Oxford University Press, Amen House, London E.C.4

GLASGOW NEW YORK TORONTO MELBOURNE WELLINGTON
BOMBAY CALCUTTA MADRAS KARACHI LAHORE DACCA
CAPE TOWN SALISBURY NAIROBI IBADAN ACCRA
KUALA LUMPUR HONG KONG

PATHOLOGY OF TREES AND SHRUBS

WITH SPECIAL REFERENCE TO BRITAIN

BY

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OXFORD
AT THE CLARENDON PRESS
1962

Control

In the nursery trees may recover if cut back. Manuring with ammonium sulphate and other substances has been suggested as a means of encouraging recovery (Caroselli 1954, 1956), but the information on this aspect of control is rather contradictory. Soil infected with *Verticillium* can be fumigated to kill the fungus before replanting (Wilhelm and Ferguson 1953). The most promising substances appear to be chloropicrin, allyl bromide, and 55 per cent. chlorobromopropene, at 25, 30, and 45 c.c. per m.^{2} respectively, injected at points 30 cm. apart and to a depth of 15 cm. in the case of chloropicrin, which diffuses rather rapidly upward, and 7·5 cm. for the other two substances. In a mixed nursery infected ground should not be used for maples or Sycamore. Unfortunately, in view of the occurrence of the fungus on so many host plants, it cannot be assumed that a period under agricultural crops will clear the ground. Attack may follow the use of ground previously occupied by a crop such as potatoes (Meer 1926).

Any diseased plants which have been grubbed up should be burnt, while those retained in the hope of recovery should not be moved to another part of the nursery, lest they carry infection with them. Tools used for cutting down or pruning infected plants should be sterilized before being used on healthy trees.

Other wilt diseases

A wilt caused by the fungus *Ceratocystis* (*Endoconidiophora*) *virescens* (Davidson) Hunt (Ascomycetes, Sphaeriales) has been reported causing the death of large Sugar maples (*Acer saccharum*) in the United States (Hepting 1944). The internal symptoms are generally similar to those of *Verticillium* wilt, though the stain in the wood is grey to reddish; but the external symptoms are quite different, the foliage getting progressively smaller and paler green each year, and death following within two to four years of their first appearance.

There is some danger inherent in the fact that the fungus causing the disease is a common sapwood stain of hardwood logs in North America, and is therefore likely to be freely transported from place to place. On the other hand, the disease does not appear to have developed seriously since it was first reported in 1944. The host range is not known, but trees of *A. rubrum* mixed with infected Sugar maples have remained healthy.

STEM DISEASES—BARK AND CAMBIUM

Nectria dieback

Nectria cinnabarina (Tode). Fr. (Chapter 18) is associated with dieback of twigs and occasionally larger branches in Sycamore and maples, but is seldom serious. There is variation in susceptibility between different species of *Acer* (Uri 1948). Spierenberg (1937) suggested that cankers caused by this fungus on maples should be treated with a very strong fungicide, the dead and dying tissue then cut out, and the wound finally treated with Bordeaux mixture. *N. coccinea* (Pers.) Fr. and other species of *Nectria* have also been found associated with canker and dieback of maples.

Sooty bark disease

Pathogen

The fungus associated with this disease, *Cryptostroma corticale* (Ell. & Ev.) Gregory and Waller (Fungi Imperfecti, Moniliales), has already been fully described (Gregory and Waller 1951; Anon. 1952*a*). It forms hard black stromatic layers in the tissue of the bark. These layers eventually separate leaving cavities, the two sides of which are kept apart by black columns of fungal tissue up to 1 mm. long by 0·33 mm. in diameter. These columns usually persist as minute spikes on the exposed surface after the outer bark has been shed. When the bark is shed, the spore mass is revealed. The spores arise from the ends of single hyphae conidiophores, which are packed closely together to form a bluish-grey layer on top overlying the hard black stroma. This bluish-grey layer is exposed after the spores have been shed, but eventually wears away, showing the black stroma underneath. The minute spores are brownish-black in mass, and are borne in chains. The number of spores produced by the fungus is enormous, ranging from approximately 30 million to 170 million per square centimetre (Gregory and Waller 1951). The herbage at the base of infected trees is often blackened by the spores falling on it. It has been suggested by C. and M. Moreau (1954) that the perfect stage of *Cryptostroma* is the very common saprophyte on Sycamore, *Eutypa acharii* (Fries.) Tul. (Ascomycetes, Sphaeriales), but there is no good evidence to support this contention. In Britain *Eutypa* appears to have a far wider distribution than *Cryptostroma*.

Symptoms and development

The most obvious symptom of the disease is a blistering of the bark, the outer layer of which subsequently peels off, exposing the spore mass (Fig. 81). This may happen over the whole trunk of a dead tree, while on live trees it may be limited to quite small areas on the trunk, or to individual twigs or branches. On some trees small lesions may lie in a vertical line up one side of the trunk. If the tree is badly affected the foliage wilts over the whole or part of the crown and sometimes this is the first sign of the disease.

If an infected twig or branch is cut across, a greenish-brown to yellow stain, which is usually darker at the edges, is found. The stain is in a single column up the stem, not in streaks, as is the case with *Verticillium* wilt. Where the stain touches the inner bark, the spore-producing lesions are usually found. This stain extends far up and down the tree, but fades rapidly after the tree dies. Although it always occurs in trees attacked by *Cryptostroma*, in which case the fungus can be cultured from it, staining cannot be taken to indicate with certainty the presence of Sooty bark disease, because similar discolorations, due to other causes, are often found in Sycamore wood.

At the moment there is no actual proof that the fungus is the cause of the disease. Such inoculation experiments as have been tried (Robertson 1955) have not been fully successful, since the fungus did not spread appreciably into the living wood beyond the cut stubs to which the inoculum was applied. On the other hand, the fungus has been found consistently associated with wilting, and often death, of Sycamores that were undoubtedly in perfectly

good health prior to attack, and the degree of dieback has been observed to be roughly proportional to the bark area colonized by *Cryptostroma*. Thus the circumstantial evidence in favour of its pathogenicity is very strong. Possibly the proper conditions for successful development of the fungus have not been achieved in the inoculation experiments. The number of successful

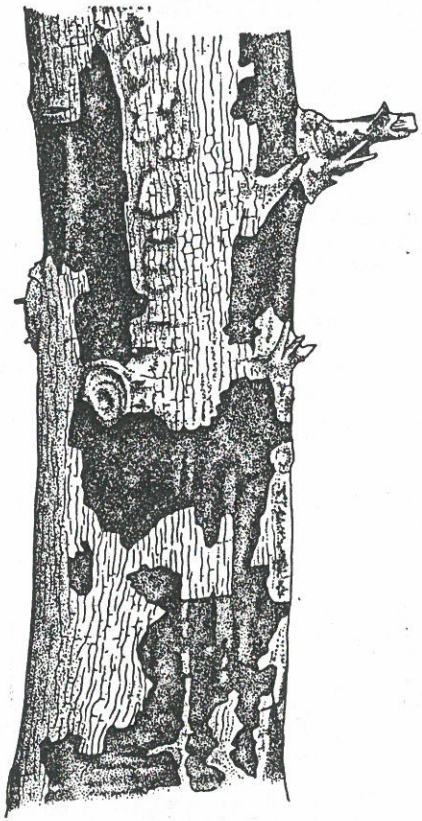

FIG. 81. *Cryptostroma corticale* on sycamore, Wanstead, Essex (× $\frac{1}{12}$). (J. C.)

infections in the field is very low in proportion to the enormous spore production, and it would appear that special conditions may be required, both for successful infection and for subsequent spread. Townrow (1954) found that the germination of the spores and the growth of the fungus are favoured by relatively high temperatures; its growth rate at 10° C. is only one-third of that at 25° C. This could mean that infection and active spread were only possible in hot weather.

Distribution and damage

Active cases of this disease have not been recorded outside the Greater London area, and the majority of the damage has been in north-east London. It is tempting to suggest some connexion with town conditions, but it is difficult to believe that a tree, generally so well suited to town life as Sycamore, could be so weakened by smoke and fumes that the fungus could attack it. Outside London, *Cryptostroma corticale* has been recorded as far afield as Somerset and Norfolk, but nowhere commonly, and always as a saprophyte on Sycamore killed by other causes, or even on felled Sycamore poles.

In Britain the disease has usually been found on Sycamore, but it has also been recorded on *A. campestre*. Other species of *Acer* may well be susceptible, for it so happens that only Sycamore and occasional Field and Norway maples were growing in the areas where the disease was active. In France it has also been recorded on *A. platanoides*, and in one place on *A. negundo*.

The disease has been reported so far only from Britain and France (Moreau and Moreau 1954), but the fungus has been known for some time in the United States and Canada, under its former name of *Coniosporium corticale* Ell. & Ev., as a saprophyte on maple logs.

At the height of its development in 1949 and 1950, the disease appeared to be a real danger to the cultivation of Sycamore, but its activity reached a peak in 1950 and has declined steadily since (Peace 1955), with a slight recrudescence in 1956, according to a recent survey by Dowden (unpubl.). This is suggestive of activity being encouraged by the hot summers of 1947, 1949, and 1955. The amount of damage so far caused by the disease is slight in relation to our Sycamore population, and the recrudescence, reported in 1956, does not compare in virulence with the behaviour of the disease in the London area in the years 1948–50. The disease has now nearly, if not quite, disappeared.

Control

Trees badly affected by the disease should be felled and barked, the bark being burnt on the site. Though the fungus might remain alive in barked logs, it appears unable to fructify in the absence of bark. Where, as quite often occurs, only a branch or even a dead branch stub is affected, this should be pruned off. The disease is very difficult to detect, except on a severely attacked tree, so that any attempt at eradication, even over a limited area, would prove an impossible task.

Other diseases of bark and cambium

Scattered dead patches on the bark of Sycamore, suggestive of fungal attack but certainly not due to *Cryptostroma*, and leading eventually to the death of the affected trees, have been reported on two occasions from Yorkshire. The cause of the disease was not ascertained.

A somewhat similar disease, in which the main symptoms were the oozing of sap from vertical fissures overlying dead areas of cambium, and a reddish-brown discoloration of the affected inner bark, cambium, and sapwood, has been reported on maples in the United States (Caroselli and Howard 1940; Pirone 1948) under the name of Bleeding canker. The disease led to