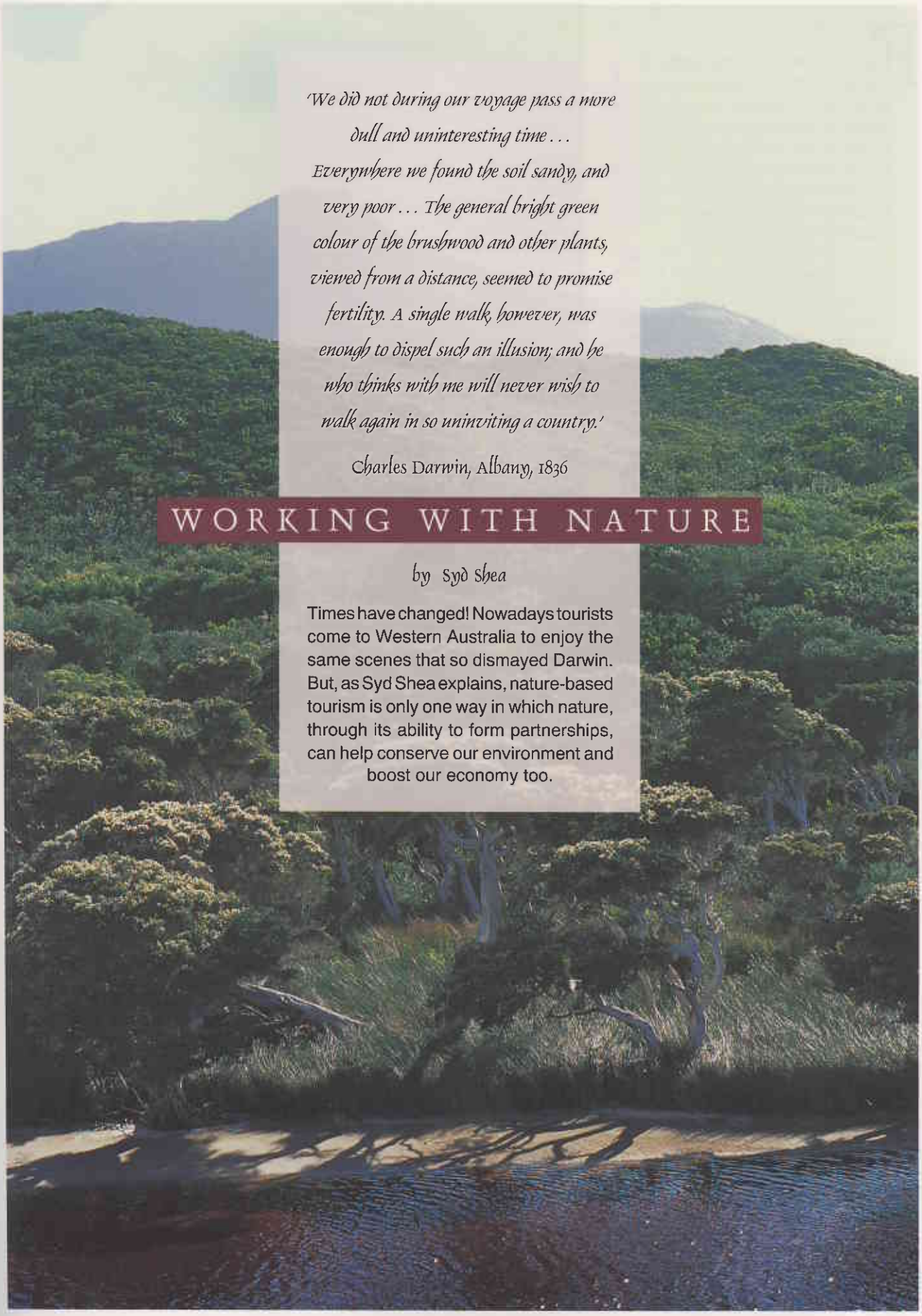


'We did not during our voyage pass a more dull and uninteresting time . . . Everywhere we found the soil sandy, and very poor . . . The general bright green colour of the brushwood and other plants, viewed from a distance, seemed to promise fertility. A single walk, however, was enough to dispel such an illusion; and he who thinks with me will never wish to walk again in so uninviting a country.'

Charles Darwin, Albany, 1836

WORKING WITH NATURE

by Syd Shea

Times have changed! Nowadays tourists come to Western Australia to enjoy the same scenes that so dismayed Darwin. But, as Syd Shea explains, nature-based tourism is only one way in which nature, through its ability to form partnerships, can help conserve our environment and boost our economy too.

Few Western Australians today would disagree that our State's environment is unique, beautiful, and should be protected. Almost daily, the media reports the formation of a local action group to protest about the destruction of a piece of unique bushland. Yet it is easy to forget that our appreciation of our natural assets has been late in coming.

As the quotation on the title page shows, even the great Charles Darwin was uncomfortable here. Nor was he alone in not respecting the local environment. After 1945, huge swathes of urban Perth were cleared of vegetation for housing, without a murmur from the community; and it is not so long ago that farmers were still being penalised if they did not clear the bush from their land. But it would be hypocritical if, with the clearer vision of hindsight, we were to condemn the efforts of the pioneers who settled and developed this State. It is their success that has given us the lifestyle we enjoy today.

How can we reconcile our belated concern for the environment with our need to retain our predecessors' gift of economic benefits? Is it possible that nature itself can provide some clues as to how we can achieve this essential reconciliation?

PARTNERS WITH NATURE

In the natural wonder stakes, Western Australia is a winner. It is an ancient land, one of the oldest places on Earth. Our soils have been heated, cooled, drenched, desiccated and leached of nutrients for billions of years. Nature, no respecter of persons or places, frequently puts her offspring to the torch with wildfire. The genes of our plants and animals have been effectively isolated for millions of years. We have a flora as diverse as any on Earth, and many of our plants and animals exist only in WA. We have more than 12 000 different flowering plants here; one of our national parks actually has more plant species than the whole of the United Kingdom.

Our plants and animals survive because they have developed remarkable techniques of synergy, or partnership. One marvellous example is the humble legume. After the dreadful Dwellingup wildfire of 1961, tens of thousands of forest hectares regenerated densely with legume species. We collected kilograms of seed from the pods formed from the flowers before they dropped to the forest floor, yet we found miserably few on the ground itself. It took more exploration to find the seed, centimetres below the surface. It did not bury itself, so we looked for whatever was moving it; and there they were - ants. Ants are attracted to legume seed and collect and store it, sometimes more than 10 centimetres below the soil surface, ensuring that the seed is not destroyed by fire. Mechanisms that ensure the maintenance of legumes in ecosystems subject to fire are vital. Legumes harbour bacteria in their root systems which extract nitrogen from the air. This ensures that the nitrogen, which is vaporised during the fire, is replaced.

Our plants would not have survived without such partnerships, such synergy. Fungi and other micro-organisms also enable them to grow in our infertile soils. So-called mycorrhizal fungi live in plant roots from which they obtain food; in return, they extend the plant's root system and suck plant nutrients from the soil. Early foresters learnt to their cost that if they didn't inoculate pine seedlings with mycorrhizal fungi their plantations were doomed.

These natural partnerships can involve many partners. For example, the

Previous page
Was Darwin right? Albany in 1994.
Photo - Marie Lochman

Top: Legumes regenerate after wildfire, ensuring that vaporised nitrogen is replaced.
Photo - Brian Downs/Lochman Transparencies

Right: The woylie lives in a three-way relationship with poison pea thickets and underground fungi. It is immune to the poison and spreads the fungal spores that help the thicket to survive.
Photo - Babs and Bert Wells

woylie is a small marsupial which lives in south-west woodlands and forests. Underground fungi form a substantial part of its diet, but spores from the fungus survive the passage through the animal's intestine. These same fungi form mycorrhizal associations with plants. The woylie prefers a habitat of poison pea thickets; it is immune to the poison and distributes and buries the seed from the plant. Thus when fire kills the poison pea thickets, the seed is protected. The synergy is awesome: the poison pea harbours the fungus and the woylie; the woylie benefits the fungus by dispersing the fungal spores; the fungus benefits the woylie by providing nitrogen, phosphorus and lipids; and both work together to protect the poison pea from extinction by fire.

Some of the adaptations that have evolved in WA appear to humans as lascivious. More than 300 species and subspecies of orchid occur in the south-west. Most flowering plants obtain the services of pollinators by offering nectar and/or pollen, but many of our orchids offer a different type of reward - sexual gratification. The slender hammer orchid emits a pheromone (or scent) similar to that emitted from a female thynnine wasp. (See 'Wicked Deceptions' in *LANDSCOPE*, Winter 1991.) The labellum of the flower is very similar to the wingless female of the species. The male wasp is attracted to what it thinks is a female and attempts to perform the ancient rite of reproduction. The male wasp is not monogamous; when it repeats this exercise on another orchid, it carries pollen with it. The flower benefits from this synergy because it achieves cross-fertilisation. (There are no studies yet that determine the male wasp's reaction to what clearly is a fraud!)

WA's ecosystems abound with remarkable adaptations in our plants and animals, and unusual physical and chemical processes. That is why our ecosystems are resilient even though they are often subject to violent disturbances. There is much we do not know, but our ecosystems stand out in two ways. They are dynamic (you can't freeze-frame nature), and, in a wonderful paradox, they cater for self-interest by encouraging partnerships.

THE GREAT CONUNDRUM

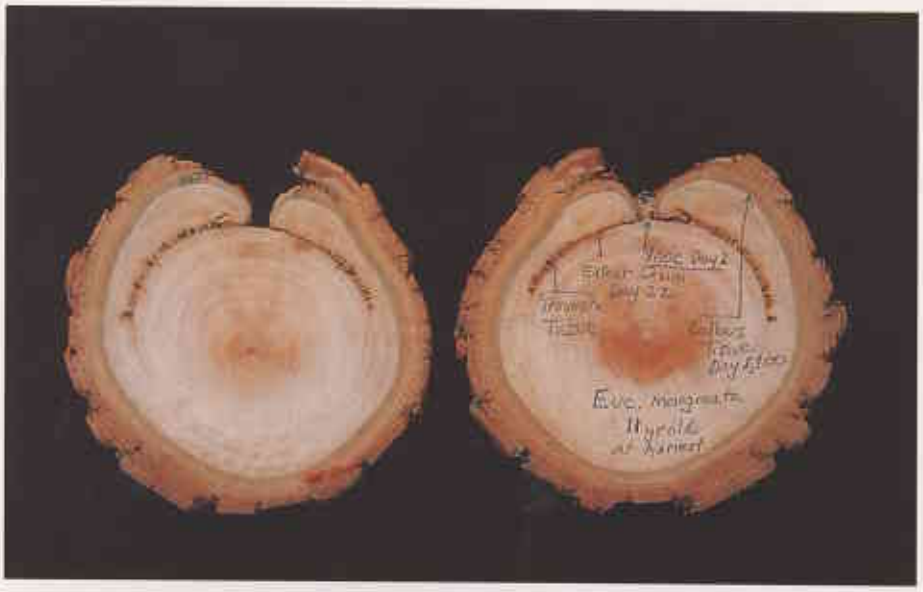
Having discovered the wonders of Western Australia's environment, we are now struggling to find how we fit into it. Some advocates for the environment have proposed that we abandon our pursuit of economic growth and subjugate ourselves to nature. Most people, however, want to improve their living standards and the employment prospects of their children; even if they did not, it is doubtful if the environment would get a better deal from a less wealthy society. Indeed, there is a high correlation between poverty and environmental degradation.

The World Commission on the Environment proposed in the Brundtland Report that the answer was to integrate economic and environmental objectives - that is, to practise ecologically sustainable development. The general response has been overwhelmingly positive. But ecologically sustainable development means different things to different people. The nature of nature is that the truth about ecosystems and the best way to manage them may take a long time to reveal. Putting

Top: Western Australian orchids ensure cross-pollination by luring wasps to their flowers.
Photo - Babs and Bert Wells

Below: Lake Murapin. Salination is a major threat to our native species as well as to our water supplies and agricultural land.
Photo - Babs and Bert Wells

Top right: The introduced water mould *Phytophthora cinnamomi* is one of the worst threats to plant conservation in Western Australia.
Photo - CALM



Top: More and more bluegum farms are being planted in the south-west of WA. They lower water tables, enhance crop growth, protect stock and generate income.
Photo - Dennis Sarson /Lochman Transparencies

Below: Cross-section of a banksia stem showing a protective barrier against *Phytophthora*. Trees highly susceptible to the fungus can grow such barriers if they are injected with phosphonate.
Photo - Frank Podger

ecologically sustainable development to work must therefore involve value judgments.

The dilemma that land managers face is illustrated by our shifting understanding of the greenhouse effect. In 1988 it was reported widely that there was likely to be a 20 per cent reduction in rainfall in the south-west of WA by the year 2030. A logical response would have been to stop planting trees and accommodate the drier conditions. But in 1993 the scenario is quite different. The recent evidence from greenhouse research suggests that rainfall may decrease *or increase* by 20 per cent some time in the future. If we bet on reduced rainfall, and cease planting trees and reduce native forest density by thinning, and we turn out to be right, we would prevent the death of native vegetation throughout the south-west. But what if we are proved wrong and the rainfall increases, resulting in rising water tables and massive salination?

Natural ecosystems are dynamic, so managers do not have the option of doing nothing. In making decisions, however, there are many chances to exploit nature's synergies.

CONQUERING THE RISING WATER TABLES

Perhaps the major environmental problem in Western Australia is land and stream salinity. This is a consequence of clearing native vegetation to establish agriculture. More than 50 per cent of our freshwater streams are saline, between 400 000 and 900 000 hectares of our agricultural soils have been degraded by salination, and up to 2.5 million hectares of agricultural land could be lost to salination even if there were no further clearing.

Even if we had known about the consequences, we would probably have cleared the land anyway; without our agricultural industries we would not have survived. Today, the impact of salination on soils and water is well known to our farmers, who initiated the landcare program taken up by the rest of Australia. What has not received much attention is the impact of salination on our conservation reserves and our wildlife. Already, significant freshwater wetlands have been lost. The residual woodlands reserved for conservation by farmers and as part of the public conservation estate are also threatened, because these reserves frequently occur in the valley systems. They are some of the most important habitats for Western Australian native animals.

Unlike many other environmental problems, salinity has a known cause and a known remedy. Salination results from rising water tables, which contain

huge stores of salt. The water tables are rising because perennial native vegetation has been replaced with annual crops that use less water. The solution is to restore nature's balance by re-establishing vegetation which pumps away the excess water into the atmosphere. (See 'Restoring Nature's Balance' in *LANDSCOPE*, April 1988.)

But we cannot simply rely on native plants. Closing down our farms and letting nature take over would not help, because native vegetation will not naturally recolonise farmland. We could re-establish the original vegetation, but apart from the farmer's loss of income, it could cost more than $1.5 billion to re-establish the plants and $100 million per year to maintain them.

There is an alternative. We can establish commercial tree crops on farms, doing it in such a way that they are integrated into the farm. This can reverse salination, enhance existing crops, and provide a new cash crop for farmers and a new export industry for the State.

The integration of tree crops into farms is a perfect example of exploiting natural synergies. The new trees benefit from the extra water in the ecosystem, and in turn modify the environment to the benefit of crops and stock. This project is not a dream; it is happening. In 1993 more than 23 million trees were established on farms in WA, and by the turn of the century 200 million trees may be established. If this is achieved, and I am confident it will be, there will be a major reduction in salination at no cost to the farmer or the State, and a new industry earning $500 million in exports.

THE FOX AND THE FUNGUS

The tactic of exploiting nature's own synergies is being used to tackle two other major environmental problems, both killers. One is the fox, the other is *Phytophthora cinnamomi* (the dieback fungus).

Australia's record for conservation of native animals is poor. Eleven of the 141 species of native mammal once present in WA are now extinct. Ten years ago the State's mammal emblem, the numbat, was close to extinction. The overwhelming reason for the decline of native mammal populations is feral mammals, particularly the European fox.

In the past decade, scientists and managers from the Department of Conservation and Land Management (CALM) have proved that when foxes are removed from native forest and woodland ecosystems by the use of poison baits, there is a dramatic increase in native animal populations. For example, in the past 10 years the populations of numbats have escalated in areas subject to fox control. Similar results have been achieved for the chuditch, woylie, tammar wallaby, brush-tailed possum and two species of rock-wallaby. This is a conservation coup of international significance - we are bringing back animals from the brink of extinction.

The baits used to control foxes contain an analogue of a naturally occurring poison in native plant species - fluoroacetate. (See '1080: The Toxic Paradox' in *LANDSCOPE*, Winter 1991.) Native animals are not harmed by fluoroacetic acid because they have evolved with it: the foxes have not.

Another feral organism causing great damage in WA is the water mould fungus *Phytophthora cinnamomi*. This introduced plant pathogen, the cause of dieback, has caused extensive damage to plants throughout the south-west of Western Australia. It has reached the zenith of its impact on the south coast, where conditions so suit this fungus that some native mammals carry *Phytophthora*-infested soil and are thus vectors of the disease.

But there may be a way of using natural plant defence mechanisms to control this disease. CALM scientists have shown that we can induce resistance in even the most susceptible plant species by inoculating them with a simple compound, 'phosphonate'. This chemical

Left: The numbat, WA's mammal emblem, was in danger of extinction until recently. After fox control was introduced at Dryandra in 1982, numbat sightings per 100 km had risen more than twenty times by 1991.
Photo - M&I Morcombe

Below: 1080 is a synthetic analogue of a poison occurring naturally in WA. It does not harm native creatures, but owners of imported animals should keep them clear of baited areas.
Photo - Dennis Sarson /Lochman Transparencies

causes the plant to develop barriers to fungal invasion within its tissue. We hope to discover how phosphonate triggers this process and to devise techniques to allow its broadscale application.

NATURE-BASED TOURISM

While there is community support for spending money to conserve plants and animals, people do not want to pay more taxes. We need to create more wealth if we are going to sponsor conservation for the sake of conservation. There is one industry which can do both.

Tourism rivals primary industries as an export earner. Worldwide, tourism's annual growth is 3.7 per cent. But nature-based tourism is increasing at a rate of more than 25 per cent. Western Australia is uniquely placed to take advantage of this trend. (See 'Our Natural Advantage' in *LANDSCOPE*, Winter 1993.) What makes us unique is our natural environment. Because of this we can integrate the economic benefits of tourism with protection of our natural assets.

The wonderful potential of this kind of partnership is shown by the Monkey Mia dolphins. One hundred thousand people visit Shark Bay each year, mainly because of the dolphins. These visitors generate more than $10 million for the region. If we could control introduced predators on Peron Peninsula, we could bring back to the mainland the banded hare-wallaby, rufous hare-wallaby, Shark Bay mouse, boodie and western barred bandicoot, which currently survive only on nearby islands. We know how to control foxes, but not feral cats. Thus a small investment in cat-control research could provide an added tourist attraction. If the average tourist stayed only one more day, an additional $5 million in tourist dollars would be generated.

Nature-based tourism also provides exciting opportunities for Aboriginal communities to develop their own enterprises. This year, for example, CALM, in partnership with the Bunuba Community centred on Fitzroy Crossing, launched a special boat tour in the Geikie Gorge which features Aboriginal culture. The integration of Aboriginal culture with the beauty and wonders of our natural environment results in a tourist experience which is second to none in the world.

FARMING PHARMACEUTICALS

Aboriginal people have used medicines derived from the bush for probably more than 40 000 years, and scientists have long suspected that WA plants could yield unique chemical components with useful pharmaceutical properties. A few, like Professor Jack Cannon working from the Chemistry Department of The University of Western Australia, have researched the chemistry of Western Australian plants and tried to stimulate further study of their potential for pharmaceuticals.

Recently, 'biological prospecting' of our native plants has received a major stimulus. Scientists from the National Cancer Institute of the USA have identified and patented (in February 1993) a chemical compound from our unique smokebush plant. In laboratory trials, the compound has shown it can destroy the HIV virus at exceptionally low concentrations. A consortium of more than 30 WA scientists from CALM, Western Australian universities, the Government Chemical Laboratories, the Royal Perth Hospital, and AMRAD, an Australian pharmaceutical company, is

working in partnership with the Institute to develop this compound.

Even if it does not lead to a cure for AIDS, the infrastructure is now in place to let us assess the pharmaceutical potential of WA's biota. We would be unlucky if we could not extract more elixirs from the cocktail of chemicals that has evolved in our ecosystems over eons. We would only need to chance on a few to enable us, with the appropriate political will, to establish a new multibillion-dollar industry based on, and protecting, our natural assets.

SEEKING THE TRUTH

It is ironic that the characteristics that made this land so inhospitable to the first Europeans - its isolation, infertile soils, harsh climate and bizarre plants and animals - are the same characteristics that give us the chance to create new, wealth-creating industries which can also repair the environment.

Even if we could achieve perfect understanding of nature's ecosystems, we could not afford to wait for it. The environment is always changing; we must see that its changes are beneficial. We can retain material benefits in a way which will also repair and protect our environment, provided that the debate over the environment matures.

Since our natural environment is shared by the whole community, it is the community's right to have its values reflected in environmental decisions. But our political process is having difficulty in delivering a rational consensus on environmental issues. The current environmental debate is a mixture of good and bad science, genuine and ideologically driven value judgements, altruism and self-interest. Community understanding of environmental issues is not helped by commentators who, almost daily, ask 'what is the truth' about an environmental issue but, like Pontius Pilate, 'never stay to hear the answer'. At the end of the day, truth will win out. But the truth about ecosystems and the way we should manage them may take a long time to reveal, and what is known today may not be the whole truth.

One thing we can learn from our ecosystems is that loners don't survive in a harsh environment: there is not one known Western Australian plant or animal that has not formed beneficial partnerships. But our political structures, government departments, community groups, and even our scientific disciplines, are so rigidly structured that it is easy to conclude that the territorial imperative in *Homo sapiens* var. *australis* is more refined than in any other species. We have no chance of understanding our ecosystems, let alone protecting them, unless we breach the fences that surround the jealously guarded turf.

Western Australia is a treasure trove of natural places, plants and animals, and natural products. The key to the treasure and its preservation is to integrate our science, our management and our goals. Integration is the only way we will be able to exploit the synergies in our environment and in our society. Synergy means 'working together', but it does not mean we cannot question with vigour - an admirable national trait. It will require, however, that we don't make Pilate's mistake. When we ask what is the truth about our natural environment and how we manage it, we must stay to hear the answer.

Top: Geikie Gorge, a beautiful destination in the partnership between nature and tourism.
Photo - Jiri Lochman

Below: Reconstructed molecule of conocurvone, which may be useful in fighting AIDS. This chemical has been isolated from a plant which is endemic to WA.
Photo - CALM

Left: Pivot Hill, near Wyndham. The unearthly beauty of the Kimberley landscape is a unique tourist drawcard.
Photo - Bill Bachman

PRINCIPLES OF ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Integrating Economic and Environmental Goals in Policies and Activities

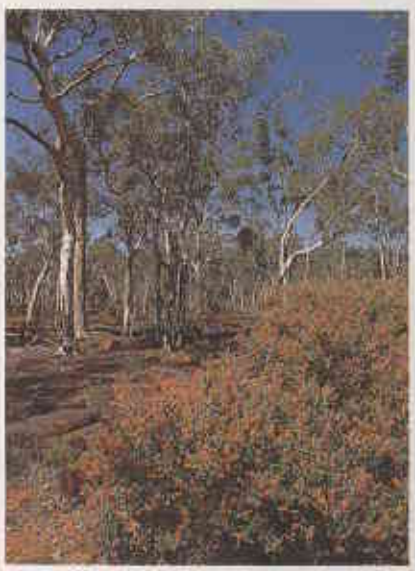
- Ensure that environmental assets are appropriately valued.
- Provide for equity within and between generations.
- Deal cautiously with risk and irreversibility.
- Recognise the global dimension.

Syd Shea is the Executive Director of CALM and can be contacted on (09) 386 8811. This article is based on a speech delivered to the annual meeting of the Royal Perth Hospital in November 1993.

LANDSCOPE

VOLUME NINE NO. 3 AUTUMN ISSUE 1994

The hidden caves and tunnels of Cape Range National Park harbour several animals found nowhere else. Turn to page 22 to find out about these bizarre cave dwellers.



The characteristics that made WA inhospitable to the first Europeans are now helping us create new industries that can also repair the environment. See page 47.

The Pinnacles, in Nambung National Park, is one of the most photographed landscapes in the world. But there is another side to Nambung. See page 41.

Perth has at least 70 species of skinks, geckoes and other reptiles. Find out how to attract these fascinating creatures to your garden on page 28.

Devastation caused by the recent NSW bushfires has fuelled debate on the practice of prescribed burning. How do managers fight fire with fire? See page 35.

FEATURES

BRING BACK THE BUTTERFLIES
MATTHEW WILLIAMS 10

TALES FROM THE DARK SIDE
GREG KEIGHERY 17

SUBTERRANEAN SECRETS
BILL HUMPHREYS AND JOHN BLYTH 22

REPTILES IN THE GARDEN
DAVID PEARSON AND JIM ROLFE 28

FIGHTING FIRE WITH FIRE
RICK SNEEUWJAGT 35

THE OTHER SIDE OF NAMBUNG
JOHN HUNTER AND KEITH HOCKEY 41

WORKING WITH NATURE
SYD SHEA 47

REGULARS

IN PERSPECTIVE 4

BUSH TELEGRAPH 5

ENDANGERED THE LANCELIN ISLAND SKINK 39

URBAN ANTICS 54

COVER

The bobtail (*Tiliqua rugosa*) is sometimes incorrectly called the 'bobtail goanna' but is actually a very large skink. They are common around Perth and often seen in gardens. During hot weather they can be seen basking on footpaths, verges or roadways. See our story 'Reptiles in the Garden' on Page 30.
The illustration is by Philippa Nikulinsky.

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