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# *Outlines of Tasmanian Geology*

## Section 11—(Continued)

### EROSION BY RUNNING WATER

(Continued).

### DESTRUCTIVE WORK OF MAN.

#### Bush Fires.

Man comes along, and in what he mistakes as his interests alters the whole face of the country and does so without a moment's thought to the geology or to the ultimate results of his actions. The greatest mischief-maker is the uncontrolled bush fire. Portions of the country required for agriculture are carefully watched, but bush fires spread over wide areas of unoccupied land, and one fire may turn a fertile hillside supporting a luxuriant forest growth into a bare, stony waste. The fires destroy the vegetation, and the next shower wears out gutters, often down to solid rock, their size depending chiefly on the slope. Before the vegetation can get a start again the surface has been scoured into great channels, which will grow from year to year, and the land ruined for many lifetimes.

This is occuring everywhere round Hobart. We should be particularly careful to keep as much vegetation as possible on our steep hillsides, until they are ready for the close attention of agriculture. Instead, fire after fire has ravished them, until in many places, notably on the slopes of Mount Wellington, all the soil has gone, and the hillside is bare of all but the most firmly established trees. The process may go further, and remove the whole of the soil, leaving only barren rock in the place of a flourishing jungle. On La Perouse a bush fire, wantonly lighted in a beautiful beech forest, even consumed the peaty soil, until now the surface of the mountain is a veritable desert. It was the same destructive agent that made Queenstown and the Linda Valley resemble a Somme battlefield. There the trees were cut down for firewood, and the undergrowth burnt by a cuccession of bush fires deliberately lighted. Very shortly the excessive rainfall had removed every vestige of soil from the steep hillsides and given what thirty years ago was a valley of ferns and mosses an aspect of utter desolation.

#### Clearings.

Clearing of land should be undertaken with great circumspection, as most farmers in hilly country know. As soon as the natural coating of vegetation is removed, rain water tends to wear deep channels, which will, if not prevented, soon ruin a fertile selection. Throughout Tasmania, which, with its steep slopes and heavy rainfall is particularly liable to this form of "pest," you can see farms that have been ruined through the development of these channels. The remedy is Nature's drainage and planting.

#### Road Cuttings.

Much damage is often caused by the careless construction of roads running across a steep slope. Often a grassy hillside can just drain off the surplus rainfall without disturbing the surface. A careless engineer, with two little keenness to think of details, makes a road across the bottom of the hillside. Such a road naturally has a high cuttting on its upper side.

Over this the water that has been draining quietly off the grassy slope runs with a velocity increased a hundredfold. In no time channels are cut in the road bank, and these extend rapidly up the hillside, soon ruining it for ever. A simple drain to catch the water on the top of the cutting, and so prevent it from developing momentum by falling over the steep slope, would have prevented this. There are numerous examples of paddocks thus ruined round Hobart, notably one just below the lower reservoir.

Another frequent form of stream erosion which has very damaging results is that originating from the cart track in hill country. A rough track or unmade road is run across a slope. The surface is worn down sufficiently to intercept the natural drainage of the hillside and the check imposed by vegetation is removed. This track then collects many streams of water, and very soon becomes a miniature gorge, increasing in size every winter. Many of the stream courses on the lower slopes of Mount Wellington were once cart tracks, and many of the prospectors' tracks through the West Coast are now mere grooves worn six feet deep or more in solid rock.

### "Bad Lands."

When an otherwise level or evenly-sloping piece of country becomes thus scoured and seamed with a bewildering maze of deep gutters and sharp, dividing ridges, it is termed "bad lands." Such are frequent when there has been a sudden alteration of drainage in the near past. They may extend over a paddock or cover thousands of acres. They are merely an exaggerated example of erosions by the small tributaries at the head of a drainage system, and illustrate what is going on over the whole landscape continually, if imperceptibly. . .

## EROSION BY RIVERS.

In the previous sections dealing with the wearing away of the landscape by running water, it was shown how the bulk of the actual work of erosion was done on the sides and at the heads of the valleys by the small rills of storm water that come into existence after every shower. But below these run the streams and often great rivers which all have their bearing on the erosion of the landscape. Although they can only work in their channels and affect a very narrow area compared with the streamlets already described, they really govern the work of these smaller agents. In the first place they provide a local base level for the rain water channels. The river, although its work is restricted in area, is far more powerful than any tributary in its basin and can wear the bottom of its valley deeper and more rapidly than the water in any of the smaller streams. Thus the bottom of the main valley in any region is continually kept the lowest portion of that region. To this level the streamlets can be always reducing the surrounding country and they are continually at work widening this deepest valley. Were it not for this work of the river in providing an ever lower base level the small streamlets would very soon reduce the valley side to a level beyond which water would be unable to flow. In the second place the river removes and distributes the material worn from the land surface by the smaller streams. Were this work not done the streamlets would soon cease to flow on account of the accumulation of sediments in the course.

### MECHANISM OF RIVER EROSION.

The principles of river erosion are similar for a vast volume of water like the Derwent or the Gordon, and for the smallest mountain stream and even for the storm water runnel formed after a heavy shower, and these remarks hold good for them all.

In the first place, while a small streamlet may be able to cut its course solely in soft soil and wear out a course by merely moving particles of this soil down the hill, a permanent stream or river very soon cuts down, in places if not throughout its whole course to solid rock. When it flows over hard rock, mere weight of water, or even volume, or speed of flow can accomplish nothing, and a river cannot erode its bed by the simple method of pushing or floating portions of the landscape down its course in fine grains. The river can only deepen its valley by rubbing boulders, pebbles, and sand over exposed beds of rock in its course As we saw in the case of the streams, the work a river can accomplish depends on (1) the volume of water and the regularity of the flow, (2) the slope, (3) the hardness of the rock over which it flows and (4) the amount of sediment it carries over its bed.

### FLOOD TIME.

It is during flood time that the river does most of the work of erosion. Then all its tributaries are discharging great volumes of sediment into it, and the additional volume of water can transport larger boulders. These pounding on and scraping over the rock of its bed always leave their mark in deepened channels and scoured bars. The force of the flood waters can be seen in the course of any of our mountain streams, and the size and quantities of piled up boulders left when the waters return to their normal flow is always a source of wonder. It is easy to see that the amount of erosion done depends directly on the volume of water. Further, a stream subject to frequent floods will erode its bed more than one with an equal annual discharge, but with a regular flow, although, on the other hand, during periods of drought, little erosion will be carried out. Also a flood may so scour out the river channel that the slope is insufficient to permit the streams during the succeeding period of low water to transport any sediment. When a river has reached this stage it can only erode its valley when its volume has been abnormally increased by floods.

## THE SLOPE OF THE VALLEY.

As explained before an increase in the slope of twice gives water a carrying capacity nine times as great. Therefore, it is where the slope is greatest — where the river is running the quickest — that it is eroding the most. Should a river, after flowing along a very gently sloping valley, come to a place where, from a recent fault or other cause, the slope is steeper, it will cut back from this place in a deep gorge. This is the simple explanation of the Cataract Gorge at Launceston, for example. Here the South Esk flowing for many miles over a very level plain came to a sudden sharp drop to the Tamar valley. The increased velocity enabled it to cut a considerable gorge in very solid diabase here, when further inland it has hardly cut at all into loose pebble drifts. The same explanation accounts for most of our great gorges.

This feature is very noticeable at the edge of the Central Plateau, and to a lesser extent on all our flat topped mountains. Streams which have hardly worn out a defined channel for themselves on the top of the plateaux and at the foot wander in wide, shallow, twisting rivers, flow in tremendous gorges, over falls and rapids as they change in level from the mountain top to the plains below. The river cuts down its bed largely by working the rapids backwards upstream.

## THE HARDNESS OF THE ROCK.

Naturally a valley takes longer to evacuate in hard rock than it does in softer rock. Thus two streams running parallel and with equal volume and slope may in time erode very different types of valleys in different kind of rock. But in Tasmania variations in rock beds are so frequent that no considerable stream flows for its whole course over rock of one kind. The result of this is that the river's bed consists of alternating beds of differing hardness. The river naturally wears out a wide, well graded valley in the softer bed, but finds considerable difficulty in cutting through the harder rock. It will wear out its valley in soft rock on the downstream side of a hard bed while this hard bar is scarcely affected. The drop from the hard rock to the softer bed will be marked and rapids will result. This is the chief cause of the many rapids in our big rivers. Take the Derwent, for example. From above New Norfolk downwards it has evacuated its bed in relatively soft mudstone and here flows in deep reaches. At Falls it has had to cross a bar of glassy trachyte (a lava), and has been unable to make much impression on it. The change of level is marked and the river runs in a series of rapids. The additional power given by the increase of rate of flow does not compensate for the greater hardness of the rock at this point. The South Esk, Mersey, and indeed all our larger rivers show the same process at work. Where rapids occur usually it will be found that the river is flowing over a bar of rock harder than the average met with on its course.

Above such a hard bar, an area of softer rock may be found. The river cannot cut into this to a depth greater than it is cutting into the hard bar below, or it would cease to flow and have cutting power, so the erosion of this portion of its valley depends on the rate of erosion of the hard rock below. Often you can find examples where a river has had its rate of erosion in a soft rock delayed for a very long period by such a hard bar lower in its course, but in time it has cut right through the hard rock, as for example when this hard rock consists of a relatively thin sheet of lava overlying softer rock.

As soon as the hard bar disappears the river starts to cut with great rapidity into the softer rock higher up. Previously it had worn a broad valley in this area. Now it starts to cut a narrow valley in the bottom of the older broad one and gives us an example of what is known as a valley within a valley—a feature common in all basalt country, especially along the North Coast of Tasmania. On the North-East Coast, tin and gold deposits, which were once deposited in the bed of a river valley, are now found a hundred or more feet above the river which, having cut through a hard layer, has deepened its valley very fast. When a river appears to cut out a narrow valley at an abnormally fast rate after a long period of gentle erosion, this is often the cause.

Another aspect of its rock bed that imparts distinctive features to a river's course is the way in which this rock is bedded. If it is a massive, igneous rock bedding is non-existant, but if it is a stratified rock its tendency will be to wear away along the bedding planes.

The rock will tend to break in slabs and the water to work down joints and cut the strata into blocks governed by these joints. A river's course is often controlled at its infancy by these joints and later it cannot move from the course so formed. Again, if the strata are dipping down stream at exactly the slope of the valley the water will flow over it without hindrance. If it is dipping at a steeper angle the water will tend to work into the planes of the strata and split off the upper layers in large slabs, the formation of the rock thus greatly assisting the river. On the other hand, if the rock is dipping up stream the whole surface of the strata will be opposed to the river, which will have to cut across upturned edges, a more difficult process than in previous cases; and if some layers of strata are harder than others these will resist the action of the river and form rock bars and rapids.

In the case of level bedded strata with layers of softer and harder rock, the river will tend to work back and cut out the softer rock, leaving a distinct ledge of harder rock overhanging, thus giving us a waterfall. Many of our falls on small mountain streams are so formed, especially in sandstone country, where we find most of these picturesque scenic beauties.

Again, while the river is cutting down the centre of its valley it is the smaller streamlets, as we have explained, that are widening the valley. These can cut more easily in soft rock than in hard, so in country where the rock is soft we tend to get broad, open, rolling valleys, while in country where the rock is harder the valleys become narrow, steep-sided gorges—the small streamlets being unable to do much towards widening them.

## THE SEDIMENT LOAD.

This has an important bearing on the amount of work a river can do. The river derives the sediment it pushes over its bed mainly from its small tributaries. The amount it can carry depends on the volume of water and the rate of flow, but whether or not the river is supplied with the maximum amount it can carry depends on the nature of the country over which the tributary streams flow, often on the recentness and volume of the rainfall and on the absence or otherwise of obstructions to the carriage of sediment.

If the streamlet tributaries are cutting away loose soil or soft rock, or if the absence of vegetation makes their work easy, the river will have a considerable load of sediment, and otherwise if the tributaries are cutting into hard rock. Also if the landscape is hilly all the streams will be assisted by the slope—while the process will be reduced in proportion as the liveling proceeds. It is common knowledge that after recent rains the rivers are charged heavily with sediments, and it is then that their greatest work is done.

As an increase of pace gives an increase of carrying power, the reverse is also true. Anything that tends to retard the flow of a river tends to reduce its eroding power. Thus, if its meets a lake its load is deposited in the still waters, and the outlet is free from sediments. The same applies in a lesser degree to deep, quiet reaches so often worn by a river at intervals in its course. Here the river is scarcely cutting at all unless in times of abnormal floods the current is strong enough to scour along these deep pools.

### The Shape of the Valley.

As the river can only cut in the bottom of its valley, and as it is always larger and more powerful than any of its tributaries, the valley tends to assume a V shape, with the bottom of the V in the centre of the river bed. If the river is cutting rapidly, and the tributaries slowly, the sides will be steep, or even precipitous when the river has cut down to a point beyond which it can cut, but the little tributaries will gradually widen the valley.

A stream in newly elevated country may commence to flow in a perfectly straight course, but soon it starts to bend. A slight obstruction, a difference in hardness of the rock, a difference in slope, will all tend to make the stream deviate. On a bend the current moves faster on the outside (as on the circumference of a wheel), and thus bends tend, by cutting into the outer bank, to enlarge themselves, until any stream we see today moves in a series of curves. The same process gives us high banks and often cliffs on the outer side of each curve, and low banks—sometimes swamps—on the inner side. Tributaries also flow into the main stream. The faster the river cuts down its bed the more power these tributaries have to cut valleys of their own. The two processes result in a series of spurs, which run out into the main valley, first from one side and then from the other, generally ending at the outer side of a bend.

A river valley, therefore, usually presents a V-shaped section with numerous spurs projecting into the valley. You can seldom see far along the valley if standing near the level of the river, and the view is from anywhere restricted by an adjacent spur.

If, from any cause the river derives additional cutting power, it only accentuates these features, as it cannot move out of the valley already cut, and merely cuts the succession of beds deeper.

## Section 12—EROSION BY ICE

In high latitudes and high altitudes, all or a certain amount, of the precipitation, falls as snow. Under favorable conditions this may become ice, in the form of an ice cap or glacier. At different periods in the world's history the climate has been such that ice has invaded areas now enjoying a temperate, or even tropical, climate. Ice, in this aspect, may be regarded as a variation of running water. It is a powerful agent of erosion in countries where it has full play, but the land features it leaves behind differ in important respects from those moulded by running water. Our Tasmanian landscape was materially affected by ice action in the near past, and these forms are therefore very important to us.

### Formation of Glaciers.

Whenever for long enough the annual snowfall over a given area is in excess of the snow melted there must be an accumulation. Soon this snow will be converted into ice under pressure of its own weight and the mass will tend to spread. Low temperature, heavy precipitation, and a long winter with a short summer are favorable conditions for ice accumulations. The earth's climatic conditions are always changing, the temperature and precipitation continually increasing and waning in cycles. So during a period when a given country is invaded by ice—an "ice age," as it is commonly called—the period of severe climate is gradually working from temperate conditions up to the maximum of the glacial epoch and then receding again to the normal climate. Such a complete period is called a cycle of glaciation.

### Summer Snow Banks.

These give us the very earliest beginnings and the very last traces of a glacial cycle. Naturally, in temperate regions, such as Tasmania, the tops of the mountains will first be affected as a glacial cycle approaches. On all mountains there are small hollows and pockets in which snow lies longer than elsewhere. At times banks of snow will persist throughout a mild summer. These are very frequent on all our mountains, and snow can always be found in the same spots at least up to Christmas time. These summer snow banks on account of their persistence, gradually "dig themselves in." As has been explained, frost is a most powerful agent of erosion. Round these snow patches it is naturally colder than on the rest of the mountain side, and here frost is at work longer than elsewhere. Also the melting snow supplies a continual flow of water which, soaking into the surrounding rock, is ready to expand and tear the particles apart during each nightly freeze. So on the whole mountain top erosion is proceeding quickest in the pocket holding these summer snow banks. This can be seen on all our mountains. Anyone who knows any mountain range can bring to mind one or more of these hollows. There is a good one on the top of the track up Mt. Wellington, and many on Mt. Field, and all the higher ranges. These are usually filled with chips of rock or soil, the products of this frost disintegration. Gradually these snow banks will work out for themselves an appreciable hollow which, if the glacial cycle is advancing, will become the seat of the glaciers.

### The Neve.

As snow accumulates in greater quantities than it can be melted it forms first a permanent snow field. The weight of a great depth of snow and the freezing action of the very low temperature soon turn any considerable accumulation into ice. This ice cap covers the highest portions of the landscape, and in time, with the increasing pressure of succeeding accumulations, it starts to move. The direction depends on the slope, but in cases of absolutely flat country pressure alone may force the ice field to creep gradually out from the centre of greatest accumulations. If the slope is regular or nonexistent, the ice will push outwards until it reaches a line where the temperature is high enough to melt each year as much ice as the pressure behind forces into the locality. If the slope is not regular the ice will tend to accumulate in valleys, where it will move as a frozen river known as a glacier. The neve is the accumulated snow bank or icefield that feeds the glacier, or moving ice sheet.

A glacier occupies a valley and therefore there is usually exposed above it crags of ice-free rocks. The neve, or an ice sheet, on the other hand covers the highest portions of a given landscape —only occasional pinnacles projecting.

### Cirques.

These snow banks gradually deepen their seat, and as they do so the force of nivation grows stronger, and also has greater surface on which to work. The base of the snow line is the point at which frost does most of its work. Higher up, under a permanent snow cap, the rocks are protected from alternating temperatures, and from erosion by water or wind. Lower down the cold is less intense, but in the zone where the sun is continually melting snow at night, and setting free water to saturate every crevice in the rock face, and the frost at night is expanding this again as ice, tearing the rocks apart fragment by fragment, and enlarging the network of tiny cracks for the water from the next thaw to percolate through, we have the maximum wear and tear.

Although this may occur right round a symmetrical peak, such features occur seldom, and the most usual position for the zone of maximum nivation is at the head of the valleys, just where the glaciers emerge from the ice sheet. The glacier appears in this way to gouge a route for itself into the general slope of the mountain, and these huge semi-circles of cliffs (mighty armchairs on the mountain side) are termed cirques. They present the most striking features of our Tasmanian mountain country, and provide us with our finest scenery. Many large volumes would be required to describe the cirques of Tasmania, but they are well known to all who love the mountains. At the head of broad valleys a horseshoe of cliffs rise sometimes in steps, sometimes in unbroken walls for a thousand or more feet to the narrow ridge of the mountain crest. The floor is always flat, and usually covered with the delightful King Billy pine and pretty grass trees, while in most repose the jewels of the highlands, the azurite blue rock tarn.

The Lake Judd cirque, on Mount Anne, is a gulf cut into the heart of the mountain three miles deep, and bounded its whole length by a circle of cliffs three thousand feet sheer from the top of the mountain to the blue waters of the lake. The so-called Crater Lake, on Cradle Mountain, lies in a cirque of white cliffs six hundred feet perpendicular from the lake's surface. The Lake Belcher cirque, in National Park, has been shown by several well-known photographs, and can equal famous spots in the Rocky Mountains for picturesque and grand mountain scenery.

### Glaciers.

From their source in the cirques, and fed by the accumulations of the Neve ice, the glaciers are pushed down the valleys until they reach a point where the pressure from behind is insufficient to replenish the wastage from melting. These rivers of ice have a considerable bearing on the erosion of the landscape. In the first place, in the cirques as the water, freed by the midday thaw, freezes again at night, the ice of the glacier becomes cemented on to the surface of the cirque wall. The glacier is continually, if very gradually, moving down the valley, and it exerts a tremendous pull on the blocks of rock already loosened, as described, by frost, and tears them bodily out of their beds. It is quite common to find blocks so wrenched from cirque walls scattered through our upland valleys, and often they measure fifty cubic feet.

In the second place, the very weight of ice does considerable work in eroding the valley over which it travels. In this work it is assisted by blocks of rock that find their way to its under surface, and to blocks which it picks up as it moves. These, with the enormous weight and power of the moving ice, tear and scratch away the rocks of the valley floor. A glacier can also scoop hollows in its bed below the general level, which is impossible with water. But too much stress must not be placed on the erosive power of glaciers, because they very easily ride over an obstacle.

### U Valleys.

As has been explained, a stream of water erodes only the very bottom of its valley. A glacier, however, usually covers a much wider bottom than a stream does. Also the streams valley is largely widened by tiny tributary rills. A glacier has nothing to compare with these, and any tributary glaciers are themselves quite main features. For this reason the sides of a glacial valley do not tend to widen. Again, a glacier can cut with its sides, which a river cannot, and the process of nivation which is responsible for the cirques is at work to some extent along the sides of the glacier. Here is maximum frost action, and the moving ice can tear blocks of the rock wall away. So as a result a glacial valley presents the general aspect of straight, often precipitous sides, with a broad, flat bottom. They resemble in section a U, just as a water-worn valley resembles a V. Further, the glacier seldom bends, and tends to shear off protruding spurs, giving a glacial valley a more open aspect, and allowing a longer view than is usual with water-worn valleys.

Such valleys are very common throughout our west coast. The well-known view looking from the Lyell mine down the Linda Valley shows these features to perfection. In many places on the west coast, for example, along the head of the Pieman and its great tributaries, the Husskinson, Murchison, and McIntosh, and further south, from Lake St. Clair, to the Vale of Rasselas and right down the Upper Huon, the valleys present this distinctive feature.

**Glaciated Landscapes.**

Water increases in capacity for erosion as it descends a hill, so the general aspect of water-worn topography is convex, that is, the slope increases towards the bottom of the hill until the zone of deposition is reached, when it attains the level with a gentle, sweeping curve. Ice-eroded country, on the other hand, owing to the peculiar methods of erosion by nivation and plucking, becomes rather conclave in general slope. The sides of a mountain are often hollowed out in perpendicular cliffs, which may occur anywhere. These cliffs do not shade off in a curving slope to the valley floor, but may meet it nearly at a right angle. Isolated mountains assume a pointed shape, and valleys are bounded by ragged cliffs. Lakes and waterfalls abound. These are a sure indication of an interruption of the orderly process of erosion. In general ice action gives the landscape beloved of the photographer and tourist, the wild, forbidding ranges of the west coast at once inspiring as scenery, and heart-breaking as source of livelihood.

## Section 14—THE SEA COAST

The seashore, so well known to us all, stands by itself as a peculiar, if common, feature in the landscape with characteristics all of its own. The border line between land and sea assumes varied forms—high cliffs, sandy beaches, low, barren, rocky shores, range after range of sand dunes, swampy reaches and mud flats, all common and often alternating within a short distance. Here we see intense erosion of a distinct type, and we often find deposited sediments, the forerunners of new fields.

The general trend of the seashore is usually regulated by major fault lines, which bound the elevated blocks of the globe which rise as land masses. These fault lines, when originally fixed by earth movements, may extend in roughly a straight line for many miles, giving a straight coast line, or may consist of series of cross faults, giving a serrated edge to the land (called a serrated coast), or again may occur in a mosaic pattern, which gives a repeated series of roughly rectangular salients and indentations (termed a "lobate" coast). The ordinary erosion agencies soon modify the coast as outlined by these faults. The end of river valleys tend to become bays and ridges to pit out as capes. Gradual sinking may produce swamps, and rising a high coast line. Alteration of the level of the sea also has its effects. But still, by looking over a long length of coast the original trend of the main causing factors can be discerned.

**Waves and Breakers.**

Waves are caused by factors (chiefly air currents) that disturb the ocean's surface. Friction reduces their effect, and a wave does not move the water below a certain depth—which depends on its size. It is only when the water is so shallow that the wave effect reaches to the bottom that the particular wave becomes an agent of erosion. This, of course, must occur sooner or later, as the wave nears the shore. When the friction of the shore is great enough to retard the bottom of the wave, the top turns over, often with great force, as a breaker.

If the coast is gently sloping and sandy or muddy, the effect of this is merely to displace some of the sand or mud. The more abruptly the coast rises, the stronger the force of the wave. This force is tremendous. At the Blowhole at Eaglehawk Neck iron stanchions, concreted into solid rock were completely smashed out of their fastenings, and thick iron railings, all many feet above high-water mark, were twisted like pieces of fencing wire by one storm. This mere force has considerable effect, but just as we saw was the case with streams, water alone has really little effect. These waves are charged with sand, pebbles, and even large boulders, which are hurled against a high coast or cliff, and break down and tear apart the rocks. The stronger the force of the waves the bigger the boulders it can hurl at the cliffs, and it is truly remarkable the size of the rocks that are sometimes left by a storm high up on a cliff ledge. Half a ton boulders hurled 30 feet above high-water mark are common occurrences. Remembering that the solidest rocks have joints and lines of weakness, it can easily be understood that no cliff face can withstand the buffeting of stormy seas for ever.

### Cliff Erosion.

Cliffs are, as a rule, indications of recent changes of geological conditions. Generally speaking, rain, streamlets, frost and wind tend to wear the top of the cliff away very quickly. Water here is flowing at its maximum rate, and soon the top is worn back, giving a sloping bank at the summit of the cliff. Gradually the bank extends itself at the expense of the cliff, and the latter disappears from the landscape. But there are many causes which tend to perpetuate the life of the cliff as such, and the method of cliff erosion is the most important of these.

The wave-forced particles destroy the weaker lines and soft spots in the rock face. Joints become more pronounced (as can be seen in a walk along a rocky shore), and ultimately cotnrol the shape of the minor features of the coast line. Crevices grow into the cliff face along these joint lines until they meet another joint or plane of weakness parallel to the cliff face; that is more or less at right angles to their own line. This is attacked, often from two parallel crevices. In time a block of cliff is isolated and stands out in the sea as a sea-stack, or crumbels away under the force of the waves. Sea-stacks are common along our coast, several splendid examples existing between Tasman's Arch at Eaglehawk Neck and Waterfall Bay. One of these rises, an almost perpendicular needle, over a hundred feet high and many yards out to sea.

Gulches, caves, blow holes and arches are all formed in the same way. The lines or zones of weakness govern the shape. Gradually these features are enlarged until eventually a whole segment of cliff face has disappeared.

### Terraces.

The maximum effect of the waves is felt just where the blow of the breaking wave hits the shore—that is from a little below low water mark to a little above high water mark. Cliffs along the sea shore persist in spite of the erosion of the upper portion because the force of the breakers is most active at the base, cutting away the rock here until blocks higher up fall from want of support. It will be noticed that between high and low water mark along the base of any cliff is a well marked rock platform or terrace. At the inner edge of this is where the greatest force of the waves is felt. There you look for caves. This platform is usually free from boulders, the force of the waves keeping it clear.

The undertow removes boulders from the shore until it loses its force in deep water. Here it drops its load, which gradually piles up into a submerged extension of the rock terrace. Sometimes this grows until it forms a rampart of boulders in front of the cliff face, and fresh storms pile up more and more boulders on it, until the waves never reach the cliff. Similarly on a low shore exposed to heavy seas, a very considerable bank of boulders will often be thrown far above high water mark. All these features together tend to reduce the area where land and sea meet to a comparatively level terrace.

### Currents and Tides.

Currents are persistent movements in the sea produced by prevailing weather, or other causes of movement in the oceans, especially the tides. The tide is the rise and fall of the level of the ocean that occurs twice a day, and is a wave motion caused by the lagging of the less dense element of water behind the rock mass of the world's surface during the of the tide on shore erosion is to produce a regular wave motion towards the daily revolution of the globe. The effect land and back again. This wave tends to carry out to sea particles of rock worn off the land by the waves. These in turn are caught by shore currents, which act towards these sediments in much the same way as rivers. The greater the velocity the greater the load that can be carried, and when this velocity is checked, which very easily happens—often through a change of wind or tide—some of the sediment load is dropped.

The currents and tides sweep along the coast collecting sediments from the shore waves. In front of headlands they tend to be congested, or to be compelled to move in a wider swyeep. Thi stends to increase their speed. In quiet bays, on the other hand, they meet a body of still water, which immediately retards their progress. Here they drop some of their sediment load in proportion to the checking of their speed.

### Beaches and Sand Dunes.

When the tide or currents drop part of their sediment load in quieter water this tends to get gradually worked inshore by the wavelets until some portion is exposed at low tide. The particles of sand then get caught by the wind and gradually moved further from high water mark. In time, sufficient accumulates to form a sandy beach; and if the wind is strong, sand dunes begin to grow. High cliffs are usually separated by fine beaches. On such a coast erosion is active. If currents run strongly and indentations abound, the best beaches will be found. If the prevailing winds are inshore you will find high sand dunes. Thus the stormy West Coast presents us Tasmania's finest beaches, and the rugged South-East has many good ones; while the relatively quiet waters of Bass Strait and D'Entrecastreaux Channel leave us with low rock coasts and few stretches of sand.

The numerous "tied-islands," or pairs of islands connected by a narrow sand spit that abound round our coast, e.g., Maria Island, Bruny, South Arm, Tasman's Peninsula, probably have their origin likewise, in the dropping of sediments by the tide and currents as they are checked when passing the two islands.

Wind piles up the sand into dunes to a certain height; but unless protected the same wind tends to blow the top sand layers off these dunes when they have reached a certain height. Thus the dunes continually tend to move inland, often spreading destruction over many miles of country. The danger to the railway line near Strahan from overwhelming dunes is a case in point. The only thing to check the onward march of the sand dunes is vegetation. Many pleasant fields have been ruined by removing vegetation near the seashore. Cutting trees or burning grass on a sand dune is as much a crime, and likely to be fraught with as dangerous results of the lighting of wanton bush fires described earlier.

**A. N. Lewis.**

# *Some Tasmanian Ferns*

It does not require a person to be a botanist in order to be interested in the form of a fern. Though they bear no beautiful flowers nor offer any agreeable fruits, there is something in the gracefulness of foliage which appeals to the sense of even the indifferent passer-by. To the student there is a much greater attraction; there is recalled to his mind the time when the ancestors of the ferns of the present day covered the earth with a mighty vegetation, filling up the marshy depressions with the spent spore cases and decaying limbs to make the coal seams of the present generation. There were then no flowering plants, no other trees but primitive forms related to the conifers, then the ferns. Their relatives, the club mosses, grew to noble dimensions of a hundred feet and more stimulated by the warm humid atmosphere then obtaining.

Few scenes in nature can be more beautiful than a fern gully. With a background of shrubs and trees the Old Man tree ferns spread their long fronds filling up every space where the light of the sun may enter. Though the complete

### Mosaic of these Fronds

may appear as though they must absorb every particle of light energy falling about them, yet beneath this canopy live the plant beings of greatest interest to the naturalist. Delicate filmy ferns of many forms, beautiful names and weird fungi revel in the fern trunks and moist soil of the depths of the gully. We all note the beauty, but how few care to know more; yet a further acquaintance with the structure and life of ferns will add so much pleasure to a walk in the bush that the little amount of thinking required will amply repay us.

Take the Old Man fern, which appears by its robustness as though it must live throughout the world, aided in this ambitious desire by the number of spares it customarily sheds, for in the case of the average tree fern these amount to about fifty million per annum, yet its distribution appears to be very restricted. It occurs in many parts of temperate Australia, also in New Zealand, but nowhere as luxuriantly as in Tasmania.

Yes, the average tree fern, after it has come to maturity, drops from its fronds no fewer than fifty millions of spores, any one of which may, if circumstances favor it, eventually grow into an Old Man tree fern itself. But how many of these fifty millions do really succeed? Examine the average gully with perhaps a hundred specimens, there are a few thousand young ones looking quite happy; out of these a few may reach the stage of beginning to form a trunk, but very few indeed appear to succeed in pushing up their heads, after

### A Hundred Years of Effort,

to take up a position of maturity amongst its fellows. Perhaps on the average not one in fifty millions ever succeeds in the struggle. What a prodigal waste of effort, yet it is very common throughout nature.

When a wattle flowers in the spring, how many pollen grains succeed in the justification for their existence? Probably not one in hundreds of millions. The same with the oak grass and many other plants. The same prodigality exists through a large part of the animal sub-kingdom, nor is the lord of creation, Man, exempt from the same charge of awful waste as our physiologists tell us. It is one of nature's ways of securing succession.

How careful of the type she seems,
How careless of the single life.

Let us enquire a little into how an Old Man fern manages to stow away so many spores. Examine a really old specimen, and underneath the edge of the leaf, or call it a frond if you like, you will notice little bodies not much more than a millimetre in diameter. Each of these bodies

**Very like a Bivalve**

that is a box consisting of a saucer and a lid. Inside this box there are about fifty little brown objects, which when dry fall from the box, and are generally called the spores, but that is not quite right, for each of these specks is itself a sack containing about fifty real spores; so here we discover one fact, namely, that one of these boxes contains 2500 spores, each one of which may become the ancestor of many generations.

To continue our means of approximate counting, we have to multiply the number in the boxes by the number of boxes on a pinnule, then this number by the number of the next division, and so on, till you have the number of spores on a leaf, and, lastly, by the number of leaves on a trunk, and now we have a rough count of the spores on each. You will find fifty millions not at all an excessive quantity.

This prolific sporing and possible growth in quantity would be of great economic importance if ferns were only of some use, but they bear no wood, and are shunned as food even by the lowest animals and almost so by the most obscure fungi. Bracken as a fodder is poisonous and stock often suffer from eating it. The natives, who had a great craving for starchy, or sugary, matter used to eat the spongy heart of the Old Man. Pigs and sometimes humans will eat the young end of the underground shoot. The only other use they may be put to is for corduroying a track, but, considering the amount of wood available, that is not great.

It is really an interesting thing that whereas in our bush we find insects and allied animals eating everything from gum leaves and hardwood timber down to toadstools and the dead bodies of grubs yet the greenest and most tender of the fern tissues

**Is Left Severely Alone.**

Is it possible that fern tissue, when green, contains some alkaloid or other obscure compound which causes immunity to attack? And may not this be an antidote for some of the hateful parasites which occasionally break out of bounds in the human system?

Useless as the old man fern is it grows mostly in deep gullies of little value, and is easily destroyed, but it is not so with bracken. Everyone knows that fern. A worse than useless plant, a harbor for snakes and rabbits, and one which is steadily driving off all useful feed from thousands of acres of good land. Bracken develops immense quantity of spores in lines put under the margin of the leaves. But the fern depends on a much more effective means of propagation than that which could be supplied by the doubtful success of a spore braving the vicissitudes to which climatic conditions would subject it. Instead of growing as does the Old Man on an erect stem, bracken progresses by an underground shoot which creeps along sending up a new frond every year. This stem occasionally branches so that as the shoot dies off behind each branch becomes an independent plant. Ferns may be readily divided into those of a creeping habit and those which are erect. The two groups are about equal in Tasmania.

Old man is not the only fern of tree habit found with us. There is the prickly tree-fern found principally towards the east and north. The palm tree-fern, with

**A Long, Slender Trunk,**

used to be met with in several gullies, but has largely been destroyed by fire. Both these have the spore sacks placed in little round patches on the under surface of the leaf. One of the Lomarias, commonly called brook fern, will, when conditions are very shady and moist, grow a good stem of a couple of feet tall.

One of our commonest ferns is Cathead, also known as Shield Fern, because the round masses of spore sack are covered when young by a round membrane fastened in the middle. This fern is coarse and robust, and found throughout the world.

A much more delicate and handsome plant is Lady Fern. This bears a large leaf divided into smaller and smaller divisions till it assumes the appearance of lace. The whole plant is covered with fine hairs which greatly add to the softness of its appearance. Accompanying this in wet bush is generally found a robust plant with tall opening frond. It is pale green, hairless and fleshy. Someone gave it the name of Oak Fern, which could be improved. There is a group of ferns, some members of which we are bound to meet with, known in the "Old Country" as Spleenworts, from some

**Fancied Resemblance to the Spleen.**

This group is marked by the structure of the spore bearing bodies. The mass of spore sacks is known as a sorus, and if it is covered by a membrane when young, this membrane is called an indusium. A Spleenwort may be known by the sori being much longer than broad, situated on the back of the leaf and covered by a membranous indusium. There are about half a dozen Spleenworts in Tasmania. The Marine Fern and Shelf Fern are familiar examples.

Maiden-hair and Parsley Ferns everyone knows, but a thing called Carrot Fern is not a fern at all. It is one of the Parsley and Carrot family of flowering plants, and very poisonous. It is known to chemists as Conium, or commonly as Hemlock. Some years ago children on the North Coast were poisoned by eating its seed. Socrates was compelled to take his own life by drinking an infusion of Hemlock.

Umbrella Fern is of

**A Very Ancient Type,**

and has a peculiar habit. The leaf is divided in two and next year a new shoot arises from the fork of these divisions; the year after a shoot from each division and so on. When some years have passed, the leaf is very long, with many tiers of annual growth. The Wire Fern and the Tangle Fern have a similar habit.

There is a group of ferns which have a style of spore bearing rather different from that adopted by any others, namely, the well-developed leaf does not bear spores, but the fertile leaf is always shrunken and looks like part dead fronds. These are called Tomarias. This name is so euphonious and easy, it may very well be elevated to the standard of a popular name. The Brook Fern already referred to is one of them; another is that very common dark green plant so often carpeting our damp gullies that it may well be called the Carpet Fern.

The only other group I should like to refer to is that of the Filmy Ferns. There are about seven forms of them, growing mainly on Tree-ferns, on bark or sometimes on the ground. Many are of singular beauty, others have special interest for the student. One forms lines only on the bark of King William Pine. It is densely hairy, and is capable of reviving after having been completely dried, a capability not at all common.

L. Rodway.

# *Notes on the Scottsdale District*

A holiday at Scottsdale gave many opportunities for nature study, and the following remarks are extracts from notes made from time to time during my stay in that district.

A favorite walk was along a grassy lane bordered on each side by bracken fern and a wire fence, and whilst here I saw at some distance ahead several birds feeding amongst the grass, and found with the aid of glasses that they were the Australian pipit, or ground lark, the parent birds with three young ones. One adult bird remained on guard upon a post of the fence, while presumably the mother kept on the ground with her family. If anything startled them they flew on to the wires of the fence, then back again on to the ground. At one time both adult birds remained on the fence posts watching and evidently were proud of their family, although on guard for any danger they appeared to enjoy seeing the happy time the youngsters were having.

This lane I referred to is very little used for traffic, so I often see numbers of birds there. Although only a short lane, I am often an hour in traversing it, as there is always something interesting to watch. The lovely

**Little Superb Warbler.**

or blue wren, and his little brown mate, are usually there. They are so friendly that as I pass slowly by they will come very near, or perch upon the post singing their charming song.

The striated field wren sings sweetly from out of a clump of bracken. Once I saw a pair of chats, and there will be a flame-breasted robin on the fence, and his dainty little brown lady flying somewhere near. Very often the little thornbill will be there. They are amusing to watch, as they fly on the bent stem of the bracken and twist and hop along it. They appear at times to slide from one end to another in their hurried search for insects.

While resting there watching these birds, I could hear just the very faintest rustle amongst the dead leaves, and as I moved the sound ceased, so I carefully moved away with my walking stick the surface leaves until I finally disclosed a young, half-grown blue-tongued lizard (generally misnamed a "goanna"). It lay partly curled up, but remained quite still while I admired its pretty markings and yellow-brown spots. I carefully laid the leaves over it again to see if it would move; but it remained perfectly still.

This lane opens out into a big grassy meadow where young cattle graze; flocks of starlings, chattering, feed here, and a pair have their nest in a hole away up near the top of a very tall dead gum. There is evidently room to turn, as one bird will fly in and disappear for a second, and then appears at the entrance and surveys the fields far below from his lofty home.

Another introduced bird of which there are numbers is the pretty goldfinch. It will often alight on the top of a thistle, no doubt receiving the name of thistle-finch from the fact.

A cuckoo will settle on the fence, and the pipit feeds amongst the grass, but keeps his distance from me, as I wend my way down to a sheltered bend of the little creek, bordered on this side with blackberry and fallen logs, and on the opposite side with bracken reeds, young blackwood and wattle, a few gum trees and several dead trees. A fire had evidently passed through last summer.

I have spent many happy hours there just listening to the birds, and keeping very quiet and still. Sometimes a

**Bandicoot Will Come**

out from under the blackberry and wander along at the side of the log where I am sitting. He will feed on the grass and come nearer and work his way under my log, and appear again on the other side, so close to me that I could put out my hand and touch him.

A young rabbit peeped out of his retreat and played about in the grass, then hopped upon a log lying parallel with mine. He came quietly along until he was level with me, then sat up and very daintily performed an elaborate toilet, taking much care over the washing of each forepaw. He watched me for a few minutes, his ears moving as he listened for any strange sound, then he scampered off, his little white tail bobbing, and disappeared into the blackberry.

There are only three sounds to hear, the rippling creek, the drowsy murmur of beetles and flies, and the wonderful singing of many wild birds which fills the air with sweet music. A goldfinch flew down from its perch on the bough of a bare tree into a tiny patch of grass, and its perfect reflection showed clearly in the water, making a charming moving picture as it moved feeding in the grass.

There are three black and white fantails in a blackwood, and they are constantly on the wing, giving their soft call of "sweet pretty little creature." They often have squabbles and chase each other, snapping with their beaks while they have a rough and tumble in mid-air. Nothing is prettier than to see one with tail and wings spread fanwise hopping about on a bough in search of insects, one left the others and flew down to the water, finding a pool well sheltered by overhanging reeds. It was a pretty sight to watch it getting a nice bath, uttering its sweet song as it came out on to a branch to

**Preen Its Feathers,**

then down again for another dip, and another preening of feathers.

The black-faced cuckoo-shrike flys about giving its purring call, and I often hear the butcher bird carolling his melodious song.

Numbers of the little Thornbill are about calling "Tiz, Tiz, Tiz," and are often in the blackwood with the fantails hopping and sliding about the boughs after insects. They are such busy birds, the young keep up a constant chirping and opening of beaks perched in the bracken, and keep the parents on the wing feeding them.

The white throated thickhead, or golden-breasted whistler, was about, and after alighting in a tree worked his way along the branches, giving his melodious calls, of which he has a varied number, one ending with a whip-like smack. He is a very fine songster, and came into a small gum on the opposite side of the creek, where he spent some time appearing to be very busy over nothing, the bush ringing with his many calls.

Here I have seen the flame-breasted robin and his mate, his favorite tree being a small dead wattle, where he makes a lovely touch of color perched on a bough. Both the pallid cuckoo, and the fan-tailed cuckoo are here, and I have watched a tiny thornbill give excited chase to the latter attempting to fly above and making very determined efforts to peck at the cuckoo's head.

There is one beautiful firetail here, and appears only just about this part of the creek. I have seen it with its head into a blackberry bush after insects, appearing like a very vivid red autumn leaf until it turned itself about and flew up on to the branch of a bare tea tree. It is a delicate quaker grey, with the gentle breeze blowing up the creek, raising the soft feathers about its neck into a tiny ruffle and the feathers about its neck into a topknot. To me it seems a quiet lonely little bird, always alone, flying about from bush to tree, or into the bracken and blackberry which grows so thickly on the opposite bank. I have named it "My Little Firetail," as only on one occasion has it failed to appear while I am spending restful hours here, and it will alight on a branch or twig quite near to me and stay for some little time.

A pair of pink-breasted robins, who have a nest in a clump of fern and blackberry under the fantail's favorite blackwood just overhanging the water, have been so busy

**Feeding Their Nestlings.**

the little brown-grey mother will hunt about and find a nice fat worm and fly with it to her special tree stump where she will beat it with care, until she has it just right, then down she flies and over the creek to her nest, and I hear the "chirp, chirp, chirp" of several young hungry birds as she arrives at the nest, then back she will fly into the grass and hunt about again. I have watched her fly quite a distance with a worm dangling from her beak just for the purpose of using this twelve foot stump and passing other bare stumps on her way. It is amusing to watch her perched up on it.. Once in her search for food she alighted at my feet.

Sparrow hawks or swamp harriers are always flying and scouting about in search of a meal; they appear to remain on the wing for a great length of time. About Muddy Creek along Minister Lane, where the mint and watercress grow tall and plentiful, these hawks fly. I have seen one chased by a pair of crows; one returned to her nest away up the creek while the other kept up the chase making darts at the enemy, but very soon the crow, becoming tired out, had to give up the chase and seek rest on the limb of the nearest tree where he scolded the hawk soundly, his mate adding her voice also from her tree some distance off. Meanwhile the hawk flapped its wings in a leisurely manner, and not disturbed in the least by all the noise the crows were creating, soared away out of sight.

Three native hens came out to feed on the other bank, and at first ran for cover when two hawks came into sight. Later they came out again, and a hawk flying low at a little distance settled upon the ground and watched them for a while, finally rising and making up the creek.

While standing upon a plank gathering an armful of watercress, I heard a quick rustling approaching me from beneath some short blackberry, and out raced a small,

**Very Drenched Water Rat.**

The rain and hail had come down heavily all the afternoon, but clearing at 5 p.m. I had set out for a walk. It was now about an hour later and possibly this rat thought he would take a short cut by crossing the plank, but he got such a fright, poor little fellow, when he almost ran into my black shoes, that he whisked about and simply fled back through the undergrowth the way he had come. I could hear the rustle grow fainter and fainter, then cease.

Just below the bridge over a creek on Ringarooma-road, a pair of fantails with three young ones were spending a happy time one sunny morning. Two blackwood trees grow tall and very close old man fern and dogwood are growing about underneath, and much blackberry. The parent birds were very busily gathering insects, flying quite a distance away in their search to get a nice dinner for their hungry family. The babies were quite the prettiest little things imaginable; they spread their little tails like miniature fans. As they flutter happily about in the branches of the dogwood they looked just tiny and prettier editions of their parents. The parent bird would flit in as a flash and feed one, then away again, then dart down again and feed another, the little things uttering soft calls as they hopped about, not attempting at any time to leave their shelter. Finally they grew tired of exercising their tiny wings, and one settled into the fork of a dead branch; in a short time the other two came, and all three cuddled up closely together. Overhead a long, dried frond of the fern dropped, and little shafts of sunlight filtered through the foliage above, touching the soft, downy feathers of the babies and warming them. Sitting thus, they blended perfectly into the coloring around them, and only when they heard the welcome sound of a parent returning with food, and little heads and yellow beaks moved, could I see what they were.

When returning from a walk on the Lietinna road I heard the charming song of that shy little bird,

**The Striated Field Wren,**

and found two parent birds feeding in the grass close to the roadside, keeping under the shelter of some short bracken. I noticed one would fly to the wooden fence and beat a worm or grub until only a small portion remained hanging from its beak; and as I could hear the chirping of a young bird, I guessed there must be one close by. It was quite some time before I could locate it, but there it was upon the lowest rung of the fence, and evidently not too steady on its little legs, which were stretched wide apart, giving it an absurd straddled appearance, and with its tail down as though that might help to keep it steady. But it looked as though a slight puff of wind might blow it over. It chirped and chirped and opened its beak, and I had now come too near for the parent birds, and they flew further down along the fence, one alighting upon the post tried to attract my attention away from their baby by singing most delightfully its beautiful little song of one tiny motif. Over and again it sang its already perfected tune, only pausing to take breath, its little tail erect and head uplifted, its throat swelling with song, in which it seemed to delight. The mother bird flew through to the other side of the fence, alighting in a nice, grassy patch, uttering soft calls to bring the young one to her, after a few minutes the little thing evidently realised this, and made quite a strong flight to its mother, who at once proceeded to feed it.

I often come upon these little birds when walking quietly along near to clumps of bracken; one will be perched upon a large bracken leaf, and the other not far away on the fence, singing their song to their hearts' content. They can be heard at some distance, but it is difficult to locate them, as they blend so perfectly into the color of dead bracken and are very shy.

I watch the bracken round about, and sometimes my patience is rewarded by seeing a slight movement as the bird turns its head or flits to another fern leaf.

I sometimes hear them down near the willows, whose young, delicate tinted leaves glisten in the sunlight after rain, and beautiful yellow, golden yellow, buttercups stand upright above their dark green foliage, and tiny wild violets grow thickly upon the bank, keeping close to their mother earth. In this quiet glade at the edge of the clear, running waters of the Little Forester, overhead in the tall trees wild pigeons (bronzewing), parrots, and other birds fly undisturbed, and give quite a romantic finish to the charm of the bush.

**Ila M. Harris.**

# *Some Notes on the "Wattle" or "Acacia"*

The word "wattle" is one which we in Australia have peculiarly adopted as our own. It dates from Anglo-Saxon times and signifies twigs or saplings or flexible rods plaited or interwoven together. The work has come down to modern days, and when early settlers came to Australia they found it convenient to construct the framework of the walls of their dwellings and other buildings of twigs and split saplings; the operation was called "wattling" and the material used "wattle." Near Sydney Cove there grew in abundance, overhanging the water courses, a small tree with small thin flexible stems, which was frequently used for the purpose, and hence was called "wattle" or "black wattle." Subsequently other plants which we now call acacias were used for the purpose, and these are recognised as "wattles" in most parts of this continent of Australia whether their stems and twigs are used for wattling or not. The term "wattle" is, however, by no means universally applied to plants of the genus acacia, particularly in the far western parts of the State of New South Wales. Myall, Boree, Mulga, Brigalow, Cooba, Dead Finish, Gidgee, Hickory, Miligee, Umbrella-bush, Wait-a-while, and Yarran all belong to the great wattle family.

The origin of the name acacia is not absolutely free from doubt, but the most reasonable derivation indicates that it comes from the Greek, Akazo. I sharpen, in allusion to the sharp spines of many of the African and Asiatic species which are, however, not characteristic of most of the Australian ones.

Acacias are found

### Mainly in the Warmer Regions

of the earth, particularly Australia and Africa; they aggregate nearly 500 species for the whole world, of which considerably over 300 are found in Australia alone. It will therefore be seen that acacia, or as we call it "wattle" is mainly Australian. The number of species can only be stated approximately, as botanists continue to discover additional ones.

### Blossoms or Flowers.

The flowers of wattles fall into two groups, those which have their flowers in small round heads or fluffy balls, and those in which the shape of the flowers may be described as short blunt rods or spikes; if you look at the blossom with a pocket lens or magnifying glass, you will observe that it consists of a very large number of tiny flowers, forming in fact, a colony of very small flowerettes, whose structure, though minute, is as perfect as that of any very large flower growing in our gardens. The minute flowers will be found to contain perfect sepals, petals, and a large number of stamens together with a pastil, the tiny sepals and petals differ amongst themselves in shape, texture, markings, in the presence or absence of hairs, and as these characters often determine the species, it may be necessary for a botanist to examine minutely a plant submitted for his opinion. The color of the flowers varies from pure white to deep yellow, different species showing flowers of varying shades of cream color or pale yellow. They do not show to advantage as cut flowers, their exquisite fluffiness departing very soon after being removed from the plant.

Most people are aware that the fruit of the wattle is a pod of legume, which although varying a good deal in shape in different species, bears a strong family likeness to the homely pea or bean, it therefore belongs to the natural order leguminosoe. In some seasons the conditions for forming pods are unfavorable over very large areas, and we may

### Look for Them in Vain,

but those of the ornamental wattles are well worthy of collection, as these plants are best propagated from seed. It may be as well to mention here that the outer coat of the wattle seed is very tough and impervious to moisture, so that it does not germinate very readily; therefore before sowing wattle seed it needs to be soaked in hot, nearly boiling water, or partly baked, an operation often performed by bush fires, the seed will be in dry grass land for many years, and as soon as a fire passes over the grass a crop of young wattles is the result.

Most of the wattles have no leaves, but only leaf stalks, which are flattened out, and have the appearance of leaves; they are called "Phyllodia," which is a word made up from two Greek ones, and means "like a leaf." The feathery foliage of the black and silver and Cootamundra wattles, which are finely divided so as to be almost fern-like, consists of true leaves. Many of these Phyllodia are almost endless in diversity of appearance. The feathery leaf wattles have a curious habit of folding their leaves at night, and going to sleep.

Wattles vary very much in size when full grown. Some tiny species only grow up to about six inches in height, and may be crushed by walking over it, but most of them are shrubs or trees of moderate size, while at least two species reach the height of very large trees, both of them being found to measure up to nearly four feet in diameter, and some 100 and 150 feet in height. I have seen silver wattles as high as the gum trees, and any thickness up to two feet or over; they grow very tall and straight in forests near rivers and in gullies.

The wattle has been set apart as

### Australia's National Emblem.

and this is very appropriate, when you consider that it is essentially a flower of winter or early spring, and its cultivation easy. It brightens up our gardens and roadsides and mountainside and forests at a season when there are few other flowers, and no flowers more attractive than yellow ones. When these facts are realised we shall see more wattles adorning the homes of this bright, sunny land than we do at present, for they are themselves an emblem of sunshine. So the appropriateness of the flower being Australia's national emblem is fully demonstrated.

We will consider some varieties of the wattle. First we will take the black wattle (Acacia Decurrens). It is the one used for bark stripping, the bark being used for tanning purposes.

The wood, after stripping, makes very good firewood; the tree also makes very good shelter trees on farms if left to grow.

**The silver wattle** (Acacia Dealbata).—This tree, as I have said before, grows to a great height; it is also stripped for bark for tanning purposes, and is used for the manufacture of wood-wool. For wood-wool it is necessary to get trees of this wattle that are grown in gullies, i.e., quick grown timber, and free from knots. The wood wool is used for packing all sorts of fruit. It could be used for work where fibre is used. A bale of wood wool will pack about 500 cases of apples; a ton of wattle wood of 80 cubic feet measurement yields between five and six cwt. of wood wool. The wood, when dry, after being stripped, is good firewood. Wattle is also used for making staves for casks, and in the whaling days a great deal of it was used; the casks for holding the whale oil were made from the wattle, cartwheel spokes, and a number of other both useful and very beautiful things.

### Blackwood (Acacia Melanoxylon).

This variety of the wattle is of the most valuable of the Australian timbers. It is a timber of the highest class, having a very ornamental character, as well as great strength; it is a hard, close-grained wood, and is very much valued and used in making furniture, billiard tables, gun stocks, walking sticks, railway and other carriages, and all sorts of cabinet work. It is also used in boat building (stern and stem posts, ribs, rudder), naves of wheels, parts of organs, pianofortes (wound boards and actions), and very many other purposes too numerous to individualise. It is a most useful timber for coachbuilders in the bent timber branch; it bends well, and with proper treatment from the felling and sawing of the timber it substitutes perfectly for the bent timber in, say, an Austrian chair, and would look better, and feel just as light. It is valuable for panelling, and will be seen in many offices in the cities. It is very like American walnut.

The blackwood known in Australia as the Mudgerabah tree, and is very much

### Used as a Shelter Tree.

It is about the only tree that pastoralists in that country do not ringbark. It grows to a most beautiful tree, having a trunk varying in thickness, and a very large spread of branches of dense foliage. It is an ideal shelter tree either in summer or winter. It should be planted also in gullies and forests for timber.

(To be continued)

**J. C. Breaden.**