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VEGETATION OF THE CENTRAL PLATEAU

by W.D. Jackson

Department of Botany, University of Tasmania.

MAJOR VARIABLES

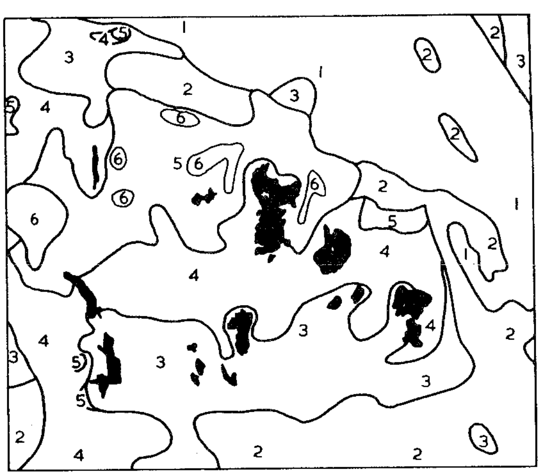
As might be expected in an upland region, the distribution of plant communities is determined largely by low temperatures, in particular by the degree and frequency of frosts below -5°C, glazing storms, and ice-bearing winds. The most significant single index which is readily available is probably the mean summer temperature. A mean temperature of 10°C for the warmest month has been accepted as the indicator of the tree line (Daubenmire 1954). Most of the Central Plateau above 1040 m is thus in this category.

There is a marked gradient in precipitation across the plateau on a NW - SE axis. The environs of Lake Mackenzie in the north west receive an annual rainfall approaching 3000 mm (Hydro-Electric Commission Hydrological Report, 1971), whereas the annual precipitation in the Bothwell-Steppes region is under 650 mm. This gradient produces corresponding gradients in the vegetation. For example the precipitation gradient in part accounts for the replacement of coniferous forest and shrubbery by eucalypt woodland. However in general the effect of precipitation is minor compared with the control exerted by temperature.

As with so much of the vegetation in Tasmania, local deflecting influences are strong. Fire frequency and edaphic factors often predominate in determining patterns of plant distribution. Over much of the plateau aspect and drainage are important physiographic factors. This is because much of the plateau is close to the limit of tree growth so that even small topographic features have a pronounced effect by producing gradient variations in cold air drainage, soil drainage and exposure. As a result of even moderate physiographic relief there is a mosaic of plant communities arising from local variations in the micro-environment.

Since the temperature exerts a major influence on plant growth and development, the distribution of vegetation can be related to altitude. The plateau has a "stepped" land form due to the development of sub-aerial erosion surfaces following periods of uplift (Davies 1959), and these surfaces form a useful reference system. Quite apart from the lapse rate of $1^{o}C$ per 100 m in altitude, the climate of the plateau deteriorates rapidly at altitudes over 1100 m because the cloud base descends to this level frequently, even in summer.

Davies (*loc. cit.*) recognised six surfaces in Tasmania:- Lower Coastal Surface, 90-275 m; Higher Coastal Surface, 365-455 m; St. Clair Surface, 730-820 m; Lower Plateau Surface, 915-1065 m; Higher Plateau Surface, 1190-1340 m; and high monadnocks 1340-1614 m. These surfaces are shown in figure 11.



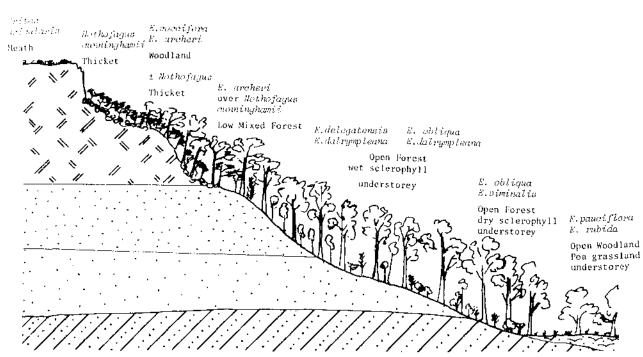
11.
Areal distribution of geomorphological surfaces of the Central Plateau region Tasmania (after Davies 1959).

Key: Major lakes black
1. Lower Coastal Surface 90-275 m
2. Higher Coastal Surface 365-455 m
3. St. Clair Surface 730-820 m
4. Lower Plateau Surface 915-1065m
5. Higher Plateau Surface 1190-1340m
6. High Monadnocks 1340-1614m

Vegetation patterns on the surfaces are complicated by changes in drainage, frost intensity and aspect effects produced by minor features of relief. Thus before considering the vegetation of these surfaces it is advisable to consider the normal unbroken altitude progression in vegetation on well-drained slopes. This may conveniently be demonstrated by considering the vegetation of the major scarp face to the plateau on the northern and eastern margins, where it forms the "Western Tiers". Here the vegetation provides a compressed section of the sequences from the lowland vegetation of the Midland Graben (400 m) to the high rim of the Plateau (1400 m).

VEGETATION OF THE WESTERN TIERS SCARP

The vegetation is summarized on an idealised section (figure 12).



12. Diagramatic idealized section of the northern scarp of the Western Tiers; precipitation 760-1000 mm; showing vegetation types.

At the base of the scarp the eucalypt savannah forests of the Midlands Graben consist of open communities of *Eucalyptus pauciflora* - *E. viminalis* or *E. pauciflora* - *E. rubida* in drier areas (Jackson 1965). Some savannah of *E. ovata* or *E. rodwayii* occur where the drainage is poor in the winter. The ground vegetation of these savannahs is a tussock grassland of *Poa billardieri*. *Themeda australis* and *Lomandra longifolia* may predominate on clayey soils. Corridor forests of *E. viminalis* - *Acacia melanoxylon* occur on stream courses, and dry sclerophyll forests occur on low hills of sandy or lateritic soils.

On the lower slopes of the scarp the open savannah is replaced by dry sclerophyll forests of the same tree species. These forests increase in density and height as the rainfall increases. On areas of deep soil and sufficient moisture the ash species *E. obliqua* may replace the peppermint species *E. pauciflora* or *E. amygdalina* partially or completely as the dominant. The macrantherous species *E. viminalis*, *E. rubida* or *E. ovata* remain as associate species. Above 300 m altitude these species are replaced by *E. dalrympleana* as the associate with *E. obliqua*. Due to increasing rainfall there is a structural transition from dry sclerophyll forest, with low and medium shrub layers of Epacridaceae and Leguminosae, to wet sclerophyll, with well developed tall shrub layers of *Olearia argophylla* and *Pomaderris apetala*.

On the wetter northern and western slopes where the annual rainfall exceeds 1250 mm, the climax is a rainforest of *Nothofagus cunninghamii - Atherosperma moschatum*. This climax is attained only in areas topographically protected from high fire incidence (Jackson 1968). Because of the fairly regular disturbance by fire, most areas carry "Mixed" forest (Gilbert 1958), with a stratum of eucalypts over a substratum of rainforest and wet sclerophyll shrub species such as *Acacia dealbata, Prostanthera lasianthos* and *Olearia argophylla*. Near the upper lip of the scarp face (c.1000 m) water availability is greatly increased by the "fog drip" or "cloud stripping" effect of the vegetation on the cloud base so prevalent around the plateau rim. Under these conditions a dwarf "elfin" rainforest or thicket of *Nothofagus* occurs. *Nothofagus cunninghamii* extends around the rim of the Western Tiers, but the deciduous *N. gunnii* is restricted to the areas of higher rainfall on the western margins.

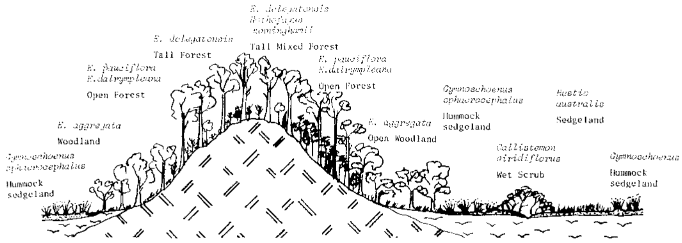
Above 450 m the sub-alpine species become increasingly evident. *E. obliqua* is replaced by *E. delegatensis*. The *E. delegatensis - E. dalrympleanea* forest extends up the slope to altitudes of about 1000 m or slightly higher in sheltered situations. The association is the characteristic forest of the lower slopes and the St. Clair Surface, and extends onto the Lower Plateau Surface. Over much of its range *E. delegatensis* is growing on a relict solifluction sorted mantle. This surface is covered in many places with large dolerite boulders, though there is commonly a deep yellow-brown soil on solifluction deposits (cf. alpine humus soil) beneath, with a shallow water table. The smaller shrubs have difficulty reaching this reliable supply of water in the summer and the shrub layer is scattered and more xeromorphic on the upper slopes. *Bedfordia salicina, Olearia viscosa, O. phlogopappa* and *Cyathodes parvifolia* predominate. With increasing and more reliable precipitation near the cloud base the sub-alpine shrub belt increases in density. Around 910 m dense shrubberies of *Hakea lissosperma, Orites diversifolia, Lomatia polymorpha* and *Telopea truncata* occur as a fire-determined deflection state of the climax *Nothofagus* thicket (Plate 2). Where fire is frequent enough to maintain eucalypts, an open woodland overstorey of *E. coccifera - E. gunnii* or *E. archerii* occurs.

At altitudes exceeding 100 m exposure to glazing winds and snow limits tree and shrub forms and only the specialised alpine communities are found. Well-drained areas are occupied by a proteaceous - epacridaceous closed heath or shrubland; while those areas receiving a high precipitation but obtaining some topographic protection from the wind, carry dwarf coniferous forest or coniferous shrubbery. Poorly drained areas carry a complex mosaic of herbfield, bog and bolster moor communities. Cold air drainage "basins" carry tussock grassland, sedgeland or bog communities. These alpine communities are described in the section dealing with the Higher Plateau Surface.

VEGETATION OF THE ST. CLAIR SURFACE

The areal distribution of the St. Clair Surface (730m - 820m) is shown in fig. 11 and a schematic representation of its vegetation types as figures 13 and 14.

Forest Types. The dominant vegetation on the Surface is the *E. delegatensis* - *E. dalrympleana* forest. The soils on most of the Surface are derived from basalt or dolerite and range from kraznozems to alpine humus soils. They will support tall forests if temperature and rainfall permit. Thus well-drained land not in a frost hollow will tend to the climax *Nothofagus cunninghamii* - *Atherosperma moschatum* rainforest where the annual precipitation is in excess of 1250 mm, or to *E. delegatensis* - *E. dalrympleana* wet sclerophyll forest in lower rainfall areas. A wide ecotone of "mixed forest" occurs as a result of disturbance by fire; for example the forests around Tarraleah. Towards the drier eastern side of the plateau the *E. delegatensis* - *E. dalrympleana* forest changes gradually to dry sclerophyll with lower tree heights and an open understorey of *Bedfordia salicina, Olearia viscosa, Cyathodes parvifolia* and *Lomatia tinctoria*. On the junction scarp with the Higher Coastal Surface, on the Shannon Tier, for example, *E. delegatensis* may be replaced by *E. amygdalina*. *E. pauciflora* - *E. dalrympleana* may displace the *E. delegatensis* forest where frost becomes important; for example the base of the Shannon and Bakers Tiers. Where frost effects are severe, even once in 50 years, sensitive eucalypt species such as *E. delegatensis* may be eliminated; thus *E. pauciflora* and *E. rodwayii* tend to replace *E. delegatensis* on the margins of frost hollows. Figure 13 shows a typical section of vegetation on the Clarence Plains with *E. delegatensis* ± *E. dalrympleana* on the slopes with surrounds of *E. pauciflora* - *E. dalrympleana* and *E. rodwayii*. Severe frosts in the highland areas in 1837 killed eucalypts in



13. Diagramatic section, St. Clair Surface, near Clarence River; precipitation 1780 mm; showing vegetation types.

valley floors and basins with poor air drainage (Calder 1850). Similar events, at least in some localities, have occurred since 1837; for example around Great Lake in 1917 (Purcell personal communication). "Killing frosts" have a more pronounced long term effect on plant distribution than fires. Presumably eucalypt regeneration is optimal in hhe open conditions produced by fires, whereas after killing frosts the growth and development of eucalypt seedlings is severely limited by the surviving frost resistant grass and the deep layer of debris under dead trees. Thus very few seedlings survive and future regeneration of forest is almost entirely restricted to a slow marginal spread from the surrounding slopes. The lowered transpiration rates in the "basins" after removal of trees leads to more waterlogged conditions, making re-establishment of the eucalypts more difficult.

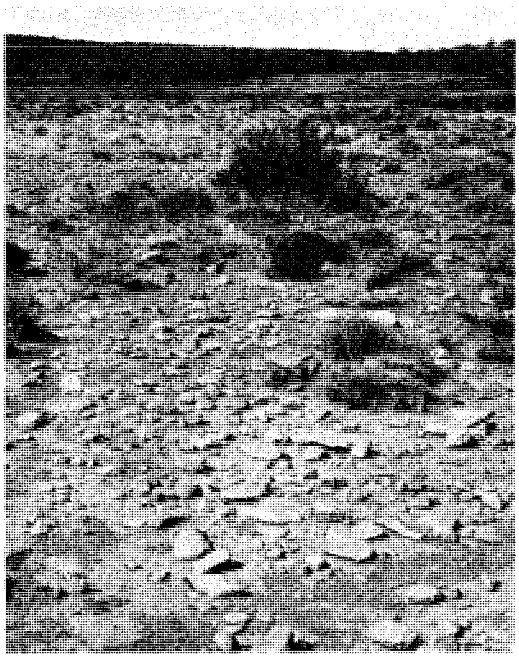
Open Communities. Fire damage and frost have certainly denuded many natural frost-prone hollows. On these, the forest is replaced by sod-tussock grassland of *Poa billardieri.* Sedgelands of *Lepidosperma filiforme* or *Gymnoschoenus sphaerocephalus* occur on more acid soils at elevations of up to about 1000 m. Swampy sedgelands of *Restio australis* and *Leptocarpus tenax* or *Carex* species are more common at higher elevations, mixed in less acid conditions, with heaths of specialized acidophilous epacridaceous species, notably *Sprengelia incarnata, Richea procera, Richea acerosa, Epacris lanuginosa* and *Epacris gunnii.*

Lake shores, stream courses and swamp margins carry dense, tall (10-15 m) stands of *Leptospermum lanigerum* with an overstorey of *Eucalyptus aggregata*, this species being tolerant of wet conditions (figure 14).

Aquatic and Wetlands. The botany of several lakes and lagoons on this Surface is of exceptional interest. Waters such as Lakes Sorell and Crescent, Woods Lake and Lagoon of Islands

PLATE 3

(a) Grazing pressure differential on fenced range; 3km south of Shannon Lagoon; altitude 1040 m.



(b) Sheet erosion on *Poa* grassland due to intertussock grazing; close to (a).

(c) Sheet erosion on *Poa* grassland due to inter-tussock grazing; less advanced than (b); community on right-hand side of fence in (a).

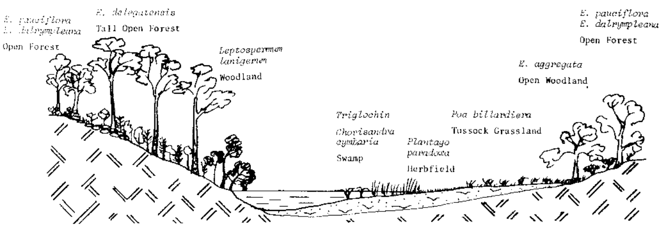
Photographs from Botany Department, University of Tasmania.

PLATE 4

(a) Detail of burnt shrubs in grassland showing evidence of grazing pressure; Stone Hut Plains, alt. 1030 m.

(b) Sheet erosion of burnt patches showing development of pedestals from tussocks following rabbit grazing and scratching after burning; Stone Hut Plains, alt.1030m.

Photographs from Botany Department, University of Tasmania.



14. Diagramatic section, St. Clair Surface near Lake Sorell; precipitation 760 mm; showing vegetation types.

present interesting studies of eutrophication processes, nutrient balances and community structure (Cheng and Tyler 1973; Tyler 1973a). These natural lakes are probably all in part deflation lakes where the lake basin has been created by differential erosion of a sandstone body rimmed by dolerite. All the lakes are shallow (2-4 m), and fully oxygenated by wind agitation, with no stratification. Evaporation is roughly equivalent to precipitation over the small catchments.

The eutrophication of Lagoon of Islands has proceeded to the stage where aquatic sedgelands of *Chorisandra cymbaria* and *Cladium tetraquetrum* have built a floating rhizome mat across the lake (Tyler 1973b). This mat is about 20 cm thick and formed about 2 m from the bottom with about 20 cm of free water above. The mat apparently rises and falls to some extent with changes in the water level of the lagoon; it is capable of supporting a person's weight but wading on it is dangerous. Chance accumulations of drifted debris are colonised by *Carex appressa* and eventually these areas become seed beds for shrubs, notably *Leptospermum lanigerum* and *Callistemon viridiflorus*. The presence of the shrubs causes rapid accumulation of wind-drifted debris so that an island of peat and rotting surface vegetation develops. Each island gains a zoned flora of aquatics such as *Villarsia exaltata*, sedgeland of *Carex appressa* and *Restio australis*, heaths of *Epacris gunnii* and dense shrubberies of *Leptospermum lanigerum*, *L. scoparium*, *Callistemon viridiflorus* and *Hakea microcarpa*. Eventually *Eucalyptus aggregata* may become established.

The floating island depresses the rhizome mat as it accumulates peat and the island sinks gradually through accumulation of debris by wind drift and plant growth. Each island is then surrounded by a moat of deep water. Instability in wind apparently causes the islands to overturn or slip so that they eventually sink, the rhizome mat returns and the cycle begins again. At any time the surface of the lagoon displays all stages in the succession. The bottom 1.5 m of the lagoon consists of a liquid ooze of perfectly preserved plant cuticle. A radio-carbon date obtained from the lowest 2 cm of the ooze immediately above a hard sandy bottom gave a date of 4700 ± 150 years BP. Considering the state of balance existing between inflow and evaporation, it is obvious that the date indicates conditions at least as wet as the present climate for the last 4500 years.

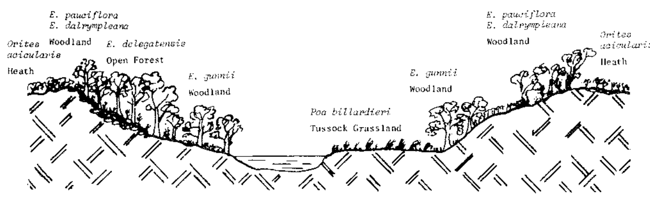
The St. Clair Surface carries extensive wetlands with large marshes and bogs, such as Father of Marshes. Most of these are on peaty black soil surrounded by solifluction soils on dolerite or basalt parent material. Such marshes are not highly acid and carry a rich herbaceous flora. The dominant vegetation on these marshes is *Carex appressa* with a rich summer growth of *Epilobium billardierianum* and *E. tasmanicum*. Dense belts of shrubs, mainly *Leptospermum lanigerum* and *Callistemon viridiflorus* have been reduced by constant burning by graziers.

A few bogs are formed in eroded basins of Triassic sandstone. These are acid and carry deep beds of *Sphagnum* and a strongly epacridaceous flora. The pollen stratigraphy of some of these bogs has been determined and carbon dating is in progress (Macphail pers. comm.). The early part of the pollen record indicates conditions such as those which now prevail on the Lower Plateau Surface, with open vegetation and a much reduced incidence of *Eucalyptus*.

VEGETATION OF THE LOWER PLATEAU SURFACE

The Lower Plateau Surface, 915-1065 m, has the areal distribution shown in figure 11. Floral distribution on this surface is shown in figures 15 and 16.

Forest Types: The characteristic vegetation of this surface is a *Eucalyptus pauciflora* - *E. dalrympleana* woodland or an *E. gunnii* - *E. dalrympleana* woodland; *E. gunnii* replaces *E. rodwayii* as the species tolerant of high water tables and acid soils on the St. Clair Surface. *E. delegatensis* - *E. dalrympleana* forest occurs, but only on the lee, or eastern, faces of the scarps and hills (figure 15). Tree height is lower and because the forest is more open, the form of the trees is more branched than corresponding trees on the St. Clair Surface. The understories are thin, especially on the boulder fields of



15. Diagramatic section, Lower Plateau Surface near Arthurs Lake; precipitation 760 mm; showing vegetation types.

the solifluction - sorted slopes. *Helichrysum antennarium, Olearia persoonioides,* and *O. viscosa* form a scattered shrub layer; the predominant layer is formed by *Cyathodes parvifolia* and *Lomatia tinctoria.*

Grassland. Extensive areas of the surface are denuded of trees; this seems to be a frost effect, for example on St. Patricks Plains, Liawenee Moor and Skittle-Ball Plains (plate 1). These areas have changed remarkably in the last fifty years as a result of poor land management. Before 1900 the vegetation was a tall tussock grassland of *Poa billardieri* with *P. gunnii* on the wetter pockets. The grassland carried a rich inter-tussock herb cover of *Microseris scapigera, Ranunculus scapigerus, Helichrysum acuminatum, H. scorpiodes, Helipterum anthemoides, Podolepis jaceoides* etc.

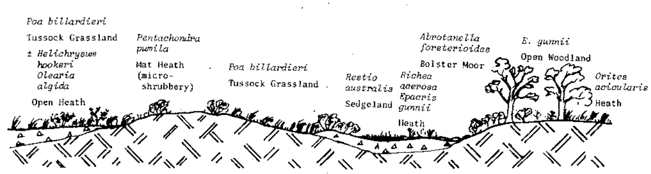
Grazing and Burning. By moving their flocks to these highland pastures for a few months each summer the early graziers were able to spell their unimproved lowland pastures during the dry period of reduced growth. By the 1880's most of the lakeland grazing rights had been established as freehold or leasehold, and by the end of the century large number of sheep were transhumanced in the summer (Scott 1955). Hares and rabbits spread to the area between 1910 and 1920 and multiplied rapidly. The summer grazing of sheep and the very high rabbit populations from 1920-1950 resulted in a depletion of the inter-tussock flora due to the intensive selective grazing.

There is no doubt that much of the serious damage to lakeland pastures has stemmed from the large populations of introduced rabbits. Rabbit populations increase over periods with mild winters and do much damage, especially during prolonged spells of drought. In the past, highland summer grazing was of sufficient value in direct wool production to warrant some control of the rabbit pest, but recently reduced wool prices, the high cost of labour, and the falling productivity of the lakeland pastures have not encouraged graziers or authorities to pursue control measures. Poor as they are, lakeland runs still form an important insurance against drought for the land-owner since they allow a higher stocking rate to be maintained on the lowland pastures than would otherwise be prudent. The economics of this are clearly demonstrated by Shepherd's analysis (this volume).

The periodic pasturing of large flocks of sheep in drought-stress years created conditions suitable for large rabbit populations; the sheep removed the seed crop from the inter-tussock herbs and by trampling and selective grazing opened up the vegetation for the rabbit (Plate 3). The combined grazing pressure resulted in many species being grazed to the soil surface and beyond. With the depletion of the herbs the productivity of the pastures dropped rapidly and the shepherds resorted to burning the pasture in order to induce the sheep to eat the relatively unpalatable *Poa*. The exposure of the inter-tussock surface was further accelerated by this burning and, in turn, the reduction in the density of the tussock improved the productivity of the rabbit by reducing the effect of disease in long and wet winters.

Burning is now a constant feature of management of highland runs. Although fire removes shrubs and induces a temporary flush of feed, in these alpine pastures it promotes the development of shrubland relative to grassland by reducing competition and exposing large areas for the development of woody species. Thus firing tends to become a cyclic process where the short term cure generates the long term disease. The selective grazing by sheep, native marsupials and most importantly the rabbits during the regeneration stages following the fire, accelerates the swing from herbs to unpalatable shrubs such as *Helichrysum hookeri* and *Olearia algida*. The serious aspects for the conservation of the watershed are that each fire causes a loss of productivity and induces serious erosion. Burning results in a loss of available nutrients by vapourization and convection; this can conservatively be put at 10-20% for most elements including phosphorous and about three times this for nitrogen and sulphur. Losses by surface run-off and leaching would be additional. By removing plant cover, the humus and the peaty layers of the soils, fires expose the mineral soil to the erosional agents of frost, water and wind. Erosion is further accelerated by scratching and root browsing by rabbits (Plate 4). As a consequence the inter-tussock surface is removed by deflation and the accentuated frost heave in the hollows so produced prevents recolonisation. Fifty years of burning and grazing have resulted in a transition from about 100% plant cover to a situation of accelerating sheet erosion and lowering productivity. Most of the former grassland now has only 50-70% plant cover and inedible shrubs account for much of the biomass. Areas without plant cover have lost 5-10 cm of top soil and erosion has now reached a self-escalating level. Practically all seedlings are heaved by winter frosts and most of the remaining plants are on pedestals of residual surface with a barren of sorted stones between, kept unconsolidated and subject to deflation because of needle ice. The serious nature of the erosion has been stated by Mitchell (1971).

Heaths and Shrublands. Extensive areas of the Lower Plateau Surface carry a shrubby vegetation. Apart from the seral heaths of *Helichrysum hookeri* and *Olearia algida* on degraded grassland, shrublands and heaths occur as stable communities on dry rocky sites, shallow soils or on stream margins. Semi-stable wet-heaths occur with bogs and bolster moor (figure 16).



16. Lower Plateau Surface near Little Pine Lagoon; precipitation 1016 mm; vegetation types.

Dense shrubberies or tall heaths up to 2 m in height cover rocky outcrops and stony soil on ridges. These communities are dominated by *Hakea lissosperma, Olearia viscosa, O. Phlogopappa* and *Cyathodes parvifolia*. Low heaths containing *Grevillea australis, Bossiaea riparia, Olearia algida, Epacris petrophila, Pultenaea fasiculata, Lissanthe montana* and *Leucopogon hookeri* occur on windy sites with shallow soils. Very shallow soils especially basaltic ones in exposed situations carry a mat heath of prostrate plants. These include *Coprosma pumila, Monotoca empetrifolia, Epacris petrophila, Leucopogon stuartii, Pentachrondra pumila* and *Cyathodes dealbata*. These communities contain a number of interesting plants typifying these environments such as *Pimelea pygmea, Cryptandra alpina* and *Muehlenbeckia axillaris*. Shallow peaty soils, which are wet in winter, carry heaths 1-1½ m in height of *Hakea microcarpa, H. epiglottis, Orites acicularis* and *Helichrysum hookeri*. Depressions and almost flat areas with clayey sub-soils carry mosaics of bog and heath communities usually with an open shrubland component of *Hakea epiglottis*. The heath consists of *Richea acerosa - Sprengelia incarnata - Epacris gunnii* communities.

Herbfield Bog and Bolster Communities. Wet herbfields occur on the margins of lakes and in depressions subject to inundation. On well drained alpine humus soils the vegetation is typically a short meadow herbfield dominated by rosette herbs such as *Ranunculus triplodontus, Plantago paradoxa, P. antarctica* and *Velleia montana.* Where clay substratum prevents the free drainage of the soil a bog community dominated by *Restio australia - Calorophus lateriflorus* develops. *Astelia alpina* bog occurs on permanently wet soil associated with a mosaic of wet heath and bolster moor. Bolster plant communities of *Abrotanella forsterioides - Pterygopappus lawrencii* impede the flow of surface water forming pools and tarns; seepage through the cushions provides conditions for the *Astelia* bog. Changing patterns of water flow leave drained areas of raised bog and bolster communities which gradually become a wet-heath due to invasion by shrubs such as *Richea acerosa, Epacris gunnii* and *Baeckea gunniana.* These communities are described in the section on the Higher Plateau Surface where they are of greater importance.

VEGETATION OF THE HIGHER PLATEAU SURFACE

The western half of the Higher Plateau Surface from the Mersey scarp to Lake Augusta was extensively glaciated in the Pleistocene (Jennings and Ahmad 1957; and figure 10). This surface is undulating and carries a large number of lakes and tarns; soils are thin high moor peats over bedrock. The eastern half does not appear to have been glaciated but shows the affects of strong periglacial action. Soils in this region are yellow-brown alpine humus soils with surface layers of solifluction-sorted boulders of dolerite.

Woodland. There are few situations on the upper plateau surface suitable for the development of forest communities. Growth is limited by the low mean summer temperatures; the mean temperature of the hottest months is close to 10^{o}C, a condition usually accepted as limiting to trees. The insular nature of the Tasmanian climate however, must produce extended growing conditions relative to more continental climates; as a consequence the tree line is difficult to define in Tasmania and certainly cannot be defined simply on the above basis. The important climatic factors limiting woody species in Tasmania appear to be severe frosts and glazing storms, both of which are subject to marked local variation due to topographic relief.

Stunted low woodlands of eucalypt species are found in

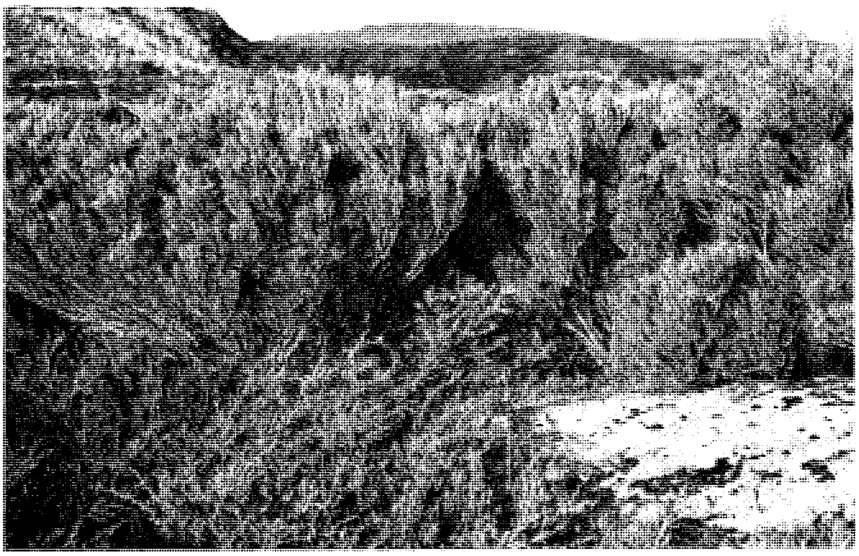
PLATE 5

Burnt eucalypt woodland near Halfmoon Creek; altitude 1180 m.

Extensive borrow pits alongside Arthurs Lakes Road; altitude 975 m; solifluction soil stripped for engineering purposes (1963-64) and not recolonised by vegetation due to lack of drainage and reclamation.

Photographs by courtesy of Botany Department,
University of Tasmania.

PLATE 6

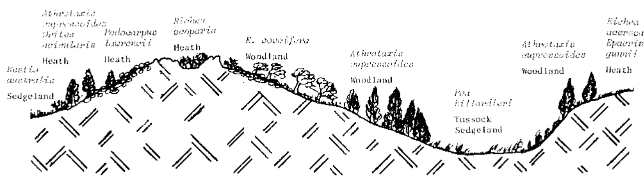


(a) Shrubbery with *Orites acicularis*, *O. revoluta*, *Leptospermum humifusum* and *Richea acerosa*; gorge of Liffey River and Drys Bluff in the background.

(b) *Donatia novozelandiae* with *Astelia alpina* bog in foreground, and *Diselma archeri* - *Richea sprengelioides* community in the background.

Photograph by courtesy of Botany Department, University of Tasmania.

sheltered sites. Towards the northern and western margins of the plateau where the precipitation is higher the eucalypt woodland tends to be replaced by montane rainforest, coniferous forest or coniferous heath (figure 17).



17. Higher Plateau Surface near Walls of Jerusalem; precipitation 2280 mm; vegetation types.

However the conifers are severely damaged and easily killed by fire, hence the conifer climax is only found in sites topographically protected from fire.

Most of the surface formed by sheet ice erosion in the Pleistocene has a low undulating relief with roches moutonnees and rock basin depressions. The low regions are poorly drained and have acid clayey soils with peaty deposits at the surface. These soil conditions are in general unsuitable for eucalypts. Because the depressions store cold air draining from higher ground these areas suffer intense radiation frosts. Exceptional frosts occur every 50-100 years. These are sufficient to kill all eucalypts in "frost hollows" and the incidence of moderate frosts is sufficient to restrict the colonisation of the region. Probably in the absence of exceptional frosts eucalypts could occupy all but the wettest sites. However the survival of acidophilous heath and sedgeland communities forming peaty soils makes it difficult for eucalypts to recolonise the area once the tree canopy is removed. The presence of decaying eucalypt lignotubers in the peaty soils of depressions now devoid of living eucalypts supports this hypothesis. The coniferous forest appears to be much more resistant to frost and to be restricted mainly by drought and fire.

As a consequence of the poor edaphic conditions and the frost activity in the depressions trees are limited to the rises. However, exposure to glazing storms tends to confine the woodland to the south eastern slopes (Plate 5). The effect of glazing storms is to kill back younger foliage and to cause the collapse of the crown due to the weight of ice under windy conditions. The effect of glazing storms is most marked in summer where unseasonable snowfalls drastically cut back fresh seasonal growth. Thus the exposed aspects carry shrubberies and heaths of plants adapted to these conditions. Trees are reduced to krumholtz form with conifers replacing eucalypts.

The conifer communites are well developed around the Walls of Jerusalem and the lakes southward through the Mountains of Jupiter to the Traveller Range. These communities have, however, been extensively damaged by the fire in 1960-61 (frontispiece). The forest consists of one tree species *Athrotaxis cupressoides*. *Athrotaxis selaginoides* becomes important in the forest on the lower plateau surface further west around Cradle Mountain but is not important on the plateau proper. The *Athrotaxis cupressoides* forest in areas with high rainfall and low fire frequency is simple in structure. In valleys and sites with adequate protection the forest carries a sod tussock grassland ground cover of *Poa billardieri*. The forest is very variable in density and is open enough to allow grassland between the trees in most situations. These forests are almost identical in structure to the open spruce forests of alpine areas in the northern hemisphere. Where the forest becomes exposed to wind and storm damage a patchy mosaic or mixture of forest, scrub and heath develops (Plate 7). A dense low tree or shrub layer is composed of the conifer species *Diselma archeri* and *Microstrobos niphophilus*. *Diselma* is typical of the colder and more exposed habitats; *Microstrobos* forms a heath or low shrub storey with *Athrotaxis* in more sheltered situations. Rock fields of congellifluction debris carry specialized shrubberies of *Podocarpus alpina*, *Leptospermum humifusum* and *Nothofagus gunnii*.

Eucalyptus coccifera - *E. subcrenulata* woodland occurs as a mosaic with conifers where exposure and drought increase the risk of fire and eventually replaces the conifers if the fire frequency approaches one fire every 70 to 100 years. *E. subcrenulata* is replaced by *E. gunnii* in rainfalls less than 1780 mm and *E. gunnii* in turn is replaced by *E. archeri* on the eastern margins of the plateau. Here *coccifera* may also be displaced from the drier sites by *E. pauciflora*.

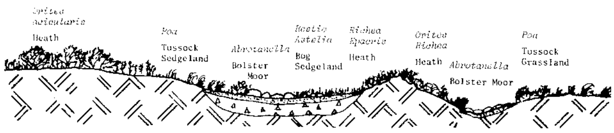
Grassland, Herbfield Bog and Sedgeland. Before 1920 much of the surface was a mosaic of shrubland and grassland tending to bolster communities, bogs and heaths in the poorly drained depressions or to woodland on the protected slopes. As on the Lower Plateau Surface the proportion of grassland relative to shrubland-heath has been reduced in the last 50 years by strong grazing pressure and repeated firing associated with the trans humance grazing of sheep. The burning and strong grazing pressures have exposed much bare soil and sheet erosion is evident generally on the grassland due to the destruction of the intertussock flora. Burning of heaths has caused the spread of unpalatable species like *Helichrysum hookeri* and *Olearia algida.*

The natural grassland climax vegetation is found on areas with moderately deep and well drained soils where frost action is severe enough to limit woody plants. It consists of a *Poa billardieri - P. gunnii* association; communities can vary from tall dense tussock grassland of *P. billardieri* with a scanty intertussock herb layer, to a short sod-tussock grassland of *P. gunnii* rich in rosette herbs such as *Velleia montana* and *Plantago antarctica.* The sod-tussock grassland increases in prevalence on the wetter and more peaty soils at higher altitudes. The principal community is an open pattern of tussocks of *P. billardieri* with an intertussock mosaic of *P. gunnii* with herbs, such as *Craspedia alpina* and *Celmisia longifolia.* Land subject to inundation carries a short herbfield of *Ranunculus nanus - Liparophyllum gunnii* or short fen sedgeland of *Carex gaudichaudiana - Montia fontana;* shallowly submersed mud carries *Myriophyllum pedunculatum.*

Sheets of boulder clay in depressions have poorly drained acid soils. On these the grassland is replaced by sedgeland, bog and wet heath. The plant characteristic of these edaphic situations is *Restio australis.* Communities of *Restio australis - Poa gunnii* are typical of sites with watertables a few inches from the surface. The permanently wet and acid depressions carry bogs of *Restio australis - Carpha alpina, R. australis - Calorophus lateriflorus* or *R. australis - Gleichenia circinata.* Deeper bogs of *Astelia alpina - Gleichenia circinata* occur where water is forced into diffuse lateral surface flow by the activities of the bolster community.

<u>Bolster Moor, Mat Shrubberies and Heaths.</u> The bolster community effects a major controlling influence over most of the other wet-land communities and does much to control the patterns of vegetation generally at high altitudes in Tasmania. In the absence of these communities streams would rapidly establish incised courses and most of the depressions would be fairly well drained. By maintaing a diffuse and shifting surface movement of water the bolster community maintains a cycle of bog and heath (figure 18).

The bolster plant communities occur more frequently than on the Lower Plateau Surface. In the eastern region the principal community is again *Abrotanella forsterioides - Pterygopappus lawrencii.* However, towards the west a greater range



18. Higher Plateau Surface near Lake Augusta; precipitation 1270 mm; vegetation types.

of species is found although the life-form and vegetation morphology remains almost unchanged. Species replacing *Abrotanella* are *Donatia novae-zelandia* - *Dracophyllum minimum*, *Phyllachne colensoi* and *Mitrasacme archeri* (Plate 6).

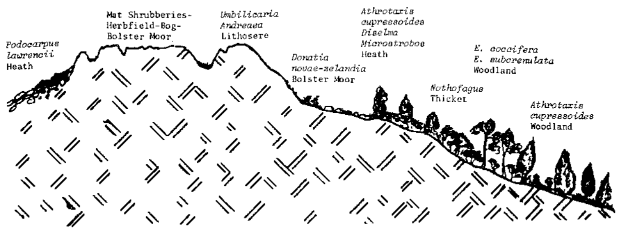
Bolster plant communities are composed of very compact diminutive shrubs whose multitudinous branches are densely packed to form a smooth surface of terminal buds and enclosing leaves. At first the surface is flat, spreading laterally enveloping and displacing other bog and heath plants. The branches maintain upward and outward growth; old leaves remain on the stems and decompose very slowly. New branches are added so that in time the growth habit comes to resemble a large cushion or bolster a metre or more in diameter and about 30 cm in height. It is common for several plants of the same or different species to grow together forming one cushion and for individual cushions to merge as they expand. Thus apart from a few pools of water the surface may eventually be covered with a mosaic of bolsters. Growth of the plants is fastest where the supply of water at or near the surface is permanent and the plants tend to colonise and invade small streams and soaks, growing along the margins of the water courses. Active growth of the cushions dams the flow of water forming small pools or tarns (Martin 1940). The water is forced to take another course whereon the site of active growth shifts to the new course. As the water flow shifts, areas of established bolster mosaic may become deprived of adequate water. This is reflected in a decline of the central areas of the bolsters. Growth and branching slow so that the cushion loses its former compactness and small areas may die or become chlorotic. During this decline the cushion becomes a seed bed for a specialized flora of small herbs and shrubs adapted to this niche on the surface of the bolsters. These bolster epiphytes include the herbs *Drosera arcturi*, *Senecio pectinatus* and *Plantago gunnii*, the grass *Danthonia pauciflora*, and the micro-shrubs *Pernettya tasmanica*, *Pentachondra pumila*, *Cyathodes dealbata*, *Sprengelia distichophylla*, *Coprosma moorii*, *C. pumila* and *Nertera depressa*. Eventually larger shrubs such as *Epacris gunnii*, *E. serpyllifolia*, *Sprengelia incarnata* and *Richea acerosa* become established and the development towards heath is initiated. Drained areas of bog or bolster moor revert to closed heath through complex wet heath mosaics where the heath component is dominated by plants such as *Richea acerosa, R. sprengelioides, R. gunnii, Boronia citriodora, Epacris serpylliflora, E. gunnii* and *Baeckea gunnianus*. Gradually the heath becomes closed with larger plants (1-1½ m in height) such as *Richea scoparium, Orites acicularis* and *O. revoluta*. In regions of high precipitation and low fire incidence the heath usually becomes coniferous, dominated ultimately with *Microstrobos niphophilus* and krumholtz forms of *Athrotaxis cupressoides*. *Diselma archeri* becomes increasingly dominant as the exposure to cold and wind increases.

Well-drained soils composed of wind blown rock particles exposed to strong cold winds, carry specialized mat shrubberies. These communities, like the bolster plants, form a cover resistant to abrasion by ice and wind-driven snow. The principal plants in the drier environments are the epacridaceous species *Cyathodes dealbata* and *Pentachondra pumila* with *Monotoca empetrifolia* and *Exocarpos humifusum* on stony soils. *Pernettia tasmanica* and *Coprosma pumila* or *Nertera depressa* are common on the wetter sites forming mosaics with patches of short sedgeland of *Oreobolus pumila* and *O. disticha*. These mat microshrubberies and short sedgelands become increasingly important at higher altitudes or greater exposure.

VEGETATION OF THE HIGHER MONADNOCKS

The scattered remnants of an even higher surface form isolated mountains around the western and northern rim of the Central Plateau (Figure 11). These monadnocks of resistant dolerite rise from the higher plateau surface at 1340 m and range up to 1460 m. In the western half they display strong glacial morphology with cirques and rock basin lakes. All have marked periglacial features. The flanks carry extensive block streams and boulder fields with rock-fall chutes cut into the scarp faces. Soils are thin high moor peats over rock particles or, in places, deeper yellow-brown alpine humus soils. The deposits are scanty, erosion by wind and water removing the material from the jointing cracks as fast as it is formed by the weathering processes. Even where soil can accumulate it is often covered with a deep layer of sorted boulders which restrict the vegetation to a few specialized shrubs.

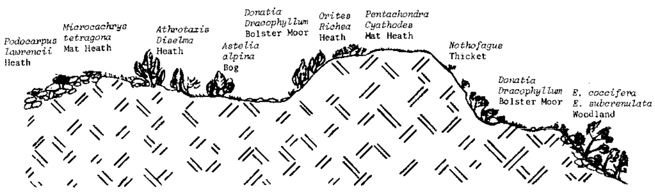
Woodland. Trees occur only in a few very sheltered alopes. Dwarf woodland of *Eucalyptus coccifera - E. subcrenulata* 6-10 m in height occurs on the south-eastern slopes where they are protected from glazing storm damage and where drift snow protects the younger trees (figure 19).



19. High Monadnocks, Walls of Jerusalem; precipitation 3000 mm; vegetation types.

Such woodlands carry an understorey of dwarf *Nothofagus cunninghamii* rainforest 2-4 m in height, or, on boulder fields, shrubberies of *Olearia pinifolia - Coprosma nitida*. Patches of *Athrotaxis cupressoides* dwarf coniferous forest are more frequent. These tend to occur in cirques, nivation hollows and rock basins which are protected from fire. Most patches of conifer forest do not have a closed canopy and the understorey is a tussock grassland or, on boulder fields, a closed heath of *Microstrobos* and *Diselma* mixed with *Archeria comberi* and *Olearia pinifolia*.

<u>Shrubberies and Heaths</u>. Shrubby vegetation accounts for most of the plant cover especially on the rock fields and solifluction debris (figure 20).



20. High Monadnocks, Wild Dog Tier; precipitation 1800 mm; vegetation types.

All the shrubs are typified by small, heavily cutinised leaves and tough flexible stems capable of surviving frequent snow and glazing storms. Many associations can be distinguished related to the various niches. Of importance are:

(a) tall heaths, 1-2 m. *Olearia pinifolia - Coprosma nitida*, boulder fields, moderate exposure; *Nothofagus gunnii*, boulder fields, high snow accumulation and adequate water in summer; *Nothofagus cunninghamii*, rock crevices, scarps, misty environments; *Orites acicularis - O. revoluta - Richea scoparia* peaty soils bordering on bog conditions; *Diselma archeri - Microstrobos niphophilus,* peaty soil accumulations with permanent water and protection from fire;

(b) low heaths, 10-25 cm. *Baeckea gunniana - Epacris serpyllifolia,* peats on bog margin; *Richea acerosa - R. sprengelioides* drained bog in wind exposed situations; *Cyathodes petiolaris* - shallow dry soils; *Podocarpus lawrencii* boulder fields in dry wind-exposed sites; *Archeria serpyllifolia* boulder fields and rock crevices at extreme exposures; *Bellendena montana - Helichrysum backhousii* exposed sites, good drainage;

(c) micro-heath or mat shrubbery, 1-5 cm. *Monotoca empetrifolia - Exocarpos humifusum* dry rocks or stoney soils; *Cyathodes dealbata - Pentachondra pumila* shallow soils drying in summer; *Coprosma pumila - C. moorii* wind exposed, shallow soils; *Pernettya tasmanica* wet peat - old bolster mosaic; *Microcachrys tetragona - Dracophyllum milliganii* wet moorland;

(d) Bolster moor, 0.5 - 1.0 cm. *Abrotanella forsterioides, Mitrasacme archeri, Donatia novae-zelandiae, Dracophyllum minimum* and *Phyllachne colensoi* in order of increasing exposure to cold winds and precipitation, all mixed with *Pterygopappus lawrencii,* occurring in soaks, springs and small streams where water is permanent; *Ewartia meridithae, E. catipes* and *E. planchonii* on shallow soils drying more in summer.

Herbfield, Bog and Sedgeland. These communities are associated with snow accumulation and the activities of bolster plants impeding water flow. Where water is seeping through the surface soil, as beneath bolster dams or in wet flushes and leads, the *Astelia alpina - Calorophus lateriflorus* bog community forms a continuous cover; with increasing snow lie this community is replaced by a short sedgeland bog of either *Carpha* sp. or *Oreobolus pumila.* Better drained soils carry a short herbfield of *Celmisia saxifraga, Helichrysum pumilum, Senecio pectinatus* var.*ochroleuca, Ewartia* species and *Lycopodium scariosum.* In situations of still longer snow lie true snow-patch communities develop with plants such as *Milligania lindoniana, Caltha phylloptera - Gaimardia fitzgeraldi* and ultimately stony barrens populated by the geophytic *Drosera arcturi.*

Lithoseres. The very large areas of boulderfields and block-streams carry a complex lichen flora. The main associations are *Umbilicaria cylindrica* - *U. polyphylla* - *U. subglabra; Andreaea exima* - *Umbilicaria polyphylla, Siphula fragillus* - *Cladia retapora* - *Polytrichum alpinum.* Crevices carry the fern *Blechnum pennamarina,* the clubmoss *Lycopodium selago* and are niches for endemic *Cheesmannia radicata* and *Gaultheria depressa.*

A more detailed list of plant communities, classified on a modified Fossberg system, into height and density classes, has been published (Jackson 1973) for related areas such as Ben Lomond, Cradle Mountain - Lake St. Clair and Mt. Field Reserves.

REFERENCES

Calder, J.E., 1850: Some account of the country between Hamilton and the Frenchman's Cap. *Courier,* Sept. 21.

Cheng, D.M.H. and Tyler, P.A., 1973: Lakes Sorell and Cresent - a Tasmanian paradox. *Int. Rev. ges. Hydrobiol.* (in press).

Daubenmire, R., 1954: Alpine timberlines in the Americas and their interpretation. *Butler Univ. Bot. Studies.* 11, 119-136.

Davies, J.L., 1959: High level erosion surfaces and landscape development. *The Australian Geographer.* 7, 193-203.

Gilbert, J.M., 1958: Forest succession in the Florentine Valley Tasmania. *Pap. and Proc. Roy. Soc. Tasm.* 9, 129-151.

Hydro-Electric Commission, 1972: *Hydrological Report.* 1971 Civil Investigation Div. Hydrology Section H.E.C.

Jackson, W.D., 1965: Vegetation, in *Atlas of Tasmania,* Ed. J.L. Davies, 30-35. Mercury Press Hobart.

Jackson, W.D., 1968: Fire, air, water and earth - an elemental ecology of Tasmania. *Proc. Ecol. Soc. Aust.* 3, 9-16.

Jackson, W.D., 1973: Conservation in Tasmania, Chapter 6, in Conservation of major plant communities in Australia and Papua New Guinea. Ed. R.L. Specht *et al.* *Aust. J. Bot.* (in press).

Jennings, J.N. and Ahmad, N., 1957: The legacy of an ice cap; the lakes of the western part of the Central Plateau of Tasmania. *The Australian Geographer*. 7, 62-75.

Martin, D.M., 1940: The vegetation of Mt. Wellington, Tasmania, the plant communities and a census of the plants. *Pap. and Proc. Roy. Soc. Tasm.*, 1939, 97-124.

Mitchell, A., 1971: *Vegetation for Soil and Water Conservation.* M.Ag.Sci. thesis. Univ. Melb.

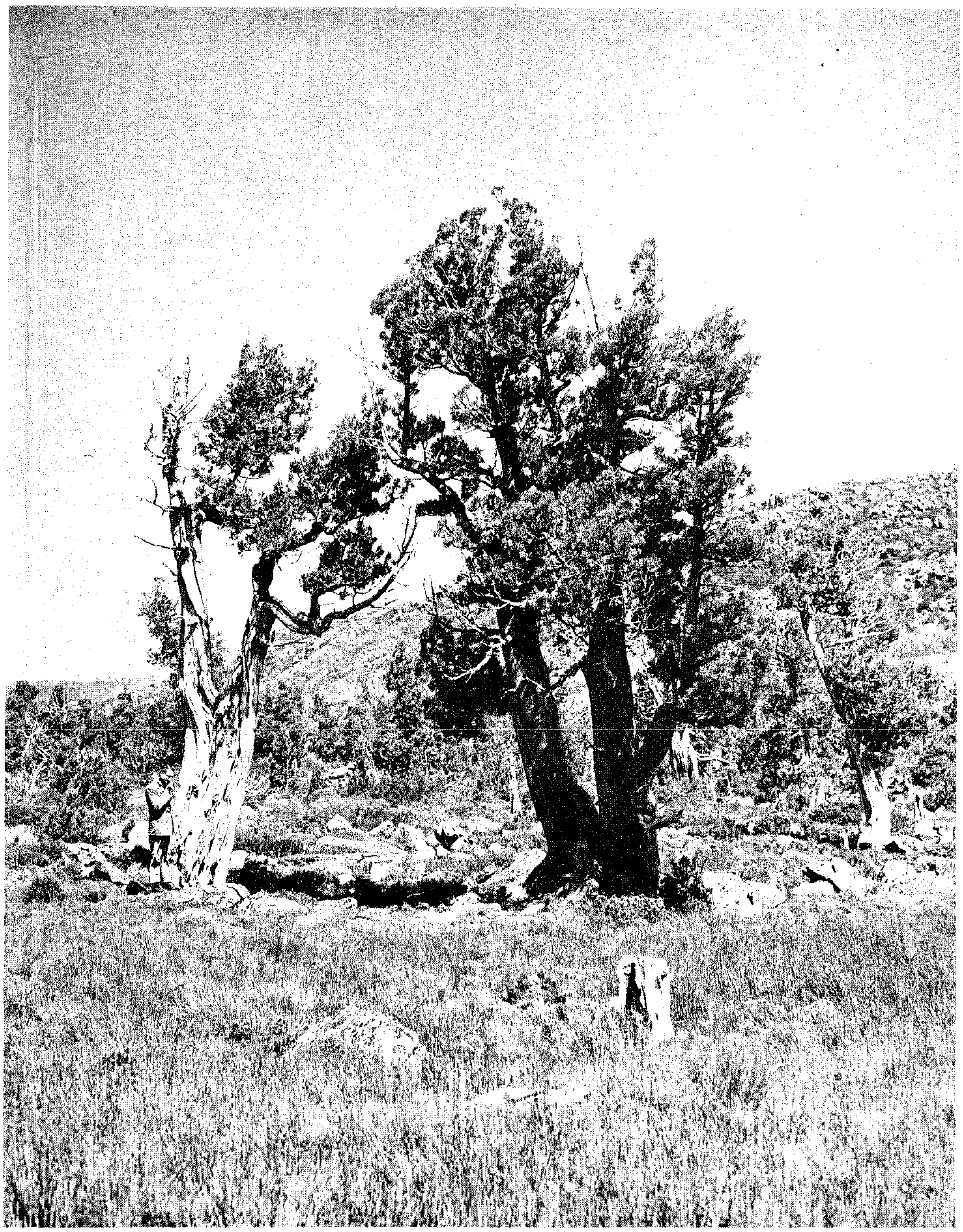
Scott, P., 1955: Transhumance in Tasmania. *N.Z. Geographer*. 11, 155-172.

Shepherd, R.R., 1973: Land Use on the Central Plateau with special reference to the grazing Industry. *This volume*, 161-176.

Tyler, P.A., 1973a: Limnological studies in Biogeography and Ecology in Tasmania. Ed. W.D. Williams *Monographiae Biologieae* den Junk, the Hague. (in press).

Tyler, P.A., 1973b: Lagoon of Islands, Tasmania - a unique but threatened ecosystem. *Biological Conservation*. (in press).

PLATE 7



Athrotaxis cupressoides (pencil pine) in the foreground, with a *Restio australis* sedgeland; *Richea scoparia* shrubland in the middle background, and pencil pine forest in the background.
Photograph by courtesy of the Botany Department, University of Tasmania.