

Bushfire mapping by infra-red scanner

This picture was taken last summer, 3 days after the Ash Wednesday disaster. Recorded by an infra-red scanner aboard the CSIRO Fokker F-27, it clearly shows the front of a big fire still burning strongly near Warburton, in Victoria's heavily timbered Upper Yarra Valley.

The Natural Disasters Organisation requested use of the airborne scanner — which the day before was flown from Perth, where it and the Fokker were being used in Project Aquarius (a study of fire behaviour, and the role that water bombers may have in control of fires). In the event, the scramble was worth while, and the Natural Disasters Organisation credits the scanner with helping to bring the fires to an early end.

The scanner can see through dense smoke (but not cloud) to clearly show the position and extent of a fire. The Warburton fire front could not be mapped by spotter aircraft because of dense smoke, and the rugged terrain made ground access difficult.

Images from the scanner allowed officers of the Forests Commission of Victoria to map the fire's extent, as shown in the accompanying illustration. Later, fire-fighters in the field made use of the maps to draw up control lines and bring the fire to an end.

Infra-red surveying by aircraft is routine in the surveillance of forest fires in North America. However, the instance here was the first time Australians have used the technique to help control a dangerous bushfire.

It has very real advantages. Infra-red radiation is only slightly blocked by dense

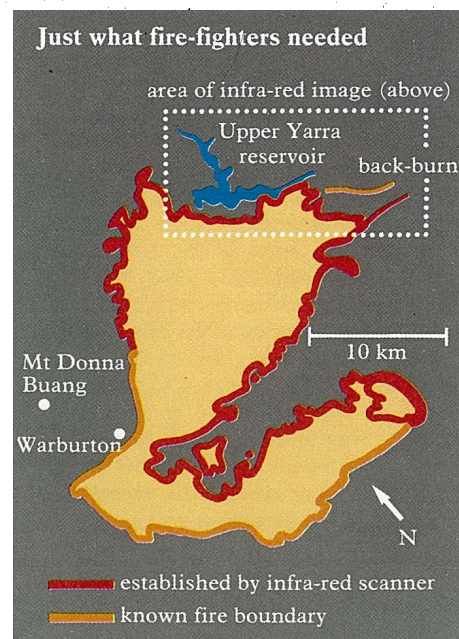
smoke. Furthermore, fires emit infra-red strongly, and show up clearly by this means.

The CSIRO instrument, a modified commercial unit, works in the 8- to 14- μ m band. This displays details of the terrain well, thereby making map-making easy; temperature differences of 0.5°C can be discerned, revealing the locations of roads, rivers, and cleared areas. However, ambiguity can arise between what is a very small fire and what is merely warm (such as a sun-warmed bare patch).

Some overseas instruments get around the problem by using an additional detector in the 3- to 5- μ m band. Only a fire will register in this band, so superimposing the two responses (in two different colours) gives a definitive picture. Dr Andy Green of the CSIRO Division of Mineral Physics, who worked on the development of the Fokker-mounted instrument, is adding this capability to it.

Improved resolution

His expertise comes from working on the analysis of Landsat images, and indeed both systems use a line-scanning technique to build up a picture. Dr Green has improved the resolution of the original instrument tenfold, and now it can pick out details on the ground as small as 5 m across from a height of 3000 m.



The Warburton fire on the afternoon of Saturday, 19 February, 1983. Although smoke hid much of the fire front from spotter aircraft, the full extent of the blaze — vital information for fire-fighters — was revealed by the infra-red scanner.

The image is recorded on magnetic tape for later analysis and enhancement. However, the data also appear on photographic film and it was in this form that the Warburton fire's location was recorded. The RAAF at Laverton rapidly processed the film, which was on its way to the Forests Commission in the city within half an hour of touchdown.

A flight on the afternoon the scanner was flown over from Perth (Friday) was spoiled by cloud and equipment malfunction, but another on Saturday morning proved most valuable, and is the one on which the photo shown here was taken. Missions on Sunday and Monday confirmed that the fire was contained.

Generally, the pictures could not be put to use until at least 5 hours after they were taken. Luckily, the fire was not moving rapidly at this time, and so the information was still useful. However, in the worst

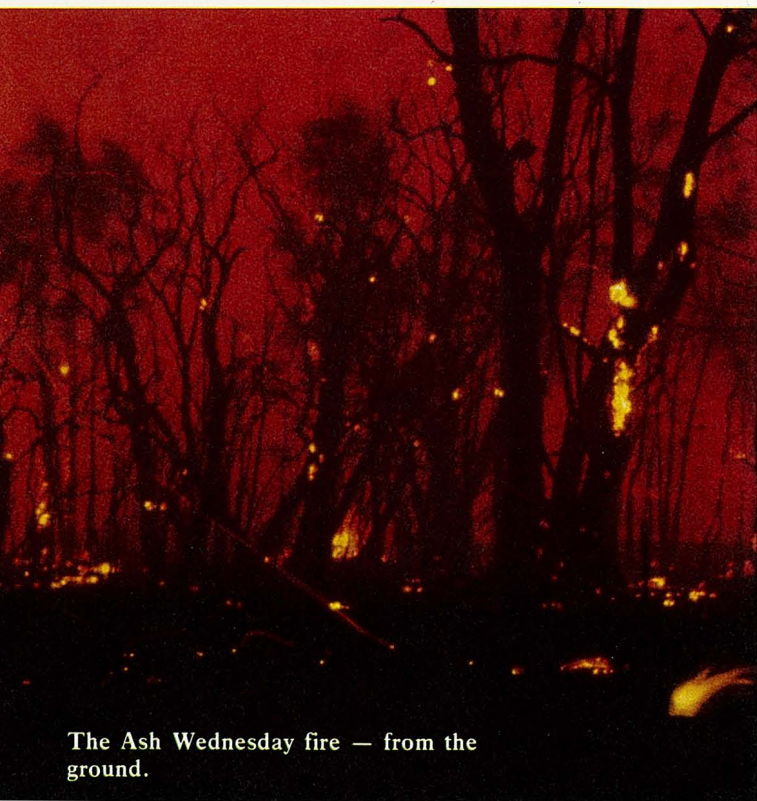


An American fire-bomber in action against a grass fire.

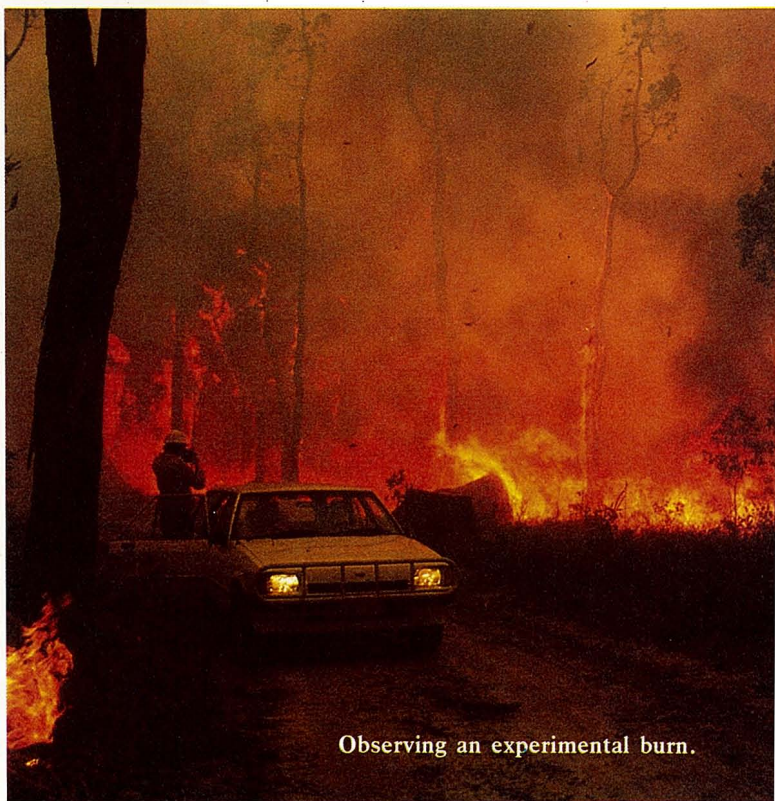
situations this is clearly not the case. Dr Green believes the only real solution to the problem is to have instantaneous transmission of the scanner images from the plane to fire-fighters on the ground. This would be much better than dropping film from the aircraft, as is sometimes done overseas.

Equipment similar to that used by TV stations for outside broadcasts could easily do the job. Dr Green thinks it would be a worth-while scheme, and is keen to see it brought into operation. Infra-red scanners will assume an increasingly important role in controlling bushfires, allowing fire-fighters to make crucial on-the-spot decisions. They offer a way of minimizing damage and saving life.

Andrew Bell



The Ash Wednesday fire — from the ground.



Observing an experimental burn.

Project Aquarius

Since early last year, CSIRO has been studying the effectiveness of controlling bushfires by aerial bombardment with water and chemical retardants.

The exercise, code-named Project Aquarius, was requested by the government, which has provided the additional resources required to carry it out. Mr Phil Cheney of the CSIRO Division of Forest Research is co-ordinating the work.

This summer, aerial bombing of experimental fires will begin. A Douglas

DC6B air-tanker from Canada will perform drops on test burns near Nowa Nowa in East Gippsland with the co-operation of the Forests Commission of Victoria. The tests are designed to provide information on the optimum bombing pattern for particular types of fire.

Data on this are lacking even for North America, where fire-bombing is routine. For Australian conditions, we need to know whether the technique is appropriate. Can the amount of water held in a

small back-yard swimming pool douse fiercely burning eucalypts? In 1982, retardant dropped from an RAAF Hercules on a high-intensity fire near Broadford, Vic., made no difference to the shape or spread of the fire.

But in this case the fire danger was extreme, and maybe on fires of lower intensity or on smaller burns the technique could be of value — but do we use water or retardant, and where do we target it for maximum effect? The logistics and eco-

nomics of the technique are also big unknowns.

The infra-red scanner will be an important tool in studying the response of the experimental fires this summer. It showed its capabilities in preliminary studies of the behaviour conducted in Western Australia earlier this year. Mr Cheney credits the scanner with providing data on fire characteristics that would take years of study on the ground to obtain.

Some 15 experimental fires were set within sections of a 2500-ha jarrah forest near Busselton. The area was surrounded by forest of low fuel load and the fires were lit so that they travelled towards previously burnt areas. Instruments set up in the path of the fires measured temperatures and wind speed. Data-loggers buried in the soil recorded the information, which was later analysed by a computer installed in a mobile laboratory. Overhead, the infra-red scanner measured the fire's rate of spread.

The exercise was a collaborative one with the Western Australian Forests Department's Project Narrik, which also seeks to understand bushfire dynamics. Investigators from Melbourne's Chisholm Institute of Technology were in-



The evolution of one of the experimental fires near Busselton, W.A., as seen by the infra-red scanner. The fire, electrically ignited, began at 3.25 p.m. at dozens of points spaced on a 100-m grid.

involved — they are developing a computer model of the effectiveness of water bombing. Doctors from the Commonwealth Institute of Health also studied the physiology of fire-fighters as they worked to extinguish a blaze.

The Busselton experiments showed how a growing fire can change from one driven by prevailing winds to a larger one that is controlled by its own convection

pattern. When a number of small fires are burning close to each other their individual convection patterns can coalesce, and suddenly the prevailing wind becomes a minor factor. All the fires are focused by incoming cold air towards a centre, where the fire intensity increases dramatically, perhaps by ten times.

Since large fires spread more rapidly, the blaze will suddenly accelerate — a dangerous situation for fire-fighters who may be on the outskirts fighting spot fires.

Clearly there is much about fire behaviour, particularly its spread, that we do not understand. Project Aquarius will provide some of the answers.