Legal light on use of safety-designed 'breakaway' poles

Collisions between motor vehicles and conventional roadside poles cause tragic loss of life in Australia each year. Overseas studies have shown, however, that so-called 'breakaway' or 'frangible' poles have a marked impact on reducing the number of deaths and serious injuries which result from car-pole collisions.

(Photo courtesy of the Sun News Pictorial.)

PUBLIC AUTHORITIES which maintain networks of roadside poles have nothing to fear legally from the introduction of so-called 'frangible' or 'breakaway' poles, designed to minimise injury and property damage in the event of a car-pole collision. This is the finding of Monash senior lecturer in law, Mr Judd Epstein, and research fellow, Ms Lucy Hunter.

The researchers further state that a motorist could make out a sound case for damages if he could demonstrate that an authority was negligent in the siting or design of a conventional hard pole. Epstein and Hunter have been investigating the use of frangible poles, and the legal implications of roadside hazards, with the aid of a grant from the Federal Department of Transport's Office of Road Safety.

Frangible poles are widely used overseas as light standards, signposts and traffic signal supports. Some are designed to shear-off close to the base, others have a 'slip' base, and some are 'soft' so that they offer little resistance in the event of a collision. Statistics show that their use markedly reduces the incidence of deaths and serious injury in car-pole collisions.

Epstein and Hunter say that some authorities in Australia have generally been reluctant to use frangible poles because they fear they might be liable for damages in a secondary accident involving a frangible pole. The authorities envisage that in such an accident, a frangible pole struck by a car could fall, injuring innocent bystanders.

The researchers say that despite an extensive investigation of overseas insurance company records and reports of local and overseas instrumentalities which use frangible poles, they could find only one instance of a secondary accident.

They say: "When you consider the number of times car-pole collisions result in death or serious injury and compare that with the somewhat bizarre possibility of a secondary accident, a strong case can be made for the widespread use of frangible poles."

According to authoritative estimates, about 500 people are killed annually in Australia in collisions with roadside furniture (including trees) and another 15,000 persons are injured. As well, car-pole collisions rank at or near the top of accident severity indices, mainly because of the force of impact which occurs when a vehicle hits a pole.

The researchers say such accidents are also extremely costly in terms of property damage, medical expenses, lost productivity, and calls for assistance on police and emergency agencies.

"In Australia, only limited use is made of frangible poles, with South Australia leading the way. They are used mainly by highway departments and only on those roads they control exclusively, such as freeways. Most of the states of Australia number their use in the hundreds.

"We have found that accidents involving frangible poles are frequently not reported. Usually no one is injured, the vehicle sustains little damage and the motorist is, in a sense, 'satisfied' with the result of the collision.

"Although the authority concerned may not ascertain the identity of the driver, if they do, they are able to seek compensation by the usual means through his insurance company."

"We have examined the records of insurance companies and the relevant instrumentalities in Australia and have found

Continued overleaf
Past bushfires threaten the habitat and future of a once ‘rare’ possum

A MONASH RESEARCHER believes that Leadbeater’s possum, which was once so rare that it was presumed to be extinct for more than 50 years, faces a bleak future as an aftermath of the disastrous bushfires which swept Victoria in 1939.

The researcher, Andrew Smith, says scientific evidence suggests that there will be a severe reduction in the population size of the animal over the next 80 years. This situation has been brought about by a loss of habitat stemming directly from the fires, which destroyed vast tracts of mountain forests.

Smith says animals in the regrowth forests rely on dead mountain ash trees to provide nest hollows vital for their survival. These large dead trees — commonly called ‘stags’ — which were killed by the fires, are rapidly falling over, and in 10 to 20 years there may be too few left in most areas of regrowth forests to support populations of hollow-dwelling possums and other animals.

Says Smith: “The problem is that it takes about 120 years for the mountain ash — the tallest trees in Victorian forests — to develop suitable nest hollows.”

“When the old stags are gone, there will be a period, probably lasting about 60 years, during which the 1939 re-growth forests will have few suitable nesting sites. Already there are many large tracts of regrowth forests that have few remaining stags.

The animals are now relatively abundant, but the loss of their habitat means there will be a dramatic fall in their population.”

Since 1977, Smith, a Ph D student in the Monash department of zoology, has been carrying out the first scientific field study of Leadbeater’s possum in its natural environment.

He says: “When I began the project, I had a map marked with about 50 locations where the animal had been sighted, and I started work at a spot where the Australian Conservation Foundation had located three nest trees.”

Over the period of the study, he has trapped and released 75 individual animals in the study area, near Marysville, close to the centre of the possum’s present known distribution.

Smith says Leadbeater’s possum, which has the scientific name Gymnobelideus leadbeateri, was first described from two specimens caught in 1867. From then until 1909, only three more animals were found.

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The law, negligence and ‘breakaway’ poles

that there has never been a claim against an authority for the siting or design of poles. This is despite the fact that some poles have a notorious accident record.

“The principal legal doctrine involved in an action against an authority is that of negligence. A motorist could make out a good case for damages against an authority if he could show to the satisfaction of the court that a pole, by reason of its design or location, was dangerous in that the authority could reasonably foresee that the pole could cause or aggravate injury in an accident.”

“But a good legal argument is not the same as saying a motorist would win such a case — and although the law of negligence is, in general, well established, actions against authorities for roadside hazards remain ‘virgin’ legal territory in Australia, as such cases have not been tried here. Because it is a common law area, and depends on prior decisions, until a case is heard and a precedent laid down there is no definitive answer as to whether such an action would succeed.”

“There have been judicial decisions in the U.S. that an authority is unreasonable, and therefore negligent, if it does not use the safest equipment economically feasible.”

“Some U.S. insurance companies have refused to meet claims for damages in pole collisions until the authority gives an assurance that the pole involved in the accident will be made safe, whether by re-location or the installation of a breakaway pole.”

“Some have gone even further, telling their policyholders to inform them about dangerous roadside hazards so that appropriate action can be taken before an accident occurs.

“This type of activity probably stems from much greater public awareness of these issues in the U.S. where the general public are also more ‘claims conscious’.”

Epstein says it is fair to ask why Australian motorists and their insurance companies have not taken authorities to court in the past.

He says: “Whether it is the costs system — with the loser also having to pay the costs of the winner — which scares potential litigants, or lack of creativity among legal counsel and insurance companies, is a difficult question to answer.

“Our research shows that insurance companies pay out to the owners of damaged poles without question, and they don’t suggest to their policyholders that they should sue.”

Awareness

Epstein and Hunter hope that increased public awareness and an enlightened approach by pole-using authorities will bring about a more widespread introduction of breakaway poles in Australia.

They say: “In the U.S., states do not enjoy Federal funding for roads unless they meet strict safety standards for highway equipment.”

“This may be difficult to do in Australia, where states’ rights are a keener issue. However, the various road safety groups in the states can play a part by making recommendations to instrumentalities which use poles.

“There are over a million poles in Victoria alone, and we don’t expect that they will be converted overnight.

“But it could reasonably be expected that dangerous poles — the ones with accident histories — could be replaced with suitable breakable poles.”

“There are some situations where it may not be desirable to install breakable poles, such as where there is heavy pedestrian traffic and slow moving vehicular traffic.

“And it is not economically feasible in the present state of technology to replace the majority of poles which support overhead power transmission and communication lines, although serious consideration could be given to undergrounding, use of impact attenuating devices, the use of guard rails, re-location of the poles to ensure a wider roadside safety area.”

Epstein and Hunter say that in South Australia, one authority found it was cheaper to use breakable poles because they were more easily salvaged.

“We don’t think this result was expected. And while the benefits of the introduction of breakable poles may not show up on the balance sheets of authorities, benefits would be apparent if a ‘notional’ national balance sheet could be drawn up. It must be pointed out in this regard that persons involved in breakable pole collisions remain productive, there is minimal property damage, and medical and welfare costs do not enter the picture.”

The researchers believe the introduction of breakable poles should come about as a natural progression, and not be forced on authorities by legislation.

“There is now little widespread opposition to breakable poles, just lack of knowledge about them. One aim of our project is to remedy this,” they add.
He says: "Despite extensive searches during the 1930s by zoologists, none was found, and the animal was presumed extinct — a view which seemed to have been confirmed after the 1939 fires.

"But in 1961, it was re-discovered at Tommy's Bend, near Marysville, in the Central Highlands of Victoria. This re-discovery aroused considerable local and worldwide interest, and subsequent searches by amateur observers succeeded in locating the possum at about 50 individual locations."

Smith says his initial trapping expeditions resulted in failure, and it was not until the end of the third that he trapped a single animal.

"This gave me tremendous encouragement, and it was just the right incentive to keep going."

He later evolved a plan to study the population dynamics of the possum by enlisting the aid of volunteers from interested groups. It was the volunteer's task to stand under the nest trees and count the numbers of animals coming out of hollows around dusk.

"Says Smith: "I had been thought that the animals were clumped together in small colonies, but the survey revealed that they were widespread throughout the forest, with nest sites evenly spaced through the bush. It also appeared that each colony used up to three stags for nest sites.

**Trapping is difficult**

"It is difficult to observe the animals because they move around high up in the canopy, and tend to turn their eyes away from spotlights. Trapping them is not easy. It involves climbing the stags, using ten-inch decking spikes as a makeshift ladder, and setting traps on wooden brackets at the entrances to the nest hollows, which can be up to 18 metres above ground.

"Tiny reflective ear tags on the animals make observation less difficult and it is possible to observe interactions between animals of different colonies.

"The animals are strongly territorial, and aggressively guard their nests, with males and females fighting male and female interlopers from other colonies.

"Leadbeater's possums are closely related to sugar gliders (see Monash Review 4-78) but because the sugar glider can glide, it is capable of colonising more open forests.

"Leadbeater's possum is limited in its range to more dense forests, where it can jump from tree to tree and branch to branch."

"The two species share similar niches in the ecosystem, and while their social organisation is different, they compete for the same food resources and for nest hollows.

"Both species feed on exudates such as eucalyptus saps, Acacia (wattle tree) gum, manna and honeydew and upon insects found under bark and on foliage. Manna is a sweet substance secreted at sites of insect damage to eucalyptus trees and honeydew is a similar sugary substance secreted by sap-sucking insects."

"In captivity, Leadbeater's possum reaches maturity in about a year, but in the wild, probably because of food shortages, they take two to three years to mature.

"Perhaps because of this, juvenile males and females appear to be tolerated in Leadbeater colonies for longer periods, compared with young sugar gliders which may be evicted from the colony only several months after they have first emerged from the nest."

Smith has found that there is an unusual population imbalance in the Leadbeater species, with adult males outnumbering adult females three to two.

"In other possum species, there is often a bias towards females. This biased sex ratio in Leadbeaters appears to be due to higher mortality amongst juvenile females. Adult females force their female offspring to leave the nest but may leave the male offspring unmolested.

"The availability of food is directly and delicately related to successful reproduction. In the first year of the study, all breeding females bred successfully in May or June and again in October or November.

"The following year, females gave birth in both breeding seasons, but no young survived, and even some of the juveniles born the previous year also died. Most of the animals suffered weight loss during the period and there was a lot of movement between nests in the study area.

"In 1978, the lack of food is thought to have been caused by a late spring, and possibly the fact that mountain ash, which flowers only every second year, did not set flowers that year."
Research aims to lift alumina efficiency

TWO RESEARCH PROJECTS being carried out in Monash University's department of chemical engineering have produced findings which could have a major impact on energy and waste disposal problems associated with the production of alumina.

One of the projects — the development of a highly efficient dryer — also has the potential for marked cost savings in the production of oil from brown coal.

The other project revolves around the more efficient handling of ‘red mud’ — a waste product formed when alumina is made.

Alumina is the base material from which aluminium is electrolytically refined.

The research initiatives are being funded by aluminium groups. Comalco has supplied alumina hydrate for the drying tests while Alcoa is supporting a research student investigating red mud waste problems.

Currently Australia is the largest producer of alumina in the world, accounting for 30 to 35 per cent of world production.

The development of the highly efficient dryer is the work of Professor Owen Potter, the chairman of the department, and a group of researchers within the department.

According to Potter, the drying of materials in industrial processes is a 'forgotten' operation.

He says: "It is a puzzle why this should be so when the total national cost of drying operations is so high.

"In Victoria, about 30 million tonnes of brown coal is mined and mostly burned each year, vapourising 20 million tonnes of water to the atmosphere, or in oil equivalent, allowing for combustion efficiency, equal to about two million tonnes of oil per annum.

"Costed as oil, this would be worth $170 million, although as brown coal the cost would be considerably less, because it is underpriced.

"These examples could be multiplied, but it is clear that the national drying bill could easily attain $500 million a year.

"A one per cent saving is then worth $5 million a year, so savings are worth going for."

Potter says the principal factor preventing energy economy in drying units has been the difficulty in recovering heat energy from the mixture of water vapour and non-condensible gases which flow from conventional dryers.

The dryer developed by the team incorporates multiple use of superheated steam in what are called ‘fluidised beds’. By this process, gas is passed through the material to be dried so that gas bubbles separate and slightly expend the material, giving it the same properties as a fluid.

This makes for maximum heat transfer within the material and also a rapid mixing of the material.

Says Potter: "When steam drying is allied to the good heat transfer properties of fluidised beds, a very powerful tool is created and substantial energy economy follows because heat can now be recovered easily since there is little, if any, non-condensible gas present."

Potter says that in the Monash process heating steam enters the heating tubes of the first dryer, then the vapour from this drying is cleaned by cyclones and fed to the heating tubes of the second dryer and so on.

"Therefore, multiple effect economy is now available to drying," he says.

Concurrent or countercurrent systems can also be used. Useful variant is to have two drying stages at one pressure, normally atmospheric pressure.

"In this type of steam drying unit, heat energy in the form of steam is passed to the second dryer."

"Furthermore, the stages in the system need not be dryers but any means of effectively utilising the energy in the steam.

"For example, in brown coal combustion, high pressure steam is used in turbines for power generation. Some of this steam may be withdrawn for drying coal. The whole of this ‘product’ vapour can then be used, indirectly, in the low pressure turbines.

"In an alumina plant, where large quantities of steam are used in bauxite (the raw material for alumina) digestion and recovery of caustic liquors used in the process, some steam may be withdrawn and used in the dryer to dry the bauxite before calcination.

"The vapour thus produced may then be used for process heating, for example, in such tasks as evaporation of the weak caustic solution.

"By this means, substantial economies in the use of oil for initial heating are made available."

Potter's team has already constructed a prototype drying plant with a capacity of up to six tonnes of brown coal or eight tonnes of alumina hydrate a day.

This plant has electrically heated tubes, and studies with bauxite have given very satisfying results.

Potter says that if brown coal is first dried before use in power generation, gains in thermal efficiency follow, capital costs are reduced, and larger units are possible, making further capital savings feasible.

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Mountain ash relationship

"The interesting fact about mountain ash is that it flowers in early winter while other gums flower in spring and summer. This may explain why the Leadbeater's possum breeds in winter, otherwise the choice of breeding in the cold months is almost baffling, because it is usually a time of limited high protein food supply.

"Leadbeater's possum seems to have a special relationship with mountain ash, although the species has been seen in other gums, such as snow gums, candlebarks, shining gums and alpine ash.

"The ideal environment for Leadbeater's possum is a mature mountain ash forest with old stags and a re-growth understorey of young trees.

"The problem is that mountain ash is slow-growing. Forests destroyed by the 1939 fires have trees of the same age, and most of the old stags which remain now have a limited time span during which they will be of value as nest sites."

Says Smith, "In the study area alone, three out of 25 stags used as nest sites have fallen over during the last two years. Because each colony seems to require up to three nest sites, several stags are needed per hectare to provide the required number of nests.

"In the 1939 regrowth, the old stags are falling over, and within ten to 20 years may be at such a low density that they will be of little or no value to the possum. This means there will be a period of up to 60 years in the 1939 regrowth forest when there will be few nest sites.

"This throws great importance on to mature mountain ash forests not burnt during the 1939 destruction. The 1939 regrowth forests make up 94 per cent of State forests in central Victoria, and mature older forests 3.5 per cent of these.

"Smith says this small area of remaining mature forest should be conserved where possible because it will be extremely important for the survival of not only Leadbeater's possum but many other hollow-dependent mammals and birds."

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In alumina plants, Potter says, low cost process steam (which has already been used in the plant at higher pressures) can be reused in the fluidised bed drying process.

"Heat transfer coefficients between the heating tubes and fluidised bed are high and drying proceeds at a good rate. This feature has been confirmed by the prototype.

"There is a two-fold benefit in such drying. Not only is the fuel requirement reduced because of the reduced heat load but so also is the gas volume handled.

"It is therefore possible to increase the throughput of materials without further increases in heat losses caused by convection and radiation."

Potter concludes that a 10 per cent saving, say, in the use of Victorian brown coal is equivalent to discovering a new coal field. In alumina processing plants, the saving is equal to three to five days of Australian motor fuel consumption.

He adds that patent applications have been made for the dryer.

The development of processes for efficient handling of red mud has been the aim of the research project being carried out by Dr. David Boger and Dr. Peter Uhlherr, who are both senior lecturers in the department, and former Ph.D. student, Guillermo Sarmiento. The research student being supported by the Alcoa scholarship is Nguyen Quoc Duy.

Waste from extraction process

Red mud is the waste product generated in the Bayer process for extracting alumina from bauxite. In the process, finely ground bauxite is digested at high temperatures and pressures in a caustic solution where the alumina hydrates present are dissolved out as sodium aluminates.

After digestion, the insoluble components of the bauxite, mainly iron oxide, silica and titania, remain as the 'red mud' residue.

This is usually discarded by pumping it to a disposal area.

The researchers say: "The disposal of red mud poses problems of considerable magnitude. A typical Australian plant generates as much as 11,000 tonnes of red mud each day on a dry basis. This is pumped as a slurry at a concentration of 25 to 40 per cent solids to the disposal area — ponds which can cover an area as large as 160 hectares.

"Recovery of the caustic liquor used in the extraction process is not simple because of the unfavorable settling characteristics of the mud.

"Our emphasis has been on the reduction of the scale of the waste disposal problem while at the same time attempting to minimise the loss of caustic liquor.

"We thought there was a possibility of pumping the mud at concentrations far in excess of those currently being used.

"Our research showed initially that a chemical additive used to break down the structure of the red mud does not need to be used.

"We found that by vigorously shearing or mixing the red mud we could break its viscosity down from around 10,000 poise (poise are a unit of viscosity) to about 50 poise, at which point it has a toothpaste-like consistency, and is easily pumpable."

Says Boger: "It is fascinating to think that you can virtually stand on the red mud 'filter cake': but by shearing it with a screw, break down its viscosity, and pump it away.

"We are also looking at the behaviour of the red mud in the settling ponds with a view to recovering the maximum amount of the valuable caustic liquors so that they can be re-cycled through the processing plant.

"Pumping the red mud requires a large and costly energy input, but by raising the level of concentration of solids to fluid, we think it is feasible to cut energy use as well as the volume of red mud to be disposed of."

"This means that ponds do not need to be as big as they are now, and problems associated with caustic recovery can be minimised.

"We believe our process would extend the life of the settling ponds and lead to an easy means of caustic liquor recovery."

"The research evidence points to the process being feasible but it remains to be seen whether it can be done economically, and whether handling heavier concentrations of red mud is viable from the point of view of pond management."

The researchers add that more work needs to be done on the chemistry of the shearing and settling processes, which are extremely complex.

All faculties active for Monash Open Day

ALL SEVEN FACULTIES at Monash University will participate in Open Day activities on Saturday, August 4.

Open Day — the twelfth staged by the University — is designed to give visitors, particularly family groups and prospective students, an interesting look at a modern university.

In all, about 100 departments and sections within the university will mount displays, demonstrations and activities typical of the university’s academic and non-academic interests.

Guidance and counselling services, which have proved of value at previous Open days, will also be extended.

Teachers, students and their parents will be welcomed by members of Monash staff, who will help establish links with sources of educational and career guidance available at Monash throughout the year, even during vacations.

Visitors to Open Day will also have an opportunity to inspect Monash University’s splendid plantings of native trees, shrubs and flowers.

Many of the University’s clubs and societies will also be staging displays and demonstrations which will give an indication of their wide-ranging activities.

The University will be ‘open’ from 10 a.m. until 5 p.m. for Open Day. Admission is free and there is ample parking on the campus.
Roo’s giant leap may indeed be effortless

HAVE YOU EVER been struck by the apparently effortless ease with which kangaroos bound through the bush or across the open plain?

Now a group of researchers at Monash University has found evidence that the kangaroo’s hop may indeed cost relatively little effort. They believe kangaroos use a remarkable property of muscle — its elasticity — which helps conserve energy when they hop at speed.

According to one of the members of the group, Dr Uwe Proske, a senior lecturer in physiology, recoil of elastic structures enables kangaroos to hop at high speed with minimal energy expenditure.

Proske explains that all animals — man included — utilise elastic recoil. It operates through a combination of muscles and tendons, and, within a certain range of movements, allows muscles, after being initially primed with energy, to recoil in exactly the same way as a pure spring.

Proske has been studying elastic recoil in muscles and tendons in collaboration with Di Warren, a former M.Sc. student at Monash and Dr David Morgan, a former senior teaching fellow in the department of electrical engineering.

Says Proske: “I had been studying the spring-like quality of muscle in a variety of animals, and had the idea that if animals made use of this, then the best animal to study would be the kangaroo. Could we consider a hopping ‘roo as resembling a bouncing ball?”

Warren, a zoologist, became interested in elastic recoil as a means of energy conservation. She had measured the amount of oxygen consumed by a hopping kangaroo, and discovered that once the kangaroo was travelling above about 18 kilometres an hour, the amount of oxygen consumed (taken as a measure of energy expenditure) did not increase with further increases in hopping speed.

“A possible explanation for this,” says Proske, “was that the animal was using elastic recoil of stretched muscles during hopping. It should be pointed out that kangaroos increase hopping speed by lengthening stride, keeping hopping frequency constant. We set out to ascertain whether we could provide a firm experimental basis for the elastic recoil hypothesis.”

Proske says Morgan helped develop a simple but ingenious method of distinguishing between the spring-like quality of muscle and of the tendon, by which the muscle is attached to the skeleton.

“By making measurements on the gastrocnemius — a muscle in the calf of the kangaroo and important in hopping — we found that over the range of movements occurring during hopping, the muscle, together with its tendon, did indeed behave as a stiff spring.

“The main contribution of our group was to recognise that within a certain limited range of movement, the muscle behaved as an almost purely elastic structure, and that this was in large part due to the muscle’s very long, compliant tendon.

“We showed that the muscle exhibited little viscosity during an imposed stretch and most of the stretch was taken up by the tendon. For the kangaroo, this means that it is largely recoil of the tendon which provides the lift for the take-off phase for the next hop.”

Proske says the elastic recoil principle applies to many different forms of animal locomotion... the jump of the flea, the leap of the frog, the swish of the shark’s tail, the galloping horse and the running athlete.

“The basic idea is that muscles do work to move the limbs which then propel the animal forward. By means of elastic recoil, advantage is taken of the kinetic energy of movement, so that the muscles, need next time, to generate proportionately less energy.

“This can be seen most easily with a stereotyped movement like hopping, where, as the animal lands, muscles which had contributed to initiate the previous take-off are stretched.

“The elastic recoil of these stretched muscles helps provide some of the energy for the next take-off. Thus, after the first hop, all subsequent hops at that speed are energetically less costly since they rely on recoil from stretch effected on landing.

“A simple analogy is the pogo stick — the springs recoil to provide take-off and are compressed on landing — and the first hop of the pogo stick requires the greatest effort.”

Says Proske: “Because of the contribution of the muscle’s tendon to elastic recoil, it is probably an advantage for kangaroos to have such long hind limbs.

“In the species of kangaroo we chose to study, the gastrocnemius muscle is about the same length as the equivalent muscle in the cat, but the tendon is four times longer than that of the cat — an indication that the kangaroo’s muscles and tendons are uniquely designed to make the most effective use of elastic recoil.

“It should be pointed out that the biochemical processes which lead to the production of the required energy for locomotion are basically inefficient. Animals, therefore, make use of elastic recoil as one means of conserving energy.

“Energy conservation is likely to be an important factor in determining the distribution and abundance of animals, and it is probable that by using elastic recoil, kangaroos have been able to minimise their energy requirements and thereby, are able to exist in what is, for the most part, an arid and inhospitable continent.

“It may well be that kangaroos thrive in Australia because of their mode of locomotion, which allows energy conservation thereby enabling them to travel long distances in their search for feed and water.

“Furthermore, Warren proposed that if kangaroos were to survive as animals which reared their young in pouches, then the upright posture of hopping did seem the more suitable way of moving around.”

Proske says there are experiments with humans which reveal the effect of elastic recoil.

He says: “For example, ask a man to hop into the air from a ‘standing start’ on the ground. Then ask him to jump off a chair before hopping into the air; jumping down from the chair will enable him to reach the greater height in the subsequent hop. Here, the man is using elastic recoil of muscles stretched on landing to give him an extra ‘kick’.

“What I find particularly satisfying about this kind of research is that it is possible to relate an animal’s gross behaviour — as in the case of the hopping kangaroos — directly back to what are, ultimately, the movements of sub-microscopic structures in the animal’s muscles and tendons”.

Physiologist Dr Uwe Proske comes face to face with a kangaroo in the Jock Marshall Reserve at Monash. Proske says kangaroos use a remarkable property of muscle and tendon, called elastic recoil, to conserve energy when they hop at speed. Photo: Mrs. Jil Paynter.