COMPRESSION WOOD IN CONIFERS AS A MORPHOGENETIC PHENOMENON

STEPHEN H. SPURR AND MATTI J. HYVÄRINEN

INTRODUCTION

Compression wood—otherwise known as "redwood", "reaction wood", "Rotholz", "Druckholz" and "bois rouge"—is of common occurrence in conifers. Much attention has been given to its occurrence, formation, and properties, yet the mechanism by which it is laid down is poorly understood. The present paper represents an effort to summarize briefly and succinctly our present knowledge of the formation and function of compression wood in conifers.

A fairly complete bibliography is appended. Several references have been omitted, for they deal only casually with the phenomenon, as well as others dealing with compression wood only as a defect in wood utilization. Apart from these omissions the bibliography is much nearer complete than any other in the literature. No effort, however, will be made to present a complete review of the literature, although practically all of the references cited have been examined in the preparation of this paper. Several of the principal references have been reviewed in English (Büsgen and Münch, 1929; Kienholz, 1930; Sinnott, 1952). It is felt that more is to be gained by extracting and emphasizing what appear to be the major points.

Lengthy though the bibliography is, it covers only a small part of the relevant literature, the part dealing expressly with compression wood. As with any other morphogenetic phenomenon, compression wood can not be considered as an isolated subject, but must be treated in relation to the rest of the plant organization. Compression wood is a tropic phenomenon, and the whole literature on geotropism and probably photoperiodism as well is relevant. Similarly attention should be paid to the literature on mechanical factors, such as induced torsion and compression; on eccentric growth; on tension wood, the related phenomenon in angiosperms; and on gravity effects other than geotropism. There

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1 Professor of Silviculture and Graduate Student, respectively, School of Natural Resources, University of Michigan.
is evidence that growth substances may play a part in causing the formation of compression wood, and a study of the related literature in this field is called for. Finally compression wood results from a change in the process of cell wall formation, and the vast literature dealing with this process should also be consulted.

**OCCURRENCE**

The occurrence of compression wood was first treated in detail by Mer (1887a, 1887b), Hartig (1896, 1899, 1901) and Cieslar (1896). It is known to occur:

1. Normally on the underside of lateral branches in conifers.
2. On the underside of the main stem in leaning trees.
3. On the underside of the main stem of living fallen trees, even though the stem is supported by the ground throughout its length.
4. On the reverse side of the stem or branch after initial abnormal curvature has been overcorrected, apparently by compression wood on the original under side.
5. Rarely as spiral bands in apparently erect trees, the bands continuing to develop throughout the life of the tree and causing as many as seven whirls of compression wood in the cross-section (Fabricius, 1932; Hartmann, 1932; Douglass, 1940; Fritz, 1940; correspondence, U. S. Forest Products Lab.). Cases have been reported from Sweden, Alaska and Quebec, all in spruce (Picea spp.). Compression wood always occurred at point of maximum diameter growth.
6. On the lower side of naturally occurring crooks and deformations in the stems of trees (Hartig, 1896; Spurr and Friend, 1941 and others).
7. In the normal stem which is apparently straight, but below natural or artificially induced deformations and obviously related to them (Cieslar, 1896; Hartmann, 1932).
8. More in fast-growing than slow-growing trees. For example, Pillow and Luxford (1937) found that with ponderosa pine (Pinus ponderosa) in the Black Hills, trees with moderate lean (3–5 degrees) which had recently formed compression wood had a rate of diameter growth more than twice as great as that in trees of similar lean in which compression wood formation was not noticeable. Similarly trees with pronounced lean (more than 5½ degrees) not forming recognizable compression wood were non-vigorous and