.

Results of a bird survey in a coastal mixed forest at Point Reyes, California. Red alder was the most abundant tree species. Twenty species were observed at a density of 1,702 birds per square kilometer. (CFH)

371. Maranville, L. Frank, and Otto Goldschmid.
1954. Ultraviolet absorption spectra as a measure of phenolic hydroxyl group content in polyphenolic tanninlike materials. Anal. Chem. 26(9):1423-1427.

"A rapid and simple method for determination of phenolic groups in natural polyphenolic materials, such as tannins, has long been needed. An ultraviolet spectrophotometric method employing difference [sic] spectra has been developed which is suitable for this determination. Results by the spectrophotometric method are compared with those by purely chemical 2,4-dinitrophenyl ether method. Values obtained by both methods on a series of bark extracts of several species of softwood and hardwood trees are in qualitative agreement. The ultraviolet procedure is an extremely rapid and convenient method for obtaining a relative measure of the phenolic content of natural polyphenolic materials and provides a convenient means of differentiating different classes of such materials." (A)

372. Margolin, Halcom.
1974. Hurray for alder, scourge of the woods. Living Wilderness 38(125):36-42.

Virtues of alder described in layman's language. Arguments are made for promoting alder management regimes. (CFH)

373. Markwardt, L. J., and T. R. C. Wilson.
1935. Strength and related properties of woods grown in the United States. U.S. Dep. Agric. Tech. Bull. 479, 99 p. Washington, D.C.

374. Marple's Business Newsleter.
1974. Wood chips are in tight supply. Marple's Business Newsl. 643, p. 3-4.

"Wood chips are in tight supply now because pulp mills are running at capacity while lumber and plywood plants, a source of by-product chips, have cut back. The price has about doubled in a year. Early this year when Japanese mills got behind in their hardwood requirements, alder went to a premium over Douglas-fir. Clean alder chips from whole logs now bring ***$60*** a unit, and those from whole-tree chipping (with up to 12% bark and other residue), about $55. Pope & Talbot will sell its Port Gamble chips to paper mills on Puget Sound." (A)

375. Matthewes, Rolf W.
1973. A palynological study of postglacial vegetation changes in the University Research Forest, southwestern British Columbia. Can. J. Bot. 51(11):2085-2103.

"The postglacial vegetation history of the University of British Columbia Research Forest was investigated using percentage and absolute pollen analysis, macrofossil analysis, and radiocarbon dating. A marine silty clay deposit records the oldest (12,690 ± 190 years before present (B.P.)) assemblage of terrestrial plant remains so far recovered from the postglacial of south-coastal British Columbia. Lodgepole pine (Pinus contorta) dominated this early vegetation, although some Abies, Picea, Alnus and herbs were also present. Sediment cores from two lakes were also studied. The older is Marion Lake, where five pollen assemblage zones are recognized, beginning with a previously undescribed assemblage of Pinus contorta, Salix, and Shepherdia in clay older than 12 350 + 190 B.P. The pollen diagram from Surprise Lake (11 230 ± 230 B.P.) is divided into three pollen zones which show the same major trends of vegetation change as the Marion Lake diagram.

"The first report of the postglacial vegetation history of cedar (Thuja and perhaps Chamaecyparis) in southwestern British Columbia is presented from Pollen and macrofossil analyses.

"At about 10 500 B.P. in both lakes, pollen of Douglas-fir (Pseudotsuga menziesii) began a rapid increase, probably in response to climatic amelioration. The palynological evidence, supported by well-preserved bryophyte subfossils, suggest that humid coastal conditions have prevailed in the study area since about 10 500 B.P., with virtually no evidence for a classical Hypsithermal interval between 8500 B.P. and 3000 B.P." (A)

376. Matthews, Oliver V.
1941. Something new among the alders. Am. For. 47(8):374-377, 400.

Reports several cut-leaved red alder at various locations in the Pacific Northwest. (CFH)

377. Menzies, Archibald.
1923. Menzies' journal of Vancouver's voyage. April to October 1792. Edited, with botanical and ethnological notes by C. F. Newcombe, M.D., and a biographical note by J. Forsyth. Mem. V. Arch. B.C. Victoria.

Menzies was the first person to collect plants from the Pacific Northwest. He did not describe his own collections.

Apparently many of the species collected have not been studied yet. Red alder appears to be one of these. On May 1, 1792, Vancouver made his first landing in a region that later was to become the United States. This was on an island in the strait of Juan de Fuca at the entrance to Port Discovery, Jefferson County, Washington. They named it Protection Island.

On May 2, Menzies went ashore with Captain Vancouver. He wrote in his journal: "Besides a variety of Pines we saw the Sycamore Maple [Acer Macrophyllum] - the American Aldar [Alnus oregona] - a species of Wild Crab [Pyrus diversifolia] and the Oriental Strawberry Tree [Arbutus menziesii] ... - We met with some other Plants which were new to me ...". (CFH)

378. Mestre, J. C.
1964. [Embryogeny of the Amentaceae. Development of the embryo of Alnus plutinosa.] C. R. Acad. Sci., Paris 258(24):5949-5951.

The morphology of development of the embryo Alnus plutinosa L. is basically the same as that of Senecio vulgaris. It departs from it, however, by the presence of a true hypophysis which furnishes the suspensor stage. This embryonic type should then be linked to the Calendula arvensis type. (CFH)

379. Metcalf, Melvin E.
1965. Hardwood timber resources of the Douglas-fir subregion. USDA For. Serv. Resour. Bull. PNW-11, 12 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Gives statistics, adjusted for 1963, from inventories of Alnus rubra, Acer macrophyllum, and Populus trichocarpa, with some data on other hardwoods."

380. Miller, James H.
1974. Nutrient losses and nitrogen mineralization on forested watersheds in Oregon's Coast Range. Ph. D. thesis. Sch. For., Oreg. State Univ., Corvallis. 94 p.

"Nutrient losses of the biologically responsive anions, nitrate and bicarbonate together with the major cations, were monitored on 14 small watersheds in Oregon's Coast Range and evaluated in relation to management-induced disturbance. Mixed forests of Douglas-fir and red alder had dominated these high-nitrogen sites prior to treatment.

"During the approximately two years of streamwater monitoring following treatments, no significant increases in dissolved solids were observed. No consistent differences appeared between treatments or between cut and uncut watersheds. Nitrate concentrations (2.8 ppm N maximum) never exceeded U.S. Public Health Service (1962) standards for drinking water.

"Nitrification rates are substantially greater in alder soils; while ammonification rates appear similar for the two soils within the normal operating regimes of temperature and moisture. In a very wet alder soils the mobile nitrate anion is reduced to the less mobile ammonium cation and ammonification rates are minimal. This behavior appears to be important in nutrient retention during winter flushings when high soil moisture is prevalent in the lower soil profile and in wet source areas (slowly draining areas) that characterize parts of these watersheds.

"The combinations of temperature and moisture exhibiting the highest rates of nitrogen mineralization (suggesting unstable states) were not encountered in the field under stands or in cleared situations. Soil temperatures above 21° C combined with moist but unsaturated conditions results in the highest rates of nitrate production. This, and the observed behavior of the nitrogen-rich watersheds, suggest that nitrate losses in streamwater following forest disturbance are only likely in climatic regions of summer-surplus precipitation." (A)

381. Miller, Richard E., and Marshall D. Murray.
1978. The effects of red alder on growth of Douglas-fir. In Utilization and management of alder, p. 283-306. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"We describe the long-term effects of off-site red alder that were interplanted in 1933 within a 4-year-old Douglas-fir plantation in southwestern Washington. Insufficient available nitrogen limits tree growth in this plantation. Red alder clearly increased height and diameter of the associated dominant Douglas-fir. Improved growth in diameter began when the Douglas-fir emerged through the alder canopy. This emergence occurred at about 30 years from seed at Wind River and in several even-aged, mixed stands that we also investigated. By age 48, Douglas-fir volume per acre in the mixed stand averaged about 3,100 cubic feet compared to 2,900 cubic feet in the pure stand. Red alder volume was about 2,500 cubic feet. Maintaining red alder in Douglas-fir stands can increase merchantable yields on nitrogen-deficient sites. Controlling stand density at an early age is necessary to maintain both Douglas-fir and alder in a dominant or codominant position. To provide adequate nitrogen and not seriously reduce Douglas-fir growing stock, about 20 to 40 uniformly distributed red alder per acre should be retained." (A)

382. Hinore, Don.
1966. Identification of rotten logs in the coastal forests of Oregon and Washington. 16 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Provides an identification key to rotted logs and species description for red alder. (CFH)

383. Minore, Don.
1968. Effects of artificial flooding on seedling survival and growth of six northwestern tree species, USDA For. Serv. Res. Note PNW-92, 12 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Winter flooding in tanks in Jan. 1967 of seedlings from seed germinated in April 1966, for periods of 1-4 weeks, severely injured Pseudotsuga menziesii but had little effect on the other species. Summer flooding from June 1967 for 4 and 8 weeks affected all species; many seedlings died and many formed adventitious roots at the water-line. Thuja plicata and Pinus contorta seemed to be the most tolerant, and Pseudotsuga menziesii to be extremely intolerant, of flooding; Alnus rubra, Picea sitchensis and Tsuga heterophylla were intermediate." (FA)

384. Minore, Don.
1970. Seedling growth of eight northwestern tree species over three water tables. USDA For. Serv. Res. Note PNW-115, 8 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Seed was sown in pots with soil of uniform texture, and water-table depth was controlled at (a) 7.5, (b) 35.5 and (c) 66 cm (techniques described and illustrated). Results indicate that Pinus contorta, Thuja plicata, Alnus rubra and Picea sitchensis are all tolerant, and Pseudotsuga menziesii intolerant, of (a); P. contortg and T. plicata grew best over (c). Tsuga heterophylla and Abies amabilis were not significantly affected by depth of the water table." (FA)

385. Minore, Don.
1972. Germination and early growth of coastal tree species on organic seed beds. USDA For. Serv. Res. Pap. PNW-135, 18 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Gives the results of field observations and field and laboratory experiments in Oregon on Pseudotsuga menziesii, Picea sitchensis, Tsuga heterophylla, Thuja plicata, Pinus contarta, Abies amabilis, and Alnus rubra, including information on the effects of shading. Nutrients were more abundant in duff (litter/humus) than in rotted wood. In dense coastal stands, seedlings were usually larger and more abundant on duff-covered rotten logs than on duff-covered mineral soil, because the duff accumulations were thicker on logs and over rotten wood embedded in the soil than over mineral soil alone. Shade limited root growth more than height growth, but seedbed differences limited height growth more than root growth. All conifer species responded similarly to the seedbed and shade differences tested, and it is concluded that the type of organic seedbed probably does not affect the species composition of forest regeneration under lightly thinned shelterwoods in this area." (FA)

386. Minore, Don, and Clark E. Smith.
1971. Occurrence and growth of four northwestern tree species over shallow water tables. USDA For. Serv. Res, Note PNW-160, 9 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The occurrence and radial growth of (a) Alnus rubra, (b) Thuja plicata, (c) Picea sitchensis and (d) Tsuga heterophylla were related to estimated water-table depths in swamps in the Olympic Peninsula, Washington. Fifty-six plots, each consisting of a line intercept 6-15 m long, were established on sites where undisturbed native trees and Lysichitum americanum were found growing together. The petiole length of L. americamum were used as an indicator of water-table depths. All four tree species were found to tolerate winter water tables at >15 cm depth. Where the water table was <15 cm deep, and (a) and (c) grew well with flowing groundwater, and (a) and (b) grew well with stagnant water; (d), however, appeared to be intolerant of water tables shallower than 15 cm." (FA)

387. Minore, Don, Clark E. Smith, and Robert F. Woollard.
1969. Effects of high soil density on seedling root growth of seven northwestern tree species. USDA **For.** Serv. Res. Note PNW-112, **6** p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Pseudotsuga menziesii, Picea sitchensis, Tsuga heterophylla, Thuja plicata, Pinus contorta, Abies amabilis, and Alnus rubra were grown in plastic pipes in soils of three degrees of compaction-- **1.32, 1.45,** and **1.59** g./c.c. Seedlings weights and root depths are tabulated. Total weights, root and shoot weight, and maximum root depths are influenced by differences in available nutrients. Average root depths, however, show that **P.** menziesii, **P.** contorta, and A. rubra can penetrate soil densities that inhibit roots of **P.** sitchensis, T. heterophylla, and **T.** plicata. **A.** amabilis ranks between the two groups." (FA)

388. Mitchell, Harry **O.**
1958. Pacific coast hardwoods and their uses. Natl. Hardwood Mag. **32(11):110-114.**

Talks about alder's uses as veneer, solid wall paneling, fine furniture, kitchen cabinets, flooring, tanned products, chairs, pattern stock, and other miscellaneous uses. **(CFH)**

389. Moravets, F. **L.**
1956. **Oregon's** hardwood resources. Pac. Coast Hardwoods, March, p. 12-13. Northwest Hardwood Assoc., Seattle, Wash.

Red alder is the most abundant of Oregon's hardwood species and is found in all 19 counties west of the Cascade Range. There are 215,000 acres of alder type in western Oregon. Total sawtimber volume of red alder is estimated at **3.9** billion board feet. **(CFH)**

390. Morrison, Vance **L.**
1949. Keeping roads alder free by the use of chemical sprays. B.C. Lumberman **33(1):108-110.**

"The Oregon State Board of Forestry in cooperation with the Crown-Zellerbach Corporation has experimented with chemical sprays used for controlling the encroachment of brush (particularly Alder) on roads in Western Oregon. Chemical use were isoprophyl ester and alkanolomine salt, both derivatives of 2,4,-D which were applied at the rate of about **4** gal. per acre. After **6** weeks **90%** of Alder under 10 ft. high was apparently killed, and a pruning effect was observed on the large Alder. The experiments were not conclusive, but the following points emerge from reports by various other organizations: **(1) 2,4-D** kills by entering the stomata and working its way to the roots. If the outer stem and leaves are killed before the chemical reaches the roots, or if the tree is large, or the application is too light,

the roots are not affected and the tree recovers. (2) Spraying should be done when the leaves have reached normal development, using any pumper with a pressure of 200-600 lb. A weak solution repeated after 2 weeks is better than one heavy application. (3) A height greater than 10 ft. should not be treated, unless a pruning effect only is required. (4) Cost estimates by different agencies vary between $20.00 and $50.00 per mile. (5) Fire hazard after treatment should not be very great since Alder tends to rot quickly." (FA)

391. Morse, William B.
1967. Don't call red alder a weed! Am. For. 73(9):38-40, 50-51.

392. Moshier, Bill.
1955. Farmers find alder can be profitable. Seattle Sunday Times, Mag. Sect., Hay 15, p. 23. Seattle, Wash.

393. Mothershead, John S., and Douglas W. Glennie.
1964. Chemical structure of lignin sulfonates. Part II. Identification of monomeric lignin sulfonates from red alder. Tappi 47(8):519-524.

"Monomeric lignin sulfonates from red alder wood were isolated and identified. A fraction containing lignin sulfonates with low molecular weight was obtained by precipitating components with higher molecular weight in 70 and 80% ethanol. Further separation was obtained by chromotography in a column on ion-exchange resin and magnesia-silica gel adsorbent. Vinylsyringyl sulfonate appeared to be a major monomeric component which formed at least 4% of the total lignin sulfonates obtained in the first stage of sulfonation. It was the major product formed by sulfonating sinapyl alcohol. Also, evidence was found for presence of the monomers vinylvanillyl sulfonate, coniferyl sulfonate, and the sulfonates of coniferaldehyde and sinapaldehyde, and their identity confirmed by thin-layer chromotography. Formation of monomeric sulfonates from coniferyl and sinapyl alcohol or hydrated coniferyl and sinapyl alcohol units in lignin from red alder wood is proposed." (CA)

394. Muenscher, W. C.
1941. The flora of Whatcom County, State of Washington. 134 p. William A. Church Co., Ithaca, N.Y.

Red alder is one of the species discussed. (CFH)

395. Mulligan, Brian O., Compiler.
1977. Woody plants in the University of Washington Arboretum, Washington Park. 183 p. Coll, For. Resour., Univ. Wash. Seattle.

A checklist of the woody plants growing in the University of Washington Arboretum in Seattle. In addition to red alder, there are 31 other species, varieties, ornamental forms, and hybrids of alder present. (CFH)

396. Mullin, Sandy.
1978. New approaches to producing furniture components from hardwood lumber. (Abstr.) **In** Utilization and management of alder, p. 123. David G. Briggs, Dean S. DeBell, and William A Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Furniture dimension parts are currently being manufactured from red alder on both the East and West Coasts. Species characteristics and the location of standing timber give alder certain competitive advantages. Dimension manufacturers, however, must continue to use every means to reduce the unit costs of processing. This paper described mini-computer systems presently being used in furniture dimension plants to reduce lumber waste." **(A)**

397. Munch, E.
1936. Das Erlensterben. Forstwiss. Centralbl. 58(6):173-194.

"In many plantations red alder trees develop bushy forms and begin to bear heavy seed crops by the 3d yr. after planting; at about the 12th yr. they commence to die. This phenomenon was first reported in Germany by Ortzen, in Mecklenburg. Black alder plantations have failed since 1865; natural stands have done well. Since at least 1873 practically all alder plantations have been made with seed or plants of foreign, chiefly Belgian, origin. It is believed that this seed is not adapted to the German conditions and is less tolerant of low temps. and changes in ground water level than the native stock. Many of the dying trees are attacked by Valsa oxystoma, but this is not the primary cause of death, for it seldom injures natural stands. In comparative plantings exps. at Tharandt with seed from native alder form East Prussia, Mecklenburg, and Saxony, and with seed of foreign alder (Belgian), the foreign stock in all cases grew faster for about 6 yrs., then more slowly than native stock. The foreign alder bore seed every year, beginning about the 4th yr., but native alder has not borne seed in 11 years. Similar results were obtained with birch from native and Belgian stock; the Belgian birch seeded abundantly every yr. after the 4th, but native birch begins after 10-30 yrs. and then seeds only about once in 3 yrs. There is danger that all seed available commercially will be from such "bred-down" races, for the tendency is to collect seed from the trees that bear soonest and most abundantly, although they are most susceptible to disease and climatic injury and have poor form. Experience with cherry (Prunus serotina) has been similar; most of that now grown in Germany is little better than a shrub but bears abundant seed at an early age. The author believes that the same principles apply to these and other spp. as have been demonstrated in the case of larch and Scotch pine; namely, that only native seed of parent trees known to be adapted to the locality where used should be employed in forestry operations." (BA)

398. Munger, Thornton T.
1938. Red alder long considered but a weed tree, now an important raw material for west coast woodworkers. Hardwood Record 76(3):7-8.

Survey of the distribution, silvics, and uses of red alder. (CFH)

399. Munns, E. N.
1938. The distribution of important forest trees of the United States. U.S. Dep. Agric. Misc. Publ. 287, 11 p. and 170 maps. Washington, D.C.

Contains distribution map of red alder. (CFH)

400. Murai, Saburo.
1964. [Phytotoxonomic and geobotanical studies on genus Alnus in Japan, 111--Taxonomy of whole world species and distribution of each section.] Gov. For. Exp. Stn. Bull. 171, 107 p. Tokyo. [In Japanese. English summary and captions.]

A taxonomic work of major importance. Contains sufficient English to be useful. See Murai (401) for English version summarizing much of the information on red alder. Concludes that Alnus is divided into the subgenera Alnaster (now relegated to this rank; with sections Bifurcatus and Alnobetula) and Gymnothyrus (with sections Cremastoggne, Clethropsis, Japonica, Fauriae, and Glutinosae). Phylogeny is discussed with referece to morphology, distribution, and chromosome numbers. Spontaneous polyploidy is found in Bifurcatus. Diagnostic characters of species and varieties are illustrated. The hybrid A. x ljungeri (A. glutinosa x A. rubra) is most promising among intrasectional crosses. (CFH)

401. Murai, Saburo.
1968. Relationships of allied species between northwestern U.S.A. and Japan on the genus Alnus. In Biology of alder, p. 23-36. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"In this paper the author has attempted to compare the genus Alnus in the northwestern United States with that in Japan. The results are reported herein; comments are solicited." (A)

402. Nagoda, Ludvik.
1968, Vanninnholdet hos trevirke og vektmaling. [Water content of wood and weight measurement (literature study)], Tidsskr. Skogbruk 76(3):191-216.

"Discusses the literature (with particular reference to Alder, Aspen and Birch) and includes sections on weights vs. volume measurements, variations in moisture content with position (radial or vertical) in the stem, season and site conditions, green density of freshly felled trees and changes in density during storage. It is concluded that green weight alone is inadequate as a basis for measurement but that weighing with a correction for dry-matter content, gives satisfactory results regardless of species, log size and season." (FA)

403. Neal, J. L., Jr., W. B. Bollen, and K. C. Lu.
1965. Influence of particle size on decomposition of red alder and Douglas fir sawdust in soil. Nature (London) 205(4975):991-993.

"Experiments made with sawdust in four particle-size ranges showed a definite parallelism between particle size and microbial activity: the smaller the particle, the greater the O consumption. The addition of NH_4NO_3 with the various sawdust sizes did not stimulate O uptake, and in fact reduced it in some cases." (FA)

404. Neal, J. L., Jr., K. C. Lu, W. B. Bollen, and J. M. Trappe.
1968. A comparison of rhizosphere microfloras associated with mycorrhizae of red alder and Douglas-fir. In Biology of alder, p. 57-71. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Rhizosphere microfloras of Cenococcum graniforme (Sow.) Ferd. and Winge mycorrhiza of Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco), of one type of ectotrophic mycorrhiza of red alder (Alnus rubra Bong.), and of non-. mycorrhizal suberized roots of both tree species were investigated. Microbial populations and the most probable numbers of ammonifying and nitrate-reducing microbes differed qualitatively and quantitatively between rhizosphere microhabitats. In manometric studies, homogenized Douglas-fir highly stimulated respiration of nonrhizosphere microbes, especially in the presence of glucose. Glucose oxidation, however, was suppressed in the presence of Douglas-fir mycorrhizal root suspension, probably by the antibiotic which the fungal symbiont, C. graniforme, is reported to produce. Glucose oxidation by nonrhizosphere microbes was similarly repressed in the presence of red alder nonmycorrhizal root suspension. An antagonistic substance found in red alder root and nodule suspensions inhibited growth of Bacillus subtilis (Cohn) Prazmowski and ~~B. cereus~~ Frankland and Frankland on glucose-salts agar. These experimental results are discussed with reference to the influence of mycorrhizal and adjacent nonmycorrhizal suberized roots upon rhizosphere microfloras." (A)

405. Neal, J. L., Jr., K. C. Lu, J. M. Trappe, and W. B. Bollen.
1966. Rhizosphere microbial activity of mycorrhizal and nonmycorrhizal roots of Douglas fir and red alder. (Abstr.) Bacteriol. Proc. 1966(2):A10.

"More microorganisms were found in the rhizosphere of both species than in the non-rhizosphere soils. The difference was much greater in Red Alder than in Douglas Fir; in Alder there were ca. twice as many microorganisms in the rhizosphere of mycorrhizal roots than in that of suberized, nonmycorrhizal roots, but microorganisms were more frequent near nonmycorrhizal roots of Douglas Fir. Crushed mycorrhizae of Alder stimulated microbial growth in vitro. The mycorrhizae of Douglas Fir associated with Cenococcum graniforme had little or no stimulating effect, possibly because of the presence of antagonistic substances.*' (FA)

406. Neal, J. L., Jr., J. M. Trappe, K. C. Lu, and W. B. Bollen. 1967. Sterilization of red alder seedcoats with hydrogen peroxide. For. Sci. 13(1):104-105.

"Concludes from data (tabulated) on the effect of duration of soaking in 30% H_2O_2 on surface sterilization (s.s.) and germination (g.) of Alnus rubra seed, that soaking for 10 min. gives complete s.s. with optimum g. (52% after 14 days)." (FA)

407. Neal, J. L., Jr., J. M. Trappe, K. C. Lu, and W. B. Bollen. 1968. Some ectotrophic mycorrhizae of Alnus rubra. In Biology of alder, p. 179-184. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Two forms of mycorrhizae predominated on root systems of red alder (Alnus ruba Bong.) in a pure stand near the Oregon coast. Detailed morphological studies, the first for this species, revealed distinct characteristic differences between fungal symbionts. The great abundance of these mycorrhizae and their immediate influence on rhizosphere microbes could markedly affect the incidence of root disease," (A)

408. Neal, John Lloyd, Jr. 1968, Rhizosphere microfloras associated with mycorrhizae of Douglas-fir and red alder. Ph. D. thesis. Oreg. State Univ., Corvallis. 88 p.

"The mycorrhizal rootlets of Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco.) and red alder (Alnus rubra Bong.) were extensively investigated. A jet-black mycorrhiza was found to be dominant on Douglas-fir rootlets. The fungal symbiont was identified as Cenococcum graniforme (Sow.) Ferd. and Winge. Two forms of mycorrhizae predominated on root systems of red alder. Detailed morphological studies, the first for this alder species, revealed distinct characteristic differences between the fungal symbionts. One common mycorrhizal form was clavate with a dark-brown roughened fungal mantle. The Hartig net was well developed. The other predominant form was pale brown and glabrous. The Hartig net was weakly developed and sporadic.

"Rhizosphere microflora of three morphologically different mycorrhizae of a Douglas-fir were examined and compared with microflora surrounding adjacent suberized roots and with that in nonrhizosphere soil. Populations of bacteria, molds, and Streptomyces were different for each microhabitat." (A)

"Rhizosphere microfloras of Cenococcum graniforme mycorrhizae of Douglas-fir, of one type of ectotrophic mycorrhiza of red alder, and of nonmycorrhizal suberized roots of both tree species were investigated. Microbial populations and the most probable numbers of ammonifying and nitrate reducing microbes differed qualitatively and quantitatively among rhizosphere microhabitats.

"These experimental results are discussed with reference to the influence of mycorrhizal adjacent nonmycorrhizal suberized roots upon rhizophere microfloras." (FA)

409. Nelson, E. E.
1968. Survival of Poria weirii in conifer, alder, and mixed conifer-alder stands. USDA For. Serv. Res. Note PNW-83, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Cubes of Douglas Fir heartwood naturally infected with P. weirii were buried for up to 18 months in stands of conifers, Alder (Alnus rubra) and mixed Alder and conifers. Survival of the fungus in the cubes was better under the pure conifers than under stands containing Alder, perhaps becuase many fungi, bacteria and antinomycetes competing with P. weirii for soil nutrients can, unlike P. weirii, use NO_3-N (present in large amounts under Alder.)." (FA)

410. Nelson, E. E.
1976. Effect of urea on Poria weirii and soil microbes in an artificial system. Soil Biol. and Biochem. 8(1):51-53.

"Reports a laboratory study on P. weirii established in small stem billets of Alder (Alnus rubra), buried in soil from a Pseudotsuga menziesii stand in Oregon and incubated in the dark at 15 deg C for 32 weeks. Results showed that no P. weirii survived in soil to which urea (147 or 294 g N/m^3) had been added. The survival of P. weirii during the first 16 weeks was inversely correlated with urea dosage and with populations of Trichoderma (first observed after 8 weeks) and actinomycetes. Field plots have been established to ascertain whether P. weirii can be controlled in the field by N treatment, possibly combined with mechanical disruption of old root systems." (FA)

411. Nelson, E. E., and H. Fay.
1974. Thermal tolerance of Poria weirii. Can. J. For. Res. 4(3):288-290.

"P. weirii may survive for years in buried wood; temperature, interacting with the microflora, influences its longevity. When grown in stem sections of alder (Alnus sp.) and incubated while relatively free of competition from other fungi, P. weirii survived for 32 weeks at between -5 deg and +30 deg C; survival was reduced progressively when the fungus was subjected to greater extremes of cold (down to -20 deg) or heat (up to +39 deg). Pre-conditioning of stem sections colonized by P. weirii for 1 week at 65 deg improved subsequent survival at -15 deg. Though extreme heat or cold can thus be lethal to P. weirii, such conditions do not occur very deep in the soil within the geographic range of the fungus, and it is concluded that temperature is probably only an indirect factor in this survival in forest soils." (BA)

412. Nelson, E. E., E. M. Hansen, C. Y. Li, and J. M. Trappe.
1978. The role of red alder in reducing losses from laminated root rot. In Utilization and management of alder, p. 273-282. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Experiment Station, Portland, Oreg.

"Red alder, in mixture with conifer or preceding stands of conifers, may be useful in reducing damage from laminated root rot (Phellinus weirii) on infested sites. This benefit could result from changes in soil nitrate, pH, fatty acids, phenolic compounds and microbial populations brought about by alder, as well as

physical separation of susceptible root systems in mixed stands. Survey data tend to support this hypothesis. Disease incidence may be limited by reducing saprophytic survival of the pathogen or inhibiting its spread along conifer roots. Evidence for the former is greater than for the latter. Long-term experimental plots have been established to provide more definitive answers." (A)

413. Nelson, Earl E.
1970. Effects of nitrogen fertilizer on survival of Poria weirii and populations of soil fungi and aerobic actinomycetes. Northwest Sci. 44(2):102-106.

Examined effects of NH_4^+ and NO_3^- fertilization on the survival of Poria weirii in buried soil cubes. Field tests were inconclusive, but laboratory tests showed a relationship between nitrogen fertilization and P. weirii survival. (CFH)

414. Nelson, Earl E.
1975. Survival of Poria weirii on paired plots in alder and conifer stands. Microbios 12(49):155-158.

"Cubes of Douglas-fir wood decayed by ~~Poria weirii~~ (Murr.) Murr. were buried for 12 months on paired plots in red alder and in conifer soils on the Cascade Head Experimental Forest. Survival of the fungus was not significantly different in the two soils, although pH was significantly lower and nitrate content significantly higher in alder soils. Even though effects on fungus survival were nil, red alder, for other reasons, might still be used to reduce damage caused by P. weirii root rot on areas of heavy infestation." (A)

415. Nelson, Earl E.
1976. Colonization of wood disks initiated by basidiospores of Phellinus weirii (laminated root rot). For. Sci. 22(4):407-411.

"Suspensions of basidiospores of Phellinus [Inonotus] weirii at concentrations from 80 to 50,000 spores/ml were sprayed on to previously frozen and scalded wood discs of 9 species of softwood and 2 species of hardwood, and incubated at 5, 10, 15, 20° C with a spore concentration of 400/ml. Discs first sprayed with a soil suspension or buried after inoculation were not colonized by I. weirii. Thuja plicata, ~~Picea~~ sitchensis, Acer macrophyllum and Alnus rubra were resistant to colonization, the latter two not being hosts of the fungus. Sapwood of Pseudotsuga menziesii was colonized more than heartwood." (FA)

416. New Zealand State Forest Service.
1944. Annual report of the Director of Forestry for the year ended 31st March, 1944. 38 p. Gov. Print., Wellington.

"Observations made on plots of exotic conifers planted during 1927-29 at high altitudes (2,200-3,800 ft. above sea-level) under exposed conditions on the central North Island Plateau, showed Pinus murrayana and P. ponderosa to be the most thrifty species followed by P. austriaca, P. sylvestris, P. banksiana, P. rigida and P. strobus. Other species, including P. radiata, gave poor results. Trees of all species are heavily branched and of poor timber form, but the study

gives a good indication of the species most suitable for the extension of upland protection forests.

"In an experimental interplanting of worked Podocarp forest with exotic hardwoods, two South American Beeches (Nothofagus procera and N. obliqua) and Red Alder (Alnus rubra) showed particularly good height growth and development." (FA)

417. Newton, M.
1966. New injection system for killing or curing trees. (Abstr.) Meet. Weed Soc. Am. 1966:30-31.

**TheHypo-Hatchet is a precision instrument, weighing ca. 3 lb., that operates automatically on impact. The chemical reservoir is of light-weight plastic and when full (2.5 lb.) should last half a day at rates of 0.5 ml. per cut. The positive-displacement pump is self-priming and will feed if the reservoir is below the instrument. The dosage may be calibrated to deliver any volume up to 1 ml. The instrument, using undiluted compounds for 0.5 ml. injections spaced 3, 6 or 9 in. apart, has given consistent control of a variety of hardwoods and conifers, including Pseudotsuga menziesii, Abies grandis, Tsuga heterophylla and Prunus spp. with cacodylic acid or picloram + 2,4-D; Picea sitchensis, Acer rubrum and Alnus rubra with 2,4-D amine; and A. macrophyllwn with picloram or fenoprop K. The instrument may also be used for precision injection of antibiotics and insecticides." (FA)

418. Newton, Michael.
1978. Herbicides in alder management and control. In Utilization and management of alder, p. 223-230. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Herbicides can be used effectively to convert alder/shrub communities to conifers, to release conifers from such cover, and probably to prepare sites for alder production. To thin and cull young stands of alder, trichlopyr (not yet registered), 2,4-D amine, and cacodylic acid can be effectively injected into selected trees. In conifer management, alder and associated species can be controlled with (1) 2,4,5-T before bud burst (the best release tool), and (2) brushkiller (2,4-D t 2,4,5-T) in late summer (best for release from alder, hazel, thimbleberry, cherry, and ocean spray).

To convert brushfields, the initially expensive brown-and-burn procedure is most successful. In site preparation, phenoxys (2,4-D and 2,4,5-T) alone often require multiple treatments and often result in heavy animal use. Krenite®, picloram/phenoxy mixtures, and glyphosate (registered in Oregon only in 1977) are satisfactory if treated stems larger than 3-in diameter are felled and large seedlings, preferably less palatable species, are used.** (A)

419. Newton, Michael, B. A. el Hassan, and Jaroslav Zavitkovski.
1968. Role of red alder in western Oregon forest succession. In Biology of alder, p. 73-84. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Red alder was studied to determine influence on long-term forest succession. Juvenile growth of alder appears responsible for failure of other species, particularly conifers, to maintain positions of dominance. Success of Douglas-fir depends on delay of 4-9 years in establishment of alder, or occurrence of the two species at such spacing that Douglas-fir will be from 8 to 10 years old before encroachment by alder.

"Alder is concentrated on mesic sites with history of scarification or fire. Dense stands were shown to fix nitrogen at an annual rate of abou 320 kg per hectare on nitrogen-deficient soils. Equilibration of fixation with nitrogen in soil tends to occur before the age of 20 years, beyond which contributions of nitrogen are small.

"Common successors to alder include salmonberry, vine maple, and hazel, in that order. Western hemlock may follow eventually, but Douglas-fir is virtually absent except where it develops concurrently with the alder in openings within the alder stand." (A)

420. Newton, William E., and C. J. Nyman, Eds.
1976. Proceedings of the 1st international symposium on nitrogen fixation. Vol. 1. 311 p. Wash. State Univ. Press, Pullman.

421. Newton, William E., and C. J. Nyman, Eds.
1976. Proceedings of the 1st international symposium on nitrogen fixation. Vol. 2. 313 p. Wash. State Univ. Press, Pullman.

422. Nielson, R. W.
1677. Red alder utilization in British Columbia – present and potential. West. For. Prod. Lab. Inf. Rep. VP-X-164, 29 p. Dep. Fish. and Environ., Vancouver, B.C.

"Red alder (Alnus rubra Bong.) is a common hardwood species in the Pacific Northwest, but is virtually unused in British Columbia. This booklet reviews the red alder resource situation and the extent of its utilization, with comparisons made between British Columbia and the neighboring states of Washington and Oregon.

"Wood properties and current utilization practices are outlined, and the potential for using this species in British Columbia is discussed. Factory lumber appears to be an economically attractive product for this species, but is dependent on the consumption of mill residues and pulpwood-quality red alder by the pulping industry." (A)

423. Noble, W., J. de Temple, and P. Neergaard.
1958. An annotated list of seed-borne diseases. 159 p. Commonw. Mycol. Inst., Kew.

**Arrangedunder families of the hosts, with an index to pathogens, and indexes to common and Latin names of hosts, which include Acer spp., Alnus spp. Araucaria excelsa, Betula spp., Chamaecyparis sp., Fraxinus spp., Larix spp., Picea sitchensis, Pinus spp., Quercus spp., Thuja spp., Ulmus americana and U. pumilla." (FA)

424. Norris, L. A.
1966. Degradation of 2,4-D and 2,4,5-T in forest litter. J. For. 64(7):475-476.

"The herbicides 2,4-D and 2,4,5-T are degraded in forest litter at different rates; 2,4-D is metabolized at an increasing rate with time while the rate of degradation of 2,4,5-T shows only a slight increase. Wore than 895 percent of the 2,4,-D was decarboxylated in 300 hours. Less than **25** percent of 2,4,5-T was decarboxylated in the same period. Similar qualitative relationship in the persistence characteristics of these herbicides is expected in the field." (A)

425. Norris, Logan A., and David Greiner.
1967. The degradation of 2,4,-D in forest litter. Bull. Environ. Contam, and Toxicol. 2(2):65-74.

"These studies have shown that 2,4-D is rapidly degraded in forest litter and that the rate of degradation varies with the type of litter, herbicide formulation and the presence of DDT. The degradation of 2,4-D varies slightly in litter from different vegetation types when incubated under similar environmental conditions. Greater variation in herbicide degradation rates may be expected in the field; but this will be due primarily to differences in the site microenvironment, rather than inherent differences in the litter.

"Various formulations of 2,4-D are degraded at different rates in forest litter although we believe this to be more a function of constituents of formulation than a direct effect of the technical acid, salt or ester.

"Finally, these experiments have shown that **up** to 4 gallons per acre of diesel oil has little or no effect on the decomposition of 2,4-D isooctyl ester, while 1 lb./A. of DDT appears to stimulate herbicide degration." (A)

426. Northwest Hardwood Association.
1957. Management of red alder in the Pacific Northwest. Advisory group on forest management. 24 p. Seattle, Wash.

"Covers the silvics of Alnus rubra, thinning practices, m.a.i. and total yield, volume tables, rotations, types of felling, and logging methods. Also considers official grading rules and the judging of quality, chemical barking for pulpwood, and the relation of markets to management." (FA)

427. Northwest Hardwood Association.
1966. Proceedings from an alder logging and milling clinic. 16 p. Seattle, Wash.

428. Nuttall, Thomas.
1857. The North American sylva; or, a description of the forest trees of the United States, Canada, and Nova Scotia, not described in the work of F. Andrew Michaux, and containing all the forest trees discovered in the Rocky Xountains, the territory of Oregon, down to the shores of the Pacific, and into the confines of California, as well as in various parts of the United States. Vol. 1, p. 41-46. D. Rice and A. N. Hart, Philadelphia.

"OREGON ALDER. Alnus Oregona. Foliis lato-ovatis utrinque acutis, duplicato-serratis junioribus glutinosis, venis subtus pubescentibus pallidis; stipules oblongis deciduis glutinosis, ramulis glabris." The original description of Oregon alder now an obsolete synonm for red alder. Nuttall found it "...as usual with the plants of this genus, growing along the border of small, clear brooks near the confluence of the Wahlamet, but seldom, if ever, on the banks of the larger streams which are subject to inundation. In our progress to the West, we first observed this tree on the borders of the rivers Boisee and Brulee [Burnt River, Oregon] which pass into the Shoshonee [Snake] not far from Walla-Walla, [this area is not considered outside the range of red alder] and at intervals it continues more or less common to Point Chinhook, near the shores of the Pacific." (CFH)

429. Olson, Bob, David Hintz, and Edwin Kittila.
1967. Thinning young stands of alder. U.S. Dep. Agric. Soil Conserv, Serv, Tech. Notes TN 122, 2 p.

The suggested minimum spacing for young alder stands is 10-12 feet. (CFH)

430. Oregon State Department of Forestry.
1962. Alder moves into timber management picture. For. Log 31(10):4-5.

431. Oregon State University, Cooperative Extension Service.
1958. Oregon hardwoods, management, marketing, manufacture. Ext. Bull. 775, 16 p.
Corvallis, Oreg.

432. Oregon State University, Cooperative Extension Service.
1963. Red alder (Alnus rubra). In Woodland handbook for the Pacific Northwest, p. 167-169. Corvallis, Oreg.

Silvicultural description of red alder. Advice and solutions to problems encountered by small woodlot owners dealing with any Northwest species. (CFH)

433. Oregon State University, Cooperative Extension Service.
1969. Red alder (Alnus rubra), In Woodland handbook for the Pacific Northwest, p. 128-130. 2d ed.
Corvallis, Oreg.

Discusses forest management in a style and scale applicable and usable by small woodlot foresters. (CFH)

434. Oregon State University, School of Forestry.
1961. Herbicides and their use in forestry. 122 p. Corvallis, Oreg.

"A symposium held in Corvallis on 7-9 Sept. 1961, at which 15 papers on various aspects of herbicides and their applications in forestry were presented, including: The development and characteristics of herbicides (V. H. Freed) [outlining the scope for their application in brush control in forests, and woody-weed suppression on farms, along highways, etc.]; Chemical selectivity on woody plants (J. H. Rediske); Chemical forms of phenoxy herbicides and their place in brush control (R. H. Schieferstein); Hormone herbicides (P. M. Ritty); Non-hormone types of weed and brush killers (M. C. Swingle); Herbicides in forest management in West Side (U.S.) Forests (P. G. Lauterbach); Soil herbicides in forestry (W. R. Furtick); and The legal responsibilities of herbicide use in forestry (S. W. Turner) [discussing ways in which those applying herbicides (and pesticides) may best protect themselves against the contingencies of litigation and adverse financial judgements, by insurance and by adequate assessment of the conditions under which phytotoxic materials can be used with least harm to property]." (FA)

435. Oregonian
1975. Alder cut on Publishers Paper land. Nov. 30, p. C-2, col. 1.

436. Overholser, James L.
1968. Oregon hardwood sawtimber. For. Res. Lab. Rep. G-9, 52 p. Oreg. State Univ., Corvallis.

"Western Oregon has extensive stands of native hardwoods of such qualities that they are suitable raw materials for making a wide selection of products. Processors and users of these woods need to know their properties so that the wood from them will provide greatest service.

"Several organizations and many individuals have published valuable information about these woods, but the numerous reports need to be combined for ready access to that information. This report is aimed at providing for that need.

"Several Oregon hardwoods supply logs for a growing industry. A dozen other species, limited in volume or without developed markets, are used little now but may be potentially valuable. Foremost in volume of lumber produced is red alder; second in production is bigleaf maple.

"Information presented here is largely about physical properties of the wood from these trees and about considerations important in their manufacture and use. Economics of the industry are not easily measured, and comments made should be taken as indications, not as definitive statements of fact." (A)

437. Pacific Northwest Forest and Range Experiment Station.
1953. Volume tables for permanent sample plots as recommended by the Puget Sound Research Center Advisory Committee for use in western Washington. 30 p. Portland, Oreg.

"The tables comprise: (1) 'recommended' tables considered suitable for use in the area and containing data on cubic volume

for entire stem and merchantable stem, and board ft. volume by the International and Scribner rules for Pseudotsuga taxofolia, Tsuga heterophylla, Picea sitchensis, Abies amabilis, and Alnus rubra; and (2) 'interim' tables, constructed from data outside the Puget Sound area and suitable for use until improved tables are available, giving similar information for Thuja plicata, Pinus contorta var. latifolia, Populus trichocarpa and Acer macrophyllum." (FA)

438. Pacific Northwest Forest and Range Experiment Station.
1957. Seasonal stem growth at McCleary forest. In Annual report 1956, p. 32-33. Portland, Oreg.

"Three years' records of radial increment indicated that stem growth of Red Alder, Western Red Cedar and Douglas Fir begins in the first week of May and ends in late September or early October, later for Douglas Fir than for the other two species. Increment was appreciably less in 1956 than in 1954–55, presumably because of the cold weather in Nov. 1955." (FA)

439. Pacific Northwest Forest and Range Experiment Station.
1959. Pruning and epicormic branching in red alder. In Annual report 1958, p. 15-17. Portland, Oreg.

"Dissection of trunks of Alnus rubra pruned 20 years earlier at 21 years of age, showed that pruning scars had healed rapidly, but that development of epicormics seriously hindered the formation of clear wood. Bud strands, originating in the leaf axils, were apparently stimulated by the pruning." (FA)

440. Pacific Northwest Forest and Range Experiment Station,
1861. Red alder and soil nitrogen. In Annual report 1960, p. 66-67. Portland, Oreg.

"Soil from under a mixed 30-year stand of Douglas Fir and Red Alder (a) was compared with that from a neighbouring pure Douglas Fir plantation of the same age, and several important differences were revealed. (1) N content of the top 12 in. of soil under (a) was 50% greater than under (b). (2) Organic-matter content in the top 6 in. was significantly greater under (a). (3) The top 36 in. of soil under (a) contained 1665 lb. more N per acre than that under (b); this represents an average annual accumulation of 64 lb./acre attributable to the Alder." (FA)

441. Pacific Northwest Forest and Range Experiment Station.
1965. Marketing young-growth timber from Tillamook County, Oregon.
32 p. U.S. Dep. Inter., Bur. Land Manage., Portland, Oreg.

Red alder is discussed as the principal hardwood species consumed by three mills in Tillamook County, Oregon, in 1962. (CFH)

442. Panshin, A. J., Carl de Zeeuw, and H. P. Brown.
1964. Textbook of wood technology: Volume 1--Structure, identification, uses, and properties of the commercial woods of the United States. 2d ed. ***643*** p. McGraw-Hill Book Co.: New York, San Francisco, Toronto, London.

Discusses tree growth and wood structure, the woody plant cell, the physical nature of wood, and the variability of wood within a species. Keys for the identification of commercial woods are given. Contains extensive tables on wood properties. (CFH)

443. Partridge, A. D., and F. D. Johnson.
1964. New records of forest fungi in Idaho. Northwest Sci. 38(4):134-137.

"Includes Poria obliqua on living Alnus rubra, a new host record for the western U.S.A." (FA)

444. Paul, B. H.
1962. Choose the right wood. Properties and uses of some western hardwoods. Woodworking Dig. 64(3)47-49.

"Tabulates the main sources, properties (i.e., sp. gr., modulus of rupture, hardness), and common and special uses of the following western U.S. hardwoods: Alnus rubra, Fraxinum oregona, Populus tremuloides, P. trichocarpa, Castanopsis chrysophylla, Cornus nuttallii, Umbellularia californica, Arbutus menziesii, Acer macrophyllum, Quercus kelloggii, Q. lobata, Q. gerrayana and Lithocarpus densiflorus." (FA)

445. Peace, T. R.
1962. Pathology of trees and shrubs with special reference to Britain. ***753*** p. Clarendon Press, Oxford, Engl.

The book is divided into two main parts: **(1)** diseases caused by nonliving and living agencies, with a breakdown into nursery diseases, root diseases, and stem, leaf, and shoot diseases; ***(2)*** descriptions of problems on important trees, groups of trees, or shrubs. Primary emphasis is on trees native to or introduced into Europe. (CFH)

446. Pechanec, Anna A., and Jerry F. Franklin.
1968. Comparison of vegetation in adjacent alder, conifer, and mixed alder-conifer communities. II. Epiphytic, epixylic, and epilithic cryptogams. **In** Biology of alder, p. ***85-98.*** J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Epiphytic and epixylic cryptogams were compared in adjacent red alder, conifer, and mixed alder-conifer communities. Twenty-four epiphytic species were encountered. Red alder was a more favorable host than Douglas-fir or Sitka spruce in terms of number of epiphytic cryptogams and their frequency and coverage. Mosses were represented best on tree bases; liverworts, on midportions of tree trunks; and lichens, on upper trunks and in crowns. Thirteen species of epixylic cryptogams were encountered during sampling of rotten logs." (A)

447. Peters, C. C., and J. F. Lutz.
1966. Some machining properties of two wood species grown in Hawaii--molucca albizzia and nepal alder. USDA For. Serv. Res. Note FPL-0117, 10 p. For. Prod. Lab., Madison, Wis.

"Presents results of studies on the machining properties of Hawaiian-grown Albizzia falcata and Alnus nepalensis, showing that they are similar to those of several U.S. hardwoods (e.g., Alnus rubra, Liriodendron tulipfera etc.). If available with straight grain, the wood should be suitable for core stock." (FA)

448. Pfeiffer, J. R.
1953. Basic data for Oregon hardwoods. Oreg. For. Prod. Lab. Rep. G-1, 40 p. Corvallis, Oreg.

449. Pfeiffer, J. R.
1953. Western hardwoods---a promising industry. Natl. Hardwood Hag., March 27(2):43-45, 51.

450. Pfeiffer, J. R.
1956. The case for northwest hardwoods. Pac. Coast Hardwoods, March, p. 10-11. Northwest Hardwoods Assoc., Seattle, Wash.

"The purpose of this paper is to project into the future from information now known about Northwest hardwoods and to attempt to show why we should give more serious consideration to them, both from the standpoint of conservation of a natural resource and from the standpoint of their possible economic contribution to the region." (A)

451. Pfeiffer, J. R., and A. C. Wollin.
1954. Red alder log and lumber grading. Oreg. For. Prod. Lab. Rep. G-3, 7 p. Oreg. State Univ., Corvallis.

"Results of trials on 472 eight-foot logs of Alnus rubra showed that the log-grading rules of the U.S. Forest Products Laboratory are suitable with minor modifications, that the lumber-grading rules of the National Hardwood Lumer Association are applicable to the lumber, and that the lumber-grade recovery from logs is comparable to that from many eastern hardwoods." (FA)

452. Pfeiffer, Jack R.
1957. General description, sources, uses, and availability of major species of Pacific coast hardwoods. Pac. Coast Hardwoods, Jan 1, p. 6-7. Northwest Hardwoods Assoc., Seattle, Wash.

Describes wood properties of eight western hardwood species. Compares various strength properties of 18 other species with those of alder when alder properties are set at a base of 100 percent. (CFH)

453. Piper, Charles V.
1906. Flora of the State of Washington. Volume XI of Contributions from the United States National Herbarium. 637 p. Gov. Print. Off., Washington, D.C.

Red alder is identified as Alnus oregona. (CFH)

454. Piper, Charles V., and R. Kent Beattie.
1915. Flora of the Northwest coast. 418 p. New Era Print. Co., Lancaster, Pa.

Red alder is identified as Alnus oregona. (CFH)

455. Plank, Marlin E.
1971. Red alder. USDA For. Serv. Am. Woods 215, 7 p. Washington, D.C.

456. Platz, Bob J., Ed.
1972. Washington's hardwood resources and markets. State Wash. Dep. Nat. Resour. DNR Rep. 23, 144 p. Olympia.

A collection of three discussions of the hardwoods of Washington. The western Washington resource report presents hardwood statistics as of the mid-1960's with future yield projections. Evaluations of domestic and Pacific rim export markets are covered in separate sections. (CFH)

457. Playfair, L., Ed.
1956. Control of woody plants. Res. Rep. West. Sect. Natl. Weed Comm. Can. 1956:81-82.

"Monuron at 3 oz./100 sq. ft. and concentrated Borascu (89% anhydrous borax) at 9 lb./100 sq. ft. were applied to woody growth along a fence-line (chiefly Rose [Rosa sp.] and Snowberry [Symphoricarpos sp.]) after the vegetation had been cut to within 3 in. of ground level. Observations up to 18 months later showed Borascu to be much more effective on woody growth than monuron; the reverse was the case for herbaceous growth. 2,4,5-T with or without 2,4-D was applied to fence-row areas as follows: (1) 1.5 lb./acre 2,4-D plus 2 lb./acre 3,4,5-T (butoxy ethanol esters); (2) 2 lb. 2,4-D plus 1 lb. 2,4,5-T (butoxy ethanol esters); (3) 4 lb. 2,4,5-T; (4) 6 lb. 2,4,5-T. (1) and (2) were applied to an area containing Alder (Alnus spp.), Silver Poplar (Populus sp.), Blackberry (Rubus laciniatus and R. procerus) and Hawthorn (Crataegus sp.); (3) and (4) were applied to areas containing Hardhack (Spiraea sp.), Blackberry and Alder. Treatment of (1) sporadic control; (2) excellent control of all species except Hawthorn; (3) and (4) excellent control of Blackberry but very little control of Spiraea sp. 2,4,6-TBA was applied at 2 and 4 lb./acre (1) in 15 and 30 gal. water as a foliage spray and (2) in 15 gal. diesel fuel oil as a dormant overall spray. Effects were very slow to appear; after about 15 months White Poplar (Populus sp.), Ash (Fraxinum sp.), Hawthorn (Crataegus sp.), Willows (Salix sp.) and Wild Rose (Rosa sp.) were dead from treatment (1) Burr Oak (Quercus macrocarpa) developed some deformed leaves and other Quercus spp. were dying. Hazel (Corylus sp.) showed regrowth from roots; Dogwood (Cornus sp.) showed only slight effects. After 12 months, more or less similar results were showing on the same species from treatment (2)." (FA)

458. Pomeroy, K. B., and Dorothy Dixon.
1966. These are the champs. Am. For 75(2):14-35.

Largest known red alder to date is 13 feet 6 inches in circumference at breast height. It is 92 feet tall, with a spread of 54 feet. It is growing in Polk County, Oregon. (CFH)

459. Ponce, Stanley L.
1974. The biochemical oxygen demand of finely divided logging debris in stream water. Water Resour. Res. 10(5):983-988.

"Describes a laboratory study, using water from a typical stream in the Oregon Coast Range, to discover the effect of Pseudotsuxa menziesii needles and twigs, Tsuga heterophylla needles, and Alnus rubra leaves on dissolved 02 and thus on the quality of the stream water. The chemical 02 demand (COD) required for total oxidation of the plant material, and the biochemical oxygen demand (BOD, i.e. the amount of 02 required by micro-organisms to decompose the material) and the rate at which 02 was used, were quantified over a 90-day period. The data on 02 depletion obtained in the study may be of use in devloping a predictive model for water quality management on forested lands." (FA)

460. Ponce, Stanley L., and George W. Brown.
1974. Demand for dissolved oxygen exerted by finely divided logging debris in streams. Oreg. State Univ. Sch. For. Res. Pap. 19, 10 p. Corvallis.

"Reports a laboratory study to determine the effect of Pseudotsuxa menziesii needles and twigs, Tsuga heterophylla needles and Alnus rubra leaves on dissolved oxygen and the amount of toxins in water from a forest stream. After 90 days at 20 deg C the biological oxygen demand (BOD) of P. menziesii was 115 mg/g dry weight, of T. heterophylla 164 mg/g and of A. rubra 287 mg/g. After 45 days the BOD for each species was 90% of the value of 90 days. Under fluctuating temperatures the BOD of A. rubra leaves after 5 days was 23.7% of their initial dry weight. The toxicity of the leachate to fish was negligible. BOD curves for each species are presented and the different reaction rates are discussed.'* (FA)

461. Porter, Dennis R., and Harry V. Wiant, Jr.
1965. Site index equations for tanoak, Pacific madrone, and red alder in the redwood region of Hwnboldt County, California. J. For. 63(4):286-287.

"Original equations for predicting the site index for tanoak and Pacific madrone are presented. The site-index equation for red alder in Humboldt County, Calif., is very similar to one previously reported for the stands in western Washingtn." (A)

462. Pouques, M. L. de.
1949. Éstudes caryologiques sur les Fagales. I. Le genre Alnus. [Studies of cell nuclei in the Fagales. I. The genus Alnus.) Bull. du Mus. Natl. d'Hist. Nat., Paris (Ser. 2) 21, p. 147-152.

463. Preston, R. J.
1948. North American trees. 371 p. Iowa State Coll. Press, hes.

464. Pulp and Paper Magazine.
1956. New kind of wood plant in far west. Pulp and Paper **30(1):100,** 101, **104.**

This plant is designed to handle and process short, 8-foot alder logs between **6** and 20 inches in diameter. Bark is mechanically removed by nine debarkers before logs are chipped. (CFH)

465. Quick, Robert **H.**
1957. Neutral sulfite semichemical pulping of alder. For. Prod. J. **7(7):246–247.**

"Describes the method now being used by the Weyerhaeuser Timber Company for pulping Red Alder. The pulp is used for making corrugated paper." (FA)

466. Radwan, M. A.
1969. Chemical composition of the sapwood of four tree species in relation to feeding by the black bear. For. Sci. **15(1):11–16.**

"The contents of sugars, N, P, Ca, Mg, Fe, and Mn, and the kinds of sugars and soluble N compounds, in the sapwood of 20- to 30-year Pseudotsuga menziesii, Tsuga heterophylla, Thuja plicata, and Alnus rubra were determined on two areas in western Washington, one of which showed considerable, and the other little, damage to trees by Euarctos americanus. Although on both areas there were significant differences among species in contents and kinds of some chemical constituents, total sugars and ash were the only components apparently related to feeding preferences by bears. Within species there were, however, only minor differences between the two areas. It is concluded that chemical analysis is insufficient to explain the problem of feeding by bears on the sapwood of trees." (FA)

467. Radwan, M. A., and G. L. Crouch.
1974. Plant characteristics related to feeding preference by black-tailed deer. J. Wildl. Manage. **38(1):32–41.**

"Presents data on the chemical composition and fermentability of six preferred food plants of Odocoileus hemionus columbianus, viz. Rhamnus purshiana, Vaccinium parvifolium, Pseudotsuga menziesii, Corylus californica, Alnus rubra and Acer circinatum. Differences between the species could not be related to the order of preference as food." (FA)

468. Rahmad, Abuhamed Mohamed.
1964. A study of the movement of elements from tree crowns by natural litterfall, stem flow, and leaf wash. M.F. thesis. Coll. For. Resour., Univ. Wash., Seattle. 118 p.

469. Randall, Robert M.
1978. Techniques and costs of converting hardwood stands to conifers. In Utilization and management of alder, p. 353-363. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The occupation by hardwoods and brush of large areas of the most highly productive coniferous timber growing sites is a vexing problem for foresters in the Douglas-fir region. In general, management of red alder is at the center of this problem. In general, management decisions have tended to favor removing hardwood-brush types and replacing them with conifer stocking.

"Considerable work has been carried out in converting hardwood-brush sites to coniferous timber types. The major portion of this work has been done on industry lands in Washington. Several conversion techniques have been employed with varying degrees of success. Techniques used include harvesting, scarification, chemical spraying, and burning. A study of the costs and successes of applying these techniques shows that, while conversion projects are expensive, they are generally financially feasible if adequate stocking is obtained the first time. It is when the conversion process must be repeated that financial feasibility is in question." (A)

470. Ray, Winfield W.
1940. A new species of Taphrina on alder. Mycologia 32(2):155-158.

"A new species, Taphrina macrophylla, is described from leaves of Alnus rubra in California. The young leaves become greatly enlarged, curled, and distorted, with a decided purple colour. After the ascospores are shed the leaves shrivel and fall, and a new crop of healthy leaves is produced." (FA)

471. Record, Samuel J., and Robert W. Hess.
1943. Timbers of the New World. Use and abuse of America's natural resources. 640 p. Arno Press, New York,

The characteristics of wood by family and genus are botanically described. Important species, including red alder, are discussed further. (CFH)

472. Rediske, J. H., and George R. Staebler.
1962. Herbicidal selectivity of chlorophenoxybutyrics on Douglas-fir. For. Sci. 8(4):353-359.

"Pot and nursery trials of formulations of 2,4-D, 2,4-DB, 2,4,5-T, and 2,4,5-TB were followed by helicopter spraying with 2,4-DB triethyl amine and 2,4,5-TB butoxy ethanol ester, each at 4 lb. active principle/10 gal. carrier/acre, producing actual doses of 2.1-3.6 lb./acre (considered too light). Species treated were the two most responsible for excluding Douglas Fir regeneration, i.e. (a) Alnus rubra (100), and (b) Acer circinatum (94), as well as (c) Douglas Fir (0), (d) Abies grandis (60), and (e) Populus trichocarpa (9). In the aerial spraying, both salts considerably reduced the canopies of (a) and (b) without damaging the Douglas, but the 2,4,5-TB salt showed the greater selectivity, the figures in brackets being the % of crown kill achieved in the nursery tests. Its mild effects on the Poplar should be useful in weeding stands of this species." (FA)

473. Rediske, John H.
1961. Chemical selectivity in woody plants. Hormolog, Ambler, Pa. 3(2):7-9.

"Experiments were undertaken at the Weyerhaeuser Forestry Research Centre to investigate the selectivity of weed-killers. Results are tabulated, giving comparative effects of different preparations on the following species: Pinus ponderosa, Picea sitchensis, Pseudotsuga taxifolia, Tsuga heterophylla, Abies grandis, Populus trichocarpa, Alnus rubra, Salix sp., Acer macrophyllum, A. circinatum and Rubus spectabilis. (1) 2,4-D, 2,4-DB, 2,4,5-T and 2,4,5-TB triethylamine salts and butoxyethanol esters as foliage sprays: in general 2,4,5-TB gave a greater margin of differential toxicity between conifers and deciduous species (P. trichocarpa excepted) than did 2,4-DB. (2) 2,4,5-T emulsifiable acid, triethylamine and dodecylamine salts and butoxyethanol ester as foliage sprays: the dodecylamine salt had a greater effect on A. circinatum than on Douglas Fir, whereas the triethylamine salt was equally effective on both. On Sitka Spruce, however, the triethylamine salt had no toxic effect, whereas the deciduous brush species were all to some degree susceptible. (3) 2,4,5-T acid in water as foliage and dormant-season sprays: most of the conifers proved highly resistant to the dormant-season sprays, e.g. on Grand Fir they had no obvious effect, whereas growing-season sprays gave 100% kill. (4) 2,4,5-T acid in toxic or non-toxic oil as dormant-season sprays: in general, conifers sustained less damage from applications in non-toxic oil. (5) Triethylamine salts of (a) 2,4-D, (b) 2,4,-DP and (c) 2,4-DB applied in water as foliage sprays: Douglas Fir was unaffected by (c), whereas similar concentrations of (a) and (b) gave 99% kill. On Sitka spruce, (a) had no effect, (c) gave 30% kill. On P. trichocarpa, (a) gave 100% kill and (c) only 2%. (6) Triethylamine salts of 2,4-D, MCPA and 2-chloro-4-fluorophenoxyacetic acid (2-Cl, 4-F); 2,4-D triethylamine was more toxic to Ponderosa Pine than the 2-Cl, 4-F, while for Sitka Spruce the reverse was true." (FA)

474. Rehder, Alfred.
1911-18. The Bradley bibliography. A guide to the literature of the woody plants of the world., published before the beginning of the twentieth century. Compiled at the Arnold Arboretum of Harvard University under the direction of Charles Sprague Sargent. Vol. 1, 1911, 566 p.; vol. 2, 1912, 926 p.; vol 3, 1915, 806 p.; vol 4, 1914, 589 p.; vol 5, 1918, 1,008 p. Riverside Press, Cambridge.

475. Rehder, Alfred.
1949. Bibliography of cultivated trees and shrubs hardy in the cooler temperate regions of the northern hemisphere. p. 101, 104. Arnold Arbor. Harvard Univ., Jamaica Plain, Mass.

"... gives references to the sources of the botanical names, valid names, and synonyms of woody plants cultivated in the cooler regions of the temperate zone of the Northern Hemisphere. ..." (A)

476. Rehder, Alfred.
1958. Manual of cultivated trees and shrubs hardy in North America exclusive of the subtropical and warmer temperature regions. 2d ed. 996 p. MacMillan Co., New York.

477. Rehill, P. S.
1968. Stimulation of Armillaria mellea rhizomorphs with alder extracts. Bi-mon. Res. Notes 24(4):34. Ottawa.

"Raabe reported that the rhizomorph production of A. mellea was stimulated by extracts from a number of wood species. Weinhold later suggested that the stimulatory substance was indole-3-acetic acid. The present paper reports stimulation by hot-water extract of Alnus rubra to a much greater degree than that obtained by IAA or ethanol." (FA)

478. Reichard, T. A.
1974. Barred owl sightings in Washington. West. Birds 5(4):138-140.

479. Remington, Rod L.
1978. Alder--should we chip it or saw it? In Utilization and management of alder, p. 103-109. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"It has been stated that the manufacture of red alder lumber is a small mill product; however, Northwest Hardwoods, Inc. has taken giant strides toward changing that image. Quality control and lumber sense are the key words that describe our operations goals. From expanded log consumption, constant machinery and process updating, to satisfied customers Northwest Hardwoods, Inc'. has taken the Mom & Pop approach out of manufacturing alder." (A)

480. Reukema, Donald L.
1965. Seasonal progress of radial growth of Douglas-fir, western redcedar, and red alder. USDA For. Serv. Res. Pap. PNW-26, 14 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Measurements of radial growth during 5 growing seasons in western Washington showed that true growth occurred between mid-April and early September with seasonal distribution of growth varying from year to year." (A)

481. Rice, P. R., and D. C. Church.
1974. Taste responses of deer to browse extracts, organic acids, and odors. J. Wildl. Manage. 38(4):830-836.

"Black-tailed deer (Odocoileus hemionus) were offered a choice of water or one water extract of browse plant. Amount drunk varied according to sex and extract concentration, but there was some preference for extracts of bitterbrush (Purshia tridentata), red alder (Alnus rubra), cascara buckthorn (Rhamnus purshiana), Douglas fir (Pseudotsuga menziesii) and western hemlock (Tsuga heterophylla). Males but not females preferred solutions of malic, succinic and citric acids and, to a lesser degree, quinic acid. Smears of butyric acid and of putrefied salmon extract; on the drinking vessels gave mixed responses, with sex differences." (A)

482. Richens, R. H.
1945. Forest tree breeding and genetics. Imp. Agric. Bur. Joint Publ. *8*, *79* p. Oxford, Engl.

Summarizes literature on forest tree breeding in the period 1930-45. Separate accounts of the information pertaining to the genera of *9* gymnosperms and *22* angiosperms. Very extensive bibliography. (CFH)

483. Roberts, A. N., and W. M. Hellenthin.
1959. Effects of sawdust mulches. 11. Horticultural crops. Oreg. Agric. Exp. Stn. Tech. Bull. SO, 34 p. Oreg. State Univ., Corvallis.

"Summarizes experiments over an 8-year period on the effect of Douglas Fir and Alder sawdust, Oak leaves, and straw, used as mulches and soil amendments, on: yield of certain horticultural crops; incidence of red-stele disease of strawberries; and fertilizer requirements (particularly N) as measured by crop response." (FA)

484. Robinson, Dan D.
1948. Utilization of Oregon hardwoods. Oreg. For. Prod. Lab. Inf. Circ. 2, 22 p. Corvallis, Oreg.

485. Rodriguez-Barrueco, *C.*
1968. The occurrence of nitrogen-fixing root nodules on non-leguminous plants. Bot. J. Linn. Soc. 62(1):77-84.

"At present it is ,known that some 13 genera of non-leguminous Angiosperms include at least some species which bear root nodules with the property of nitrogen fixation. Alnus is the best known example. To assist in the assessment of the ecological importance of these plants, the author has surveyed the relevant literature to discover how many species in each of the genera have been recorded to bear nodules. He also provides evidence of this feature in several species not hitherto reported. Of an estimated total complement of *342* species in the 13 genera, 118 species have so far been recorded to bear nodules. The remaining species do not appear to have been examined for the presence of nodules." (A)

486. Rodriguez-Barrueco, *C.*
1970. [Studies on cross inoculations between N-fixing species of the genus Alnus.] An. Edafol. Agrobiol. 29(1/2):87-97.

"A suspension of triturated nodules was used for cross-inoculation of plants grown in a sterile medium. A. glutinosa (a), A. cordata (b) and A. incana (c) formed nodules rapidly after inoculation with suspensions from (a). Nodulation was slower with suspensions from A. rubra (an American species), and the inoculated plants generally showed inferior growth to those inoculated with (a). N fixation by plants inoculated with A. rubra suspensions, expressed in % of that fixed by the same species inoculated with (a) was: (a) *32*, (b) *6*, and (c) 19. There seems, therefore, to be a certain degree of inconpatability between the nodule-forming organisms of the American species and the European Alder, though, after a period of adaptation, the nodules thus formed were able to fix N efficiently." (FA)

487. Rodriguez-Barrueco, C., and G. Bond.
1968. Nodule endophytes in the genus Alnus. In Biology of alder, p. 185-192. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. H. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The Alnus elutinosa endophyte symbiosed satisfactorily with two other European alders (A. cordata and A. incana), but the A. rubra endophyte performed less satisfactorily on the European host species, mainly because of a delay in nodule formation. This provides further evidence that the endophytes of Alnus species from different geographical regions may not be identical. This regional specialization is particularly likely in such a widely dispersed genus as Alnus." (A)

488. Rogers, Jack D.
1968. Hypoxylon fuscum: A review of the fungus and its relationship with Alnus in the Northwest. In Biology of alder, p. 251-258. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Hypoxylon fuscum is a widely distributed inhabitant of Alnus species and other betulaceous species throughout the North Temperate Zone. The fungus causes a rapid white-type rot of wood of dead or dying Alnus plants. It probably is a weak parasite, possibly contributing to killing of trees. The morphology and development of the fungus and known aspects of its relationship to Alnus tenuifolia are discussed." (A)

489. Roof, James.
1951. Growing California's four alders. J. Calif. Hort. Soc. 12(4):167-173.

"The 4 California alders, in order of size Alnus rubra, A. rhombifolia, A. tenuifolia, and A. viridis var. sinuata, are each considered in detail, both as to their behavior in the wild and in cultivation. In full sun with abundant water throughout the year red alder 10 yrs. old may be 40 ft. in ht. and 7 in. in diam. 4 ft. above the ground. It thrives under lawn conditions. White alder, A. rhombifolia, grows in cultivation 3 ft. a yr. after the 1st 3 yrs. It may be grown under the same conditions as red alder except that it will not tolerate saline conditions. Red alder will grow in sandy soil in protected places near the sea; white alder probably will not. Fresh seed should be sown in Aug. or for white alder until Oct. Germination is 55 to 60%. Seedlings in cans should be watered almost daily and planted out after a ys. Young transplants can be moved at any time except in summer. Mountain alder, A. tenuifolia, when planted as a lawn tree, will reach a mature ht. of 16 ft. in 7 yrs. Then it will grow no higher but begins to add main trunks that grow from the base of the tree; these are not suckers or runners. Although a native of the mountains, it thrives in the bay region. The coastal form of the Sitka alder is expected to be an attractive small yard tree for the San Francisco fog belt. Germination of fresh seed of mountain alder is 48%, of coastal Sitka alder 352. Seedlings should be held in cans for 2 yrs. Mountain alder should be watered only at the base after the 1st 3 yrs. as excessive water will turn the leaves prematurely rusty in summer. Overhead sprinkling keeps Sitka alder fresh and clean-looking. All the alders need full sun. The alders are recommended for home landscaping." (BA)

490. Ross, Herbert H.
1932. Records of additional European sawflies in America and descriptions of new varieties of North American species. Can. Entomol. 64(11):247-251.

"The 4 following spp. are recent introductions from Europe: Hemichroa crocea Geof. (= H. washingtonia Rohw. & Middl.), on Alnus rubra, in Washington and Brit. Columbia; Selandria stramineipes Klug (= S. urbia Ross), on Pteris aquilina in Brit. Columbia; Tomostethus luteiventris, new to Brit. Columbia, on snow, 4700 ft., descr. of ♀; T. ephippium Panser (= Selandria inhabilis Norton), new to Brit. Columbia; Monosoma inferentia v. andronosa ♀ (p. 249), Ontario; Strongylogaster annulosus v. cingulerscens (p. 259), Michigan (type), Ontario, New York, Illinois, and Indiana; Crabro americana v. rubrosa ♂ (p. 259), Michigan (type), Illinois, New York, S. Dakota, Manitoba, Ontario, Quebec." (BA)

491. Roy, Douglass F.
1962. California hardwoods: Management practices and problems. J. For. 60(3):184-186.

"Briefly considers 14 species of potential commercial value, in the categories (1) stream-side, bottomland or moist-site hardwoods (Alnus rubra, in particular), (2) non-manageable hardwoods, and (3) potentially manageable hardwoods (Lithocarpus densiflorus and guercus kelloggii)." (FA)

492. Rubin, A., and B. P. Beirne.
1975. Natural enemies of the European fruit lecanium, Lecanium tiliae (Homoptera:Coccidae), in British Columbia. Can. Entomol. 107(4):337-342.

"Reports a survey of the predators and parasites of L. tiliae, based on 241 collections of infested branches and leaves of Broadleaf Maple (Acer macrophyllum), Horse Chestnut (Aesculus hippocastanum), Black Cherry (Prunus serotina), Japanese Plum, Hawthorn (Crataegus sp.) and Red Alder (Alnus rubra) on which there were 50 022 scales. Three species of parasites, 18 predators and a fungus were found. Unsuccessful attempts at biological control are briefly described." (FA)

493. Russell, Sterling A., Harold J. Evans, and Patricia Hayeux.
1968. The effect of cobalt and certain other trace metals on the growth and vitamin B_{12} content of Alnus rubra. In Biology of alder, p. 259-271. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"An investigation has been made of the effects of increasing concentrations of Ni, Fe, and Mn on the growth and the chlorophyll, N, vitamin B_{12}, and Co contents of Alnus rubra in the presence and absence of 50 ppm Co in the nutrient medium. The effects of the Mn, Fe, and Ni on growth,, both in the presence and absence of Co, were not statistically significant. At the first harvest (144 days after being placed in culture), the effects of the Co treatment on dry and

fresh weights of plant tops, on the chlorophyll content of leaves, and the N content of tops were highly significant. However, at the final harvest (after 213 days in culture), the plants apparently had obtained sufficient Co from contaminating sources to satisfy most of their requirements; th'us, no appreciable responses to Co addition were apparent.

"The effects of the heavy metal additions on the vitamin B_{12} content of nodules were striking and statistically significant. From the B_{12} analyses, it appeared that increasing concentrations of Ni, Fe, or Mn resulted in marked decreases in the biosynthesis of vitamin B_{12} in nodules. This was most pronounced where *0.05* ppm of Co was added to the nutrient solution and where the lowest increments of Ni, Fe, or Mn were added. The highest concentrations of these trace elements (Ni, Fe, and Mn) were associated with an increase in the B_{12} content of nodules. This increase was attributed to Co impurities in Ni, Fe, and Mn salts. In general, the effects of increasing concentrations of Ni, Fe, and Mn in nutrient solutions on Co uptake by'alder tissues were similar in trends to those exhibited by effects of added metals on the B_{12} content. It is concluded that excessive Ni, Fe, and Mn may competitively interfere with the incorporation of Co into B_{12} compounds." (A)

494. Ruth, Robert H.
1968. First-season growth of red alder seedlings under gradients in solar radiation. In Biology of alder, p. 99-105. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Red alder (Alnus rubra Bong.) seedlings were grown on mineral soil near the Oregon coast under a conifer stand thinned to provide gradients in canopy density. First-season survival was one seedling per 31 viable seeds sown, indicating a low efficiency for alder establishment compared with conifers under similar conditions. Only a small part of variation in growth was associated with radiation reaching the forest floor." (A)

495. Ruth, Robert H.
1970. Effect of shade on germina-. tion and growth of salmonberry. USDA For. Serv. Res. Pap. PNW-96, 10 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Thinning the forest overstory stimulated germination of viable salmonberry seed apparently present in the forest topsoil." (A)

496. Ruth, Robert H., and Carl M. Berntsen.
1956. Chemical basal treatment to control red alder. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Note 128, 6 p. Portland, Oreg.

"Stems of trees in a 6-year stand were sprayed with a 4 or 8% concentration of 2,4,5-T in diesel oil or 2,4,5-T plus 2,4-D to a height of 12 in. for trees <3 in. dim. and to a height equal to 4 times the diameter for larger trees. Equipment is illustrated. After 15-17 months 96% of the treated trees were dead and the remaining 4% were largely defoliated. Costs for the 8% 2,4,5-T were $0-44/tree, and 90 trees were treated per man-hour." (FA)

497. Ruth, Robert Harvey.
1967. Differential effect of solar radiation on seedling establishment under a forest stand. Ph. D. thesis. Oreg. State Univ., Corvallis. 176 p.

"In the main study, on the Oregon coast, scarified plots were established under a 118-year mixed conifer stand thinned to provide a range of canopy densities, and the establishment and growth of seedlings of Picea sitchensis, Tsuga heterophylla, Pseudotsuga menziesii and Alnus rubra, from natural seedfall or from sowing, were measured and related to solar radiation. The conifers all became established on mineral soil more readily than A. rubra. The intensity of solar radiation (ranging from <10 to nearly 70% of that in the open) had little effect on establishment, but growth in the first season of P. menziesii increased with radiation, and that of the other three species increased with radiation to an optimum, varying with the species from 39 to 50% of that in the open, and then declined; this decline appeared to be related to high soil moisture tension." (FA)

498. Rymer, K. W.
1951. Red alder in British Columbia. For. Prod. Lab. Div. Bull. 98, 19 p. For. Branch, Can. Dep. Resour. and Dev., Ottawa.

"Red alder is one of the most important hardwoods in British Columbia. It is found in the coastal regions of the province and extends northward into Alaska and southward to California. It occurs in small pure stands and also in association with other hardwoods and softwoods. The tree matures in 50 to 60 years and may reach a diameter of 20 inches. Present silvicultural experiments suggest that a growing cycle of 30 to 40 years is economically feasible.

"The wood varies in colour from pale yellow to light brown, is moderate in hardness, and moderately light in weight. It is not a strong wood and should not be used where it will be subject to severe stresses. Its chief use is for furniture manufacture, especially as core stock for overlays of valuable veneers; for "turned" parts; and, in solid form, for chairs and a variety of moderately priced furnishings. Other uses include interior panelling, fuel, charcoal, toys and novelties, paper roll plugs, fixtures, and handles. Red alder slabs and edgings are used for fuel, and some sawdust is used in smoke-curing meat and fish.

"Investigations indicate that under managed growth conditions, where a reliable source of supply could be assured, the uses of alder might be extended to include products of both the plywood and pulp industries." (A)

499. Sakai, A., and C. J. Weiser.
1973. Freezing resistance of trees in North America with reference to tree regions. Ecology 54(1):118-126.

"Dormant one-year-old twigs of about 70 tree species were collected during mid-winter from five tree regions in North America (Rocky and Western Mountain, Northern, Pacific Coast, Southeastern Coast, and Central and Eastern Lowlands). The twigs were artifically hardened in a regime of sub-freezing temperatures between -3° C and -10° C for 24 days to induce maximum freezing resistance.

"Four Northern species, Populus tremuloides, Populus balsamifera, Betula papyrifera and Larix laricina had the greatest freezing resistance of the species tested. They resisted freezing to –80° C and even immersion in liquid nitrogen (-196" C) following prefreezing to -15" C. Most of the Northern and Rocky and Western Mountain conifers survived freezing between -60" and –80° C while several species from the Pacific and Southeastern Coast regions, which have relatively mild humid winter climates, were hardy to only about –15° C.

"The ranges of some Pacific Coast species such as Pseudotsuga menziesii, Thuja plicata and Tsuga heterophylla extend into the mountainous inland. Samples collected from inland sites were found to be much hardier than those from the coast. A similar trend was observed in the various collections of Tsuga heterophylla from northern, central, and southern areas along the Pacific Coast.

"Winter minimal temperatures are among the important factors setting the northern boundaries of the natural ranges of many forest tree species. However, Populus deltoides and Salix nigra from locations with temperate or moderate winter climates survived freezing to at least -50" C irrespective of their native habitats. In these species, winter minimal temperatures do not appear to be the principal factor governing geographic distribution." (A)

500. Sander, G. H.
1958. Oregon hardwoods: Management, marketing, manufacture. Oreg. State Univ. Fed. Coop. Ext. Bull. 775, 16 p. Corvallis.

501. Sargent, Charles Sprague.
1890. The silva of North America-- a description of the trees which grow naturally in North America exclusive of Mexico. Vol. 9, p. 73-74. Reprinted in 1947. Peter Smith, New York.

Classical botanical description of red alder under the name Oregon alder, Alnus oregona Nuttall. (CFH)

502. Sawbridge, D. F., and M. A. M. Bell.
1872. Vegetation and soils of shell middens on the coast of British Columbia. Ecology 53(5):840–849.

"Twenty three archaeological midden sites were studied. Alnus, Thuja, Tsuga, and. Pseudotsuga dominant vegetation types were distinguished. Midden soil profiles are described and their physical and chemical properties tabulated. The midden deposits, which were overlain by an organic horizon and, at some sites, mineral horizons, were composed primarily of shell and some ash in black soil. Radiocarbon dating of shell samples indicated ages from 770 to 6250 years B.P. Negative relationships were found between age and exchangeable Ca, Total N and organic C." (SO)

503. Schmitz, John.
1976. Alder: From a "weed" to a valuable species, Crow's For. Prod. Dig. 54(3):26–27.

A brief history of red alder promotion as a hardwood species. Lists several manufacturers using alder and their products. Red alder is promoted under the trade name western alder. (CFH)

504. Schniewind, A. P.
1966. Irregularities of finished surfaces caused by unequal ray shrinkage. For. Prod. J. 16(8):66-67.

"'Grain raising' in table tops of Alnus rubra was found to be related to the low radial shrinkage of ray tissue. Only a very narrow range of fluctuation in m.c. (< ± 3%) could be tolerated without giving rise to noticeable effects." (FA)

505. Schopmeyer, C. S.
1974. Alnus B. Ehrh. Alder. In Seeds of woody plants in the United States, p. 206-211. C. S. Schopmeyer, Tech. Coor. U.S. Dep. Agric. Agric. Handb. 450. Washington, D.C.

Information and data on the seed of alder species growing in the United States. (CFH)

506. Schroeder, Herbert A., and Edward D. Hansen.
1968. Two-stage high-yield sulfite pulping of red alder. Tappi 51(1):1-7.

"Within arbitrarily set limits, two-stage pulping conditions were determined, which produced a high-yield pulp from red alder having the best overall strength properties. Those cooks, consisting of a bisulfite first stage and a slightly alkaline second stage, produced pulps with the highest strength characteristics. These pulps were chemically characterized, with particular attention given the xylan constituent, which was isolated and further analyzed. The major hemicellulose, O-acetyl-(4-O-methylglucurono)-xylan, had most of the acetyl groups removed and the reducing end groups partially oxidized, but the uronic acid groups were completely retained during the pulping process. The cellulose appeared to be retained almost quantitatively and together with a relatively high hemicellulose content, gave a high-yield pulp with desireable properties. The good retention of the carbohydrate material by the pulp can probably be ascribed to the oxidative effect of the first-stage bisulfite liquor, which resulted in protection against alkaline degradation in the second stage of the pulping process. This oxidative protection was shown by the identification of xylonic acid as one of the more important acidic end groups of the xylan retained in the pulp." (A)

507. Schubert, Karel R., and Harold J. Evans.
1976. Hydrogen evolution: A major factor affecting the efficiency of nitrogen fixation in nodulated symbionts. Natl. Acad. Sci. USA Proc. 73(4):1207-1211.

"Nitrogenase-dependent hydrogen evolution from detached legume nodules and from reaction mixtures containing cell-free nitrogenase has been well established, but the overall effect of hydrogen evolution on the efficiency of nitrogen fixation in vivo has not been critically assessed. This paper describes a survey which revealed that hydrogen evolution is a general phenomenon associated with nitrogen fixation by many nodulated nitrogen-fixing symbionts. An evaluation of the magnitude of energy loss in terms of the efficiency of electron transfer to nitrogen, via nitrogenase, in excised nodules suggested that hydrogen production may severely reduce nitrogen fixation in many legumes where photosynthate supply is a factor limiting

fixation. With most symbionts, including soybeans, only 40-60% of the electron flow to nitrogenase was transferred to nitrogen. The remainder was lost through hydrogen evolution. In situ measurements of hydrogen evolution and acetylene reduction by nodulated soybeans confirmed the results obtained with excised nodules. In an atmosphere of air, a major portion of the total electron flux available for the reduction of atmospheric nitrogen by either excised nodules or intact nodulated plants was utilized in the production of hydrogen gas. Some nonleguminous symbionts, such as Alnus rubra, and a few legumes (i.e., Vigna sinensis) apparently have evolved mechanisms of minimizing net hydrogen production, thus increasing their efficiency of electron transfer to nitrogen. Our results indicate that the extent of hydrogen evolution during nitrogen reduction is a major factor affecting the efficiency of nitrogen fixation by many agronomically important legumes." (BA)

508. Schumann, D. R.
1972. Dimension yields from alder (Alnus rubra) lumber. USDA For. Serv. Res. Pap. FPL-170, 12 p. For. Prod. Lab., Madison, Wis.

"Presents charts for determining yields of dimension stock from the top three grades of A. rubra lumber, and explains their use in yield and cost comparisons to indicate the most economical choice of grade or combination of grades for a specific cutting order." (FA)

509. Schwartz, Sidney L.
1958. Hardboard from red alder and from a mixture of slow-growth southern oaks. U.S. For. Prod. Lab. Rep. 2125, 8 p. Madison, Wis.

"A study (1) to demonstrate the suitability of two widely different classes of hardwood (Red Alder [Alnus rubra] and a mixture of Red and White Oaks [Quercus falcata, Q. coccinea, Q. velutina, Q. stellata, Q. alba and Q. prinus]) for the production of hardboard, and (2) to discover how the degree of hydrolysis influences yield, board strength, and sizing efficiency. The following factors were covered: the effect (i) of the degree of steam cooking on yield and quality of the board stock, (ii) of the amount of alum and of size added to the stock on board quality, and (iii) of pressure on Oak hardboard. From the data obtained on the response of both materials to defibration, pulping and pressing treatments, it was established that for untreated hardboard prepared from both classes, (a) the flexural strength and toughness reach an optimum at the 83-85% yield level; (b) water absorption and thickness and volume-change decrease with yield; and (c) the linear dimensional change, though relatively small, increases with a decrease in yield. As Oak was sensitive to steam cooking it was necessary to defibrate it at 125, and the Alder at 175 lb./sq. in." (FA)

510. Sedell, James R., Frank J. Triska, and Nancy M. Triska.
1975. The processing of conifer and hardwood leaves in two coniferous forest streams: I. Weight loss and associated invertebrates. Verh. Int. Ver. Limnol. 19(3):1617-1627.

Douglas-fir and bigleaf maple leaves decomposed slower than red alder or vine maple leaves in two streams in western Oregon. The differences in breakdown rates between the streams may be explained by the differences in the number of invertebrate colonizers on the leaves. Differences between species are believed to be related to the rate at which they are conditioned by microbes. (CFH)

511. Shaw, Charles Gardner.
1958. Host fungus index for the Pacific Northwest. I. Hosts. Wash. Agric. Exp. Stn. Circ. **335,** **127** p. Pullman.

512. Shaw, Charles Gardner.
1958. Host fungus index for the Pacific Northwest. 11. Fungi. Wash. Agric. Exp. Stn. Circ. **336,** **237** p. Pullman.

513. Shaw, Charles Gardner.
1973. Host fungus index for the Pacific Northwest. I. Hosts. Wash. Agric. Exp. Stn. Bull. **765,** **121** p. Pullman.

Records known occurrences and distributions of parasitic fungi in the Pacific Northwest. Volume I lists host species of vascular plants except Gramineae. Alnus rubra is reported to be attacked by **167** species of fungi. Citations to attacking species are not given but can be supplied by Washington State University on request. (CFH)

514. Shaw, Charles Gardner.
1973. Host fungus index for the Pacific Northwest. II. Fungi. Wash. Agric. Exp. Stn. Bull. **766,** 162 p. Pullman.

Lists by species fungi parasitizing vascular plants in the Pacific Northwest and provides a cross index to the host species listed in volume I (513). At least one literature reference to each fungus genus is included. (CFH)

515. Shelford, J. A., W. D. Kitts, and C. R. Krishnamurti.
1970. Utilization of alder sawdust (Alnus rubra) by ruminants. Can. J. Anim. Sci. 50(1):208-209.

Feeding on sawdust of red alder by cattle was associated with a change in the volatile fatty acid composition of rumen fluids. These changes indicate extensive fermentation of the sawdust by rumen microflora and suggest that sawdust be used as a source of food and energy for the cattle. (CFH)

516. Sheth, K., E. Bianchi, R. Wiedhopf, and J. R. Cole.
1973. Antitumor agents from Alnus oregona (Betulaceae). J. Pharm. Sci. 62(1):139-140.

"The chloroform extract of Alnus oregona showed antitumor activity against the Walker 256 (5WA16) tumor system. Lupeol and betulin were identified as the two constituents responsible for this activity." (BA)

517. Silver, W. S.
1969. Biology and ecology of nitrogen fixation by symbiotic associations of non-leguminous plants. Royal Soc. London Proc. (Ser. B) 172(1029):389-400.

"A literature review, with discussion on c'ytological aspects of nodulation in, and the ecological role of, such nodule-bearing genera as Alnus, Casuarina, Ceanothus, Coriaria, Myrica and Podocarpus." (FA)

518. Silvester, W. B.
1976. Ecological and economic significance of the non-legume symbioses. In Proceedings of the 1st international symposium on nitrogen fixation, Vol. 2, p. 489-506. William E. Newton and C. J. Nyman, eds. Wash. State Univ. Press, Pullman.

All the nonlegume root nodule plants are woody perennial shrubs or small trees. As such, they find little direct use and are not readily adaptable to agricultural use as direct or indirect sources of combined nitrogen. The only really significant contribution is that of red alder. (CFH)

519. Sivak, Bela, and C. O. Person.
1973. The bacterial and fungal flora of the bark, wood, and pith of alder, black cottonwood, maple, and willow. Can. J. Bot. 51(10):1985-1988.

"The occurrence and distribution of symbiotic cauloplane organisms on dormant cuttings of 1- to 2-year-old stems of alder, black cottonwood, maple, and willow were determined from tissue samples removed to 2% malt extract and nutrient broth agars, and from scanning electron micrographs of the bark surface. Fungal and bacterial symbionts were found to be confined to the bark surfaces, where their occurrence was related to the surface topography. Inner bark, wood, and pith were virtually aseptic." (A)

520. Skinner, Edgel C.
1959. Cubic volume tables for red alder and Sitka spruce. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Note 170, 4 p. Portland, Oreg.

**Threetables supplementing or amending those.already published." (FA)

521. Smith, Harvey H.
1956. Improved utilization of western hardwoods by modern drying. For. Prod. J. 6(3):121-124.

"Describes uses and resources (estimated at 23,000 million bd. ft. for the more important species) and discusses both air and kiln drying. Species mentioned are Alnus rubra, Acer macrophyllum, Fraxinus latifolia, Populus trichocarpa, Lithocarpus densiflorus, Umbellularia californica and Quercus kelloggii." (FA)

522. Smith, J. H. G., and D. S. DeBell. **1973.** Opportunities for short rotation culture and complete utilization of seven northwestern tree species. For. Chron. **49(1):31–34.**

"Presents new data for the average height and d.b.h. of well spaced trees of Alnus rubra, Pinus contorta, Populus tremuloides, P. trichocarpa, Pseudotsuga menziesii, Thuja plicata and Tsuga heterophylla in fully stocked young stands (5, 10, and 15 years old) on good sites in southern British Columbia. Data on the above-ground weight distribution of tree components, the green sp. gr. of wood and bark, and the estimation of tree volume are compiled from various sources. Other new data indicate that very high yields of small stemwood (for fibre products) can be obtained on short rotations (8 and 2 years respectively) with dense stands of A. rubra and coppice stands of P. trichocarpa. Some practical problems of this type of management are discussed." (FA)

523. Smith, J. H. G., and D. S. DeBell. **1974.** Some effects of stand density on biomass of red alder. Can. J. For. Res. **4(3):335–340.**

"Stand density (degree of crowding of trees within stocked areas) was studied in relation to formation and yield of juvenile red alder (Alnus rubra Bong.) stands. Large variations in tree size and biomass of fully-stocked stands were associated with differences in stand density. Measurement of density in addition to stocking (the fraction of area occupied by trees) will improve biomass studies. It will also facilitate comparisons of biomass results with existing information from spacing studies and yield tables." (A)

524. Smith, J. H. G., and J. W. Ker. **1957.** Timber volume depends on D^2H. B.C. Lumberman **41(9):28, 30.**

"The values of the constants a and b within given limits of d.b.h. (D) or of the last term, are tabulated for $V = a + b \frac{D^2H}{100}$, where V is volume and H is total height. Species (grouped variously for maturity, d.b.h., and provenance) include Douglas and Balsam Fir, Thuja plicata and Chamaecyparis nootkatensis, Tsuga heterophylla, Sitka and 'interior' Spruce (Picea spp.), Pinus monticola, P. ponderosa and P. contorta, Larix occidentalis, Alder, Birch, Maple, Cottonwood and Aspen, in British Columbia. Another table shows the standard error in % for very tall and very short trees for each species or group." (FA)

525. Smith, J. H. G., and A. Kozak. 1967. Thickness and percentage of bark of the commercial trees of British Columbia. **33** p. Fac. For., Univ. B.C., Vancouver.

"Thickness and percentage of bark at stump, breast height and tenths of total height above breast height were analysed in relation to tree and section characteristics for mature trees in 19 species or species groups. Dbh and bark thickness at breast height are the best indicators of tree bark thickness. Dob at that height is the best indicator of bark thickness at any particular height in a tree. Influences of age, crown class, various crown characteristics, and sapwood thickness also are statistically significant but of lesser importance.

"Data on young trees which have thinner bark than mature trees were summarized for Douglas fir, western hemlock, western red cedar, silver fir, black cottonwood, and red alder. For a given dob, root thickness is less than at the root collar; but similar diameters of root collar, bole, and branch have just about the same thickness of bark." (A)

526. Smith, J. H. G., and A. Kozak.
1971. Thickness, moisture content, and specific gravity of inner and outer bark of some Pacific Northwest trees. For. Prod. J. 21(2):38-40.

"Improved methods involving bark thickness and percentages and corrections for volumes lost in voids are discussed. Tabulated averages and measures of variation in thickness, moisture, and specific gravity provide new data about both inner and outer bark for 19 common tree species of the Pacific Northwest, 13 conifers, and six hardwoods." (A)

527. Smith, J. Harry G.
1957. Forest history from aerial photographs. For. Chron. 33(4):390-392.

"A brief comparison of two series of aerial photographs of a research forest, taken in 1949 and 1955 respectively, illustrating the kind of information to be obtained from such a scrutiny on e.g. the pattern of reproduction, weeds etc." (FA)

528. Smith, J. Harry G.
1964. Root spread can be estimated from crown width of Douglas fir, lodgepole pine, and other British Columbia tree species. For. Chron. 40(4):456-473.

"Root systems of trees blown down by a gale in October 1962 in the U.B.C. Campus forest were excavated and studied. Roots of 90 Douglas Fir, 81 Western Hemlock, 61 Western Red Cedar, and 33 Red Alder trees were mapped and analysed in relation to 18 tree and stand variables. Average and maximum radius of roots of Douglas Fir and Lodgepole Pine were also analysed in relation to crown width, d.b.h., height, age, and other tree and stand characteristics. Ratios of root spread to crown width were influenced by species, stand density, and soil type. Ratios averaged 1.1 for open- and 0.9 for forest-grown Douglas Fir, but were 2.4 for both open- and forest-grown Lodgepole Pine on peat or poorly drained soils." (FA)

529. Smith, J. Harry G.
1968. Growth and yield of red alder in British Columbia. In Biology of alder, p. 273-286. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"A gross volume of 1 billion cubic feet of red alder exists on about 350,000 acres of British Columbia forest land that could produce much higher values if stocked with Douglas-fir or black cottonwood. However, the characteristically rapid juvenile growth of alder from seed, which permits full stocking at

early ages, may prove valuable for management of alder on very short rotations. Data are presented on radial growth and important tree characteristics for open- and forest-grown trees. Regressions of crown width on dbh and a yield table based on these are included. It is shown that crown width and root spread are highly correlated. Several total cubic-foot tree volume equations are given, and it is noted that one of these, V/B = 0.44H, also can be used to estimate growth and yield per acre. Merchantable volume factors and reductions for decay, waste, and breakage are summarized. Distributions of section volumes and diameters inside bark are described by regression equations. Data on bark thickness and percentage are summarized. British Columbia Forest Service normal yield and stand tables for alder and Schon's empirical merchantable yield table, as well as data from University of British Columbia campus and Haney Forests, are used to illustrate the need for early and effective control of spacing." (A)

530. Smith, J. Harry G.
1972. Tree size and yields in juvenile red alder stands. Northwest Sci. Assoc. Annu. Meet. 1972, 35 p. Bellingham, Wash.

"Interest in biomass analysis and in complete stand utilization has focussed attention on species such as red alder, Alnus rubra Bong. that are prolific seeders and abundant on disturbed sites. Information collected since 1967 by a variety of methods has been analysed to describe growth of stands up to 10 years of age. Moisture contents, specific gravity, and fresh and dry-weight components have been determined on 131 young trees. Size, volume, bark characteristics, form, taper, and other elements of growth and yield have been studied on 457 trees including some sprout clumps which have originated following cleaning. Yields measured on small plots and those calculated directly from crown area and other variables indicate potential values from short-rotation management." (A)

531. Smith, J. Harry G.
1974. Biomass of some young red alder stands. Proc. Int. Union For. Res. Organ. Meet., Vancouver Biomass Studies, Coll. Life Sci. and Agric., Univ. Maine, Orono, p. 401-410.

"Moisture contents, specific gravity, and fresh- and dry-weight components have been measured on 131 young red alder trees (Alnus rubra Bong.). Size, volume, bark, form, and taper of 457 red alder trees from 1 to 10 years in age have been analysed intensively by graphical and multiple regression methods. Yields have been determined in a variety of stand conditions ranging from isolated open-grown trees to the densest thickets that could be found as a result of natural seeding on bare ground. Yields from very young stands have been compared with those found in young and mature types on the South Coast of British Columbia. Growth in dense stands has been evaluated on 19 small plots for two years. Biological and managerial implications of both average and maximum yields in biomass and volume are discussed, briefly." (A)

532 Smith, J. Harry G.
1978. Growth and yield of red alder: Effects of spacing and thinning. In Utilization and management of alder, p. 245-263. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"In this paper I review information on the growth and yield of red alder. Recent point sample studies of 131 trees from Point Grey near Vancouver, British Columbia and 116 trees from the University of British Columbia Research Forest near Haney, B.C. are reported to show how trees and stands grow. Host attention is paid to the few studies which have demonstrated how growth of 20-year and older stands can be concentrated on fewer, higher quality stems.

"Because very little is known about potential gains from spacing, planting, or precommercial thinning of red alder in the Pacific Northwest, I summarize data from current studies. Tree ring analyses of disks and cores are used to learn how surviving trees in old stands grew when young. I also discuss problems caused by multiple, missing, and locally absent rings. The critical period of stand establishment and heavy self-thinning is described using data from eight 0.1-acre plots in 8- to 10-year-old stands and from two 0.1-acre plots in 25-year-old stands. The basic units were 0,001-acre plots in which species and d.b.h. of all live and dead trees were recorded. Comparisons are made between several characteristics of mean trees on 0.001-acre plots and the biggest trees on 0.01 acres (top height trees). The 0.001-acre plots are regrouped into various plot sizes and configurations and stand densities measured by numbers of trees, d.b.h., and basal area to show what increases in d.b.h. and height might result from spacing and thinning. I summarize stand density indices and stocking as expressed by crown cover as well as discuss the roles of light-seeking and lean in self-thinning. I give examples of the numbers of years required to grow to breast height and patterns of growth in height and diameter by deciles above breast height and I compare recent annual height growth with growth of branches.

"Premiums for size and quality for well-spaced stands are reviewed in comparison with gains in volume for very dense stands. I conclude that stand managers have many exciting options for improving growth and yield of red alder; but, in order to confirm conclusions drawn tentatively from examination of temporary plots, sustained studies of spacing and precommercial thinning are needed." (A)

533. Smith, J. Harry G., and Robert E. Breadon.
1964. Combined variable equations and volume-basal area ratios for total cubic foot volumes of the commercial trees of B.C. For. Chron. 40(2):258-261.

"Presents revised tables for B.C. and discusses their practical application." (FA)

534. Smith, J. Harry G., and Donald D. Munro.
1965. Point sampling and merchantable volume factors for the commercial trees of British Columbia. Univ. B.C., Fac. For., 39 p. Vancouver, B.C.

"Point-sampling factors (PSF) are stated as volume per square foot of basal area at breast height. They have been calculated here in both cubic and board feet (B.C. Log Rules) for the commercial trees of British Columbia. PSF have been derived from standard volume tables and taper curves prepared by the B.C. Forest Service and have been checked against data from other tables and from samples collected in the field. PSF can be used directly to simplify summary of data collected with the aid of a prism or relascope.

"Merchantable-volume factors (MVF) are stated as ratios of total cubic foot volumes that remain after deductions have been made for standard of utilization expected and for amounts of loss anticipated from decay, waste, and breakage. In addition some approaches to theoretical derivation of MVF are described to provide checks on empirically derived constants.

"PSF and MVF are tabulated to facilitate their use in field or office. Factors that govern tree volume, methods of measuring tree volume, and tests of the various approaches to calculation of PSF and MVF are described briefly." (A)

535. Smith, Nicholas J.
1978. Red alder as a potential source of energy. In Utilization and management of alder, p. 139-155. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The energy plantation is defined and set in the Pacific Northwest energy context. Analyses on naturally established 8- to 10-year-old red alder (Alnus rubra Bong.) at University of British Columbia are used to demonstrate above-ground yields and energy flows. Results show a current net community productivity of 28.5 oven dry metric tonnes/ha per yr (conversion efficiencies of 3-percent visible net radiation), and a mean annual productivity of 9.0 oven dry metric tonnes/ha per yr. Possible sources of fuel by bioconversion are discussed. Fluidized-bed, combined-cycle systems have good prospects for electrical generation. To satisfy British Columbia's (B.C.) 1981 energy needs, at least 1.2×10^7 ha of alder plantations will be needed (12 percent of B.C.). Use will probably continue as domestic fuelwood. A market for supplements to utilities based on coal, mill waste, and forest waste may develop. In the long-term, small energy plantations for local communities in B.C. are envisaged. The term biomass farm is used preferentially since it allows flexible appropriation of yields to a spectrum of potential uses." (A)

536. Smith, R. S., and C. V. Shaman.
1971. Effect of gamma radiation, wet-heat, and ethylene oxide sterilization of wood on its subsequent decay by four wood-destroying fungi. Wood & Fiber 2(4):356-362.

"Sapwood of Alnus rubra and Pinus ponderosa was sterilized by impregnation with ethylene oxide, steaming at 121° C or -radiation at three dosages (2.5×10^6, 5.0×10^6, and 10^7 rad), and then exposed to two brown-rot and two white-rot fungi. Gamma radiation at 2.5×10^6 rad is a suitable alternative to the other methods of sterilization.

A small loss of wood occurs at all three radiation doses. A dosage of 10^7 rad caused a significant increase in decay of both wood species by Poria weirii." (FA)

537. Springer, E. L., F. L. Schmidt, W. C. Feist, L. L. Zoch, Jr., and G. J. Hajny.
1975. Storage of red alder chips with and without bark - treated and untreated. USDA For. Serv. Res. Pap. FPL-261, 9 p. For. Prod. Lab., Madison, Wis.

"Screened chips from unbarked and barked ~~Alnus rubra~~ logs were stored for 6 months in simulators of chip piles. Large losses in wood substances, pulp yield and pulp strength occurred in both types of chips equally; slightly more heat was evolved in barked chips during the last 4 months of storage. Immersion of the chips in 0.1% metham-Na t 0.4% Na 2,4-dinitrophenol before storage was effective in preventing losses." (FA)

538. Springer, Edward L., Fred L. Schmidt,
William C. Feist, Lawrence L. Zoch, Jr., and George J. Hajny.
1975. Recent results in chip storage--comparisons of the storage characteristics of chips produced from barked and unbarked red alder logs, Tappi Annu. Meet. 1975:83-91.

"Chips produced from unbarked (rough) and debarked red alder logs were stored for 6 months in chip pile simulators. Only minor differences were found in the storage characteristics of the untreated chips. During the last 4 months of storage, a little more heat was evolved from the bark-free chips. Large losses in wood substance, pulp yield, and pulp strength were observed; however, they were essentially the same for both types of chips. Treatment of both types of chips by immersion in an aqueous solution of sodium N-methyldithiocarbamate + sodium, 2,4-dinitrophenol very effectively preserved the chips." (A)

539. Staebler, George R.
1960. Basal injection of 2,4,5-T fails to kill red alder and bigleaf maple. For. Res. Note 23, 2 p. Weyerhaeuser Co., Centralia, Wash.

"Trees of 4-26 in. diam. at ground line in S.W. Washington were mostly unharmed by 2,4,5-T in diesel oil, injected with the Little tree injector in incisions 2, 5 and 8 in. apart. Failure to kill was presumably due to failure to get enough chemical into the stem. Trees were successfully killed with a similar chemical squirted into frill girdles." (FA)

540. Stark, Eric W.
1953. Wood anatomy of the Betulaceae indigenous to the United States. Agric. Exp. Stn., Stn. Bull. 602, 31 p. Purdue Univ., Lafayette, Ind.

"Includes keys to photomicrographs for the identification of seven species of Betula, six of Alnus, one of Carpinus, three of Ostrya, and two of Corylus." (FA)

541. Starker, T. J.
1939. A new alder. J. For. 37(5):415-417.

Describes Alnus rubra var. pinnatisecta as a new cut-leaved variety of red alder. (CFH)

542. Steele, Robert W.
1971. Red alder habitats in Clearwater County, Idaho. M.S. thesis. Univ. Idaho, Moscow. 88 p.

"Seral stands of Alnus rubra grow in northern Idaho disjunct from populations west of the Cascade Range. A study of red alder habitats along the north Fork of the Clearwater River revealed other coastal disjunct and endemic species uncommon in the northern Rocky Mountains. Climax stands of Thuja plicata and Tsuga heterophylla in red alder habitat had undescribed understories dominated by ferns. A Dryopteria austriaca - D. filix-mas union and an Adiantum pedatum union were described as new habitat types. Association tables show that certain species appear confined to these two unions while other species common to the Pachistima union appear excluded. Red alder habitats support several species unreported from Clearwater County including Viola sempervirens, a disjunct species unreported from Idaho. Certain other species on or near red alder habitats have consistently abberant morphological and ecological traits which suggest an inclination of these plants to resemble related taxa growing west of the Cascades. "Stands of red alder had understories similar to those in adjacent climax communities. Site indices for red alder ranged from 71 to 104 but averaged only slightly lower than those west of the Cascades." (A)

543. Stenzel, George.
1954. Marketing woodlot products in the State of Washington. Inst. For. Prod. Bull. 15, 56 p. Univ. Wash., Seattle.

Assorted information on wood specifications, potential markets, log scale, and standing volume tables for Pacific Northwest tree species, including red alder. Useful for the small woodlot owner. (CFH)

544. Stettler, R. F., and J. C. Cummings.
1973. A guide to forest-tree collections of known source or parentage in the Western United States and Canada. Results of a preliminary survey. Coniferous For. Biome Bull. 3, 59 p. Coll. For. Resour., Univ. Wash., Seattle.

"This publication reports the results of a preliminary survey listing 527 forest-tree plantations in the western United States and Canada. Of these, 250 involve families of known parentage, 131 provenance-test material, 87 clonal material, and 59 interspecific hybrids. The report is intended (1) to serve forest researchers in locating genetic material relevant to their work, and (2) to facilitate an assessment of regional forest-gene resources. A list of agencies, a species index, a brief discussion of survey results, and recommendations complete the report." (A)

545. Stettler, Reinhard F.
1978. Biological aspects of red alder pertinent to potential breeding programs. In Utilization and management of alder, p. 209-222. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"After a brief introduction to general concepts of genetic improvement, I discuss selected biological factors of red alder (Alnus rubra) affecting the feasibility and direction of potential breeding programs. These factors include the diversity of the genus, the species' life history, growth, reproductive biology, and nitrogen fixation. Because of its early sexual maturity, annual seed crops, and rapid juvenile growth, red alder promises to offer comparatively large genetic gains per unit of time and effort. Three alternative improvement programs with different emphases appear meritorious, i.e., (1) short- rotation fiber production, (2) normal-rotation log production, and (3) nitrogen production. Pending genetic improvement, information is needed on basic genetic parameters and on silvicultural techniques of intensive management." (A)

546. Steucek, G. L., and R. M. Kellogg.
1975. Action potentials in Alnus rubra stem segments in relation to mechanical stress. (Abstr.) Pa. Acad. Sci. Proc. 49(1):93.

"After a 30 second period of mechanical stress, action potentials were recorded from alder (Alnus rubra) stem segments using Ag:AgCl electrodes. Subsequently, electrical stimulation was employed to elicite and characterize these action potentials. Action potentials had a stimulation threshold, a refractory period which illustrated fatigue, and a rest time characteristic of plant cells. These action potentials could not be produced in tissue killed by heat or treated with dinitrophenol. Only when tissue was hyperpolarized did action potentials occur. The ability of stem tissue to generate action potentials varied with the season." (A)

547. Stewart, R. E.
1972. Field screening of granular herbicides on pole-size red alder. West. Soc. Weed Sci. Res. Prog. Rep., p. 19–20.

"In evaluation of granular herbicides for the control of woody and herbaceous weeds in Alnus rubra communities in coastal Oregon and Washington, dicamba at 15 lb/acre and picloram at 5 lb/acre gave complete top kill of Sambucus callicarpa and S. glaucus, while Rubus vitifolius was best controlled with picloram at 15 lb. Picea sitchensis saplings were killed by picloram at 0.5 lb/acre and by dicamba at 5 and 15 lb/acre but proved resistant to karbutilate. Herbaceous ground cover was reduced by ca. 70% with 15 lb/acre of any of the herbicides. March and April appeared to be the best months for application." (FA)

548. Stewart, R. E.
1972. Field screening of stem applied herbicides on Coast Range brush species. West. Soc. Weed Sci. Res. Prog. Rep., p. 18-19.

"In trials in Oregon and Washington, stems of Acer circinatum, Alnus rubra, Corylus cornuta, Rubus spectabilis, and R. parviflorus were sprayed thoroughly at bud-break with 2,4-D, 2,4,5-T, dichlorprop, Silvex (fenoprop) and dicamba, alone or in mixtures, at 1 lb/100 gal diesel oil. By the end of the first growing season, 2,4,5-T and fenoprop resulted in the best defoliation and top-kill, while the incidence of re-sprouting on plots treated with 2,4,5-T was reduced by the addition of dicamba. All treatments suppressed re-sprouting of Alnus rubra." **(FA)**

549. Stewart, R. E.
1974. Budbreak sprays for site preparation and release from six coastal brush species. USDA For. Serv. Res. Pap. PNW-176, 20, p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Ten herbicides or combinations of herbicides were applied at budbreak on red alder, salmonberry, western thimble.- berry, vine maple, California hazel, and salal. Results show that red alder, vine maple, and California hazel can be adequately controlled for conifer release by budbreak sprays of 2,4,5-T applied in diesel oil. Sprays containing 2,4,5-T are promising for control of salal, but additional tests are necessary. Budbreak sprays should not be used to control salmonberry or western thimbleberry shrubs. Aerial spray tests indicate that combinations of dicamba with 2,4,5-T may be useful for site preparation. Herbicidal treatments for conifer release and site preparation are recommended for each species." (A)

550. Stewart, R. E.
1974. Foliage sprays for site preparation and release from six coastal brush species. USDA For. Serv. Res. Pap. PNW-172, 18 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Fifteen herbicides or combinations of herbicides were tested as ground-applied foliage sprays on red alder, salmonberry, western thimbleberry, vine maple, California hazel, and salal. Picloram produced the best overall control of the six species, although not even picloram produced acceptable control of salal. Foliage sprays of 2,4,5-T were effective on all species except salal. Herbicides were generally more effective when applied in late spring than in midsummer. However, adequate control for release of conifers can be obtained with midsummer sprays of 2,4,5-T on red alder, salmon- berry, and western thimbleberry, Herbi- cidal treatments suitable for conifer release and site preparation are recommended for each species." (A)

551. Stewart, W. D. P.
1962. A quantitative study of fixation and transfer of nitrogen in Alnus. J. Exp. Bot. 13(38):250-256.

"In Alder [A. glutinosa?] plants during the first season's growth, N fixation per plant reached a maximum in late

August, but fell rapidly with the onset of autumn. Fixation per unit dry weight of nodule tissue was greatest in young nodules and was of the same order as in nodulated legumes. Throughout the growing season there was a steady transfer from the nodules of some 90% of the N fixed. The rate of fixation relative to the growth of the endophyte is much higher than in free-living N-fixing organisms, and is clearly governed by the N requirements of the entire symbiotic system. These findings are compatible with the view that the fixation process is extracellular to the endophyte." (FA)

552. Stewart, W. D. P.
1967. Nitrogen-fixing plants. Science 158(3807):1426-1432.

"A review, discussing the legume/ Rhizobium association, the non-leguminous nitrogen-fixing plants and their sym-. bionts (algae or bacteria), and the biochemical aspects of nitrogen reduction." (FA)

553. Stubblefield, George, and Chadwick D. Oliver.
1978. Silvicultural implications of the reconstruction of mixed alder/conifer stands. In Utilization and management of alder, p. 307-320. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Mixed alder hemlock redcedar Douglas-fir stands which began growth after a 1927 logging fire were studied on till soils of the Marchworth Forest of the central Washington Cascades. The stand was always sparsely stocked. Essentially all stems had begun within 20 years of the disturbance. Red alders were the same age or up to 17 years younger than the associated conifers on the same plot, although the conifers were usually in a subordinate position. For analyses of site index, stocking, and growth rates, it cannot be assumed that the alders are the same age as the initiating disturbance. The alders varied widely in crown size and diameter but varied less in height. Basal area of individual alders was closely related to spacing. Closely spaced alders resulted in spindly stems of poor quality. Very recent alder stands generally begin with many more stems per acre than this stand did. Early thinning may be necessary to achieve adequate alder growth." (A)

554. Stuntz, D. E., and E. C. Seliskar.
1943. A stem canker of dogwood and madrona. Hycologia 35(2):207-221.

"During the past few years Cornus nuttallii and Arbutus menziesii trees in Seattle and the vicinity have become increasingly affected by cankers which girdle the stem and eventually kill the tree. When tissues from cankers on both tree species were incubated, two organisms were obtained:--a Phomopsis, later found to be a secondary parasite, and a species of Phytophthora, identified as P. cactorum. This is the first record of P. cactorum on these hosts.

"The fungus was found by inoculation tests to be quite virulent on Acer macrophyllum and able to attack Pseudotsuga taxifolia, Alnus rubra, Salix scouleriana, and Corylus californica." (FA)

555. Sudworth, George B.
1908. Forest trees of the Pacific slope. 441 p. Washington, D.C.

556. Sund, Jimmie Damon.
1977. Some responses of red alder to herbicide application. M.S. thesis. Univ. Wash., Seattle. 60p.

"Under conditions of this study, relative humidity and interactions of relative humidity with plant moisture stress or temperature explained or were associated with 50 percent of the variation in control of red alder by 2,4-D. Best control was obtained under conditions of high relative humidity during the morning hours, if foliage was not overly wet; or under conditions of rising relative humidity during the late afternoon. Timing of diurnal transport of carbohydrates and herbicide to the roots and rates of respiration along the transport route appear to be additional factors as they relate to plant water relations and temperature. The period of poorest control was during the midday depression between 1:00 p.m. and 4:00 p.m. when relative humidity was below 50% and a plant moisture stress of 15 atmospheres." **(A)**

557. Swan, Eric P.
1973. Resin acids and fatty acids of Canadian pulpwoods--a review of the literature. West. For. Prod. Lab. Inf. Rep. VP-X-115, 21 p. Can. For. Serv., Vancouver, B.C.

"The literature on the fatty acids and resin acids, and bound forms of these acids, found in Canadian pulpwoods is reviewed. Data for the following trees are presented: jack pine, lodgepole pine, ponderosa pine, red pine, eastern white pine, radiata pine, western larch, tamarack, white spruce, Sitka spruce, Norway spruce, western hemlock, Douglas-fir, alpine fir, amabilis fir, western red cedar, red alder, red maple, sugar maple, silver birch, trembling aspen, white elm, white and yellow birch and basswood.

"Further research on a variety of important variables and on unreported species is discussed." (A)

558. Szczawinski, Adam F., and Antony S. Harrison.
1972. Flora on the Saanich Peninsula: Annotated list of vascular plants. Occas. Pap. B.C. Prov. Mus. 16, 114 p. Victoria, B.C.

Red alder is among the species listed. (CFH)

559. Tarrant, R. F.
1972. The role of alder in improving soil fertility and growth of associated trees. **In** Managing young forests in the Douglas-fir region, Vol. 3, p. 17-34. Alan B. Berg, ed. Sch. For., Oreg. State Univ., Corvallis.

560. Tarrant, Robert F.
1961. Stand development and soil fertility in a Douglas-fir--red alder plantation. For. Sci. 7(3):238-246.

"Douglas Fir planted (8 X 8 ft.) at 2000 ft. was interplanted in part 4 years later with 2-year Alnus rubra from seed collected at 100 ft. alt., the latter plants suffering early from frost. The following advantages for the mixture at 27 years are shown from plot and sample-tree studies. The volume (Alder and Douglas) was more than twice that of pure Douglas, with no adverse effect on stern size and with an adequate stem number of Douglas (443/acre). Dominant Douglas grew faster in diam. and height over the years 20-27. Form class and upper crowns of Douglas were better. Total N in soil and in Douglas foliage was also greater. The Alder has evidently contributed to increased growth in Douglas dominants from age 20." (FA)

561. Tarrant, Robert F.
1964. Forest soil improvement through growing red alder (Alnus rubra Bong.) in Pacific Northwestern United States. 8th Int. Congr, Soil. Sci. Trans. V:1029-1043. Bucharest, Rumania.

562. Tarrant, Robert F.
1968. Some effects of alder on the forest environment. (Abstr.) In Biology of alder, p. 193. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

563. Tarrant, Robert F.
1978. Attitudes toward red alder in the Douglas-fir region. In Utilization and management o f alder, p. 1-7. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"A positive change in attitudes toward purposeful management of red alder is increasingly evident. Reasons for this change include critical problems of wood fiber supply and increasing costs of fertilizer materials. Several possibilities for exploiting red alder in forest management programs are discussed in light of its rapid early growth rate and ability to improve soil fertility. Additional research must be done, both in the physical and biological sciences if we are to capture the unique attributes of red alder in improved forest management systems. Red alder must be considered a tree of high potential value in a mature forest economy." (A)

564. Tarrant, Robert F., Leo A. Isaac, and Robert F. Chandler, Jr.
1951. Observations on litter fall and foliage nutrient content of some Pacific Northwest tree species. J. For. 49(12):914-915.

"Gives annual oven-dry.weight of litter fall, nutrient content of foliage (lb./acre), and soil pH at 3 depths under the following species: Thuja plicata, Pseudotsuga taxifolia (100 and 350 years old), Abies amabilis, Acer macrophyllum, Pinus monticola, Alnus rubra, Tsuga heterophylla, Picea sitchensis, Pinus ponderosa (100 and 350 years old), and Pinus contorta var. latifolia." (FA)

565. Tarrant, Robert F., K. C. Lu, W. B. Bollen, and C. S. Chen.
1968. Nutrient cycling by throughfall and stemflow precipitation in three coastal Oregon forest types. USDA For. Serv. Res. Pap. PNW-54, 7 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Throughfall and stemflow were collected beneath three adjacent forest types--red alder; conifer--Douglas-fir, western hemlock, and Sitka spruce; and a mixture of alder and conifer. Weight of N and dissolved solids in stemflow was insignificant because of small amounts of stemflow and soil area affected. Nutrient cycling rates differ appreciably between the three forest types." (A)

566. Tarrant, Robert F., K. C. Lu, W. B. Bollen, and J. F. Franklin.
1969. Nitrogen enrichment of two forest ecosystems by red alder. USDA For. Serv. Res. Pap. PNW-76, 8 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"In a study of 40-year-old forests on the Oregon coast, a natural mixed stand of Red Alder and conifers (a) contained 860 trees/acre and had a litter-fall of 5930 lb./acre; corresponding figures for a pure conifer (Douglas Fir, Western Hemlock and Sitka Spruce) stand (b) were 490 trees and 4232 lb./acre, and for pure Alder (c) 381 trees and 4490 lb./acre. In each, the weight of litter varied with the season (significantly for all three stands) and the year (significantly in (b) but not in (a) or (c)); this latter variation is attributed to variations in the weather between years. The seasonal effect varied from year to year. In all stands the N% of the litter-fall varied with season and year and the season/year interaction was highly significant. Over three years, the average N% in the litter-fall of (c) was nearly three times and that in (a) more than twice that in (b). The average weight of N in the annual litter-fall was (a) 104, (c) 100 and (b) 32 lb./acre. Net annual addition of N fixed by Red Alder and returned in litter is estimated at ca. 72 lb./acre in (a) and 68 in (c). Over all years and seasons, the C/N ratio averaged 69 on (b), 27 on (c) and 32 on (a). The silvicultural value of Red Alder in enhancing soil fertility is discussed." (FA)

567. Tarrant, Robert F., and Richard E. Hiller.
1963. Accumulation of organic matter and soil nitrogen beneath a plantation of red alder and Douglas-fir. Soil Sci. Soc. Am. Proc. 27(2):231-234.

"Soil nitrogen accumulation beneath a plantation of red alder and Douglas-fir was compared with that under a pure fir segment of the same 30-year-old stand on the Wind River Experimental Forest in southwestern Washington.

"Beneath the mixed plantation, there were significantly greater amounts of nitrogen in the forest floor and in the upper 24 inches of the mineral soil. Organic matter content in the upper 12 inches of mineral soil was also greater and bulk density at 0 to 3 inches was significantly less. Beneath the alder-fir stand, the carbon-nitrogen ratio was less, both in the forest floor and at 0 to 3 inches.

"There were 938 pounds more N per acre to depth of 36 inches under the alder-fir plantation. Consequently, an average of 36 pounds more soil N per acre per year has accumulated beneath the mixed stand than under pure fir." (A)

568. Tarrant, Robert F., and James H. Trappe.
1971. The role of Alnus in improving the forest environment. Plant and Soil, Spec./Vol. 1971:335–348.

"Worldwide experiences indicates that alder contributes significantly to the supply of nitrogen in the ecosystem. This contribution markedly benefits soil fertility. A definite potential exists for employing alder in forest management in much the same way that legumes are utilized in agriculture. Current research indicates also that Alnus rubra may play a significant role in controlling Poria weirii, a virulent root pathogen which causes extensive losses of commercial timber tree species in western North America and Japan." (A)

569. Taylor, Roy L., and Bruce MacBryde.
1977. Vascular plants of British Columbia: A descriptive resource inventory. Tech. Bull. 4, 754 p. Bot. Gar. Univ. B.C., Vancouver.

Describes Alnus rubra on page 126. Useful information on biology and chromosome complement of red alder. (CFH)

570. Tehon, L. R.
1943. Canker of Pacific dogwood and madrona. Am. Nurseryman 77(7):18–19.

"Pacific Dogwood (Cornus nuttalli) and Madrona (Arbutus menziesi) are sometimes attacked by Phytophthora cactorum which causes a girdling canker and which may kill the tree. Inoculation experiments resulted in very large cankers on these species after a period of 13 weeks, and also showed the following species to be more or less susceptible to the disease: --Oregon Maple (Acer macrophyllum), Red Alder (Alnus rubra), Scouler Willow (Salix scouleriana), California Hazel (Corylus californica), and Douglas Fir (Pseudotsuga taxifolia). A method of treatment by removing the canker (scarification) is described." (FA)

571. Tessier, J. P., and J. H. G. Smith.
1961. Effect of tree size of red alder on harvesting and conversion of lumber. Fac. For. Res. Pap. 45, 8 p. Univ. B.C., Vancouver.

**Alogging study was made on two 5-acre blocks--(a) only hardwoods cut, (b) clear felled--and a mill study on ninety-four 12-ft. logs. It is concluded that, under the conditions of this study, Alnus rubra trees <11 in. d.b.h., and logs <8 in. top diam. u.b. cannot be harvested and converted at a profit." (FA)

572. Tilton, Donald L., and John H. Bernard.
1975. Primary productivity and biomass distribution in an alder shrub ecosystem. Am. Midl. Nat. 94(1):251–256.

"Net primary productivity of an alder [Alnus rugosa (Du Roi) Spreng.] tall-shrub community in the S-central Finger Lakes region of New York was estimated by a stratified sampling method. The total aboveground dry weight production of alder was 730 g/m^2/year. Leaves and twigs represented 42% of total production: 25% was in the bole; 21% in

branches, and 12% in fruits. These values varied with size class, with the greatest variation in fruit production. The herbaceous layer contributed 241 g/m^2/year to a total aboveground production of 972 g/m^2/year. This relatively high production value is thought to be due in part to symbiotic nitrogen fixation in alder root nodules and to favorable soil moisture and oxygen levels." (A)

573. Timberman.
1946. New use for over-ripe alder. Timberman 48(2):70.

574. Timberman.
1957. Western hardwood panels with fir cores studied. Timberman 58(1B):105.

575. Timberman.
1958. Preparing site posed problem on this western tree farm. Timberman 59(2):43, 55-56.

"The reclamation of 60,000 acres of twice-logged, constantly fired Alder and brush (15% of Weyerhaeuser Timber Co.'s tree farm at Clemons, Wash.) involved: aerial and ground survey to map vegetation and distinguish the unmerchantable Alder; the use of T-D 24 crawler tractors for constructing roads (300 miles) and heliports (1 mile apart), for scarifying ground ($25/acre) and clearing brush (1.0-1.5 acre/hour); aerial spraying of unmerchantable Alder with 2,4-D or 2,4,5-T at 5 gal./acre; logging the rest under contract, with bonuses for snags; free shooting of deer; and sowing with helicopters of repellent- (not poison-) treated Douglas Fir seed at 1 lb./acre. The helicopter capacity is 400 lb. of seed. It sows, from 200 ft. at 50 m.p.h., a 90-ft. strip, and costs for criss-cross sowing are $2/acre. An area of 70,000 acres is sown in 75 hours. On scarified ground 2700-5500 seedlings/acre are obtained, of which 3000 are expected to become estalished." (FA)

576. Trappe, James M.
1972. Regulation of soil organisms by red alder: A potential biological system for control of Poria weirii. In Managing young forests in the Douglas-fir region, Vol. 3, p. 35-61. Alan B. Berg, ed. Sch. For., Oreg. State Univ., Corvallis.

"Analysis of field samples and lab. tests indicate that red alder (Alnus rubra) produces Poria inhibiting compounds that are added to the soil and could reduce longevity of the pathogen in buried inoculum. Such compounds, with the relatively high N levels under alder and the lack of a food base in the resistant alder, result in a selective increase in populations of organisms actively competing with, inhibiting, or parasitizing P. weirii." (MO)

577. Trappe, James M., Jerry F. Franklin, Robert F. Tarrant, and George M. Hansen, eds.
1968. Biology of alder. (Proceedings of a symposium held at Northwest Scientific Association 40th annual meeting, Pullman, Washington, April 14-15, 1967.) 292 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Papers (or their abstracts) read are divided into five sections--(1) Taxonomy and distribution: Disjunct populations of Red Alder in Idaho, and Taxonomy and

distribution of northwestern Alders (both by F. D. Johnson); Relationships of allied species between northwestern U.S.A. and Japan on the genus Alnus (S. Murai). (2) Ecology: Comparison of vegetation in adjacent Alder, conifer, and mixed Alder-conifer communities. I. Understory vegetation and stand structure (J. F. Franklin and A. A. Pechanec); On the ecology of Sitka Alder [Alnus crispula subsp. sinuata] in the subalpine zone of south-cental Alaska (W. W. Mitchell); A comparison of rhizosphere microfloras associated with mycorrhizae of Red Alder and Douglas Fir (J. L. Neal et al.); Role of Red Alder in western Oregon forest succession (M. Newton, B. A. el Hassan, and J. Zavitkovski); Comparison of vegetation in adjacent Alder, conifer and mixed Alder-conifer communities. 11. Epiphytic, epixylic and epilithic cryptogams (A. A. Pechanec and J. F. Franklin); First-season growth of Red Alder seedlings under gradients in solar radiation (R. H. Ruth); Germination analysis of Grey Alder (Alnus incana) and Black Alder (Alnus glutinosa) seeds (I. Schalin); Soil development and Alder invasion in a recently deglaciated area of Glacier Bay, Alaska (F. C. Ugolini). (3) Soil and microbiological relationships: Nitrogen transformations in soils beneath Red Alder and conifers (W. B. Bollen and K. C. Lu); Effect of stemflow precipitation on chemical and microbiological soil properties beneath a single [Red] Alder and conifers (J. F. Franklin et al.); Comparison of microbial populations between Red Alder and conifer soils (K. C. Lu, C. S. Chen and W. B. Bollen); Some ectotrophic mycorrhizae of ~~Alnus~~ ~~rubra~~ (J. L. Neal et al.); Nodule endophytes in the genus Alnus (C. Rodriguez-Barreuco and G. Bond); Some effects of Alder on the forest environment (R. F. Tarrant); Resistance of Alnus rubra to infection by the root rot fungus ~~Poria~~ ~~weirii~~ (G. Wallis); On the influence of Alder (Alnus inokumae) on soil properties in northern Japan (K. Yamaya); Effect of organic matter and combined nitrogen on nodulation and nitrogen fixation in Red Alder (J. Zavitkovski and H. Newton). (4) Physiology: Red Alder deficiency symptoms and fertilizer trials (D. R. Hughes, S. P. Gessel and R. B. Walker); Photosynthesis of Red Alder, Douglas-Fir, Sitka Spruce and Western Hemlock seedlings (K. W. Krueger and R. H. Ruth); Enzyme systems of Red Alder and Douglas-Fir in relation to infection by Poria weirii (C. Y. Li et al.); Hypoxylon fuscum: a review of the fungus and its relationship with Alnus in the northwest (J. F. Rogers); The effect of cobalt and certain other trace metals on the growth and vitamin B_{12} content of Alnus rubra (S. A. Russell, H. J. Evans and P. Hayeux). (5) Growth and yield: Growth and yield of Red Alder in British Columbia (J. H. G. Smith); Productivity of Red Alder in western Oregon and Washington (R. L. Williamson)." (FA)

578. Trappe, James M., C. Y. Li, K. C. Lu, and W. B. Bollen.
1973. Differential response of ~~Poria~~ ~~weirii~~ to phenolic acids from Douglas-fir and red alder roots. For. Sci. 19(3):191-196.

"In previous studies the phenolic acids, p-coumaric, ferulic, syringic, and vanillic, have been quantitatively determined from hydrolyzed extracts of

red alder roots, and p-coumaric and vanillic, from Douglas-fir roots. Alder roots resist infection by Poria weirii, whereas Douglas-fir roots are highly susceptible. In the present study, the compounds alone and in all combinations were tested for effects on growth of two genotypes of **P.** weirii in vitro. The combination of all compounds, as found in alder root hydrolysates, inhibited growth of both Poria isolates. The p-coumaric-vanillic combination associated with Douglas-fir root hydrolysates inhibited one isolate and stimulated the other. The two isolates differed markedly in response to several other combinations of the compounds and in their effects on pH of the medium. Phenolic substances probably participate in the Poria-resistance system of alder. Physiological strains of **P.** weirii that effectively attack any susceptible host may exist, but not all strains are likely to be equally pathogenic on all hosts or all root parts of a host (bark **vs.** sapwood vs. heartwood, €or example). Biological control of **P.** weirii, seeming anomalies in behavior of **P.** weirii in nature, and breeding for host resistance are discussed." (A)

579. Triska, F. J., J. R. Sedell, and B. Buckley.
1975. The processing of conifer and hardwood leaves in two coniferous forest streams: II. Biochemical and nutrient changes. Verh. Int. Ver. Limnol. 19(3):1628-1639.

"Leaf material, as it entered the stream, underwent leaching and microbial colonization. This process, called conditioning, rendered allochthonous debris palatable to stream invertebrates. This conditioning process also resulted in increased concentration of certain essential nutrients such as N and P. Concentration increases were highest in the larger stream with the more active microbial flora. The cost of conditioning was some qualitative deterioration of carbon quality for detritus-consuming invertebrates.

"Faster leaf processing was observed in Mack Creek, the larger stream, when compared to Watershed 10 by all measured parameters, weight loss, nutrient immobilization, carbon quality, and microbial respiration. The mechanism for faster microbial processing remains obscure. Such data indicate the need for a more thorough examination of the physical, chemical, and biological properties of the soil-water interface." (A)

580. Tschirley, F. H., Ed.
1956. Undesirable woody plants. West. Weed Control Conf. Res. Prog. Rep. 1956:26-42.

"... Alnus rubra was readily controlled by basal treatments with 2,4,5-T alone or with 2,4-D (esters). ..." (FA)

581. Tuckerman, E.
1843. Observations on some interesting plants of New England. **Am.** J. Sci. Ser. 2, 45:27-49.

Alnus serrulata is described as **A.** rubra. This is an obsolete synonym but can cause confusion in older literature. (CFH)

582. Turnbull, K. J., Gene R. Little, and Gerald E. Hoyer
1963. Comprehensive tree-volume tarif tables. 23 p. Wash. State Dep. Nat. Resour., Olympia.

"The tables contain both cubic and board-foot volume to various minimum top diameters, and also volume/b.a. ratios and growth multipliers to estimate annual volume growth from increment cores, based on field work in Washington State. 'Access tables' for selecting the correct tariff for Douglas Fir, Ponderosa Pine, Western Hemlock and Red Alder are included." (FA)

583. Turner, J., D. W. Cole, and S. P. Gessel.
1976. Mineral nutrient accumulation and cycling in a stand of red alder (Alnus rubra). J. Ecol. 64(3):965-974.

"The distribution of organic matter and mineral nutrients in a thirty-four-year-old stand of red alder (Alnus rubra) in Washington State, U.S.A., is described, together with the annual nutrient transfers between components. The nutrients studied were nitrogen, phosphorus, potassium, calcium, magnesium and manganese. There was a large quantity of N in the ecosystem, presumably because of N-fixation by the alder. The stand was deteriorating and thus there was a high quantity of wood in the litterfall. The understorey made an important contribution to the biomass, stand productivity and return of mineral nutrients to the forest floor. Comparison with a nearby stand of Douglas-fir (Pseudotsuga menziesii) of similar age indicates that, while the organic matter distribution is similar, they have different patterns of nutrient accumulation and cycling. Data from an overmature 450-year-old Douglas-fir stand are also included so that a comparison of two deteriorating stands can be made." (A)

584. Turner, John, and Dale W. Cole.
1973. A review of forest biomass accumulation. Coniferous For. Biome Intern. Rep. 56, 43 p. Univ. Wash., Seattle.

585. Turner, Nancy J.
1975. Food plants of British Columbia Indians: Part 1--Coastal peoples. B.C. Prov. Mus. Handb. 34, 264 p. Victoria, B.C.

586. U.S. Department of Agriculture, Agricultural Research Service.
1960. Index of plant diseases in the United States. U.S. Dep. Agric. Agric. Handb. 165, 531 p. Washington, D.C.

A list of more than 1,200 host genera and 50,000 parasitic and nonparasitic diseases arranged by host. Useful annotation on some diseases. (CFH)

587. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.
1950. Veneer cutting and drying properties. Red alder (Alnus rubra). For. Prod. Lab. Rep. D1766-2, 2 p. Madison, Wis.

"Laboratory tests covering the preparation of logs for cutting, suitable lathe settings, and veneer drying, were made on bolts of Red Alder (Alnus rubra).

The wood was found to be in excellent condition for cutting after washing in water at 140° F. for about 8 hr. for a 12-in. and 15 hr. for a 16-in. bolt, both 4 ft. long. It is possible that good veneer could be cut from unheated wood, and heating in steam would probably result in overheating. A thorough study of lathe settings has not been made, but settings that produce tight, smooth veneer are given for 3 veneer thicknesses. The green veneer varied in moisture content from 71 to 105%. At a temperature of 250°, the 1/32- and 1/24-in. veneer dried in 5 minutes to a moisture content of 2-3%; it was rather brittle and split in handling. The 1/16-in. veneer dried in 8 min. to about 5%. Tangential shrinking based on green width was about 7%." (FA)

588. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.
1958. Factors that influence the decay of untreated wood in service and comparative decay resistance of different. species. For. Prod. Lab. Rep. 68, 6 p. Madison, Wis.

Discusses in general terms factors influencing decay of wood: moisture, air, warmth, heartwood and sapwood, amounts of natural preservatives, season of culling, and seasoning and servicing conditions. Alder is considered slightly resistant or nonresistant to decay. (CFH)

589. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.
1973. Standard terms for describing wood. USDA For. Serv. Res. Note FPL-0171, 12 p. For. Prod. Lab, Madison, Wis.

"Presents series of standards for describing specific gravity, shrinkage, bending and compressive strength, hardness, shock resistance, and stiffness of the various species of wood as developed by the U.S. Forest Products Laboratory." (A)

590. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.
1974. Wood handbook: Wood as an engineering material. U.S. Dep. Agric. Agric. Handb. 72, 528 p. Washington, D.C.

Basic information on wood as a material for construction, with data for its use in design and specifications. Also a 1955 edition. (CFH)

591. Uemura, S.
1971. Non-leguminous root nodules in Japan. Plant and Soil, Spec. Vol. 1971:349-360.

"Among plants native to Japan, nodule formation is confirmed in 14 species and varieties of Alnus, 10 of Elaeagnus, 2 of Nyrica and 1 of Coriaria, in a number of instances for the first time. Plants of 20 foreign species, in 8 genera, which bear nodules in their native countries, were raised in the nursery in Tokyo; only species of Alnus, Myrica and Ceanothus formed nodules. No nodules were found on native plants of Dryas octopetala var. asiatica.

"In a trial extending over 12 years evidence was obtained that the growth of Pinus thunbergii was benefited by underplanting with Myrica rubra, a result attributed to nitrogen fixation in the root nodules of the latter species.

"In the attempted isolation of the endophytes from the nodules of Alnus and other non-legume Angiosperms, although actinomycetes peculiar to the host species were usually obtained from the nodules, none of the isolates induced nodules in re-inoculation tests. Also from Podocarpus nodules actinomycetal and bacterial strains were commonly isolated; re-inoculation tests with these are in progress." (A)

592. Ulrich, B.
1962. [Fifteen years experience with poplar and red alder in the Danndorf Forest Administration.] Holzzucht 16(1/2):4-7.

593. United Kingdom Forestry Commission.
1964. Report on forest research for the year ended March 1974. 109 p. Her Majesty's Stationery off,, London.

"Provenance trials in progress are reported for Picea sitchensis, P. Englemannii, P. Abies, Pinus contorta, Abies grandis, and Alnus rubra." (PO)

594. Vancura, V., and G. Stotzky.
1976. Gaseous and volatile exudates from germinating seeds and seedlings. Can. J. Bot. 54(5-6):518-532.

"The quantities of gaseous and volatile metabolites liberated by germinating seeds and seedlings appeared to be related, in general, to the amount of storage substances present in the seeds. Both qualitative and quantitative differences were found between various plant species and varieties of both angiosperms and gymnosperms. The release of volatile compounds preceded the appearance of the first root and, with most seeds, was greatest in the first 24 to 48 h. Organic volatiles could be detected, by gas chromatography, in as little as 5% of the atmosphere from one germinating seed. All seeds that were studied liberated ethanol, and most seeds evolved methanol, formaldehyde, acetaldehyde, formic acid, ethylene, and propylene. Propionaldehyde and (or) acetone was also evolved by cotton, pea, and yellow pine. The possible source of these volatile metabolites and their ecological implications are discussed."(A)

595. van Dijk, C., and E. Merkus.
1976. A microscopial study of the development of a spore-like stage in the life cycle of the root-nodule endophyte of Alnus glutinosa (L.) Gaertn. New Phytol. 77(1):73-91.

"A light- and electron-microscopial study of the root-nodule endophyte of Alnus glutinosa (L.) Gaertn. was carried out to investigate the development of a spore-like stage, here called the granule, in the life cycle of the endophyte. Comparison of granule-rich and granule-free root nodules showed that granule formation takes place via local transverse growth of thick endophytic hyphae, giving rise to multicellular 'granulated bodies' differing in shape and size. Subsequently, the cells of these granulated bodies are transformed into

granules by cell separation and ultrastructural changes, the most striking of which are cell-wall thickening, reduction of the number of mesosomes, and increased density of the cytoplasm. Granule development takes place both intracellularly and intercellularly. Intracellularly produced granules are eventually liberated by the death of the host cell. Mature granules show a strong resemblance to spores of free-living actinomycetes in their ultrastructure and behavior.

"It is concluded that, in view of the terminology currently used in the description of members of the Actinomycetales, the term granule should be replaced by spore and thus the term granulated body by sporogenous body." (A)

596. Vanosdoll, John Clark.
1977. Red alder whole-tree chipping characterization in relation to kraft pulping. M.S. thesis. Univ. Wash., Seattle. **37** p.

The biggest problem in utilizing whole-tree chips is bark contamination; the more bark in the chip supply, the lower the yield and the higher the kappa number of resulting pulps. Successful utilization of whole-tree chips will require development of methods to allow mills to adapt to the varying chip supply. The bark content of a chip supply and lignin were found to correlate with the screened pulp yield of corresponding kraft cooks. Lower yields are accompanied by increases in black liquor solids and British thermal unit per pound of ovendry solids, reduced digestor output and decreases in production. These plus an increased alkali demand increase costs of pulp production. Other problems, such as wear from sand and grit in bark, and possible overloading of the recovery furnace caused by an increased load of black liquor solids is also important. (CFH)

597. Viereck, Leslie A., and Elbert L. Little, Jr.
1972. Alaska trees and shrubs. U.S. Dep. Agric. Agric. Handb. **410, 265** p. Washington, D.C.

A description of the woody species of Alaska. Includes separate summer and winter keys for Alaska trees and for shrubs; illustrations, range maps; and discussions of botanical and silvicultural features. (CFH)

598. Viereck, Leslie A., and Elbert L. Little, Jr.
1974. Guide to Alaska trees. U.S. Dep. Agric. Agric. Handb. **472, 98** p. Washington, D.C.

"Alaska's native trees, **32** species, are described in nontechnical terms and illustrated by drawings for identification. Six species of shrubs rarely reaching tree size are mentioned briefly. There are notes on occurrence and uses, also small maps showing distribution within the State. Keys are provided for both summer and winer, and the summary of the vegetation has a map. This new Guide... is condensed and slightly revised from 'Alaska Trees and Shrubs' **(1972) [(592)]** by the same authors." (A)

599. Virtanen, A. I., T. Moisio, R. M. Allison, and R. H. Burris.
1955. Fixation of nitrogen by excised nodules of the alder. Acta Chem. Scand. **9:184-186.**

600. Virtanen, Artturi I.
1957. Investigations on nitrogen fixation by the alder. 11. Associated culture of spruce and inoculated alder without combined nitrogen. Physiol. Plant., Copenhagen 10(1):164-169.

"Seedlings of Picea abies were grown from 1931 to 1942 in quartz sand in association with seedlings of Alnus glutinosa that had been inoculated with a water suspension of crushed Alder root nodules. No combined N was added; but the test plants were watered with a nutrient solution of $MgSO_4$, KCl, KH_2PO_4, $CaCO_3$ and tapwater. All fallen Alder leaves were removed from the soil surface. After 7 years, seedlings of both species were analysed to determine the amounts of dry matter and the N content of different parts of the plant. Results are tabulated. Results of analyses after 11 years were lost during the war but photos show the growth of both species. Spruce obtained N fixed in the nodules of Alder roots even during its first years of growth. Data are given on the amount of N fixed by Alder after 7 years." (FA)

601. Vockeroth, J. R.
1974. Notes on the biology of Cramptonomyia spenceri Alexander (Diptera:Cramptonomyiidae). J. Entomol. Soc. B.C. 71:38-42.

"Adults of Cramptonomyia spenceri were abundant in the lower Fraser Valley, British Columbia, from late February to early April of 1973. Eggs, larvae and pupal skins were found on or in dead fallen stems of Alnus rubra. Wing frequency measurements of both sexes indicate that auditory stimuli are not involved in finding of mates," (A)

602. Voigt, G. K.
1965. Nitrogen recovery from decomposing tree leaf tissue and forest humus. Soil Sci. Soc. Am. Proc. 29(6):756-759.

"Recovery of N from decomposing leaf litter of alder (Alnus rugosa [Du Rois] Spring.), dogwood (Corus florida L.), tulip poplar (Liriodendron tulipifera L.), hemlock (Tsuga canadensis [L.] Carr.), eastern redcedar (Juniperus virginiana L.), and red pine (Pinus resinosa Ait.) was studied under laboratory and greenhouse conditions. Weight loss and N deficits in decomposing tissue were more marked in hardwoods than in conifers. There was no pronounced species correlation between Ca concentration of the leaf litter and either weight loss or N deficit, but N deficit was increased in some cases by addition of $CaCo_3$. Considerable variation in avail-ability of N to Douglas-fir (Pseudotsuga menziesii [Mirb.] Franco) seedlings was observed in soil cultures where N originated from decomposing leaf tissue or from humus samples collected under the aforementioned species. Recovery of N ranged from about 60 to over 90% of the original N content." (A)

603. Voigt, G, K., and G. L. Steucek.
1969. Nitrogen distribution and accretion in an alder ecosystem. soil Sci. Soc. Am. Proc. 33(6):946-949.

"Analysis of plant and soil components of an alder (Alnus rugosa [Du Roil Spreng.) community that had invaded the bed of an abandoned mill pond showed an average annual N accretion of about 85 kg/ha. Host (93%) of the N in the ecosystem was found in the soil and there was a strong

correlation between soil moisture content and N concentration. This may have resulted in part from more favorable conditions for nodule functioning. The amount of N in the alder stand during the growing season was about equal to that contained in freshly fallen litter. About three-fourths of the N in alder plants was found in stems and twigs but highest concentrations of N were found in leaves and nodules." (A)

604. Voorhies, Glenn.
1944. The essentials of kiln drying Oregon hardwood lumber. Oreg. For, Prod. Lab., Res. Leafl. 2, **17** p. Corvallis.

605. Voth, Elver H., and Hugh C. Black.
1973. A historic technique for determining feeding habits of small herbivores. J. Wildl. Manage. **37(2):223–231.**

"The mountain beaver (Aplodontia rufa) was used in a feeding experiment involving **20** species of vascular plants. A foliar epidermal digestibility characteristic was measured. A fecal recognition item was a flat epidermal fragment that measured at least **0.1 mm** in at least one direction. The number of recognition items per gram of dry weight of each plant eaten in captivity was determined and divided into a standard number, which was the number **(11.0)** of fragments counted per gram (dry weight) of sword-fern (Polystichum munitum) ingested. The resulting conversion factor was called an equivalence factor. The equivalence factors varied through a 15-fold range--from **0.8** for red alder (Alnus oregona) to **12.2** for western spring beauty (Montia sibirica). The conversion factors increase the accuracy of relative volumetric estimates of food intake based on istologic analysis of fecal samples collected in the field. Conversion factors can be predicted by correlating equivalence factors with moisture content and reading factors for unknown plants from a line of regression when the percentage dry weight of the plant has been determined." (A)

606. Voth, Elver Howard.
1968. Food habits of the Pacific mountain beaver, Aplodontia rufa pacifica Merriam. Ph. D. thesis. Oreg. State Univ., Corvallis. **276** p.

"The mountain beaver causes heavy loss in the Pacific Northwest, primarily to Douglas Fir, by clipping or burying seedlings during burrowing and by pruning or girdling older trees. A study of a heavy population and its annual consumption of vegetation in a 2-ha. site with alder succession problems in the Oregon Coast Range in **1964–66** showed that sword-fern or bracken (neither much eaten by deer) form **82%** of the diet of the adult." (FA)

607. Wagener, Willis W., T. W. Childs, and J. W. Kimmey. **1949.** Notes on some foliage diseases of forest trees on the Pacific slope. Plant Dis. Rep. **33(4):195–197.**

608. Waggener, Thomas R.
1978. Should alder be replaced by conifers? In Utilization and management of alder, p. 365-379. David G. Briggs, Dean S. DeBell, and William A. Atkinson, compilers. USDA For. Serv. Gen. Tech. Rep. PNW-70. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"As with most hypothetical questions, the question of whether alder should or should not be replaced with conifer must be answered ambiguously. It is assumed that this basic question will be approached from an economic or financial point of view.

"Application of financial analysis to the question of site conversion requires two basic sets of information: 1) biological response data relevant to the management options to be considered, and 2) present and future values for both costs and returns for each management option, including the relevant cost of capital.

"A primary consideration in the analysis of site conversion is the determination of yield responses from management. Also, projected time trends in both yield values and costs need to be carefully considered, since both management and feasibility and the comparative advantage of an optimal management program can change greatly under such trends. Because of the long financial production periods, the cost of time is often a major determinant of economic feasibility.

"Examples for generalized site conversion analysis are reviewed and the implications of the major management variables are discussed. The application of these approaches requires each manager to carefully assess the specifics of his forest land and the site-specific cost and value relationships." (A)

609. Wall, Brian R.
1969. Projected developments of the timber economy of the Columbia-North Pacfic region. USDA For. Serv. Res. Pap. PNW-84, 87 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Economic projections of the forest industry of the Northwest through 2020. Extensive tables describe commercial and private forest area, forest industry employment income, volumes of growing stock by species, etc. (51 tables). (CFH)

610. Wallis, G.
1968. Resistance of Alnus rubra to infection by the root rot fungus Poria weirii. In Biology of alder, p. 195. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp, Stn., Portland, Oreg.

"Attempts at inoculating red alder roots with cultures of Poria weirii plus studies of excavated root systems indicated that alder is not susceptible to sustained infection by this pathogen."(A)

611. Wallis, G. W., and G. Reynolds.
1962. Inoculation of Douglas fir roots with Poria weirii. Can. J. Bot. 40(5):637-645.

"A method for the inoculation of Douglas-fir roots with Poria weirii using Douglas fir, alder, maple, and oak wood for preparing the inoculum is described. When the deciduous wood was used as the food base on which the fungus was grown, a higher percentage of infection was

achieved than when either Douglas fir stem or roots were used. Six months was sufficient time for the fungus to become well established on the bark surface; penetration of healthy bark occurred in 12 months. Spread of the fungus to adjacent roots at points of root contact was noted. Growth of mycelium on the bark surface was usually in advance of infection in the wood. Poria weirii mycelium continued to grow vigorously during the fall and winter months of the study period." (A)

612. Wallis, G. W., and G. Reynolds.
1965. The initiation and spread of Poria weirii root rot of Douglas fir. Can J. Bot. 43(1):1-9.

"Reports...infection trials indicating that mycelium could invade roots of trees felled at least 12 months earlier, and the heartwood that had been buried for 12 months, and that Alnus rubra and Acer macrophyllum showed considerable resistance." (FA)

613. Wang, Yu-Min.
1965. Use of a series of aerial photographs to estimate growth of trees and stands. H.F. thesis. Univ. B.C., Vancouver. 143 p.

"On the whole, methods of prediction of growth of stands by the use of a series of aerial photographs should be useful unless the stand is so densely stocked that it would affect the measurements of compilation height.

"Heasurements of crown width were revealed to be fairly accurate. The minimum standard error of the mean aifference was ± 0.21 feet for Douglas fir when compared with he ground data, and the maximum error was ± 0.58 feet for alder. When comparisons were made in terms of mean errors, cottonwood showed the least accuracy (-1.3 feet) while a consistent mean error of zero was obtained for Douglas fir, cedar and hemlock.

"There was no consistent result which would give a clue to determine which species gives the best height estimates." (A)

614. Warrack, G. C.
1956. The management of hardwood timber stands. Pac. Coast Hardwoods (July), p. 12-14; Dec., p. 10. Northwest Hardwood Assoc., Seattle, Wash.

Discusses hardwoods grown in British Columbia. Makes suggestions for management, planting, thinning, and harvesting of red alder. (CFH)

615. Warrack, G. C.
1958. Thinning experiments in red alder. In Research review, p. 48-50. B.C. For. Serv., Victoria.

616. Warrack, G. C.
1964. Thinning effects in red alder. 8 p. B.C. For. Serv., Res. Div., Victoria.

617. Warrack, George.
1949. Treatment of red alder in the coastal region of British Columbia. B.C. For. Serv. Res. Note 14, 7 p. Victoria, B.C.

"Preliminary results of a thinning study started in 1948 indicate that a suitable time for a heavy thinning of pure Alder stands on good sites would be between 15 and 20 years. This should assist in the production of a merchantable stand within a 30- to 40-year rotation. The occurrence of epicormic branches may be a factor in determining rotation and density requirements." (FA)

618. Washington State University, Cooperative Extension Service.
[n.d.] Growing red alder for profit. 6 p. Wash. State Univ., Pullman.

619. Washington Woodland Council.
1964. Growing red alder for profit. Oreg. State Univ. Fed. Coop. Ext. Circ. 725, 2 p. Corvallis.

620. Wayman, M., C. B. Anderson, and W. H. Rapson.
1965. Peracetic acid bleaching of groundwood from nine Canadian wood species. Tappi 48(2):113-120.

"Promising results have been obtained with 6 Canadian hardwoods and 3 softwoods, the best with Populus trichocarpa and the poorest with Alnus rubra." (FA)

621. Weatherby, Hugh.
1949. The use of chemical weed killers. B.C. Lumberman 33(8):51-52.

"Several projects using chemical sprays to keep roads and power-line rights of way free of weeds and tree growth have been examined, and it was concluded that chemical sprays kill any Alder and Arbutus they hit. Conifers among the Alder were apparently unharmed. The cost is only about 30% of that of slashing. A power-line right of way, 68 miles long and 100 ft. wide, was sprayed in 24 days by a crew of 9 men, 3 tank trucks and a jeep. Bracken can be killed, but is not much affected by the spray used for killing Alder and other brush." (FA)

622. Webb, Warren L.
1972. A model of light and temperature controlled net photosynthetic rates for terrestrial plants. In Proceedings--.Research on coniferous forest ecosystems--A symposium, p. 237-242. Jerry F. Franklin, L. J. Dempster, and Richard H. Waring, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"The model described represents net C02 exchange in a steady state as the difference of two empirical functions describing respectively photosynthesis (in terms of light energy and temperature) and respiration (in terms of temperature only). The six parameters of the model were evaluated the use of data for the CO_2 exchange of Alnus rubra seedlings, 1-2 years old, in a controlled environment. The behaviour of the model agreed with experimental results over a wide range of temperatures (0-50 deg C) and light-energy values. The maximum CO_2 uptake by light-saturated seedlings occurred at 23 deg C." (FA)

623. Webb, Warren L., Michael Newton, and Duane Starr.
1974. Carbon dioxide exchange of Alnus rubra: A mathematical model. Oecologia 17(4):281-291.

"The CO_2 exchange response of plants to multiple environmental variables is often difficult to frame for purposes of comparison. In this paper, a nonlinear model relating CO_2 exchange to light and temperature is derived from experimental curves determined in other investigations. Parameter values, determined from a least-squares fit of the model to CO_2 exchange data, are useful for comparing responses to light and temperature in terms of seasonal phenology, population heterogeneity, or species variation.

"The model was fitted to CO_2 exchange data of a group of 40 Alnus rubra Bong. (red alder) seedlings for steady-state combinations of light and temperature. The average deviation of the data from the model was ± 6.7%. This steady-state expression satisfactorily predicted C02 exchange for dynamic conditions of light and temperature occurring in a diurnal cycle." (A)

624. Webb, Warren Lewis.
1971. Photosynthetic response models for a terrestrial plant community. Ph. D. thesis. Oreg. State Univ., Corvallis. 88 p.

"Photosynthetic response to light and temperature was modeled using data from a small red alder (Alnus rubra B.) community growing in a controlled environment chamber linked to the computer. This new system controls air temperature, root temperature, and vapor pressure over a wide range, and both light intensity and spectral quality are comparable with natural sunlight. Net photosynthetic rates are measured by continuously monitoring atmospheric CO_2 in the gas-tight environment chamber. Photosynthetic measurements were taken between 0.06 ly/min and 0.68 ly/min (total short-wave radiation) at temperatures from 6° to 30° C.

**A stepwise multiple linear regression analysis accounted for 98% of the variation in stady-state net photosynthesis using light and temperature plus two interaction terms as independent variables. Non-linear models were constructed based on the known light curve for photosynthesis of single plants. The weighted average deviation of the data from the best non-linear model was ± 3.7%. Extrapolation of predicted photosynthetic response appears reliable except for an inconsistency at light energies below 5% full sunlight for temperatures less than 6° C." (BI)

625. Wells, Frank L., Lloyd E. Herdle, and Alexander Walker, Jr.
1969. Rapid sulfite pulping in concentrated sulfur dioxide solutions. Tappi (52)11:2136-2140.

"Using concentrated solutions of free sulfur dioxide at pressures higher than those normally used in sulfite pulping, bleachable sulfite pulps have been made in 2 hr or less from a variety of hardwoods and softwoods, including Douglas-fir [and red alder]. The addition of an alcohol or organic acid to the cooking liquor reduces the maximum pressure reached and improves yield and bleachability of the pulps. With appropriate adjustments in cooking conditions, pulps suitable for paper or for esterification can be made. In either case the pulps can be bleached by a simple sequence

without alkaline refinement. The very short cooking times required suggest that a continuous process for the manufacture of sulfite pulp could be developed." (A)

626. Wellwood, R. W.
1956. The manufacture and uses of hardwood in British Columbia. 4 p. Northwest Hardwoods Assoc., Seattle, Wash.

627. West Coast Lumberman.
1949. Alder for plastics. West Coast Lumberman 76(10):102.

628. Westcott, Cynthia.
1971, Plant disease handbook. 3d ed. 843 p. Van Nostrand Reinhold Co.: New York, Cincinnati, Toronto, London, Melbourne.

A comprehensive volume discussing plant diseases and their pathogens; illustrated; alphabetical listing of host plants and their diseases, easily cross-referenced to specific pathogens. Alder is classified by generic name only. Good general index. (CFH)

629. Western Forestry and Conservation Association.
1953. Reports of the Pacific Northwest Seeding and Planting Committee on various recommended reforestation practices and techniques. 69 p. West. For. and Conserv. Assoc., Portland, Oreg.

630. Western Society of Weed Science.
1969. Degradation of several herbicides in red alder forest floor material. Res. Prog. Rep. 1969:21-22.

"Analyses of herbicide residues in material from the forest floor under Alnus rubra showed that amitrole and 2,4-D were rapidly decomposed; picloram was the herbicide most resistant to degradation, and 2,4,5-T was of intermediate persistence. The higher the rate of decomposition of the herbicide, the lower the hazard of stream pollution." (FA)

631. Wetzel, G.
1927. Chromosomenzahlen bei den Fagales. Ber. Dtsch. Bot Ges. 45(4):251-252.

632. Wetzel, G.
1928. Chromosomenstudien bei den Fagales. Ber. Dtsch. Bot. Ges. 46(3):212-214.

633. Wetzel, G.
1929. Chromosomenstudien bei den Fagales. Bot. Arch. 25:257-283.

634. White, Gordon.
1974. Industrial hardwood research in northern Alabama. J. Ala. Acad, Sci. 45(4):353-358.

635. Wickliff, Carlos.
1877. The effects of cadmium on the nitrogen fixation system in Alnus rubra. Ph. D. thesis. Oreg. State Univ., Corvallis. 242 p.

"Alnus rubra (Bong.) seedlings were grown in sand culture and irrigated with nutrient solution containing $CdCl_2$ ranging from 5 µg to 100 mg per liter. Treatment of A. rubra seedlings for 4 weeks with 50 and 100 mg $CdCl_2$ per liter of nitrogen-free nutrient solution decreased in situ nitrogenase activity 93 and 99%, respectively, when compared to controls. Nitrogen fixation was decreased 32 and 65% at $CdCl_2$ concentrations of 50 and 100 mg per liter, respectively. Growth was decreased to about the same extent as nitrogen fixation. Cadmium concentrations in the organs of A. rubra increased with increasing $CdCl_2$ concentrations in the nutrient solution and increasing duration of treatment.

"A. rubra seedlings without nodules were inoculated at the start of the experiment. The growth period prior to apparent nodulation increased from 5 to 8 weeks as the $CdCl_2$ concentration increased from 10 to 100 µg per liter of nitrogen-free nutrient solution. No detectable nitrogen fixation was observed at higher cadmium concentrations. Decreases in plant growth from $CdCl_2$ treatment were roughly parallel to decreases in nitrogen fixation.

"These results indicate that cadmium in nutrient media inhibits nitrogenase activity, and therefore nitrogen fixation in Alnus rubra. Growth, nodulation, and nitrate reductase activity were inhibited by the element. Observations of root and nodule cell ultrastructure suggest that cadmium exerts a portion of its effect by influencing the structure of organelles." (A)

636. Wicklow, Marcia C., Walter B. Bollen, and William C. Denison.
1974. Comparison of soil microfungi in 40-year-old stands of pure alder, pure conier, and alder-conifer mixtures. Soil Biol. and Biochem. 6(2):73-78.

"Samples were taken from the L, F, and All layers in three adjacent stands composed of (a) pure Alnus rubra, (b) a mixture of Picea sitchensis, Pseudotsuga menziesii, and Tsuga heterophylla, and (c) a mixture of alder and conifers, in the coastal fog belt of Oregon. The 92 species of microfungi isolated are tabulated, and their occurrence and frequency in species composition of the fungal populations was strongly correlated with the dominant vascular vegetation, and differed little between horizons within a stand. Stand (a) had a large number (16) of co-dominant fungus species, and Penicillium daleae, generally considered a rare species, reached a frequency of 83%. Stands (b) and (c) showed significantly fewer fungus species, and stand (c) was intermediate between the other two stands in terms of species composition." (FA)

637. Wicklow, Marcia Cope.
1972. A comparison of soil microfungi in forest stands of red alder, conifer, and alder-conifer mixtures. Ph. D. thesis. Oreg. State Univ., Corvallis. 64. p.

"The species composition of soil microfungal populations in adjacent stands of red alder, conifers, and mixed alder conifer correlated strongly with the dominant vascular vegetation. A total of 92 species were isolated: 55 from the alder stand; 45 from the conifers; and 46 from the mixed alder-conifer,

with few species (16, 7, and 5 in the three plots, respectively) reaching average frequencies of 50% or higher. Penicillium nigricans, Aureobasidium pullulans, Cephalosporium curtipes, and Cladosporium herbarum were present with high frequence at all sites.

"There was little difference in species composition among soil horizons within a stand. Fungi which were dominant in one layer were dominant in the others.

"Three isolation techniques: dilution plates, soil plates, and immersion tubes, did not yield significant differences in species composition.

"In all three stands, numbers of species were greatest in February and lowest in June, following seasonal maxima and minima of soil moisture." (BI)

638. Wiley, Kenneth N.
1965. Effects of the October 1.2, 1962 windstorm on permanent growth plots in southwestern Washington. Weyerhaeuser For. Pap. 7, 13 p. Weyerhaeuser Co., Centralia, Wash.

"Two hundred nineteen permanent growth plots in Southwest Washington, primarily Douglas-fir and western hemlock 20 to 130 years of age, were examined. Nineteen had been destroyed and 74 were damaged. Damage was concentrated in the older age classes of both species. On the damaged plots, dominant and codominant trees accounted for 83 per cent of the mortality in terms of basal area but 40 percent of this mortality as in trees with root. or stem rot." (A)

639. Williamson, Richard L.
1868. Productivity of red alder in western Oregon and Washington. In Biology of alder, p. 287-292. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Red alder in western Oregon and Washington grows rapidly when young and outproduces Douglas-fir up to ages 25-30 years on median sites of both species. Red alder readily responds to thinning. Its ability to add nitrogen to soil is important for site improvement over much of its natural range." (A)

640. Willis, J. C.
1966. A dictionary of the flowering plants and ferns.. 7th ed. 42 p. Cambridge Univ. Press, Cambridge.

641. Wilson, Donald F., L. N. Johanson, and Bjorn F. Hrutfiord.
1972, Methanol, ethanol, and acetone in kraft pulp mill condensate streams. Tappi 55(8):1244-1246.

"Methanol, ethanol, and acetone are three important water-soluble steam-volatile compounds found in kraft mill condensate streams. The extent of their formation is reported as a function of wood species pulped, based on laboratory digestion of

642. Winjum, Jack keith.
1969. Studies of the competitive performance of outplanted 2 + 0 Douglas fir (Pseudotsuga menziesii (Mirb.) Franco) through the first growing season. Ph. D. thesis. Univ. Mich., Ann Arbor. **130** p.

"Pot studies were used to determine optimum environments for Douglas Fir seedling growth as regards light, moisture and rates of NPK application, and the effect of competition by Gaultheria shallon (which favoured Douglas Fir growth in terms of dry-weight gain) and Alnus rubra (which depressed growth). In field studies, however, when Douglas Fir was planted out in natural G. Shallon or A. rubra communities, both species reduced root and shoot growth of the Douglas Fir compared with controls." (FA)

643. Wise, Louise E., Evelyn K. Ratcliff, and B. L. Browning.
1948. Determination of mannose. Mannans in hardwoods. Anal. Chem. **20(9):825–828.**

"The Hagglund-Bratt method for the determination of mannose and mannans in wood was modified and applied to **4** hardwoods (Oregon maple [Acer macrophyllum], Aspen [Populus tremuloides], Red Alder [Alnus rubra] and Querbracho Colorado [Schinopsis sp.]) all of which proved to contain small amounts of mannan. In at least one case (Aspen), mannose units were shown to be present in hardwood -cellulose. Cotton linters, on hydrolysis, gave no mannose. The results are tabulated.** (FA)

644. Wollum, A. **G.,** 11, and C. T. Youngberg.
1964. The influence of nitrogen fixation by nonleguminous woody plants on the growth of pine seedlings. J. For. **62(5):316–321.**

Nodulatedseedlings of Ceanothus velutinus (a) and Alnus rubra (b) were grown in low-N-content soils (pumice and granitic respectively) in the greenhouse. After **9 months the seedling tops were removed at the ground line and Pinus radiata sown in the pots and also in pots of fresh soil that had been supplied with N at **0, *25*, *50*, 75**, and **100** p.p.m. All treatments received **100** p.p.m. of P. After 12 months, the Pine seedlings were harvested, weighed, and analysed for N. The yield and N content of seedlings in (a) pots were comparable to those receiving **35** p.p.m. of added n, and those in (b) pots to 15 p.p.m. Another experiment was designed to investigate the effect of various litters on growth of P. radiata seedlings in a granitic soil. Douglas Fir litter at a rate of ***250*** g./2500 **g.** soil depressed the growth of P. radiata, whereas Alder improved it." (FA)

645. Woodworth, Robert H.
1929. Cytological studies in the Betulaceae. 11. Corylus and Alnus. Bot. Gaz. **88(4):383–399.**

"Corylus exhibits no polyploidy, all species and hybrids having the haploid number of **14** chromosomes. Throughout the genus there occurs a fusion of 1, 2, or **3** pairs of bivalent chromosomes, thus often causing the haploid number to appear to be less than **14.** Natural hybrids are easily formed. These plants show some of the cytological peculiarities known to be due to heterozygosis. The fundamental number of chromosomes in Alnus is also **14,** 2n and 4n species are

described. Alnus rugosa shown marked hybrid cytological characters and is considered heterozygous. It forms its seed apomictically. Alnus rugosa and A. glutinosa exhibit fusion of bivalent chromosomes. Cytomyxis and chromosome migration take place in certain species of Corylus and Alnus. Dysploidy may be due to unequal chromosome distribution, chromosome extrusion, or to cytomyxis and chromosome migration. A perinuclear zone occurs in the pollen mother cells." (BA)

646. Worthington, Norman P.
1957, Silvical characteristics of red alder. Pac. Northwest For. and Range Exp. Stn. Silvical Ser. 1, 15 p. Portland, Oreg.

"The first of a 'silvical characteristics' series to be produced by this Station on the same lines as those being published by other Federal Stations. These compilations aim at giving information on habitat conditions, life history, including growth and yield, injuries, races and hybrids, and any special features, preliminary to eventual publication in book form." (FA)

647. Worthington, Norman P.
1963. Thirteen years of thinning in a Douglas-fir woodland. USDA For. Ser. Res. Note PNW-8, 4 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Yields over the past 13 years from a typical 57-year small woodland in Washington (consisting of 2/3 Douglas Fir with Western Redcedar, Western Hemlock and Red Alder) are analysed to demonstrate that management can produce an annual income from thinnings while maintaining or increasing production." (FA)

648. Worthington, Norman P., Floyd A. Johnson, George R. Staebler, and William J. Lloyd.
1960. Normal yield tables for red alder. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Pap. 36, 32 p. Portland, Oreg.

"Computed from data from 428 Alnus rubra sample plots in pure stands aged 10-80 years in N.W. Oregon, W. Washington, and S. British Columbia. Methods of preparation are briefly described." (FA)

649. Worthington, Norman P., Robert H. Ruth, and Elmer E. Matson.
1962. Red alder, its management and utilization. U.S. Dep. Agric. Misc. Publ. 881, 44 p. Washington, D.C.

Covers silvicultural characteristics and increment as well as management and utilization. (CFH)

650. Wright, Ernest.
1954. A preliminary study of the deterioration of alder and Douglas-fir chips in outdoor piles. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn. Res. Note 99, 5 p. Portland, Oreg.

"In a pilot test, lasting 1 year, of a pile containing 2/3 Alder and 1/3 Douglas, deterioration of Alder chips was slowed down without increasing the decay in Douglas Fir for the test period. A pile containing 90% Douglas Fir and 10% Alder showed no decay during the test. This test is not considered conclusive." (FA)

651. Wu, Chih Fae.
1977. The chromophoric behavior of Norway spruce, western hemlock and red alder thermomechanical pulps. H.S. thesis. Univ. Wash., Seattle. **57** p.

Pulp produced by thermomechanically processing wood with high temperature pressurized steam is discolored because of the extractive and lignin components of wood. Brightness varies with species and with steaming temperature. High temperatures usually result in darker pulp. Under the same conditions, Norway spruce is brighter than either western hemlock or red alder. Sodium sulfite pretreatment can increase the brightness of thermomechanically produced pulp, largely eliminating the effect of extractives. It demonstrates a potential for producing pulp by thermomechanically processing wood especially that of hardwood species. (CFH)

652. Yarwood, **C.** E., and H. W. Gardner.
1972. Powdery mildews favored by agriculture. (Abstr.)
Phytopathology **62(7):799.**

"Certain host/pathogen associations in the Erysiphaceae have been found only in habitats disturbed by man, and not where the hosts occur naturally: Erysiphe cichoracearum on 11 species of Eucalyptus; **E.** polygoni, Hicrosphaera alni, and Phyllactinia corylea on 30 species of guercus and Lithocarpus; and others. Only three host/pathogen associations, including M. alni on Alnus oregona (**A.** rubra) appeared to be as abundant on undisturbed wild plants as on those influenced by man. Tillage and pruning were shown in this study to favour disease." (FA)

653. Yarwood, C. E., and H. W. Gardner.
1972. Powdery mildews favored by man. Plant Dis. Rep.
56(10):852-855.

"The following Erysiphaceae were abundant in cultivated areas, but conspicuously absent where the hosts occurred naturally in areas relatively undisturbed by man: Erysiphe cichoracearum on Baccharis pilularis var. consanguinea, Erysiphe polygoni on Eschscholtzia californica, Sphaerotheca fuliginea on Navarretia squarrosa, S. fuliginea on Prunella vulgaris, and S. lanestris, **E.** trina, Microsphaera alni and Phyllactinia corylea on 30 species of Lithocarpus and Quercus. Host of some 1400 collections of Erysiphaceae on some 536 host species from **1934** to **1972** have been **on** cultivated plants, or in botanic gardens, greenhouses, parks, campuses, and roadsides, and it is not known whether the mildew also occurs in the native habitat of the host. Only three host: pathogen associations (M. alni on Alnus oregona, P. corylea on Diplacus aurantiacus, and E. cichoracearum on Myosotis sylvatica) appeared to be as abundant on undisturbed wild plants as on those manipulated by man. **A** positive correlation of leaf size with susceptibility of Quercus agrifolia to **E.** trina and of **Q.** ilex to S. lanestris was established. The relative role of tillage, fertilization, watering, pruning, greenhouse culture, or some unknown factor in favoring mildews is unclear. Of these, only tillage and pruning have been demonstrated to favor disease in this study." (A)

654. Yoho, James G., Daniel E. Chappelle, and Dennis L. Schweitzer. 1969. The economics of converting red alder to Douglas-fir. USDA For. Serv. Res. Pap. PNW-88, 31 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"This study defines those conditions where it is more profitable to replace red alder stands with Douglas-fir than to manage for red alder. Under most of the circumstances analyzed, red alder stands should be immediately converted. In order of importance, the critical variables in this decision were found to be the discount rate, site productivity, expected stumpage prices, the present age of the existing red alder stand, costs of conversion, and annual management costs. Sensitivity analyses suggest how these variables influence the conversion decision." (A)

655. Yoho, James G., Daniel E. Chappelle, and Dennis L. Schweitzer. 1969. The marketing of red alder pulpwood and saw logs. USDA For. Serv. Res. Note PNW-96, 7 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"In the Pacific Northwest, red alder has invaded many cutover areas which once supported Douglas-fir. As the supply of red alder increased, more uses were found and red alder became more valuable. This Note measures the present red alder resource and summarizes its production, marketing, and future prospects." (A)

656. Zabka, Josef. 1942. Taxonomické poznámky o olši a jejím geografickém rozšíreni. [Taxonomic notes on alder and its geographic distribution.]. Lesn. Pr. 21(1):10-20. [In Czech., German summary.]

"Two subgenera of Alnus are distinguished: Alnobetula, with 1 species, A. virdis; and Gymnothrysus, with 8 species, A. cordata, A. subcordata, A. japonica, A. incana, A. rubra, A. tenuifolia, A. rugosa, and A. glutinosa." (FA)

657. Zach, Lawrence W., Don Bauer, and Hal Goodyear. 1943. Practical application of plant hormones in forest-tree propagation. J. For. 41(3):214.

"Results from preliminary experiments show that: (a) for extensive field planting, cuttings treated with indolebutyric acid are not practicable in the propagating of Douglas Fir, Port Orford Cedar, Western White Pine, Western Weeping Hemlock, Red Alder, and Shipmast Locust; (b) seedlings (2-0 and 1-0 stock) of Douglas-fir, Port Orford Cedar and Ponderosa Pine, and of Western White Pine (2-0 stock only) do not react significantly to treatment with indolebutyric acid; (c) seeds of Sugar Pine and Port Orford Cedar treated with indolebutyric acid appear to give positive results, those of Western White Pine negative results, while those of Douglas Fir show no significant effect. It is suggested that the apparent ineffectiveness of hormone treatment may be due to temperature conditions." (FA)

658. Zavitkovski, J., and M. Newton. 1971. Litterfall and litter accumulation in red alder stands in western Oregon. Plant and Soil 35(2):257-268.

"Litter accumulation in 2- to 33-year-old Alnus rubra communities in the Coast Range area of W. Oregon is greater than that reported for any other plant community of the temperate regions. Litter production is also unusually high in communities of other N-fixers, such as Ceanothus velutinus; This character suggests that the ability of such species to produce large quantities of N-rich litter, even in an unfavourable environment, is related to their ability to fix N. Litter accumulates rapidly on the ground during the first five years after establishment of **A.** rubra, but equilibrium is reached at age 6, and is maintained after several decades. During this time, the decomposition of litter equals the annual litter fall. In 50 years, cumulative litter fall reaches >300 metric tons/ha, most of which is decomposed and incorporated into the mineral soil. Favourable physical, chemical, and nutritional soil conditions are created by Alder for the development of the climax vegetation." **(FA)**

659. Zavitkovski, J., and Michael Newton. 1968. Effect of organic matter and combined nitrogen on nodulation and nitrogen fixation in red alder. **In** Biology of alder, p. 209-223. J. M. Trappe, J. F. Franklin, R. F. Tarrant, and G. M. Hansen, eds. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

"Nodulation and growth in dry weight of red alder plants were influenced favorably by increasing levels of total soil nitrogen (TSN). Few but large nodules developed in soils with low TSN; in soils with high TSN, nodules were small but more numerous. Accretions of nitrogen to the systems and efficiency of nitrogen fixation peaked between 0.03 and 0.05 percent TSN. Nodulation was adversely affected by urea-nitrogen, but additions of 15-30 ppm of nitrate-nitrogen depressed the nodulation. Rates of nitrogen fixation of over 300 kg/ha year, determined under red alder stands 2-14 years old, were substantiated by greenhouse experiments, Based on efficiency of nitrogen fixation of about 5.4 mg N/day g nodule, dry weight, rate of fixation could reach 140 kg/ha year of nitrogen in a 7-year-old alder stand, and up to 209 kg/ha year in a 30-year-old stand. Based on average accretion of 220 mg of nitrogen per kilogram of soil, nitrogen fixation could approach 100 kg/ha during the first year in the field." (A)

660. Zavitkovski, J., and R. D. Stevens. 1972. Primary productivity of red alder ecosystems., Ecology 53(2):235-242.

"Fifty red alder communities from 1 to 65 years old were studied in western Oregon. Highly significant correlations were found between an index of volume and dry weights of whole trees, individual stems, crowns, tops, and roots. Correlations of dry weight with other independent variables (age, dbh, height) were variable and strongly curvilinear. Ratios of crown to stem in dominant trees were higher than those of suppressed or intermediate trees. Biomass of aboveground parts increased rapidly during the first 20 years and reached about 240 mt/ha by the age of 33 years. Net primary productivity during the years of maximum growth (between 10 and 15 years) averaged 26 mg/ha per year. Net assimilation rates ranged from 2.58 to 4.33 mt/mt per year. To produce best yields, red alder stands should be harvested before 20 years of age." (A)

661. Zavitkovski, Jaroslav, and Michael Newton. 1967. The role of snowbrush (Ceanothus velutinus Dougl.) and red alder (Alnus rubra Bong.), in forest regeneration in the Pacific Northwest. Int. Union For. Res. Organ. 14th Congr. Proc. Part II (Sect. 21), p. 429-440. [Munich.]

"Both species are, because of their litter production, important pioneer species and soil builders in the early stages of succession on infertile soils. Their role as nurse crops is, however, of doubtful value and their net effect on conifers is more harmful than beneficial. Snowbrush may decrease the survival of natural or planted conifer seedlings, development of which may be retarded by 5-15 years. The suppressive potential of Red Alder is even more pronounced, and only the most tolerant species may be able to survive under heavy stands." (FA)

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The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

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