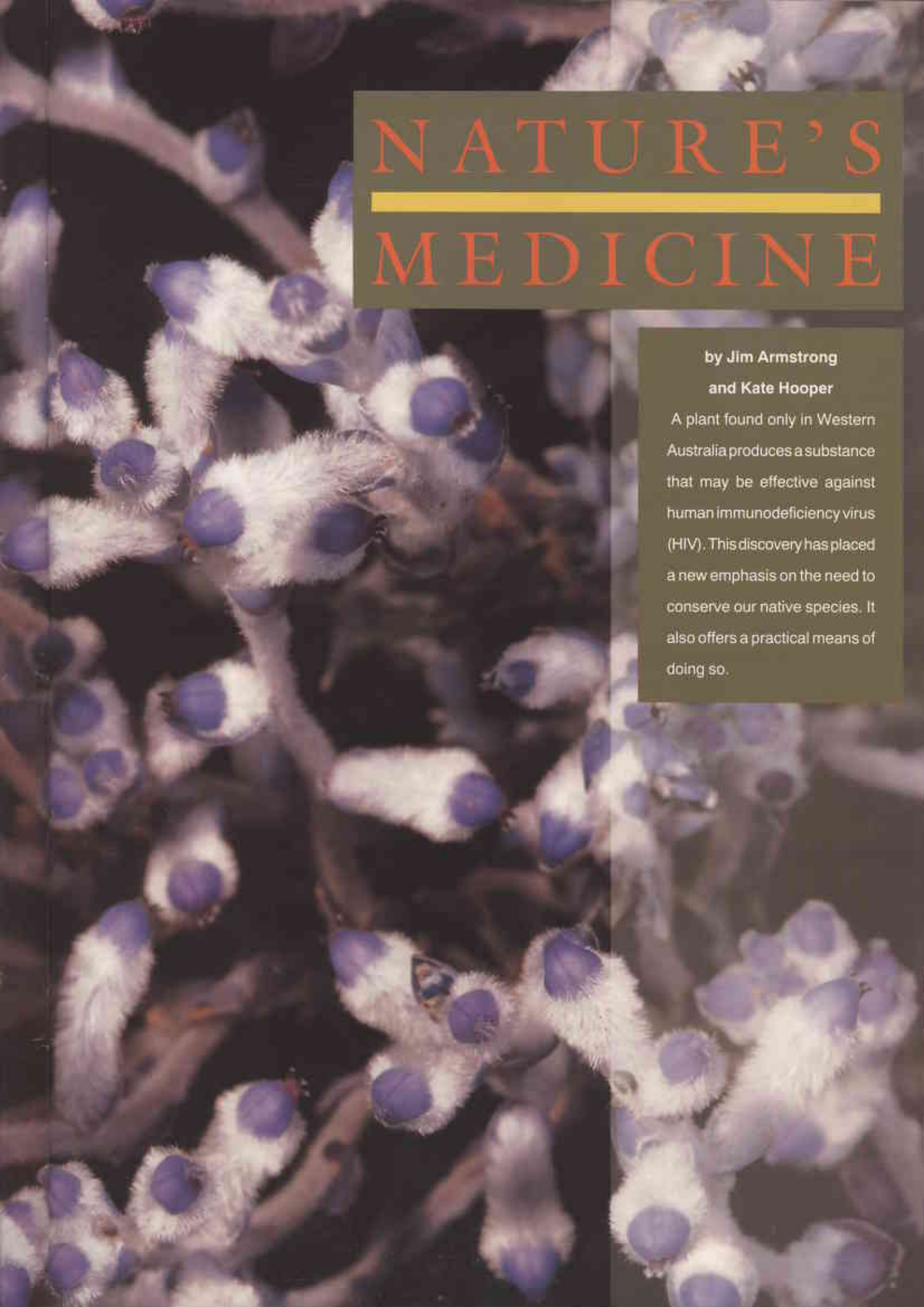

NATURE'S MEDICINE

by Jim Armstrong
and Kate Hooper

A plant found only in Western Australia produces a substance that may be effective against human immunodeficiency virus (HIV). This discovery has placed a new emphasis on the need to conserve our native species. It also offers a practical means of doing so.

Biodiversity has become the buzzword of the nineties in conservation circles. The term means the variety of life on earth, and embraces all the world's plants, animals, fungi and micro-organisms. The genetic information they contain represents a priceless resource, but it is one we are squandering.

The fact that the growth in human population is leading to the rapid loss of wild communities is only too well documented; but it is not generally appreciated that every extinction of a species is a lost opportunity. Despite the best efforts of conservationists, the majority of people remain unconvinced of the value in genetic variety. One way of turning the tide of public opinion is to demonstrate the commercial value of the biota; we need to realise the 'bio-wealth' in our biodiversity.

The Department of Conservation and Land Management (CALM) has long recognised the importance of funding its conservation work by promoting initiatives such as nature-based tourism. But one recent initiative has made headlines because it could place a tangible value on all our biological resources, not just those with aesthetic appeal.

REMEDIES FROM NATURE

Remedies derived from plants have been central to traditional medicine for centuries. But it is only in the past 25 years or so that mainstream science has begun to recognise their value.

During the 1960s, the National Institutes of Health in the United States became interested in deriving potentially useful drugs from plants. They were particularly keen to find new drugs for the treatment of cancer, and the work was based at the prestigious National Cancer Institute (NCI). They established a huge collecting program, employing a network of professional plant collectors worldwide. These collectors worked in collaboration with national agencies. For example, the Institute's contracted collector in Western Australia was issued with a licence to collect plants for scientific purposes, and the WA Herbarium assisted by processing about 1 200 plant specimens for the program.

By 1981, the NCI had accumulated many thousands of plant specimens from around the world. Extracts made from these specimens were tested in the laboratory for their ability to inhibit the growth of cancerous cells. In the late 1980s, when a new threat to health, AIDS, was emerging, scientists once again sought help from nature. They turned to the bank of plant samples held in cold storage at the NCI.

Using human cells infected with human immunodeficiency virus (HIV), they tested the extracts for their ability to inactivate the virus. By 1989, at least four extracts were shown to have some effectiveness. One of these was made from a plant collected in Western Australia. This extract was particularly exciting because, even at low concentrations, it was very effective at inactivating HIV and, crucially for a potential drug, without apparent ill-effects on the cells.

The extract was made from a species of smokebush (genus *Conospermum*), a plant common on the sand heaths of the south-west. The smokebush belongs to the same family as the banksias and grevilleas - the Proteaceae. The genus is found mainly in Western Australia. The active component isolated from *Conospermum* was named Conocurvone.

REALISING OUR BIO-ASSETS

When news of the potential biological activity of the smokebush extract was published in 1993, there was great excitement in Western Australia. Pharmaceuticals are big business. This is especially true where a disease like AIDS is involved, which has reached epidemic proportions and is still spreading rapidly.

In the past, Australia has allowed unhindered access to its biological resources. For example, Israel is now selling eucalypt leaves as 'fillers' to the cut-flower trade and making exports to the European market worth 70 million dollars per year. New Zealanders are marketing an Australian waratah (*Telopea speciosissima*) as the 'kiwi rose', with great success.

CALM wished to ensure that Western Australia would receive the maximum benefit from the use of its own biological resources. This meant more than simply receiving royalties on production of any drug from the smokebush plant. Not content with this traditional role of resource provider, CALM was determined that the development and production of any potential drug should be based and co-ordinated in Western Australia.

With the benefit of hindsight, it seems obvious that Western Australia should

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A species of *Conospermum* (smokebush). The anti-HIV compound Concocurvone has been extracted from species in this genus.
Photo - Jiri Lochman

Left: Scarlet banksia (*Banksia coccinea*), a highly successful Western Australian species cultivated for the wildflower trade.
Photo - Eva Boogard, Lochman Transparencies

Opposite page: Smokebush in full flower. It is easy to see why its common name is appropriate.
Photo - Marie Lochman

have kept a far tighter rein on the export of its plant resources for scientific purposes. We should have recognised the potential commercial value of our biodiversity. But in the past we were prompted by the prevailing scientific ethos of the day: namely that scientific research is undertaken for the benefit of all, and the results should be shared openly among the community.

Although these are laudable sentiments, the scientific community has been forced to adapt to the economic realities of life in the late twentieth century. Scientific research costs money, and as the research dollar becomes scarcer, there is increasing pressure on research institutes to find ways of generating revenue.

With the aim of ensuring that the research and development work was based in Western Australia, CALM entered negotiations with an Australian company, AMRAD. In addition, CALM brought together a consortium of talented scientists to investigate the smokebush substance. These included ecologists, geographers, botanists, chemists, pharmacologists and immunologists.

In a landmark agreement signed in December 1993, AMRAD agreed to fund the basic research into Conocurvone, which would be undertaken by the CALM consortium of scientists in collaboration with the National Cancer Institute. In March 1994, after being put out to tender, an exclusive production and marketing licence was awarded to AMRAD. The agreement with AMRAD has already provided CALM with more than a million dollars to help conservation research.

Drawing up the agreement required changes to the CALM Act. These changes have given the State sovereignty over our flora, ensuring for the first time that Western Australians will benefit from its commercial use. They also allow CALM to grant exclusive rights to one commercial company, necessary because of the huge costs of developing a potential drug. For example, the basic research into the drug Taxol, which is derived from the Pacific yew tree (*Taxus brevifolia*) and is effective against ovarian cancer, cost the NCI an estimated $70 million. Once they had demonstrated its efficacy, they sold the development licence to a pharmaceutical company. It cost that company a further $200 million to develop the compound into a marketable drug.

With such large sums of money

TESTING PLANT EXTRACTS

The plant material is ground into powder, and each sample is coded and placed in cold storage. When needed, samples are dissolved in various solutions to make extracts.

To test for activity against human immunodeficiency virus (HIV), the extracts are added to tissue-culture plates containing cells infected with HIV and uninfected 'control' cells.

Cells infected with HIV would normally die. If one of the plant extracts allows infected cells to survive, the extract may contain a biologically active compound that is effective against the virus. Of course, to be useful, it should also have no toxic effects on the 'control' cells.

An indicator dye is used, which develops colour in the presence of living cells. The 'bio-assay' plates are scanned by computer to detect colour changes.

Once a useful plant extract has been detected, the extract is chemically 'fractionated' - or divided into its separate constituents. The bio-assay is used repeatedly throughout this process until the fraction containing the biologically active compound is identified.

When the pure, active compound has been obtained, chemical characterisation techniques are used to establish the chemical structure of the compound.

involved, a pharmaceutical company must be confident of the potential of a prospective drug. Conocurvone is considered viable for pre-clinical development because it seems to be exceptionally potent against HIV, yet with a low toxicity to human cells. The mode of action of Conocurvone is not yet known, but it seems to act in a different way from currently used drugs such as AZT. Therefore, it is an excellent candidate for use in conjunction with other drugs.

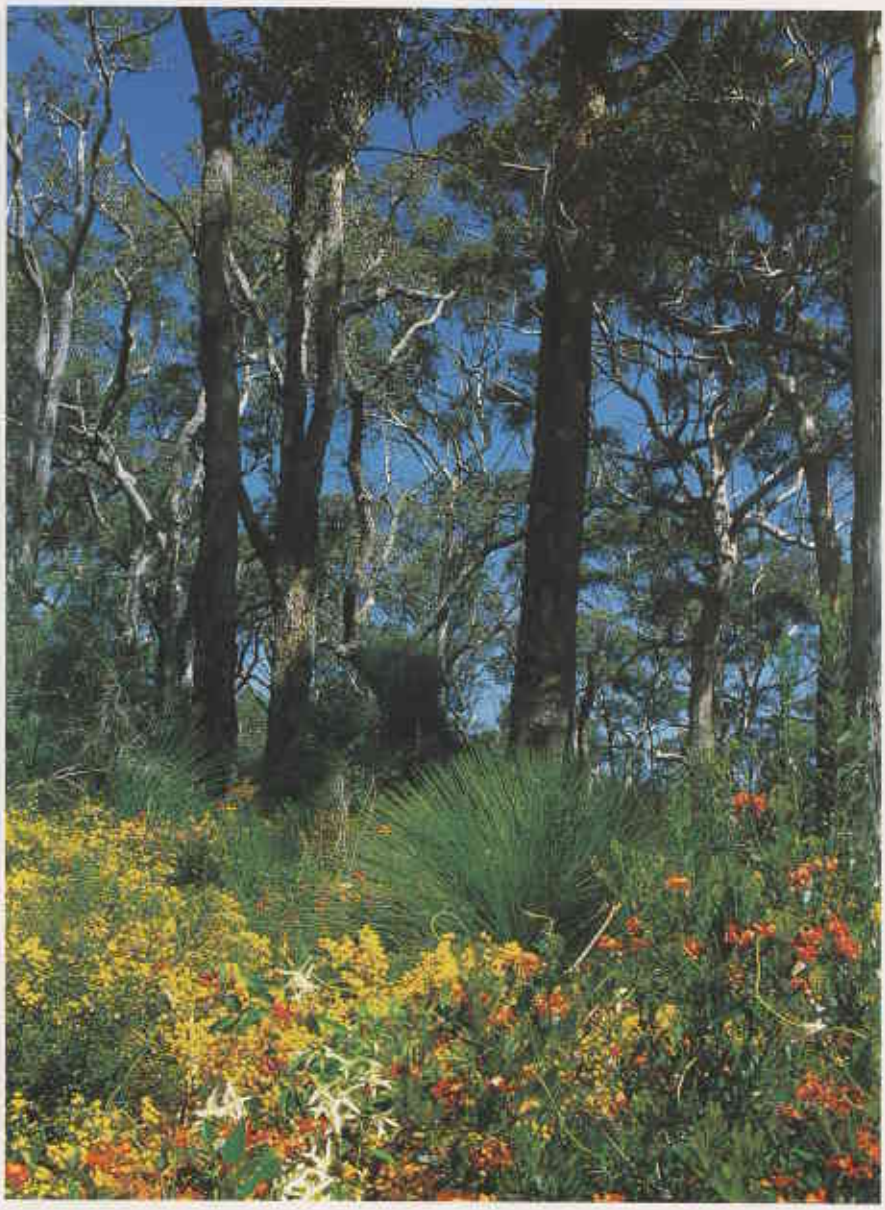
CHANGING ATTITUDES

What place does a conservation agency have in taking advantage of our natural biological assets? Cynics might say that such activities are about wealth-generation, not conservation, but it is more and more difficult to achieve the latter without the former. Nowadays, a vital part of conservation work lies in changing attitudes to our environment. If we are to protect the goose that lays the golden eggs, the community must see some golden eggs.

Western Australia has one of the richest floras in the world. It is estimated that there are 12 000 species of flowering plant in Western Australia, about half of the total number in Australia. But we also have more than our fair share of threatened species; 42 per cent of Australia's rare or threatened flora occurs in Western Australia.

Although dieback disease is now the major threat to our flora and fauna, the biggest problem in the past has been the clearing of land for agriculture and grazing by introduced animals. This is reflected in the fact that three quarters of the State's threatened plant species occur in the area now known as the Wheatbelt. Many of the plant and animal species that were once found throughout the area are now either extinct or are confined to small isolated nature reserves and to road reserves. The thin strips of native vegetation bordering roads are the last bastions of biodiversity in the Wheatbelt. But they are outside the conservation estate, and are under immense pressure from weed invasion, fertiliser drift and road widening.

Historically, land was only considered valuable once it had been cleared. Areas set aside as national parks or reserves were those that were of little use for agriculture. For example, the remarkable



Stirling Ranges were too inaccessible to clear. They now represent one of our most valuable areas of natural diversity and are home to many species that are found nowhere else. The Stirling Range National Park contains about 1 500 plant species, more than the entire flora of Great Britain.

The exception to this rule is the forests of the south-west. Unlike land originally cleared for agriculture, State forest, which has been carefully managed for the past century, retains an almost complete set of native vertebrate and vascular plant species. But the forests were initially left standing because it was difficult to plough the stony soils and clear the many trees; by the 1860s the export value of jarrah timber had also become known.

Conservation is often driven by practicalities and economics rather than ideals. It is a cold, hard fact that activities which return little or no revenue to the State are at a disadvantage when government funds are allocated. National parks and reserves, for instance, have attracted little funding. Although there is no question of their value in cultural, aesthetic and recreational terms, they make little money for the State; the revenue raised from entry and camping fees in national parks does not even cover their management costs. Nature reserves do not generate any revenue, but cannot be simply 'left to nature'; they must be managed to minimise damage by fire, exotic weed invasion and feral animals. In addition, money must be found for documenting the characteristics, distribution and abundance of species if we are to conserve them effectively. Yet the economic reality is that conservation is often in need of more funding than government spending priorities permit.

Noble ideals such as the 'inalienable rights of species to exist' and the

Opposite page: Western Australia is endowed with a wealth of floral diversity, as shown in this mass display of wildflowers within a woodland in the South West. Any one species may at some time yield a potential new medicine such as Concocurvone.
Photo - Brian Downs, Lochman Transparencies

Top left: Kwongan (heath) in the Stirling National Park, location of some of the greatest biodiversity in Western Australia.
Photo - Kim Howe

Top: Fruits of the quandong (*Santalum acuminatum*), useful as a source of bush tucker. The commercial sandalwood tree belongs to the same genus.
Photo - Babs and Bert Wells

Left: Remnant vegetation in the Wheatbelt. More than 90 per cent of the native vegetation of this region has been cleared for farming.
Photo - Barbara Porter

'preservation of natural heritage' are of no use, either to species or to heritage, if there is neither the public will nor the money to support them. One way of protecting our native species is by realising their 'bio-wealth' and demonstrating the commercial value of the biota to the community. We cannot afford to allow species and plant communities to become extinct.

FUTURE OF BIOPROSPECTING

Conocurvone is still in the very early stages of development. It may turn out not to be a viable drug, but we have now established a firm platform to evaluate systematically the pharmaceutical potential of the Western Australian flora.

Australian plants are unique and full of potential. Plant populations have evolved here in virtual isolation over millions of years, and have developed a vast array of chemical defences against herbivores, predators and pathogens. Western Australia is well placed to take advantage of this approach to conservation because it contains more species than other States, a high proportion occurring nowhere else. It is hoped that we can attract further commercial interest in funding the documentation, discrimination and conservation of our biota through the collecting and testing of plant specimens.

Turning our flora to economic gain must not prejudice one of CALM's prime aims: conservation. Harvesting of resources has to be managed professionally to ensure that dieback disease is not spread, the landscape is not degraded and the plant populations are sustained.

The Conocurvone story is a model for the innovative and sustainable use of our biological resources. Genetic assets could take their place alongside minerals as a wealth-generating resource for the State - and, unlike minerals or hydrocarbons, biological organisms are renewable if they are managed sustainably.

If Conocurvone progresses to become a commercial drug, the State could receive royalties by the year 2002 of $100 million per annum. Imagine the potential value of just five pharmaceutically useful compounds derived from Western Australian plants. While you think about that, CALM scientists are working in partnership with scientists from tertiary institutions and other government agencies to discover more such compounds.

Jim Armstrong is CALM's Director of Science and Information and can be contacted on (09) 442 0300. Kate Hooper is a contributing editor to *LANDSCOPE* and can be contacted on (09) 384 5711.

Hand in hand with nature. This brushtail possum is just one of the animals studied during fauna surveys of the Batalling Forest. *See page 16.*

Lush vegetation and a welcoming smile greet you as you arrive at Mt Hart Homestead, the 'Oasis in the Leopolds'. *See page 48.*

LANDSCOPE

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'Fire, Wind and Water', on page 42, tells of recent research into the rehabilitation of exploration tracks in the Rudall River area of the Little Sandy Desert.

Deep beneath the Southern Ocean lies the wreck of the Sanko Harvest. *This rotting hull is now an artificial reef attracting marine life and divers alike.* *See page 23.*

Plantations of brown mallet in the early 1900's began a chain of events that resulted in the 'Woodland Wonderland' of Dryandra. *See page 28.*

FEATURES

REGULARS

COVER

Woylies prefer clumped, relatively open vegetation with sandy soils that are easy to dig. They are found, among other places, at Batalling Forest and the Dryandra Woodland. See stories on pages 16 and 28.

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