Traumatic Vertical Lysigenous Canals in Cacao in Papua and New Guinea.

BY DOROTHY E. SHAW.*

ABSTRACT.

The occurrence of tangential series of traumatic vertical lysigenous canals or pseudo growth rings is recorded in some cacao wood specimens from three areas in Papua and New Guinea. The traumatic canals replace xylem and fibres and constitute a zone of weakness in the wood when it is cut from the tree. Normal and traumatic lysigenous cavities of cacao are clearly distinguished with excitation with ultra violet light after treatment with acridine orange, the mucilage appearing brilliant red. The cause of the traumatic canals is not known but was probably injury to the cambium.

INTRODUCTION.

During the examination of sections through the stem and branches of many specimens of cacao (*Theobroma cacao* L.) at the Port Moresby laboratories several cases have been noted where lysigenous canals have occurred in tissue other than the pith and cortex, viz., in the wood. In cacao the normal location of lysigenous cavities filled with mucilage is in the pith and cortex (Metcalfe and Chalk 1950, Brooks and Guard 1952).

Record (1925) described traumatic vertical lysigenous intercellular canals in various plant families including Sterculiaceae. Later he listed *Theobroma* as one of the genera of the Sterculiaceae in which the intercellular canals occur, without, however, further elaboration (Record, 1934).

A description of the condition found in the Papua and New Guinea specimens is given below.

MACROSCOPIC EXAMINATION.

In stems and branches split longitudinally or cut transversely the abnormal elements were slightly yellower than the rest of the wood.

They were much easier to see after the wood had been split for some time, at which stage they appeared speckled brown to the naked eye. In transverse section they formed tangential series or pseudo growth rings (*Plate* I, A) and in longitudinal section they formed lines running parallel to the long axis (*Plate* I, B and C). The lines were unbranched, each varying very little in width throughout its length although some were wider than others. Where side branches occurred, the lines could be traced into the branches in positions similar to those in the main axis (*Plate* II, A).

To date no more than three rings or partial rings have been noted in any stem; in some stems only two occurred and in others only one. The distance of the rings from the centre of the stem and from one another varied between specimens.

In freshly split specimens the mucilage was viscous but became brown and hard in wood which had been split for some time, at which stage it formed thin incrustations in the canals; the canals themselves could usually be distinguished with a 10 x hand lens as minute holes in the wood. The speckled appearance was due to fine strands of normal tissue interrupting the longitudinal lines of canals (*Plate* I, C).

In some of the affected branches which had been split for a week it was found that the ring of abnormal tissue formed a zone of weakness so that very little pressure was necessary to cause fracture of the wood in that area. *Plate* II, A shows where such a zone of weakness occurred, and *Plate* II, B shows the cleavage after a little pressure had been applied and the two parts had separated with little difficulty. The faces of the cleavage planes slightly resembled honeycomb with very tenuous cross walls, as shown in *Plate* II, B.

MICROSCOPIC EXAMINATION.

Sections through tissue of affected stems revealed that the pseudo growth rings consisted

* Chief Plant Pathologist, Department of Agriculture, Stock and Fisheries, Port Moresby.

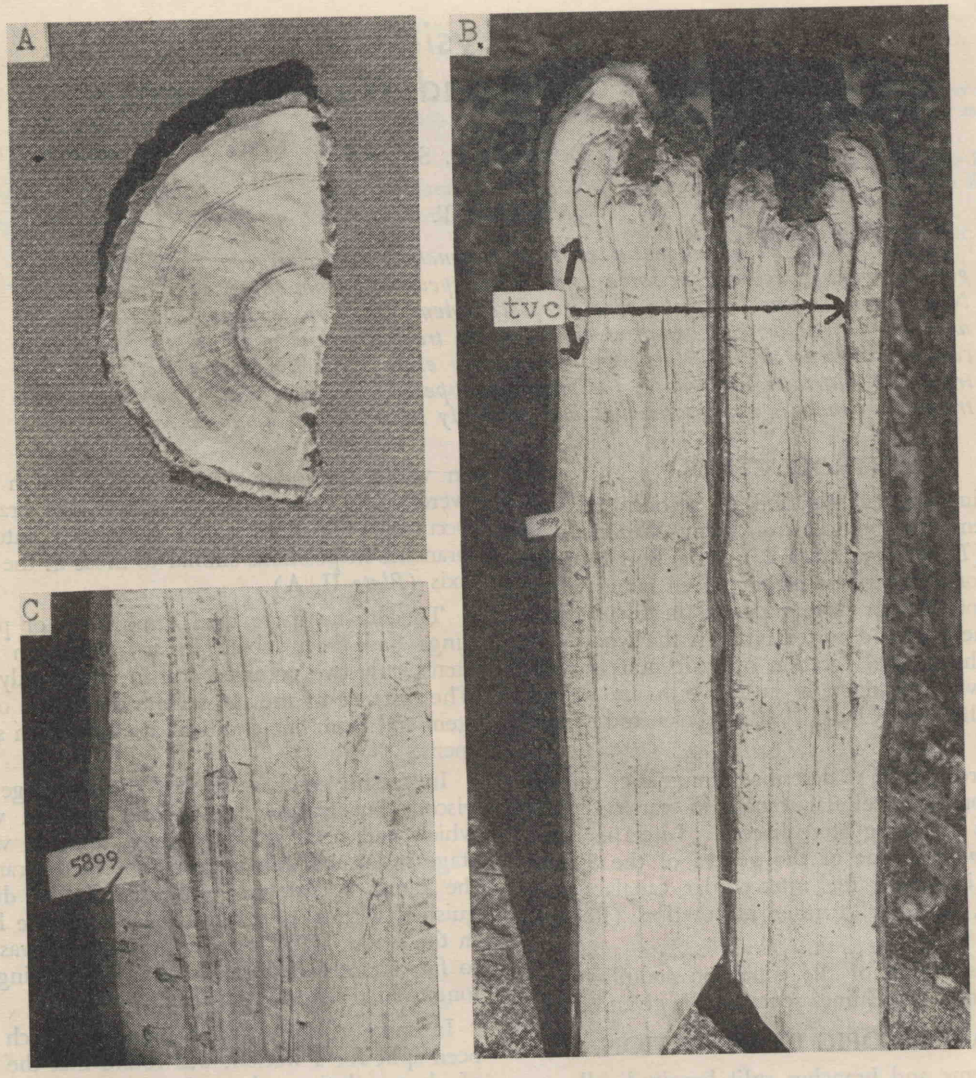

Plate I.—(A) Transverse section showing two pseudo growth rings each consisting of several rings of traumatic certical lysigenous canals. (B) A branch split longitudinally showing line of traumatic vertical canals (tvc). (C) Enlargement of portion of (B) showing speckled appearance of the lines of canals due to cross strands of tissue.

of tangential series of lysigenous cavities (or canals, as the length was greater than the width) formed in the wood. The lysigenous cavities of the pith and cortex occurred as usual.

A portion of a transverse section is shown in *Plate* III. The canals occur between the rays, replacing the xylem vessels and fibres. The rays are slightly compressed where they pass between two canals. One or more vessels or groups of vessels occur between the rows of canals. In this specimen three rows of canals occurred in the zone shown in the Plate.

The canals are mostly very regularly oval in outline in transverse section. In *Plate* III they are approximately five times longer and four times wider than the vessels, the average lengths

and breadths of twenty cavities and vessels taken at random in one section being 345 x 230u for the canals compared with 66 x 64u for the vessels.

In longitudinal section the lacuna of each canal is seen to be interrupted at intervals of up to 1.3 mm by thin cross strands of parenchyma.

The narrow strands of ray parenchyma between the canals and the relative absence of fibres in the ring of tissue in which the cavities were situated constituted the zone of weakness which was evident when a little pressure was applied to the wood, resulting in the cleavage as shown in *Plate* II, B.

Plate II.—(A) Lines of traumatic vertical canals (tvc) passing into two side branches. Zone of weakness (zw) due to lines of canals already partially split. (B) Same section as (A) with cleavage in zone of weakness; faces of the cleavage zone with slight minute honey comb appearance.

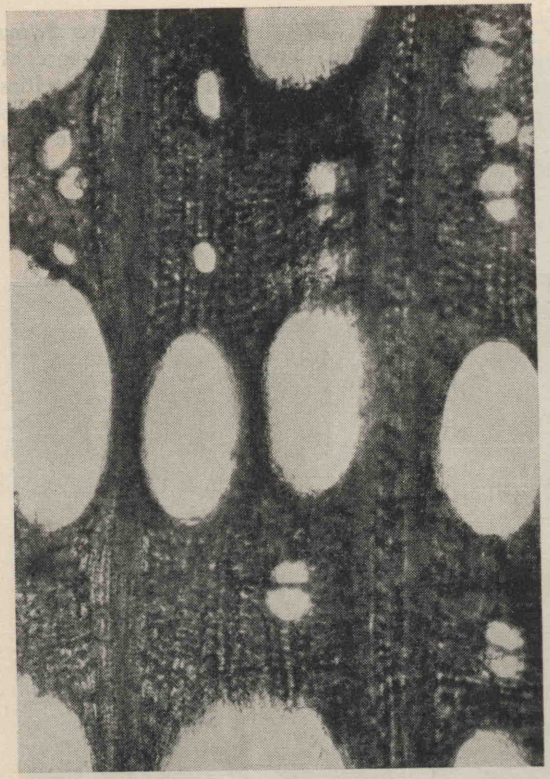

Plate III.—Transverse section through stem showing three rings of traumatic canals in the wood replacing xylem and fibres. x60

EXCITATION WITH ULTRA VIOLET LIGHT.

When sections of normal cacao wood direct from the tree are treated with acridine orange and ultra violet light is used as the excitant, the xylem, fibres and parenchyma of the wood and the fibres of the cortex capping the phloem groups appear yellowish green. The non-living mucilage, however, appears brilliant red, whether it occurs in the mucilage cells of the cortex or in the lysigenous cavities of the cortex and pith. Much of the mucilage seeps out of the cavities and cells in thin sections taken from young shoots of normal cacao so that the cells of the pith and the cells of the cortex other than the fibres also have a red cast. The mucilage which seeps into the mountant is also brilliant red (*Plate* IV).

The traumatic lysigenous canals which occurred in some branches as described in this paper also appeared brilliant red in acridine orange with ultra violet excitation, and were spectacularly distinguished from the xylem, fibre and parenchyma tissues of the wood.

OCCURRENCE.

The rings of traumatic lysigenous canals have been found to date in cacao wood from the Popondetta area in Papua, and from the Gazelle Peninsula in New Britain and from New Ireland, both in New Guinea. It is quite possible that they occur in cacao in other areas.

DISCUSSION.

The cause of the condition is at present unknown.

The wood samples which were found to contain the traumatic lysigenous canals were forwarded to the writer as sample lengths from six inches to three feet in length and were stripped of leaves before dispatch. The trees from which the samples were derived were unmarked so that it was not possible for the collectors or the writer to go back to the trees and examine them in order to determine whether any abnormal growth habit or damage was evident.

Brooks and Guard (1952) stated that in the stem tips of normal cacao the position of the lysigenous cavities is indicated by groups of cells in which cytoplasm is more granular and has a greater affinity for stain. Each of the groups rapidly develops into a large lysigenous cavity filled with mucilage.

Record (1925) considered that traumatic (as distinct from normal) vertical intercellular canals presumably arise as a consequence of injury to the cambium.

Whether the factor initiating the traumatic vertical canals under discussion was mechanical or insect damage, or a physiological disturbance to the tree, is not known. Whatever the initiating factor, it seems (from the lengths of wood studied to date) that once the canals form they persist for several feet at least. It is not known whether the growing point can revert to normal wood production without the traumatic canals once they have been formed in the stem ; tracing throughout the whole tree will be necessary to determine this point.

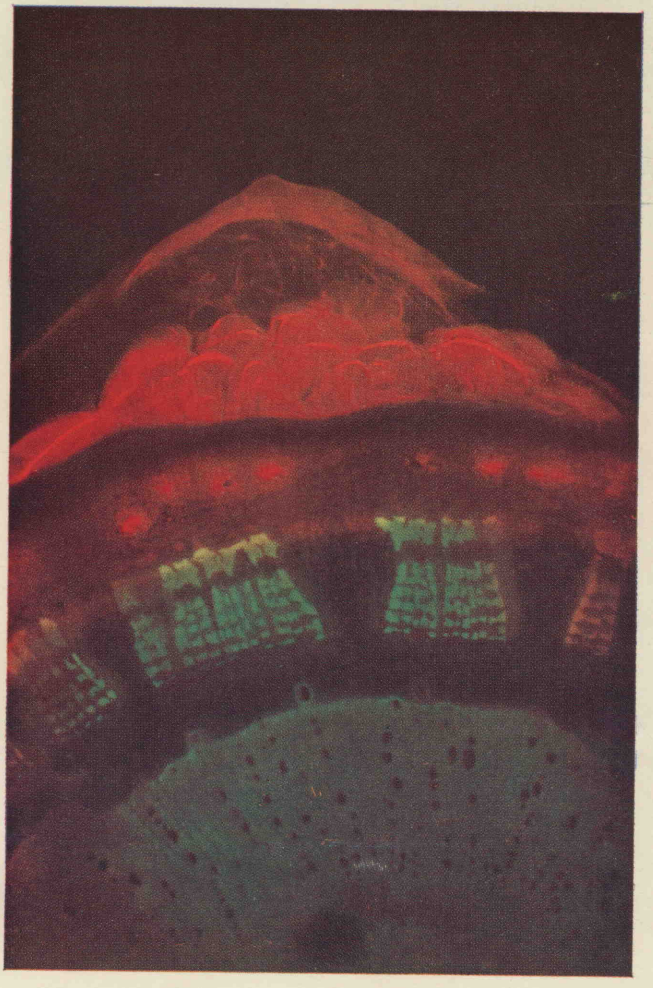

Plate IV.—Transverse section through stem of healthy Cacao stained with Acridine Orange and with U.V. excipation. Mucilage in cells of cortex and seeping into mountant brilliant red. x15.

While the canals constitute a zone of weakness in the wood when the tree is cut, it is not known whether their presence constitutes a zone of weakness in the live tree, that is, as distinct from the presumed injury which initiated their occurrence.

ACKNOWLEDGEMENTS.

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