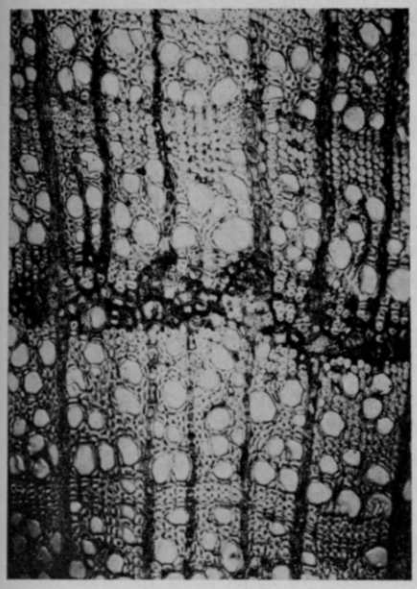

Protrusion, in this closeup of a frost rib in cross section of an elm stem, is associated with bacterial wetwood and heart-rotting fungi.

conditions making it possible are known to occur.

Following direct freezing of plant tissue without formation of intracellular ice, the affected cells may recover or not. If the contraction of the internal protoplasm has been severe, protoplasmic coagulation may occur to a degree that is irreversible, and the cells may die. The extent of recovery possible will depend on the manner of thawing, during which the cells can be injured further. On thawing, the intercellular ice melts first, causing a flow-back of water into the cells with a subsequent swelling of the protoplasm. If the rate of thaw is rapid the swelling may be so sudden that the cells may rupture. The manner in which cold-affected cells become sensitive to turgor pressures not affecting them previously, and the decreased elasticity of the cell membrane to moisture changes following injury, indicate that freezing even without intracellular ice in some way alters the permeability of the membrane.

Synthetic studies of slow freezing damage indicate, that following intercellular ice, ice forms between walls and membranes first, in cytoplasm next, and in the vacuole last of all. The nucleus is the last of the protoplasm to be affected. Within the cell then, the degree of susceptibility appears to be largely positional, since in mature cells the vacuole lies at the center of the cellular complex. For the most part, however, cellular damage results from collapse of cells alone, without internal freezing, and from tearing or bursting of tissue following freezing of intercellular water and subsequent thawing.

Although the mechanism of freezing injury is similar for plant tissues generally, all cells and tissues are not necessarily affected in the same way. Apart from heritable differences not expressed structurally, differences in susceptibility and sensitivity result primarily from differences in structure of tissue, and location and exposure of species. Some plants are affected only mildly or not at all because of their capacity to become "hardened." Hardening involves a gradual conditioning through repeated exposure to slowly increasing coldness. During this period there is time for newly formed tissues to mature fully, and the cell walls of both inner and outer tissues become impregnated with various degrees and types of exposure-resistant chemicals, such as: the cutin of shiny leaves; the suberin of corky bark; the cellulose of all plant cells; and the lignin of woody cell walls. In addition, there is a gradual loss of water, so that hardened tissues are relatively dry. Woody plants generally begin hardening off immediately after growth ceases and become progressively cold resistant with approaching frost. These species are characterized by formation of truly terminal buds on ends of branches, in contrast to "pseudoterminal" buds. The latter type are typical of species which do not cease growth until literally stopped "cold" by freezing temperatures. Interestingly, some of these same species, such as the willows, are among the first to resume growth in the spring. This practically guarantees their premature exposure to a certain degree of late frost in the spring, but such species appear to be relatively resistant to such frost, suggesting an adaptation to these conditions.

Destruction of terminal meristems by freezing changes the distribution of auxin which regulates the growth of lateral branches. As with death of terminals from any cause, dormant meristematic tissues in the living stem below the injury may be stimulated to activity. The result may be a profusion of so-called water sprouts appearing as lateral branches in an irregular pattern, or the internal formation of aggregations of tightly packed and sometimes distorted cells, whose growth is short lived. The net effect of such internal tissues may be to interfere with the normal development of food and water-conducting tissues (phloem in bark, and xylem in wood).

The net affect then of freezing may include: partial death of leaf tissue to vigorously growing plants; dieback of terminals; death of cambial tissue, abnormal cell formation, with formation of frost rings in woody plants; failure of new cells to differentiate, with the formation of excessive parenchyma; formation of callus tissue; stimulation of dormant meristematic activity; and complete death of all or parts of individual trees.

Part II will appear in a later issue—Ed.

Plans Being Completed for 12th Fla. Turf-Grass Conference

Final arrangements are now being made for the 12th Annual Florida Turf-Grass Management Conference set for Gainesville, August 25-27, on the University of Florida campus there.

In addition to details announced in W&T last month (p. 20), spokesmen now announce that speakers and turf professionals for the event will be drawn not only from Florida, but from surrounding southeastern states and the Caribbean.

Included in the annual seminar are separate sessions devoted to the specific interests of various turfgrass management groups. Included are discussion groups covering golf course turf; horticultural spraymen and lawn service agencies; retail dealers and garden supply houses; industrial sites; and nurseries.

Those who wish to attend may write for further information to: Dr. Granville C. Horn (or John C. Cabler), 401 Newell Hall, University of Florida, Gainesville; or Walter D. Anderson, Executive Secretary, Florida Turf-Grass Association, 4065 University Blvd. North, Jacksonville.