



University of Queensland

PAPERS

DEPARTMENT OF BIOLOGY

Volume 1

1938

Number 7

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South Queensland

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REPRINTED

from

THE PROCEEDINGS OF THE ROYAL SOCIETY OF QUEENSLAND

VOL. XLIX, No. 12, pp. 145-149, Plate V

JUNE, 1938

THE UPLAND SAVANNAHS OF THE BUNYA
MOUNTAINS, SOUTH QUEENSLAND.

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[Reprinted from the *Proceedings of the Royal Society of Queensland*,
Vol. XLIX., No. 12, pp. 145-149, pl. V.]

DAVID WHYTE, Government Printer, Brisbane.

The Upland Savannas of the Bunya Mountains, South Queensland.

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[Read before the Royal Society of Queensland, 25th October, 1937.]

Plate V.

ABOUT thirty miles to the north-east of Dalby, the Bunya Mountains rise up from the low foothills and reach their greatest height on the bald summit of Mount Mowbullán, 3,611 feet. A general account of the vegetation, and a list of species collected at an altitude of 2,000 feet or over, is given by C. T. White (1). He points out that there are four main types of vegetation, all very sharply defined from each other; they are open grasslands, open eucalyptus forest, rain forest, and swamps—the open grassland being on the slopes and tops of bald hills and backed up by a solid wall of rain forest. Treeless patches are one of the most conspicuous features as the mountains are approached from the plains that stretch away to the south and west. From a distance they contrast strongly with the dark rain forest dominated by Bunya Pines (*Araucaria Bidwillii*), and are reminiscent of the blady grass-covered clearings in the rain forests of the Malayan Islands. They commence about 800 feet from the top of the range, and often run up the steep western slopes to the ridges and about a hundred yards down the other side, where the rain forest suddenly rises up like a dark wall. The patches are mainly found on the steep western slopes, but isolated balds may be found on almost any exposure. Usually they are on spurs, and the creeks and gullies flanking them are lined with rain forest, or, where conditions are suitable, with swamp types.

PLANTS OF THE SAVANNAHS.

The sharp line of demarcation between grassland and rain forest is striking. *Lantana camara*, which elsewhere in Queensland commonly fringes rain forests, is absent; *Acacia maidenii*, *Rubus moluccanus*, and *Rubus rosaeifolius* may grow in intermittent narrow strips around the forest margin, but are not continuous. In general, there is little suggestion of that dynamic equilibrium that is so commonly observed. It appears as if in the course of time the rain forest has progressed to the limit of its powers, and has then stopped; its pioneers have fulfilled their function, and the climax formation occupies its potential territory to the fullest extent; or alternatively, that the grassland is so firmly established under the present conditions of grazing that encroachment of the usual ecotone types is not taking place.

The grassy areas vary in size from a few acres up to several hundred acres in extent. Their plant cover is well grazed, and forms a sward, the common grass species being *Themeda australis* (Kangaroo Grass), *Cymbopogon refractus* (barbed-wire grass), *Danthonia longifolia* (Wallaby Grass), *Cynodon dactylon* (Indian Couch), *Aristida vagans*, *Festuca bromoides*, and *Poa caespitosa* (Tussock Grass), the lastnamed being conspicuous on account of its habit. Amongst the non-grasses are *Viola bentoicaefolia*, *Hydrocotyle vulgaris*, *Apium leptophyllum*, and *Tillaea verticillaris*.

It is to be noted that the bald patches are chosen as sites for farm houses and buildings and that a considerable number of weeds—native and introduced—make their appearance round them; included amongst these are *Sida rhombifolia*, *Acaena ovina*, *A. sanguisorbae*, *Verbena officinalis*, *Rumex acetosella*, *R. crispus*, *R. Brownii*, *Sonchus oleraceus*, and *Lepidium ruderales*.

Though the grassy areas of these mountains stand out in such sharp contrast to the surrounding rain forest, they are not entirely devoid of trees. Occasional trees, or sometimes groves, are to be found (Plate I., Fig. 2). On a large bald patch, across which climbs the road from Dalby to Mount Mowbullen and Kingaroy, may be seen *Acacia decurrens* var. *pauciglandulosa* (Black Wattle), *Rhodospaera rhodanthema* (Deep Yellow Wood), *Grevillea robusta* (Silky Oak), *Laportea gigas* (Stinging Tree), *Ficus eugenioides* (Small-leaved Fig), *Sterculia diversifolia* (Kurrajong), and *Eucalyptus tereticornis* (Blue Gum). On a smaller area above the Big Falls is a large cedar, *Cedrela toona* var. *australis*, growing about ten yards from the rain forest margin, while in the middle of the area is a tree of *Ficus eugenioides*. *Sida rhombifolia* is another ligneous plant scattered through the grassland.

Of these trees, the two which tend to form communities are *Eucalyptus tereticornis* and *Acacia decurrens* var. *pauciglandulosa*, both common further down the mountain, but sporadic in the upper part within 800 feet of the top of Mount Mowbullen. On a large bald near Munroe's camp there is a fine grove of mature *Eucalyptus tereticornis* forming a pure stand on a ridge; the road passes this particular grove. Elsewhere single trees or groups may be seen occasionally.

Near the bald top of Mount Mowbullen, groves of the black wattle dot the grassy slopes; many of these are perhaps not more than ten years old, but are full grown, the plant being quick growing and short lived. Some of the trees carry large numbers of the beautiful little epiphytic orchid *Sarcochilus falcatus*, a common epiphyte of the nearby rain forest, but which is absent from the wattles at the foot of the range. A point to be specially noted is that these two tree species both provide good firewood, and are used for that purpose very commonly on the mountains, most of the rain forest trees being comparatively worthless for that purpose, besides being more difficult to get at.

The other trees that have been mentioned as occurring on the balds are isolated individuals. They are usually to be found at the foot of sudden steep dips, or on the rocky areas where the grasses are not as dominant. *Ficus eugenioides* is occasionally found perched on exposed rocks, clasping them with its roots

ECOLOGICAL CONDITIONS.

Unfortunately there are no meteorological records of these mountains. Stations on the plains below record about 26 inches rainfall per annum, but that of the mountains is obviously much higher, as is evidenced by the luxuriance of the vegetation. In the absence of data, the vegetation itself must be taken as the sole indicator of the rainfall. The 26-inch country is quite incapable of supporting rain forest. At the base of the mountains the creeks are still lined by Eucalypts, but in the foothills *Grevillea robusta* (Silky Oak), *Castanospermum australe* (Moreton Bay Chestnut), and other trees

common in such situations near the better watered coast make their appearance. On the lower parts of the mountains themselves a rain forest first makes its appearance along the creeks, the flats and ridges being clothed with open Eucalyptus forest—*Eucalyptus tereticornis*, *Eucalyptus eugenioides*, *Angophora intermedia*, *Acacia decurrens* var. *pauciglandulosa*, and *Sterculia diversifolia* as the common trees. About 800 feet from the top of the ranges the bald patches appear. *They take the place of the open forests.* The Eucalypts disappear at about this level, and persist only as isolated individual trees or groves, infrequent enough to be overlooked by casual observers. The rain forest, however, continues in its expected habitat. At the top of the mountain it spreads out over the spurs and ridges, though not in every case. If the grasslands were replaced by Eucalyptus forest there would be nothing surprising in the distribution of the natural vegetation; the alternation of open forest on the spurs with rain forest in sheltered situations and the upper mountain ridges would be a repetition of what is commonly found in the coastal mountain ranges of Queensland. Those trees which do invade the grassland are species found in the open forest, though some of them are also common rain forest types.

It can be agreed that the grassland is characteristic of the drier situations in the upper parts of the mountain. It forms a sward which makes tree invasion difficult, especially as cattle are pastured on the balds. Further down the mountain the grass growth is much more sparse when the Eucalyptus and other open forest trees are cleared, and there is more opportunity for forest regeneration. Where on the balds a tree does become established, its competition with the grass makes conditions a little more favourable for its seedlings, and there is a tendency towards the establishment of groves.

ORIGIN OF THE GRASSY AREAS.

The bald areas of the Bunya Mountains have existed in the present state for a very long time, and have not been tree-covered within living memory. Trees, however, have come and gone. Evidence of this is afforded by *Acacia decurrens* var. *pauciglandulosa*, a short-lived tree, which may be found at all stages as isolated individuals or in groves; and by the presence of dead roots of *Eucalyptus* and *Cedrela* in the soil in places where no trees now grow. No theories as to the origin of the grass patches have been published. One current opinion, not held locally, is that the soil is too shallow to support trees. This may be dismissed, as the soil along the road is often a foot deep, and in one place near Munroe's camp a hole was sunk for five feet before rock was encountered. Further, the isolated trees of the balds are usually in very shallow, rocky soil, and *Ficus eugenioides* may even perch on bare rocks. There is, too, the obvious evidence of sporadic trees, and of the dead roots already mentioned.

The question of the effect of winds is worthy of notice. Most of the balds are on the slopes exposed to the dry westerly winds, which from time to time sweep across the plains and up over the mountains. These are the driest slopes of the region, and their exposure and steep slope, which latter naturally has a marked effect on run-off, are reflected in the restriction of rain forest, which on the other slopes occupies most of the territory. It does not, however, explain the absence of open forest trees, which in other mountain ranges in South Queensland

dominate such slopes. There is no sign of wind shearing even in isolated trees growing right out in the middle of a grassed area. Further, epiphytes such as *Sarcochilus falcatus* grow on the Acacias; their absence from the Eucalypts is due to the unsuitable nature of the bark. Along the rain forest margin, too, the trees are commonly invested with epiphytes, including *Platyserium alaicorne* and orchids. At the edge of one open stretch the luxuriant growth of *Dicksonia antarctica* following a stream, made it apparent that wind was not a factor at that particular spot. Wind has been suggested as the factor in the production of balds in the southern Appalachians; they are a conspicuous feature of the Great Smoky Mountains in North Carolina. (I am unable to trace the paper in which this claim was made; it was not, however, supported by evidence, and was advanced as a suggestion only.) Clements (2) states that these balds are seral communities of heaths or grasses initiated and maintained primarily by fire.

Sub-climax grasslands are of widespread occurrence, and in most cases fire is the important factor in their origin and persistence.

Myers (3) has described a somewhat similar occurrence of upland savannahs often on steep slopes in the Pakaraima Mountains of British Guiana. He regards the present vegetation as so eminently adapted to burning that it is justifiable to regard it as a fire climax (sub-climax in Clements' terminology). Lane Poole (4) has discussed the grasslands of the mountains of New Guinea, and advanced strong evidence of their being the result of persistent firing by natives. van Steenis (5) collected a vast array of evidence for the anthropogenous nature of grasslands in Malaysia. One very pertinent remark, made in another paper (6) is: "Climate is not the cause of, but only the condition under which deserts originate." This is equally applicable to grasslands in general, and as far as this paper is concerned, to the Bunya Mountains in particular.

My opinion is that the grasslands of these mountains were induced by fire. The aboriginal tribes formerly travelled over great distances to the Bunya Mountains for the fruiting season of the bunya pines (January to March), collecting the large starchy seeds by day and camping in the Eucalyptus forest below to roast them at night. According to some estimates, thousands of blacks gathered in the bunya season. I can trace no records of their having habitually fired the open forest area; but with great numbers camping in a limited area very susceptible to fires, it seems reasonable to assume that this would be the case. Captain Cook noted bush fires all along the Queensland coast, and great areas in coastal Queensland, formerly savannah, have, following protection from fire, become re-clothed with trees. I have been informed by Mr. Romeo Lahey that when his father came to Brisbane, One Tree Hill, which is now heavily forested, was open savannah. That the balds have had trees in the past is shown by the fact that roots can be dug up. Repeated firing of the forests would result in destruction of the trees and the establishment of a grassland sub-climax. Within about 800 feet of the top of the range the increased rainfall has produced such a grass cover that the regeneration of trees is particularly difficult, except in a few spots such as rock outcrops and the foot of small cliffs. The pasturing of cattle helps to hold the sere in the grassland stage, though in a few patches the open Eucalyptus forest climax has re-established itself (or persisted). It



Fig. 1.



Fig. 2.

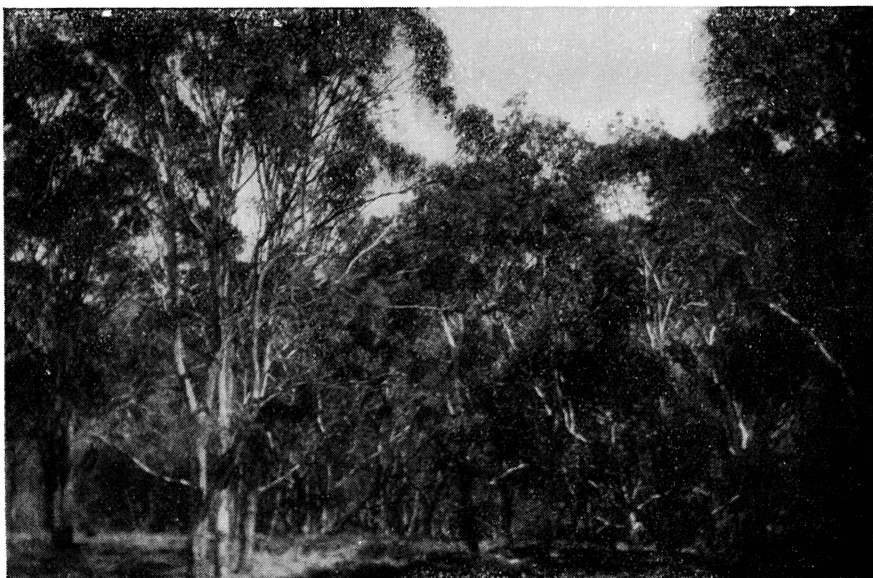


Fig. 3.

is a remarkable fact that below the rain forest the open forest has not given way to grassland, except where it has been cleared by settlers. Whether the areas away from the rain forest levels were not so persistently fired by the blacks is a point which cannot now be settled. Observation, however, indicates that regeneration of forest takes place more readily on the sparser induced grassland of the lower and drier foothills than on the mountain. Even assuming that upper and lower levels had been equally burnt over, regeneration on the lower and drier slopes would re-clothe them before the upper. On the lower slopes the Eucalypts are not aged trees; this is indicated in Plate VI., Fig. 3, which is a photograph of the eucalyptus forest just below a bald, and about 800 feet from the top of Mount Mowbullan. They would thus appear to represent a returned forest rather than a primaeval one.

SUMMARY.

Grassy areas varying in size from a few acres to several hundred acres are interspersed with rain forest on the Bunya Mountains, about 30 miles north-east of Dalby. These replace the open eucalyptus forest at an elevation of about 2,800 feet. They represent a grassland sub-climax, and only in isolated places does the *Eucalyptus tereticornis* forest climax become established. It is considered that the grassed slopes are the result of destruction of Eucalyptus forest, probably by fire by the blacks in the days when they gathered for the collection of bunya pine seeds.

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ILLUSTRATIONS.

PLATE V.

- FIG. 1.—Typical grass-covered balds in the Bunya Mountains near Munro's Camp, with rain forest in a gully.
- FIG. 2.—Rain forest edge near Munroe's Camp, with a narrow ecotone of *Acacia Maidenii*.
- FIG. 3.—Eucalyptus tereticornis forest abutting on rain forest (right) at about 2,800 feet altitude. Above this level, such a situation would be occupied by grassland.