



wildflower country

DISCOVERING BIODIVERSITY IN AUSTRALIA'S SOUTHWEST

STANLEY BREEDEN *and* KAISA BREEDEN

 FREMANTLE PRESS

ENDPAPERS: Weathered banksia seed cones on a woodland floor.

HALF TITLE: Wreath Flower, *Lechenaultia macrantha*.

PRECEDING PAGE: One-sided Bottlebrush of the genus *Calothamnus*. Most of the 45 described species of this genus are unique to the Southwest Botanical Province.

OPPOSITE: Golden Dryandra, *Banksia (Dryandra) nobilis*. The dryandras are emblematic of the Province. With nearly 100 species it has great diversity and each one is unique to the region. The genus *Dryandra* was merged with *Banksia* in 2007 (see page 124).

FOLLOWING PAGES: White Plume Grevillea, *Grevillea leucopteris*, is a tall shrub that rises majestically out of low scrubby heath known as kwongan. The flower spikes grow at the end of long slender stems.

PAGES 8–9: Giant Red Tingle, *Eucalyptus jacksonii*, is one of several forest giants growing in the high rainfall areas of the southwest coast.

PAGE 11: Fuchsia Grevillea, *Grevillea bipinnatifida*. Mostly an understory shrub in woodland and forest.



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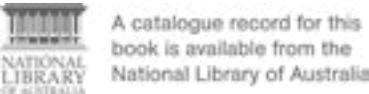
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FOREWORD *Stephen Hopper*

I write this foreword on a grey drizzling day in London, seemingly a world removed from the relatively little known floral wonders and richness of the southwest of Western Australia. Yet I am there, half a world away, my computer screen enriched with the vibrancy and stunning colours of the red and green kangaroo paw as photographed by Stan and Kaisa Breeden in this book.

I know the kangaroo paw well. Four decades ago I was lucky enough to undertake research for a PhD at the University of Western Australia on all twelve species of kangaroo paws, found nowhere else but the southwest. Each time I return in spring, I cannot resist the thrill of seeing kangaroo paws again, observing honeyeaters feeding on the nectar of flowers in one of the planet's most colourful biological partnerships. The temperate to semi-arid southwest is extraordinarily well-endowed with such local floral treasures, as rich in species and endemics as many tropical rainforests.

Today, I am mesmerised by the Breedens' photograph of the kangaroo paw, Western Australia's floral emblem. The image is so evocative, so three-dimensional and real, that I am there, on the spot again, hearing the brown honeyeaters and wattlebirds, smelling the eucalypts and boronias, breathing the crisp clean air of a Perth spring. This image is like no other published of the plant; an unheralded combination of artistic endeavour and technical mastery of twenty-first century digital photography. How lucky we are to have interpreters of nature as gifted, passionate and technically competent as Stan and Kaisa Breeden.

As a bibliophile and vicarious consumer of such floral exotica, I am inspired to return to the southwest, and return soon. Image after image herein heightens this

desire. Stan's carefully crafted text whets the appetite, citing familiar stories, plants and place names as he explains the underlying philosophy and photographic challenges involved in completing this book over six years of field work.

To many readers, the names, places and plants of the southwest may seem strange, bizarre, a world apart. You are not alone. Even the most exalted natural historian, Charles Darwin, struggled to understand the southwest on his first, brief and only encounter. Yet, for those who stay longer and look with open hearts and minds, enrichment abounds, and discovery of new things quickens at an extraordinary pace across the landscape and through the seasons. So it is for much of the southwest, where, once accustomed, one can revel in its subdued landscapes, nutrient poor soils, bright blue skies, beaches to die for, and travel rewarded by biological richness rarely seen on the earth's temperate lands.

I commend this handsomely produced book, and congratulate all involved in its publication. Stan and Kaisa Breeden have unreservedly accomplished their aim 'to arouse our sense of wonder' in a spectacular and beautiful contribution to the study of a region on Earth like no other.

I hope you will be as inspired as I have been to celebrate this floristic uniqueness and help ensure it has a future as long and astounding as its past.

Professor Stephen D. Hopper Director, Royal Botanic Gardens, Kew



INTRODUCTION

Kaisa and I are standing in the shade of a Firewood Banksia. My hand rests on its granular, lumpy trunk and just above my head are several spikes of its pink flowers. On our other side grows a White Plume Grevillea with bunches of curling, coiling flowers. Banksia and grevillea stand on the edge of a heath. The warm sun of spring has been absorbed by the plants and with winter's rain transformed them into growth, ultimately into flowers. A breeze rustles through the banksia's stiff leaves and carries the scent of honey and other sweet perfumes. Beetles, flies, bees and wasps buzz from flower to flower. Birds, mostly honeyeaters, flit among the foliage seeking nectar. As far as we can see there are licks and splashes of colour on a field of sage green.

We wonder how the pollinators might see the flowers. Moving about slowly, we look closely, very closely. The Firewood Banksia's spikes are not single flowers. Each spike carries hundreds if not thousands of them. Looking from beneath I see the spike's dark brown and white fishnet pattern, velvet in texture. The flowers – long pink tubes – arise in pairs among the white 'tiles'. Only pollinators with long tongues or beaks can reach the nectar at the bottom of the tube.

The White Plume Grevillea also carries its numerous flowers on spikes. In those not yet fully opened the long style (the female part) is held in a loop by the

flower tube. As the tubes open, the styles spring free. Black ants, looking for nectar, dodge in and out among the loops and curves, picking up pollen (the male part of the flower) as they go. In their travels they will deposit some of the pollen on the styles.

A sweet scent drifts on the breeze. It comes from a froth of fluffy yellow balls rising out of the surrounding foliage – one of the many species of wattle. As with the banksia spike, each ball is not a single flower but a cluster. The flower bud as it matures bursts open and pushes out a yellow brush, each filament tipped with pollen. The brushes coalesce to form pom-poms. Wattles do not attract birds: there is no nectar. But beetles and bees come to harvest the generous supply of golden pollen.

A few paces away are the red flowers of a one-sided bottlebrush. The bush leans over a patch of the intensely coloured Blue Lechenaultia. Beside them, swaying on their tall stems, are the flowers of a Red and Green Kangaroo Paw. Hidden deep inside a tangle of prickly leaves are the purple-rimmed honey pots of a flowering Honeypot Dryandra. There is no end.

Among the dazzle of colour on this euphoric spring day we are reminded of the obvious. To our human eyes the flowers are a spectacle of colour, form, texture, pattern, of purity even; of extraordinary beauty



PRECEDING PAGE: Ashby's Banksia, *Banksia ashbyi*, is found in the northern parts of the Province. The flower spikes grace spreading shrubs or even trees to 8 m tall.

OPPOSITE: Graceful Honeymyrtle, *Melaleuca radula*, sometimes hybridises naturally with the equally brilliantly coloured Scarlet Honeymyrtle (pages 77, 87).

and peace. But flowers did not evolve to soothe the human soul. Flowers are sex organs. The male parts must somehow deposit their pollen on the female parts so that it may reach the ovum, set seed and reproduce. This sexual reproduction needs a third party to transport the pollen. It is to entice and then reward the pollinators that flowers have evolved their extravagant beauty. Some go even further, they seduce their pollinators. What is happening all around us is a vast intermeshing activity whose purpose is the reproduction of the plants.

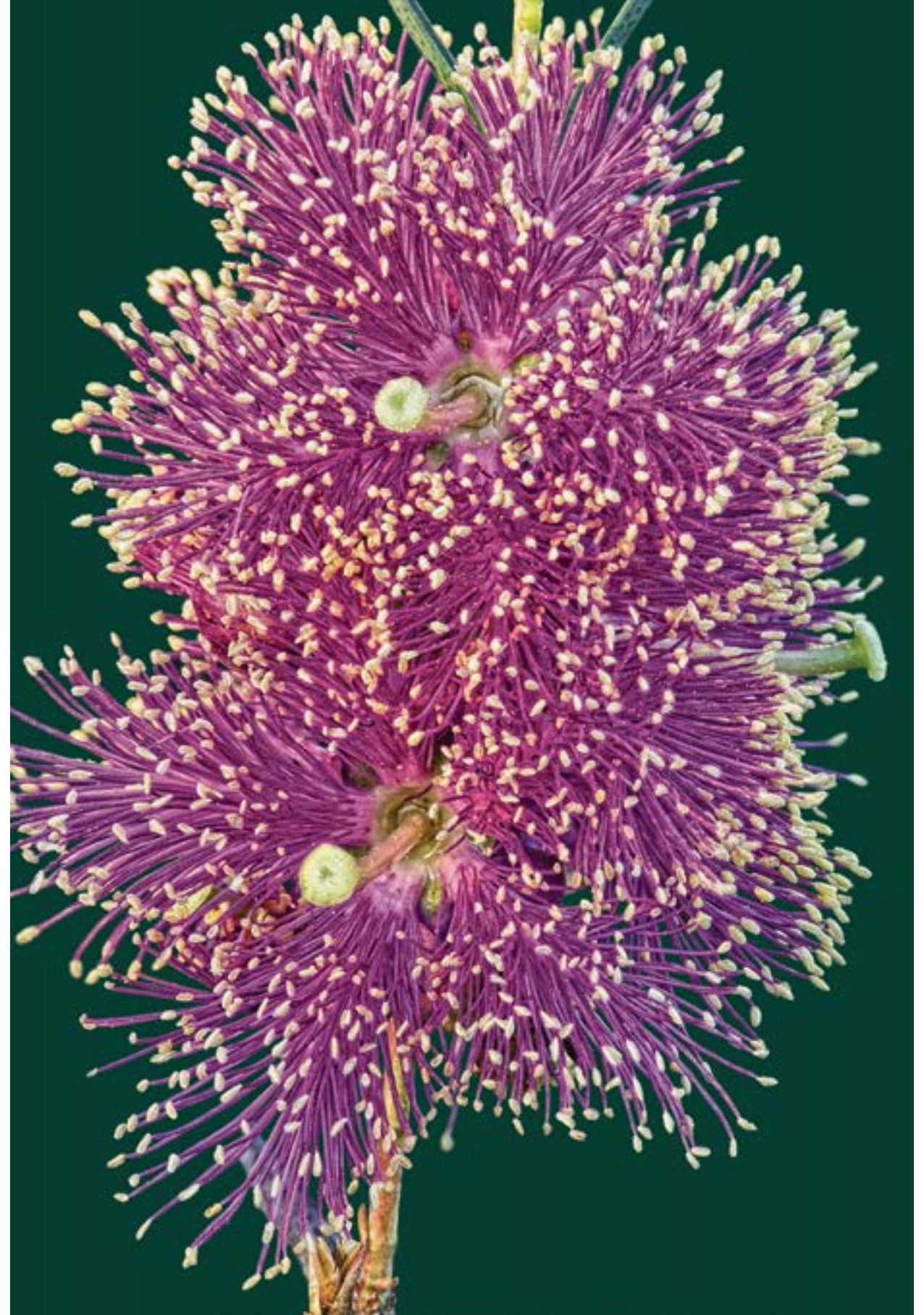
The extraordinary feeling of wellbeing, a feeling that all is well with the world, is nonetheless induced by the wildflowers. Their wondrous variety is unmatched. The southwest corner of Australia is the place of the ultimate wildflowers.

For the past six years we have worked hard to perfect our techniques in the new photography – digital photography. High-end digital photography surpasses film photography in many ways, enabling us to make clearer, sharper, more luminous pictures.

Kaisa puts it this way: *'We strive to make our pictures as true to human perception as possible, so that they are so clear, so moulded and defined that you feel you can reach out and touch the flower, lizard or whatever the subject is. You feel they are no longer on a two-dimensional piece of paper, that there are no barriers between us and the experience of what we saw – no fuzziness, no grain or noise, no blown highlights, no blocked shadows, no photographic interference between you and it.'*

Our quest is to take the ultimate pictures of the ultimate wildflowers. However, this is not simply a quest for the best and brightest. Above all we wish to evoke an experience and to draw the reader more deeply into the natural world.

It fell to me (Stan) to write the text. The photographs are a collaboration between the two of us from beginning to end.





LEFT: Red and Green Kangaroo Paw, *Anigozanthos manglesii*, is Western Australia's floral emblem.

FOLLOWING PAGES: *Peplidium muelleri*, like many other plants in the southwest, has no English name. After rare heavy rain in the northern, drier parts of the Province, these plants grow in the mud forming mats only a few centimetres high. The constant wind abrades the flowers and peppers them with sand. Only the newly unfolded ones are pristine.





PRECEDING PAGES: Blue-eyed Smokebush, *Conospermum brownii*. The buds at the centre of each flower cluster have given this species its name. Several kinds of smokebush form dense shrubs with flexible stems covered in blue, pale grey or white flowers. In the breeze these give the impression of drifting smoke.

RIGHT: A mallee — a small multi-trunked eucalypt — among wildflowers in the Stirling Range. The mallee-kwongan combination supports the richest variety of plants.



A close-up photograph of a dense field of wildflowers. The foreground is filled with numerous small, bright yellow flowers with a fuzzy, pom-pom-like texture. Interspersed among these are clusters of small, five-petaled blue flowers. The background is a soft-focus continuation of the yellow flowers. The overall scene is vibrant and colorful, representing a diverse ecosystem.

Part One

BIODIVERSITY
AND
PHOTOGRAPHING
WILDFLOWERS

PRECEDING PAGES: The wattle *Acacia scirpifolia* and *Dampiera lavandulacea*. Spring flowering is so vigorous that many species and colours intertwine.

Chapter One

A CAULDRON OF SPECIES-MAKING

The flowers we seek to understand and portray are found in a discrete area in the southwest corner of the continent. Botanists have named it the Southwest Botanical Province. It is to the west of a line from Shark Bay on the Indian Ocean to Israelite Bay on the Southern Ocean. The line marks the limit of 300 mm annual rainfall, which is the minimum necessary for the Province’s great diversity. Where there is less than 300 mm, the numbers and species of flowering plants decline, leaving mainly the more widely distributed species that can be found over the vast area of Australia’s dry interior. In the Southwest Botanical Province about half the species are found nowhere else.

There are few other places on earth where flowers are so all pervasive, so varied, so sumptuous. There are no other such places in Australia. The variety of species has been recognised internationally. Conservation International has identified Australia’s southwest is one of only 36 International Biodiversity Hotspots. There is just one other in Australia, in the diagonally opposite corner of the continent – Queensland’s wet tropics.

The southwest is a cauldron of species-making, of biodiversity; it has 5800 kinds of vascular plants. (There seems to be no general agreement on the number of plant species in the Southwest Botanical Province. The Western Australian Herbarium listed 5710 in 2000.

Stephen Hopper and Paul Gioia, in a 2004 paper, state that there are 7380, which they say will swell to 8000 or more with further exploration and study.) In the bush on a spring day, surrounded by flowers, the feeling that we are somewhere that is distinctly, essentially Australian is inescapable. We can feel it in our blood. We can see it in the kinds of flowers surrounding us. We can smell it in the bracing scent of the eucalypts. Surely this is Australia in its purest form?

To appreciate how Australian, or otherwise, these wildflowers are, it is helpful to delve into how plants are classified. The base unit is the species. Individual members of a species are much the same wherever they grow. In science each species has a two-part name, its scientific name. The Acorn Banksia, for example, is *Banksia prionotes*. These Latin or Greek derived names refer to a person, a place or some special characteristic of the plant. *Banksia* is named after Sir Joseph Banks, the great naturalist who collected so many plants during Captain Cook’s voyage to Australia; *prionotes* is Greek for ‘like a saw’ and refers to the leaf margins.

There are many other kinds of banksias, different to *Banksia prionotes*. Different enough to be separate species, yet similar enough to be grouped together. Groups of like species make up a genus. Going one step further, genera with certain characteristics –



OPPOSITE: Pink Featherflower, *Verticordia insignis*. The name *insignis* means remarkable or distinguished and honours the plant's masses of flowers. Most of the 101 described species of featherflowers occur only in the Southwest.

flower structure for example – in common are grouped together in a family. The family the banksias belong to is called Proteaceae. It is a well-chosen name, after the god Proteus of Greek mythology who could change his shape at will. Among the Proteaceae too there are many shapes – grevilleas, hakeas, isopogons, petrophiles and many others. They range from small ground plants to tall trees with a great variety of flower size and arrangement – but all with the same basic structure.

The Myrtaceae, members of the Myrtle family, are equally well represented in the southwest and are extremely diverse – eucalypts, featherflowers, bottlebrushes, net bushes, starflowers, melaleucas and many more are all myrtles. The family Papilionaceae stands out with numerous genera of peas. All the wattles belong to the single genus, *Acacia*, in the family Mimosaceae.

When you cast a botanical eye over the families of flowering plants in the southwest there is nothing uniquely Australian about them. The banksia family has many genera distributed across other southern hemisphere continents. Myrtles are found all over the world as are members of the pea family. Even the group of flowers that symbolises the southwest of Australia more than any other – the kangaroo paws – belong to a family, the Bloodworts, that is widely distributed in the world's tropics. But when you look closely at the genera and species and how they have adapted to this corner of the continent, you become aware that the plants are uniquely, sublimely Australian.

We feel there is something more to this feeling of Australianness. The distinctive character of the bush

is not just in the species composition but also in the way the plants grow. How they grow is a response to soil and climate. On a cool spring day it is difficult to imagine the harshness of summer. But by December most soil moisture will be spent. There will be no appreciable rain till winter, in June and July. The temperature may rise to 40°C or more. And to top it off the soils, virtually throughout the Province, are low in nutrients. The plants had to become tough to survive and it is this toughness that imparts that special feel and appearance, and Australianness, to these plants and through them, the landscape. Botanists have a term for this adaptation – sclerophylly and scleromorphy.

In Greek *sclero* means hard, *phyll* leaf and *morph* form. Sclerophyll therefore means having hard or leathery leaves. A scleromorph is a plant that has not only hard leaves but also woody stems and seed pods. Some of the eucalypts, such as the Mottlecah, have a waxy covering over the leaves and stems which gives them an ethereal blue-grey colour. Leaves often have sharp, spiny tips. Hardness, leatheriness, brittleness, spikiness, protective wax – all these speak of an ability to endure hardship. In spring the scleromorphs' harshness is masked by soft, even delicate, flowers, but we could feel it; the prickles, spikes and rough-edged leaves ripped our skin and shredded our clothes.

Scleromorphs are not unique to the southwest, nor are the plant families or even many genera. There are grevilleas, eucalypts and wattles all over Australia. But in another aspect, and this is its glory, the Southwest stands alone; it has a far greater variety of brilliantly flowering plants than any other place on the continent. It is the southwest's mystery and paradox.





OPPOSITE: Scarlet Banksia, *Banksia coccinea*.

BELOW: Creeping Banksia, *Banksia repens*.

Banksias richly illustrate the biodiversity of the Southwest Botanical Province. Out of the 170 or so described species, 155 occur here and only 14 grow outside Western Australia. This diversity is reflected in the flowers and growth habits, ranging from brightly coloured flowers growing on trees to earth coloured ones erupting out of the soil from underground stems.



Chapter Two

MYSTERY AND PARADOX

Plant species-making on the scale that is found in Australia's southwest is complex. Many factors, and subtle nuances between them, influence the process. Climate determines how much rain falls and when; how hot, how cold. Then there is the soil – how fertile, how well drained, how deep. The connection to other regions comes into play; how isolated it is from these, what influences impinge on species composition. Upheavals and other forces in the earth's crust affect the course of evolution: mountain building, subsidence, erosion, glaciation, volcanic eruptions, changing sea levels. The history of plants over the aeons is yet another determinant. Climate, soils, geology, isolation, history are the alchemy that regulate the proliferation and diversity of species.

Nature is often portrayed as a machine, predictable in all it does, from the movement of the tides to the cycle of the seasons. But this is not always so. Nature's laws are more aligned with chaos theory, which holds that minor changes in conditions in one place can have major consequences in another. This is true for the evolution of plants. A small change in rainfall or soil fertility can set in motion a series of events that drastically change species composition. Yet neither alchemy nor chaos theory comprehensively explains why the southwest has *such* a variety of plants. Conditions in other parts of Australia are different but not vastly so. That is the mystery.

The paradox is that the Southwest's unique variety thrives on poor soils. You would think that the more fertile the soil the greater the variety of plants it would support, that low nutrients would weed out less adaptable species. But the opposite is true. Over great areas of northern Europe, for example, there are fertile plains with reliable rainfall yet comparatively few plants dominate. The rich nutrients enable a few vigorous species to overwhelm more sensitive ones. The whole of Great Britain, which has its fair share of good soil, has 1600 species of plants while a single reserve in Australia's southwest – Fitzgerald River National Park with sandy soils low in nutrients – is home to 1900.

There is another paradox. The southwest's underlying rock is ancient and worn. You would expect this to produce uniform soils. Not so. They have given rise to a complex mosaic creating a great variety of niches. Every niche is an invitation to new species to evolve to fill it.

The underlying rock is a good place to begin this story; it is the platform on which its dramas were staged. Almost the entire Southwest Botanical Province is supported by a solid, hard, unyielding block of granite and gneiss of an unimaginable age. About 270 million years ago (mya) the entire block, named the Yilgarn Shield, was smothered beneath a thick sheet of ice. The south pole was then in Tasmania. By about 250 mya glaciers had ground the Shield into a flat surface,



PRECEDING PAGE: Leaves of a Royal Hakea, *Hakea victoria*. This species is found only in a small area centred around the Fitzgerald River National Park on the southern coast. The colour of the leaves represents an extra dimension in sclerophylly – the adaptation to low soil nutrients and a long, hot dry season (see pages 34, 182).

OPPOSITE: The Illyarrie, *Eucalyptus erythrocorys*, grows to about 8m. It is found in a very small area along the west coast between Green Head and Dongara. Many different species restricted to small areas of specialised habitat give the southwest its astonishing variety of plants.

scraping off its mountains and filling in its valleys. Never again was this land disrupted by glaciers, rising sea levels, volcanoes or mountain building. It is one of the oldest and most stable exposed land surfaces on earth.

About 200 mya the Yilgarn Shield was covered in dense forests of pines, cycads, ferns and other plant groups. Dinosaurs and small mammals lived in the undergrowth. Australia was not yet an island but part of Gondwana, a super continent made up of all the southern hemisphere lands joined together.

Plants bearing true flowers, the Angiosperms, did not evolve until much later. The earliest Australian fossil Angiosperms are dated to 124 to 112 mya. Just where and from which ancestors flowering plants evolved is not known. They were, however, a major – if not the major – evolutionary leap in the entire history of plants. In five to ten million years, a very short time, flowering plants had taken over the earth – pushing ferns, conifers and cycads to the margins and causing the extinction of others. Today there are some 235,000 species of flowering plants but only about 700 species of cycads and pines combined. All the flowers we admire, and virtually all the plants we eat, use for medicine and fibre, are Angiosperms.

By 60 mya the dinosaurs had been extinct for five million years and Gondwana had begun to break up into its component parts. Australia, still attached to Antarctica, drifted northwards. The climate was warm and humid. Tropical rainforest thrived throughout Australia, including the southwest, and did so for

millions of years. These were the great Gondwanan forests where the present day flora has its origins. Small remnants of Gondwanan forests remain along Australia's east coast.

The demands of these great primordial forests and the constant heavy rainfall leached the Yilgarn Shield's soils. Phosphorus especially became scarce. Even then the flowering plants had a solution to this problem – scleromorphy. Scleromorphy was not born in the later austere, dry periods but in the fecund Gondwana rainforest. A beautifully preserved fossil seed cone of a banksia from the southwest, one very like today's Slender Banksia, is dated at 40–50 mya. Other fossils of the same era show that more plants with tough leaves as well as woody seed cones existed in the rainforest. These early scleromorphs were poised for a species explosion in the harsher times that followed.

Gondwana had broken up into all its component parts by 30 mya. The last separation was Australia's breaking away from Antarctica. Antarctica drifted southwards. Its plants were obliterated by ice sheets. Australia had become an island. Over the next 20 million years, as it drifted slowly and inexorably northwards, it became cooler and drier. By 2.6 mya rainforests had disappeared from the southwest. The surrounding oceans buffered the region from the extreme cold of the ice ages of a million years ago. No glaciers scoured the Yilgarn Shield this time. It escaped Antarctica's fate. The scleromorphs now took over. Their adaptation to poor soils had also prepared them for a colder, dry climate.



OPPOSITE: Warted Yate, *Eucalyptus megacornuta*, is another eucalypt confined to a small geographical area – it is found in only a few places in the Ravensthorpe Range (see page 184).

FOLLOWING PAGES: Baxter's Banksia, *Banksia baxteri*. The flowers' colours are subdued. The young seed follicles, however, are brightly coloured (see page 211).

About a million years ago the southwest corner of the continent had drifted into the climatic zone with cool wet winters and hot dry summers. And that is where it is today – the only part of Australia with this kind of climate. It is called a Mediterranean climate and is found on the western edges of most continents. However, the combination of a Mediterranean climate, poor soils and an ancient, stable land surface is rare. There is only one other such place – on the southwest coast of South Africa.

There too, an explosion of plant evolution occurred. In fact, there are several thousand more species of flowering plants in the western Cape Province than in Australia's southwest. Interestingly, one of the major plant families in South Africa, the Proteaceae, is also strongly represented in Australia. It is call the Protea family in South Africa and the Banksia family in Australia. These two places have the greatest variety of plants in the world's temperate zones, exceeding those of many tropical areas. The rainforests of northeast Queensland, for example, have only 3700 species of vascular plants; the southwest has more than 6000.

The scleromorphs not only survived the cooling, drying and soil leaching, they had proliferated into a dazzling, breathtaking variety of forms. And they had one more trick up their sleeve.

Scleromorphs produce quantities of litter – trunks, limbs, twigs, leaves, seed pods, bark – all of it hard, woody and dry. Rainforest plants also produce litter but

mostly with soft tissues that soon decay in the forest's moisture, enriching the soil in the process. But the dry matter discarded by the scleromorphs decays slowly. A fallen eucalypt trunk may take a century or more to rot away.

The stage was set for the entry of a new natural force – one of drama and fury that is still experienced in the Province every summer. Fire. It is a force as potent as any that shaped the southwest's flora. Wildfires have ravaged the southwest for millions of years. They were frequent enough that plants had to adapt or perish. The scleromorphs' inherent qualities rescued them again – thick insulating bark; large woody roots (called lignotubers) which sprout after the stems have been destroyed; seeds stored in stout woody capsules. Any soft-tissue rainforest plants that may have survived were now eliminated.

The ancient stability of the Yilgarn Shield, Gondwana's floristic heritage, Terra Australis' tearing away from Antarctica, poor soils, climatic extremes and fire, all interacted over an unimaginably long time to form the crucible in which today's exquisitely beautiful and varied wildflowers were fashioned.

With the arrival of humans yet another hardship was imposed on the plants, one for which not even scleromorphy offered protection. What will the Province look like in a hundred thousand, half a million, a million years? Will there be wildflowers at all?

