PART II

THE NATURAL ENVIRONMENT
SOILS

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SOIL PARENT MATERIALS AND TOPOGRAPHY

The Soil Parent Materials

The soil parent materials can be considered in three main groups (i) those derived from basic igneous rocks,

(ii) those derived from acid igneous and sedimentary rocks, and their metamorphosed derivatives,

(iii) those of alluvial origin, which may contain material of either group but which are predominantly derived from group (ii).

Because of the influence of soil texture on leaching, a further breakdown on the basis of texture of the parent material is useful. The basic igneous rocks are fine textured, but the metamorphic, acid igneous and sedimentary rocks, and alluvial parent materials, vary widely. The red and grey granites, granodiorite, quartz porphyry and gneiss, which occur over considerable areas, the trachyte and the syenite from near Benambra, and the Mt. Wills muscovite granite are all predominantly coarse-textured parent materials. Of the coarse-textured rocks, the red granites seem to weather to produce the coarsest textured and chemically poorest soils. The widespread Ordovician sedimentary rocks, mainly shales and fine sandstones, and the schists are predominantly fine-textured rocks.

Alluvial material may vary from very coarse to very fine textures. Some of the older deposits are built up of boulders and coarse gravels overlain by fine-textured sediments. Silts and clays have been deposited in sluggish drainage areas of more recent flood plains. Recent alluvial deposits are generally no coarser than sands, and although some shingle beds may be considered as belonging to this category, they are usually of older origin but have been re-exposed by recent stream activity.

In the northern third of the catchment, coarse-textured, acid igneous and metamorphosed rocks are predominant. They range from gneiss and gneissic-granites on the western side, to the grey granites of the Granya-Koetong-Shelley uplands, and include the quartz porphyry of Mt. Burrowa and the red granites of Pine Mountain and Mt. Mittamatite. Small areas of schists occur in a band up to four miles wide on the western side of the Mitta Mitta River north and south of Eskdale. Another major occurrence is from Mt. Cudgewa, down the Tallangatta Creek valley and up into the catchment of Georges Creek. These schists also extend easterly from Mt. Cudgewa across the Reedy Creek and Logbridge Creek valleys, down the western side of Nariel Creek, and run as a narrow strip across Thowgla Creek. East of Thowgla Creek, the band of schists broadens out and extends to the Murray River near Biggera. This generally narrow, meandering strip of schist forms the contact aureole between the granite and Ordovician rocks in the centre of the catchment. Small areas of schists also occur around Burrowye, west of Walwa, and north of Stony Creek in the Cudgewa valley.

By far the most extensive areas of alluvial parent materials occur in the valley bottoms of the major streams in the northern third of the catchment.

The central third of the catchment is dominated by fine-textured sedimentary and metamorphic rocks. These are mainly Ordovician shales and fine sandstones. Some schists occur to the west of Mitta Mitta township and around the granitic intrusions of Granite Peak, Mt. Morgan and Mt. Barlow. Quartz porphyry, another of the coarse-textured acid igneous rocks, extends up the Mitta Mitta River valley from near its confluence with the Gibbo River and trends north-easterly from the confluence with the Dart River to include Mt. Benambra and the ridge dividing the headwaters of Tallangatta and Reedy Creeks.

In the southern third of the catchment the distribution of all the groups of parent materials is complex. However, the coarse-textured acid igneous and metamorphic rocks are dominant. Gneiss, and closely related gneissic rocks, occupy most of the western half of the area. Other rocks of this group, which occur in the southern third of the catchment are the muscovite granite of Mt. Wills, the red granite of the Anglers Rest-Nine Mile Creek area, the quartz porphyry of the Sisters and the smaller occurrences south-east of Gibbo Park and South of Marengo Gap, the related rocks of the Cobberas area and the syenite of The Brothers and Mt. Leinster. Small areas of grey granite occur east of Mt. Leinster and around Mt. Misery at the head of Morass Creek. Isolated and very small grey granite intrusions occur at several other locations in the south.

The fine-textured sedimentary and metamorphic rocks, predominantly schists, extend in a wide band from Mt. Bogong, through the Glen Wills and Hinno Munjie areas to the Divide between Tongio Gap and The Sisters. Schists also occur amongst the coarse-textured rocks in the eastern part of this area. Extensions of the Ordovician shales and fine sandstones from the central part of the catchment occur along Morass Creek and in the Limestone Creek-Upper Indi River areas.

Basic igneous parent materials also occur in the southern third of the catchment, but are not extensive in area. "Older" basalt (mid-Tertiary) occurs around Mt. Jim, Mt. Loch, Mt. Higginbotham and as isolated residuals on some of the ridges in the far west of the catchment. "Newer" basalt occurs in the lower valley of Morass Creek. There are small occurrences of limestone in Wombat Creek and Limestone Creek.

There is little alluvial parent material in the south of the catchment. The flats of Morass Creek around Benambra and the flats of Lake Omeo are the most extensive areas. Stream flats along the Livingstone Creek are not extensive except near its junction with the Mitta Mitta River.

Topography

The topography has a considerable influence on regional and local climate and on soil drainage and stability. Because of these effects, topography directly affects the pattern of distribution of soil and vegetation types.

Mountains make up most of the central part of the catchment and occur as a major component of the landscape elsewhere. Mountain-top elevations range from about 6,500 feet on the western boundary near Mt. Bogong to about 1,200 feet to 2,000 feet in the north-western corner of the catchment. Slopes of from 23 per cent to 50 per cent are common. Differences in elevation between ridge and spur top and adjacent valley bottom may vary from several hundred to several thousand feet.

Plateaux with undulating to rolling surfaces are a notable feature of the topography of the catchment. The highest plateau is that of Mt. Bogong, at about 6,500 feet. On the south-western side of the catchment, through Mt. Nels, Mt. Jim and Braithwaites Top, plateaux occur at about 5,500 feet and continue along the south-eastern edge of the catchment at decreasing elevations to about 4,500 feet towards Mt. Phipps (Plate 5). The plateaux of Davies Plains, on the ridge between Buckwong Creek and the Indi River, are at elevations of about 5,500 feet. Several small plateaux at about 4,000 feet occur on the ridges between Middle Creek, Cobungra and Bundarrah Rivers.

To the west of Mt. Pinnibar, and extending along the divide between Dart River, Tallangatta Creek and Thowgla Creek drainages, is a plateau at about 4,000 feet. Further north is the extensive dissected plateau of the Koetong-Shelley uplands at about 2,500 feet to 3,000 feet. Other plateaux, some fairly extensive, occur at elevations of about 2,000 feet to 2,500 feet to the south of the Murray River around Talgarno and Granya, and south of the Mitta Mitta River near Tallangatta. Small plateaux also occur along the ridge between the Mitta Mitta River and Tallangatta Creek.

Plate 5. Rolling plateau country between Mt. Hotham (out of picture on left), and Mt. Loch (on right), and steep montane slopes into Swindlers Creek.
The dead trees (*E. pauciflora*) were burned in the 1939 fire. Note the absence of shrubs on the southern aspects in the small valleys on the right.

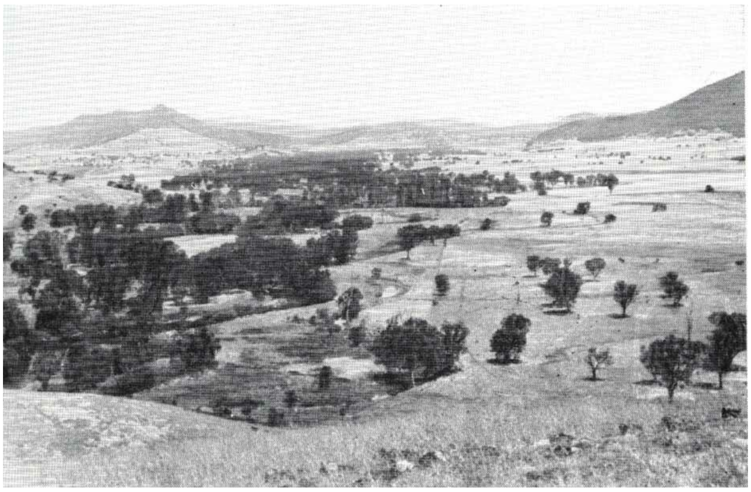

Plate 6. The broad valley of the Mitta Mitta River-the Noorongong plains (Murray land system). Note the remnants of the *E. camaldulensis* woodlands along the river. Forested steep montane slopes in the background.

Rolling to hilly country, in which the streams have few or no alluvial flats, occurs in the south-east, at elevations of about 2,500 feet. The most extensive area of this country extends from the Divide south of Omeo, down the Livingstone Creek Valley to Nine Mile Creek, and cast of Livingstone Creek to include the valleys of Morass and Benambra Creeks. However, Morass Creek has rather extensive alluvial flats around Benambra.

Broad valleys with generally rolling topography, and mountainous interfluves occur in the Cobungra-Spring Creek and Limestone Creek areas where elevations range from about 3,000 feet to over 4,000 feet.

Some extensive areas, consisting of mountainous interfluves and rolling to hilly valleys, occur in some major drainage basins in the northern part of the catchment. The largest of these includes almost all of' each of the catchments of Lucyvale Creek, Logbridge Creek and Wabba Creek. The lower valley of the Dart River and the Mitta Mitta River valley in the vicinity of and including the Six Mile Creek and Granite Flat areas is another. Other areas with this topography occur on Omeo Creek and the lower Buckwong Creek in the east, and at Annandale on Dry Forest Creek, Burrowye Creek and east to Walwa Creek.

Mature valleys with broad alluvial flats and raised alluvial terraces occur on the major streams in the north (Plate 6). There are usually at least two terraces present, the upper one[*] being some 20 feet or more above the lower. A third terrace, intermediate to the other two, may sometimes be found, particularly on the lower reaches of secondary streams (Plate 7). The valley *of* the Mitta Mitta River up to Mitta Mitta township, the Murray Valley up to Biggara and the valley of Tallangatta Creek up to Cravensville are the most extensive occurrences of this valley topography. Elevations in the valleys range from about 600 feet in the north-west to about 1,200 feet at the upper extremes.

The extensive plains between Cudgewa and Corryong consist of a greater proportion of upper terrace and relatively small areas *of* lower terraces and flats. The upper terrace has been mildly dissected.

The flats and terrace landscape of the mature valleys are usually bordered by hilly country which grades into the mountainous major interfluves.

Alluvial-colluvial fans are not an important feature of the regional landscape but they occur extensively where steep slopes intersect less-steep country, such as terraces (Plate 8). They may have split the drainage lines of their origin. The fans are younger than the terrace on which they form.

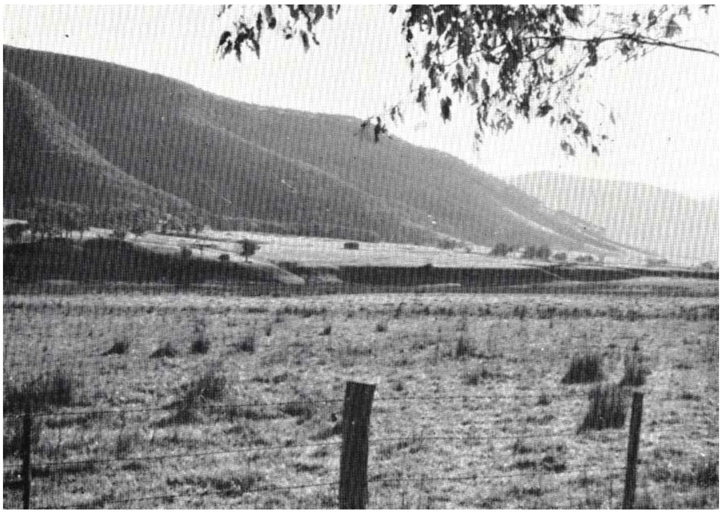

Plate 7. Terraces of the Murray land system with steep montane slopes of the Benambra land system behind.
Dissection of the upper terrace has resulted in the formation of small alluvial fans on the lower terrace. A large fan is visible on the right.

[*] The term upper terrace is applied to a generally undulating part of the landscape which is well above the so called river flats, and which consists of only small fragments of the old alluvial terrace proper, but includes the gently sloping sections of the high alluvial-colluvial fans which merged with it.

Plate 8. Alluvial fans south of Eskdale.
The larger fan had been truncated by the stream entrenchment before the formation of the flats in the foreground. The dissection of the large fan occurred at the same time, and the small fan (the gate is on its centre) was built up when the flats were being formed and subsequently. Stock terrecettes can be seen along the scarp of the large fan.

Another minor landscape feature of similar origin to the colluvial-alluvial fans are the gully fills which are frequently seen in road cuttings in mountainous and relatively high-rainfall areas. They appear as masses of soil and rock chips, orientated in flow planes, filling V-shaped channels in bedrock. There may not be any surface indication of their presence.

Some of the stream patterns and trends are worthy of comment. The strongly north-westerly-trending courses of Tallangatta Creek, Charleroi Creek, Georges Creek and parts of the Mitta Mitta River, indicate some structural control. The south-easterly or south-westerly courses of several streams in the south, Big River, Dart River, and Benambra Creek particularly, probably indicate an earlier southerly drainage has been captured. These are further discussed in the next Section.

Development of the Landscape

Whilst no specific study to explain the origins of the landscape of the catchment has been made, geologists and others have commented on most of the notable landscape features. These comments and observations made during the course of the survey, form the basis of this broad outline of the development of the landscape. Only a brief outline can be given as little substantiated evidence is available. This area would seem to provide ample scope for geornorphological studies.

Talent (1965) has commented briefly on the difficulty of correlating the various plateaux in eastern Victoria. However, an attempt has been made with the object of stimulating interest in the area.

The oldest existing surface is represented by isolated mountain tops such as the tops of Mts. Bogong, Gibbo, Feathertop and Hotham. This surface has been referred to as a Cretaceous peneplain (David 1950 Keble 1954; Gill and Sharp 1956) and may be comparable to the "Gondwana” surface of King (1950).

Mild dissection of the Cretaceous surface had produced a topography of moderate relief and with a general southerly drainage by the time the " Older " basalts were extruded. These flows contain fossiliferous leaf beds, which have enabled Gill and Sharp (op. cit.) to date the flows as being of late-Eocene or early-Oligocene age. The presence of the inter-basaltic and sub-basaltic leaf beds and clays has lead them to suggest that slight tilting to the north caused restriction of drainage during the period of basalt extrusion. The gravels on which the basalt rests are the beds of some of the streams of the Cretaceous age surface. Tin-bearing gravels on the plateau at Thologolong and Koetong could be of similar age though they may be younger, possibly of Miocene age.

The surfaces of the basalt flows on the Bogong High Plains are now well above the broadly rolling topography of the Plains, indicating subsequent stream entrenchment and peneplanation. David (1950) suggests that this surface developed during the Miocene epoch.

The extensive plateaux of the Koetong-Shelley area, the Bunjil area, smaller areas to the north and south of Tallangatta and the numerous accordant ridge tops at about 2,500 feet to 3,000 feet elevation in the north, may be remnants of this surface. The plateau to the north-west of Mt. Pinnibar at about 3,500 feet to 4,000 feet elevation, appears also to be part of this surface, its higher elevation being attributable to its location in relation to the axis of the Kosciusko uplift (discussed below). In the mountainous south of the area, most of the Miocene surface has been destroyed by subsequent geological events, but there is clear evidence of its existence in the flat-topped spurs and occasional small plateaux in the upper reaches of the Big River. The Ti-tree Creek plateau, Mt. Battery plateau and several other small isolated flat-topped hills, such as Macmillan's Lookout are also probably related.

The broad, relatively low gaps in the Divide south of Omeo (Tongio and Cassilis Gaps) are considered by David (op. cit.) to be Pliocene in age.

The most important event influencing the landscape of this area was the Kosciusko uplift which Andrews (quoted by Gill and Sharp 1956) considered to have occurred during Pliocene or early Pleistocene times. Keble (op. cit.) describes the uplift as a long, low hump with a more or less north-easterly axis through Mts. Kosciusko and Hotham, and possibly extending as far as Mt. Buller. The uplift caused a reversal of drainage of the northern sections of the south-flowing streams on the pre-uplift surface.

There is strong evidence of major faulting parallel to the axis of the uplift. The Tawonga fault and associated lines of weakness run across the heads of the broad alluvial valleys of the Kiewa and Mitta Mitta Rivers and Tallangatta Creek. Parallel trends in the lower reaches of Cudgewa and Corryong Creeks and in parts of the course of the Mitta Mitta River and numerous other smaller streams, are good examples. These lineaments, more or less parallel to the axis of uplift, are presumably the result of stress relief in the distorted crust. Most of the major faulting probably occurred about or during the period of maximum uplift, although some significant movements appear to be much more recent. Many of these features are discussed elsewhere (Beavis 1962; Central Planning Authority 1949; Crohn 1951).

Immediately after the Kosciusko uplift, the present-day streams of the Big River and its tributaries and Gibbo River and Morass Creek were left on the uplifted land mass and possibly south of the axis of uplift and continued draining to the south, probably through the gaps mentioned above. The uplift produced the Murray gutter (Keble 1954) with westerly drainage. Rapid entrenchment of a major stream, the present-day Mitta Mitta River, resulted in capture of the Big and Gibbo Rivers and Morass Creek, before their southerly courses became significantly entrenched.

A flow of basalt blocked the lower part of the valley of Morass Creek before the broad, mature valley topography had time to develop. The plug effectively restricted entrenchment and allowed the valley behind the plug to aggrade and develop a mature topography.

A fault along the Livingstone Creek (Crohn 1951) has resulted in the uplift of the western side by several hundred feet. Thus, the broad rolling valleys of Jim and Jack Creek and the Cobungra area, are possibly related to the rolling hilltops south of Omeo. Entrenchment of the Livingstone Creek after the faulting resulted in dissection of much of the old surface.

The internal drainage basin to Lake Omeo appears to have been produced by a fault along the northern margin of the Lake accompanied by down tilting of the northern edge of the block.

The formation of the broad valleys characteristic of the major streams north of the Tawonga fault must have been interrupted by movement of the fault. Rejuvenation of streams on the uplifted block, south of the fault, has destroyed most of the old broad valley. However, a study of the valley-in-valley features evident in the major drainages south of the fault would probably reveal the relationship to the broad northern valleys. The northern valleys received the erosional debris from the rejuvenated streams and a substantial filling of the valley bottoms occurred.

Abundant valley-in-valley features also exist in the valleys north of the Tawonga fault, indicating stages in formation of these valleys prior to the Tawonga fault and controlled by stages in the upwarping of the Kosciusko uplift.

There are several examples of apparent stream capture other than those mentioned above. A broad low gap at Red Bluff, east of Tangambalanga, may have been occupied by the Kiewa River, which would then have flowed directly into the Mitta Mitta River. The Wombat Creek may have entered the Mitta Mitta River via Toaks Creek but now flows in a south-easterly direction to meet the river. It seems possible that the High Plains section of the Big River may have entered the Kiewa drainage via Bogong Gap and Bogong Creek.

Major geological movement ceased during the Pleistocene epoch. The major landscape features had been formed and subsequent events resulted mainly in slight lowering of elevated surfaces and the building up and dissection of alluvial deposits. Since the last major geological movements, the streams of the northern valley bottoms have aggraded and the coarse detritus has been covered with fine material. The history of development of the landscape from those times to the present is largely explained by the theory of cyclic landscape development (Butler 1959). Climatic change, which induced periods of landscape instability alternating with periods of stability, is considered by Butler to be the major factor influencing landscape development during this period, which may be traced back at least 29,000 years (Walker 1962).