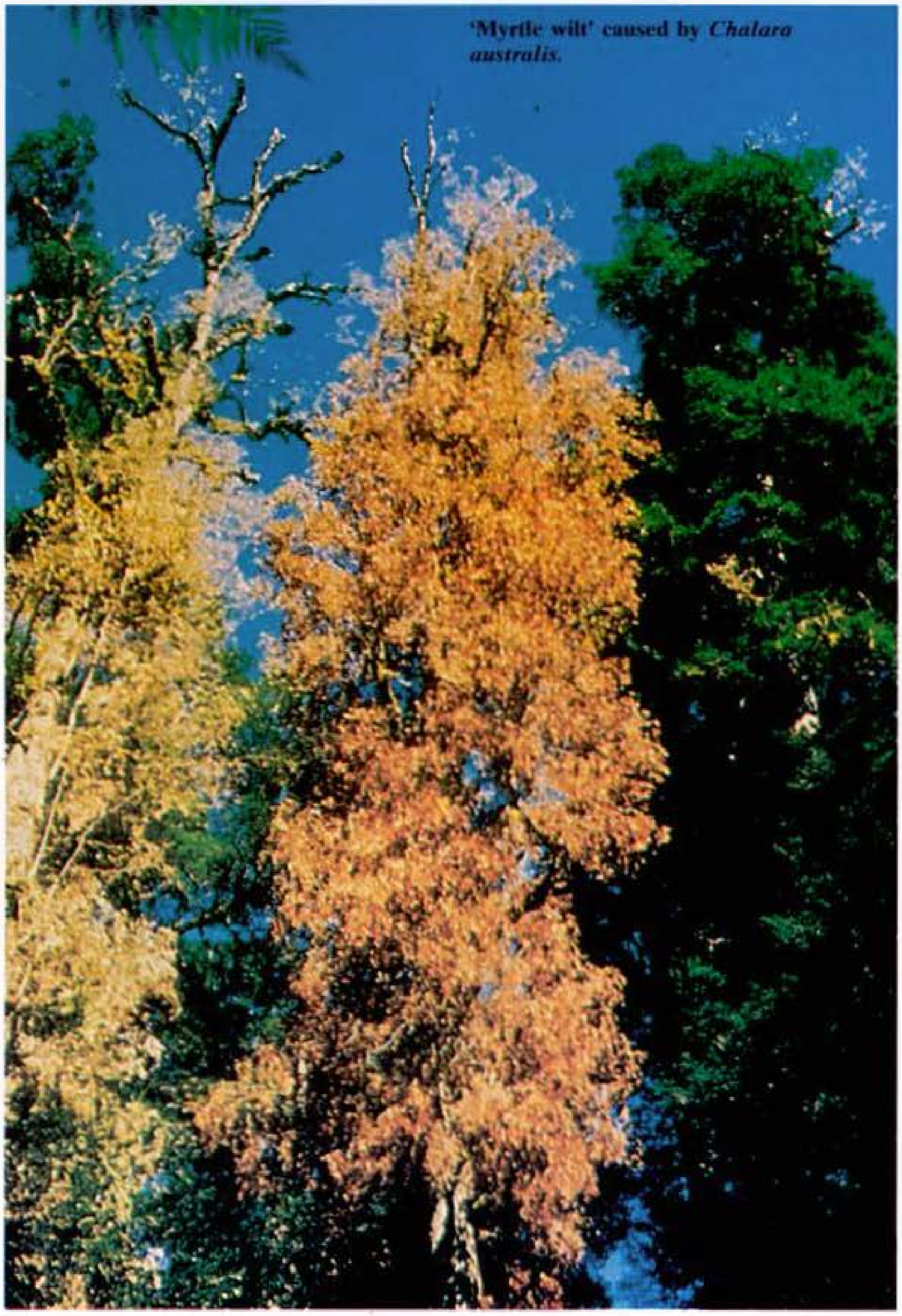
Myrtles, *Platypus*, and fungi

A possible threat is facing Tasmania's cool temperate rainforest — and it's not man-made. The story of how a fungus previously unknown to science is infecting and killing the native myrtle beech, the predominant rainforest tree, has been partly unravelled by CSIRO scientist Dr Glen Kile of the Division of Forest Research's Hobart laboratory, in co-operation with the Tasmanian Forestry Commission.



'Myrtle wilt' caused by *Chalara australis*.

Disease of the tree, *Nothofagus cunninghamii*, was first noticed in Tasmania many years ago. Today, the problem is widespread in western and north-eastern Tasmania, and is also found in parts of southern Victoria, although information about its occurrence there is limited. Affected trees show wilting of the crown, followed by leaf fall — hence the colloquial name 'myrtle wilt'. Other symptoms include discolouration of the sapwood, reaching from the roots to the upper stem.

Although scientists have been aware of the problem for nearly two decades, they lack sufficient data from the past to say whether or not it is increasing. The newly discovered fungus is probably native and therefore the disease itself is presumably not new.

Dr Kile has the impression that the disease has intensified in the last decade, but this could be merely because scientists are starting to look into the question a little more. Alternatively, a genuine upsurge might have been caused by the increasing disturbance of the forests for road-building and logging, both of which can aid the spread of the problem. Another possibility is that we are witnessing a change in the pathogenicity of the fungus, and hence the severity of the disease. (Such a change in the characteristics of a pathogen occurred recently with Dutch elm disease in Europe and North America.)

Dr Truda Howard, when working for Associated Forest Holdings at Ridgley, Tasmania, was the first to report myrtle wilt in the scientific literature back in 1973.

The wood discolouration that is a symptom of the disease. This is from a naturally infected tree.

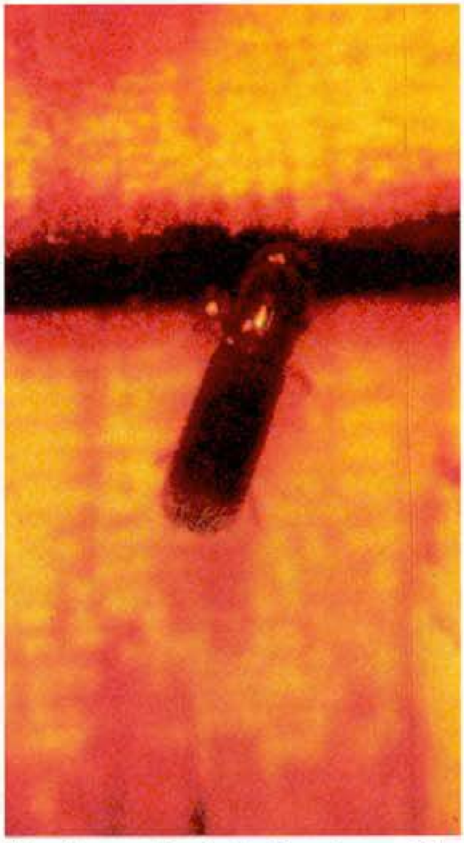
In diseased and recently dead trees she observed large numbers of tunnels made by a small bark-boring beetle. Curiously, the little insect goes by the scientific name of *Platypus* — *Platypus subgranosus*, to be exact — but it bears no relation to its vastly more famous aquatic namesake (which anyway is called *Ornithorhynchus* by scientists, so there should be no confusion)!

Dr Howard also noticed a fungal mat on the cut surfaces of stems, and she hypothesised that the beetle was carrying the fungus from tree to tree and leaving fungal spores in its tunnels, so acting as the vector of the disease.

About 3 years ago, Dr Kile started some intensive research on the issue. In collaboration with Dr Humphrey Elliott of the Tasmanian Forestry Commission, he counted healthy and diseased trees of *N. cunninghamii* along 30 km of transects in 20 different rainforest stands in Tasmania.

The disease tended to occur in patches, and was less common at higher altitudes. Its incidence ranged from 9% to 53% of *N. cunninghamii* in the forest stands studied. While disturbance, such as logging or road-making, increases that incidence, the scientists also found extensive patches of dead and dying trees occurring in some of the remote and undisturbed places that they surveyed.

Now, all this was useful information, but the matter of the cause remained. To prove that an organism causes a disease, you must first isolate your suspect from infected trees, and then administer it to healthy trees and see whether they develop symptoms. If so, you must then be able to isolate the original suspect again from those trees. And all this must be performed with suitable controls, just in case of coincidence.



The *Platypus* beetle itself, and one of its tunnels.

Even so, misleading complications can arise: for instance, once a tree is weakened by disease, plenty of other pathogens may 'jump on the bandwagon' and invade the ailing organism just because the opportunity is there when its defences are down. Such opportunistic pathogens can easily be mistaken for the real culprit.

The fungus eventually makes a spore-producing mat, seen here in the cut end of a myrtle stem.

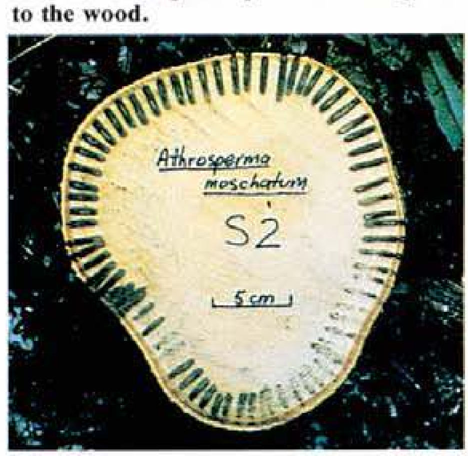
In the laboratory, Dr Kile took discoloured wood from the diseased trees and cultivated any fungi present in it. One species consistently turned up, and it was later identified as a new species by mycologist Mr John Walker of the New South Wales Department of Agriculture, who dubbed it *Chalara australis* (meaning the southern *Chalara*).

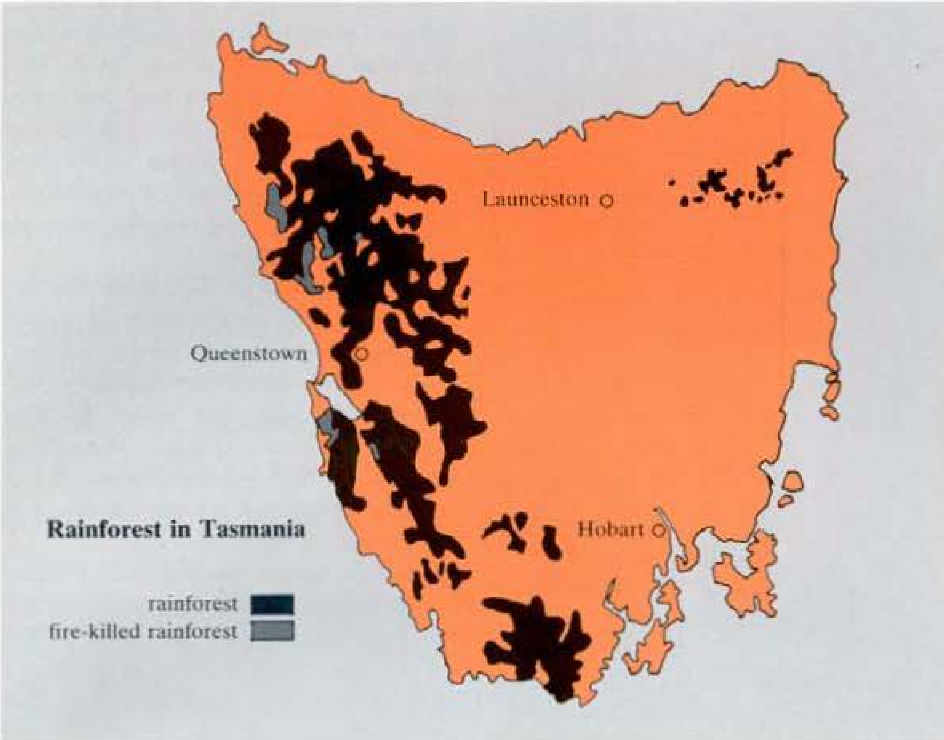
Plant pathologists already knew *Chalara*, the genus to which it belongs. The new disease-causing fungus' closest relative, *Chalara neo-caleodoniae*, causes a wilt disease of coffee and guava in New Caledonia. The new species is also related to fungi that cause a wilting disease in oak and a condition called sapstreak found in sugar maple in North America.

Dr Kile inoculated spores of *Chalara australis* into seedlings, saplings, and mature trees of *N. cunninghamii* and successfully reproduced all the symptoms observed in infected trees in the wild. The only difference was that the artificially infected trees sickened more quickly than those in the wild, probably because the method of spore inoculation allowed the fungus to invade and spread through the host's vascular system more rapidly than it would in a natural infection. (Naturally infected trees may take from less than 1 year to 2·5 years or more to die; and the great majority of infections are fatal.)

The next step was to see whether the fungus posed a threat to other trees. Accordingly, Dr Kile inoculated a wide range of tree species — both native and exotic — and found most of them unaffected. The fungus is evidently very specialised. Would it attack a close relative of *N. cunninghamii*? The only other species of *Nothofagus* in Tasmania is *N. gunni* (tanglefoot), and Dr Kile found that *Chalara* did indeed cause symptoms in this tree.

Another forest tree species artificially inoculated with the fungus. The black lines show where the fungal spores were injected into the wood, but there has been no subsequent spread or damage to the wood.





The distribution of cool temperate rainforest in Tasmania.

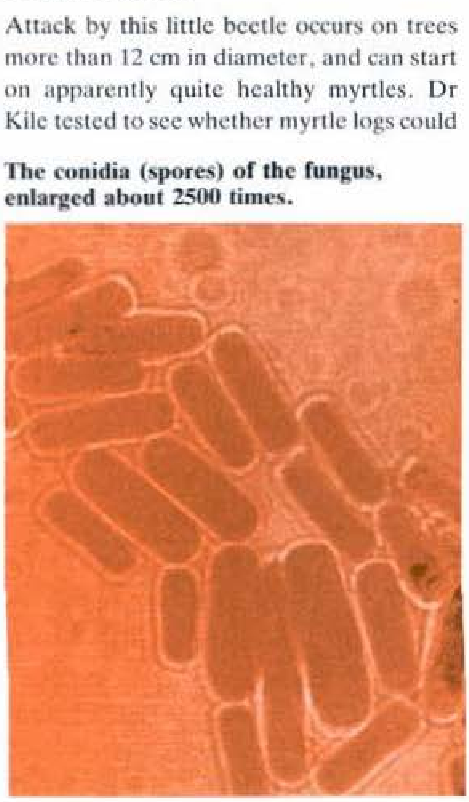
However, in the wild, *N. gunni* seldom succumbs. Dr Kile suspects that the reason is connected with the fact that the species grows at higher altitudes, on average, than does *N. cunninghamii* — perhaps the lower temperatures there retard or prevent fungal growth.

Having found that *C. australis* is almost certainly the pathogenic agent, Dr Kile next addressed the questions: how do trees become infected in the wild, and what part, if any, does the *Platypus* beetle play in this?

Platypus attack

Attack by this little beetle occurs on trees more than 12 cm in diameter, and can start on apparently quite healthy myrtles. Dr Kile tested to see whether myrtle logs could become infected with *C. australis* without the beetle's presence.

The conidia (spores) of the fungus, enlarged about 2500 times.



He left freshly cut logs exposed in the rainforest. Sure enough, they became infected with *C. australis*, but he saw no sign of the beetle. He suspects, therefore, that the infection was started by fungal spores carried in the air or water, which infected the cut surface of the logs as they would wounds on a tree in the natural state. This would explain why logging and other disturbance can increase the incidence of the infection.

Concerning the observed clumping of infected trees, Dr Kile has strong circumstantial evidence that this is caused by root-to-root spread of the fungus underground. He deliberately inoculated small trees (on which beetles would not normally be found). Around each infected tree, others slowly became infected, forming a clump of affected individuals. And, most importantly, no beetles were present.

Extensive tests on the beetle have failed to show that it carries or is contaminated by the fungus. When Dr Kile encouraged beetles to attack logs, any subsequent *Chalara* infection was carefully monitored and traced. It did not originate from their tunnels.

Dr Kile's hypothesis is that the beetles generally attack trees that are already infected, to which they may be attracted by volatile chemicals — possibly alcohols — produced by the fungus and emanating from the sick plant. Of interest here is the work of Dr Elliott of the Tasmanian Forestry Commission and Dr John Madden of the University of Tasmania. They confirmed that ethanol lured the beetles to the wood and found that wet logs produce more ethanol than dry ones. As well as attracting the beetles, the ethanol stimulated them to bore into the wood.

Once beetles have been attracted, then the wounds they make could, of course, act as further entry points for fungal spores, and thus exacerbate the disease.

Is myrtle wilt an important disease? *N.cunninghamii* itself is important as a popular source of wood for cabinet-making. The disease poses a threat to the conservation of isolated stands of mature trees, as they are the ones infected in the wild.

Although death of canopy trees seems anyway to be part of the regeneration process for myrtle, severe outbreaks of the disease could lead to changes in the species composition of the forest, and so it is important to understand whether the balance between the host and the pathogen is changing. Furthermore, large numbers of dead and dying trees increase the risk of fire and also, being likely to fall, pose a definite safety hazard if they occur in areas used for recreation.

More work is needed to confirm some of the details of the parts played by the fungus and the beetle in the distribution of myrtle wilt. Scientists will then have more idea about what to do and what not to do in order to limit the spread of this problem.

Roger Beckmann

More about the topic

Myrtle wilt in Tassie's rainforests. G. Kile. *Tasmanian Wood*, 1985, **16**, 5–9.

The incidence and spatial pattern of *Nothofagus cunninghamii* (Hook.) attacked by *Platypus subgranosus* Schedl in Tasmania's cool temperate rainforest. H.J. Elliott, G.A. Kile, S.G. Candy, and D.A. Ratkowsky. *Australian Journal of Ecology*, 1987, **75** (in press).

Chalara australis sp. nov. (Hyphomycetes), a vascular pathogen of *Nothofagus cunninghamii* (Fagaceae) in Australia, and its relationship to other *Chalara* species. G.A. Kile and J. Walker. *Australian Journal of Botany*, 1987, **35** (in press).

The association of ethanol in the attack behaviour of the mountain pinhole borer *Platypus subgranosus* Schedl (Coleoptera: Curculionidae: Platypodinae). H.J. Elliott, J.L. Madden, and R. Bashford. *Journal of the Australian Entomological Society*, 1983, **22**, 299–302.