

Conclusions.

1. The six species fall into logical groups as indicated by the key.
2. *D. bidwillii* is occasionally difficult to distinguish from *D. colensoi* on the basis of ray-tracheid pits; the latter are, in those cases, obscurely bordered. In other material supplied as *D. bidwillii* the ray-tracheid pits lack the extended borders shown in the drawing and the structure is closely related to that of *D. biforme*.

Summary.

A wide range of material of *Dacrydium* spp. indigenous to New Zealand has been examined. In this discussion of wood anatomy, rimu (*Dacrydium cupressinum*) is referred to briefly as having anatomical links with *Podocarpus* spp., rather than with its sister species in New Zealand. The latter comprise six recognized species referred to as the *silver pine group*; in general the heartwood of the five species attaining tree size is rated as durable in the ground. The feature emphasized as being of principal importance in separating the species is the shape, number and size of pits between ray cells and tracheids.

AERIAL FIRE PATROL IN THE ROTORUA DISTRICT 1945-46 FIRE SEASON

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Introduction.

Although planes were first used for fire patrol duties in the Rotorua District in 1943, this article deals only briefly with the 1943-44 and 1944-45 fire seasons. It was from the experience gained then that the organisation for 1945-46 was built up.

Early in 1944 very dry conditions prevailed and a number of scrub fires raged. The haze and smoke from these made it impossible for lookouts or patrolmen to report their location accurately or to determine their potential danger. Accordingly the R.N.Z.A.F. was requested to provide a plane for general patrol duties and an Oxford was assigned for the purpose. This plane, later replaced by a Harvard was stationed at Rotorua Aerodrome. On all flights a forest officer was carried as an observer, but as the machine was not equipped with suitable radio, it was impossible to communicate with the Kaingaroa Forest radio station, ZLGA. All reports on location of fires or on action required were therefore transmitted by telephone after the plane landed. Nevertheless, the advantages of an aerial patrol were apparent, and from the experience gained during the few hours flown during this season, the foundations were laid for a similar service in the following year.

For the 1944-45 season arrangements were made with the R.N.Z.A.F. for an Oxford to be on call at any time from the Rukuhia Aerodrome. The machine was equipped with radio and communicated with ZLGA on 4750 kcs. This was the normal air force fre-

quency, and its use caused a considerable amount of interference with control towers in the North Island. The frequency was, therefore, changed so that the plane transmitted on the State Forest Service frequency, 2760 kcs. but still received on 4750 kcs. An improvement resulted, but there was still some interference. Furthermore, the radio was prone to get out of order and this, combined with the fact that the patrol operated spasmodically meant that the service generally was not entirely satisfactory. Some 30 hours were flown during the season, and on all flights maps marked with military grids were carried. The map references of any fire requiring reports were transmitted to Kaingaroa Forest, which was the headquarters for the district.

The experience gained in 1944-45 brought out three important points. Firstly, it demonstrated that an Oxford was not a suitable type of aircraft; secondly it showed that the use of Air Force frequencies was unsatisfactory; and finally it proved that to maintain an efficient service it was essential to have a plane stationed permanently at Rotorua and available at a moment's notice. These were the points to which attention was given in designing an improved system for 1945-46.

Organisation.

In order to maintain continuity of service at Rotorua it was essential to have two planes available for fire patrol duties. The R.N.Z.A.F. co-operated magnificently and provided a DH Fox Moth and a DH Tiger Moth, both equipped with radio. The Fox Moth was permanently stationed at Rotorua and returned to its base only when periodical inspections were necessary; the Tiger Moth then took over. The Air Force provided the necessary personnel; pilots and fitters in rotation and a permanent wireless mechanic. Particular points stressed in the relevant R.N.Z.A.F. operation order were that under no circumstances was Rotorua to be left without one plane standing by, that servicing was to be undertaken as far as possible during periods of high humidity, that the patrol was to operate seven days a week including holidays if fire conditions made this necessary, and that except in the case of discretionary power delegated to the pilot when questions of safety were involved, the local Conservator of Forests was to have complete authority to control all flying operations (in the manner best suited to the needs of the particular situation). The order, therefore, was designed to give the maximum possible service to the forest authority. The aircraft were housed in a dispersal pen type of hangar erected by the State Forest Service at Rotorua aerodrome. Petrol supplies were kept there as well as some engine and radio servicing equipment. Auxilliary landing fields used were the landing strip at Kaingaroa Forest and the airfield at Taupo. Both these points were kept supplied with petrol so that planes were able to operate from them without returning to the Rotorua base. They came back to Rotorua each night, however, for hanging, checking and radio servicing.

Radio Equipment.

The main radio station for the district was at Kaingaroa Forest Headquarters where a 100 watt transmitter operating on 2760 kcs. was installed. Supplementary equipment at this station comprised a 100 watt Collins transmitter for operating on the air force frequency of 4750 kcs. and a 35 watt battery-operated set for use in the event of a power failure.

At Rotorua a 25 watt transmitter was installed and while the set could call up all other installations in the district, reception was not very satisfactory owing to local interference. The major forest look-outs of Rainbow Mountain, Pekepeke, Ngapuketurua and Wairango, the Kaingaroa ranger stations of Wairapukau and Waimihia and the forest headquarters of Waiotapu and Rotoehu forests were all equipped with battery operated 15 watt sets. Similar equipment was used in the patrol cars and, during actual fire-fighting operations, at advanced fire headquarters. Where electric power units were not available wind chargers were used for keeping the batteries charged. Experience proved that it was essential to make frequent changes of the batteries in order to ensure that they were up to strength and that there would be no danger of communications breaking down during periods of fire emergency.

During the critical period in February and March of 1946, the batteries at Taupo Fire Headquarters were changed every day as there was no possibility of forecasting the extent to which the sets might be required to operate. Largely for this reason radio communication was efficient and reliable at all times.

The planes were equipped with 5 watt sets and in these also the batteries were changed frequently so that maximum efficiency was ensured.

Types of Planes Used.

The types of planes used on patrol and preliminary reconnaissance work, together with some of their main features are shown in the following schedule.

Aircraft	Tiger Moth	Puss Moth	Fox Moth	Oxford	Harvard
Description	Single engine biplane	Single engine high wing monoplane	Single engine biplane	Twin eng. low wing monoplane	Single engine low wing monoplane
Fuel Capacity (gals.)	25	25	25	92	85
Fuel Consumption (gals. per hour)	7	7	9	28	23
Safe Endurance (hrs.)	2½	3	2½	3	3
Cruising Speed (m.p.h.)	80/85	100/105	100/110	140	150
Landing Speed (m.p.h.)	45	45	50	57	63
Take-off Run (yds.)	300	400	400	5/600	5/600
Landing Run (yds.)	100	100	300	500 (ap.)	500 (ap.)
Seating when equipped with radio	Pilot and 1 other	Pilot and 1 other	Pilot and 2 others	Pilot and 2-3 others	Pilot and 1 other

Of the planes in regular use the Tiger Moth was the most suitable as it was economical in fuel consumption, was able to operate from all landing fields, and was good for observation purposes. The open cockpit, however, made conditions somewhat trying for the air crew unless they were suitably clothed and in high winds there was an element of risk in taking off and landing. For this reason on a few occasions the patrol had to be abandoned.

In the Fox Moth the observer occupied a cabin which made flying comfortable but interfered somewhat with his visibility.

The Harvard was an excellent machine for observation purposes and could operate under the most windy conditions. Owing to its relatively high fuel consumption, however, it was expensive to run and it could not operate from the Kaingaroa landing strip.

A Puss Moth was used on preliminary reconnaissance work in connection with the aerial patrol and had it been available for the season would have been the most suitable type of aircraft. The high wing does not interfere in the slightest degree with visibility and it is able to operate from all landing fields. The pilot and observer occupy the same cabin and this is a feature which has much to commend it apart from the fact that it obviates the necessity of using the intercommunicating system.

From the experience gained from the use of different types it is hoped that in the future something similar to the Puss Moth will be available for aerial patrol.

Operation of the Patrol.

Although established primarily for the safety of State Forests, privately owned exotic forests were also patrolled during periods of high fire hazard. Patrols were undertaken when the relative humidity was below 30 per cent, when wide-spread fires created so much smoke and haze that visibility from look-outs was interfered with, and when fires reported by look-outs required examination. In the case of such fires the aerial inspection might be needed either because their location could not be accurately fixed or because information on their danger could not be determined without lengthy ground inspections.

Immediately the plane left the airfield radio contact was established with ZLGA and at frequent intervals throughout the flights the contact was checked and the position of the plane reported. At the scene of any fire requiring examination the observer's duty was to report its location, size, direction of travel and potential danger to forests and to indicate whether it should be attended to. When a fire required action to be taken the observer would radio as much information as possible to ZLGA detailing the quickest way of gaining access, how it should be dealt with and what personnel and equipment would be required to extinguish it.

When the fire fighting crews arrived at the outbreak the observer would, if necessary, direct the operations by radio communication

with advanced headquarters. At the same time he would keep a close watch round the perimeter of the fire to make sure that it had not jumped the fire fighters and started an outbreak which had escaped the notice of the ground crews.

On patrols undertaken purely for observation purposes any fires seen which were a source of danger to forests had usually been reported by the look-outs. In such instances aerial reports were useful to confirm the information already available, and to provide more details of the outbreaks.

During holiday periods and week-ends, roads in or near State Forests were carefully observed for the purpose of discovering the presence of cars, horsemen, or pedestrians who might be trespassing and creating a fire risk.

When the patrol was completed the observer submitted a detailed report covering time of departure from and return to base, duration of flight, locality patrolled, reason for flight and number and nature of fires reported.

Experience during the Taupo Fires.

During the actual period of February-March, 1946, two pilots were employed and as a rule one plane stood by on the Kaingaroa landing strip and one on the Taupo airfield. Flying conditions were trying and at times hazardous, but the patrols operated successfully nevertheless. Two minor accidents occurred, both of which necessitated relief planes being flown to Rotorua. They were on duty within a few hours of the mishaps occurring.

Flying times at first extended from early morning to late evening. But it was found that the early patrol gave a false impression of the conditions of the fires, since a fire which appeared to be wholly subdued at, say, 7 a.m. would become a major conflagration by 11 a.m. The early morning flight was therefore abandoned and routine patrols made at 11 a.m., 2 p.m. and 4.30 p.m. Flights for particular purposes were of course made at intervening periods; in fact so useful did the aerial view prove to be that during the worst of the fires the planes were more or less constantly in the air.

The normal patrol included inspection of areas on which fires had been already extinguished to make sure that there was no possibility of their flaring up again. This was a most useful service, not the least advantage of which was the feeling of security it gave the parties on the ground. The observer would also keep the ground parties fully informed on the progress of fire-fighting operations along the whole front. This, too, helped to engender a feeling of security, particularly when a fire-fighting party was fully extended coping with a fire in its own sector and did not otherwise know whether there was a danger of another and major fire starting in the rear.

There were many examples of how the observer's better appreciation of the fire was of assistance to the men on the ground. At one fire the officer in charge concluded he was unable to handle it with

the personnel and equipment under his control and consequently radioed to headquarters for support. His request for 50 men and additional equipment was countermanded by the observer who was in a much better position to make a more accurate tactical appreciation. Events proved him to be right. On occasions the plane was used to fly the routes by which the best and easiest firebreak could be found. After reconnoitring the route the plane would fly up and down it several times and the ground crews would then be able to follow the general direction of the line to be taken. This service was particularly useful when bulldozers were operating from two ends of an emergency break and were some miles apart at the commencement.

Other instances of the planes usefulness were in spotting trespassers, and, on one occasion, in receiving signals from a bulldozer driver that his machine had broken down. In this particular instance the bulldozer was engaged on vital fire protection work and the message from the plane enabled a replacement to be made with the least possible delay.

Conclusion and Comments.

Over 200 hours were flown on 1945-46 and it can be said that the aerial patrol was highly successful. Despite its apparent expense it is cheap insurance. It can and does result in considerable saving in time and cost as some of the examples quoted above will demonstrate. Not only does it lead to efficient and hence cheap fire-fighting, but in the early detection and accurate location of small fires it enables quick suppression measures to be undertaken. Both from the point of view of the value of the forest and of the cost of fire fighting the financial advantage of immediate suppression is obvious.

The planes on patrol have a marked psychological effect which operates in two ways. For fire fighting crews, as already stressed, they have a beneficial effect on morale; for the general public they are a constant reminder that it is necessary to be careful with fire. Detection not only of the fires but of the person or persons responsible for causing them is quite feasible and there are clear indications of possibilities of law enforcement in this direction.

Aerial patrol is by no means perfect yet but each year brings some improvement in its operations. As better types of aircraft become available, as air crews become better trained for the highly specialised work involved, and as more experience is gained by the observers, there will without doubt be greater advancements still. It is not suggested that planes will ever replace look-outs or that radio will ever take the place of telephones: all are tools which can be made to assist each other and to work together on a concerted plan. A maximum efficiency in the prevention, detection and suppression of forest fires depends on their successful integration, but the part that aerial patrol plays in this has already proved vital.