Monash botanist, Dr Neil Hallam, has built up an enormous body of knowledge about Ewens Ponds and Piccannini Ponds in South Australia. Monash student Phil Evans is pictured above diving in Piccannini Ponds. Right: scanning electron microscope picture of diatoms on the surface of plants of Ewens Ponds.

Underwater caverns reveal their secrets

SOME 10 to 30 million years ago, when parts of southern Australia were covered by ocean, the face of south-eastern South Australia underwent a transformation.

The remnants of minute sea animals that carpeted the Miocene seafloor were transformed into limestone.

The land rose and the sea retreated. Rainwater filtered into the porous limestone, which slowly dissolved, forming the great underwater caverns and aquifer systems which are now known as Ewens and Piccannini Ponds.

Ewens Ponds, which is close to the Victorian border, is made up of three interconnected ponds which drain into the sea through Eight Mile Creek. Piccannini Ponds, which is part of a South Australian National Park, consists of a great chasm, at least 50 metres deep, which leads into a huge underwater cavern known as the Cathedral.

Ewens Ponds and Piccannini Ponds have been the subject of 10 years of research by Monash botanist, Dr Neil Hallam, who, with the help of Monash students, has built up an enormous body of knowledge about the two sinkhole systems, regarded by scientists as ecologically unique.

Hallam’s work was featured in a recent issue of the magazine, National Geographic.

Much of Hallam’s research has been done at Ewens Ponds, which was originally part of Eight Mile Creek swamp which extended eight kilometres along the coast between Nelson in Victoria to Port MacDonnell in South Australia.

In 1937 a drainage program was implemented to clear the area for farming land. In 1947 the program was escalated and the water level in the first of Ewens Ponds is now about one and two thirds metres below its 1947 mark.

Nevertheless, each day roughly 52 million gallons of water — nearly three times the intake in Piccannini Ponds — flow into Ewens Ponds from aquifer fissures scattered across the pond bottoms.

Hallam and Monash students, using rhodamine, a water-tracing dye, have clocked the rate of water exchange in the three ponds. Their calculations indicate flush times of six hours, two hours and 1½ hours respectively.

Hallam says that one of the most striking features of the ponds is the clarity of the water.

"Under water," he says, "you can see 30 metres with no trouble at all."

Continued overleaf
He says the water is clear partly because of its relatively high levels of calcium. This causes organic detritus in the water to flocculate and settle on the bottom. Other reasons for the clarity are the almost complete absence of phytoplankton (phytoplankton and zooplankton normally impede the transmission of light), and the rapid turnover of water in the pond systems.

From the zoological point of view, Hallam says, the whole system is relatively poor in animal life. But because of the water clarity, which encourages photosynthesis, there is an incredible plant population.

"Swimming in the Ponds is like swimming in somebody's fresh water aquarium," he says.

The vegetation surrounding Ewens Ponds, he says, includes many well known swamp species such as Triglochin procer, Slum laticollum (water-parsnip) Nasturtium officinale (water-cress) and Lemna trisulca (duckweed). Duckweed also floats on the surface and in the pools.

The dominant species before drainage was water cress, which occurred then in great masses from deep in the ponds to the surface. At the present time it is mainly restricted to Eight Mile Creek between the ponds and along the edges of Eight Mile Creek as it flows from the third pond to the sea.

"The pond system is relatively poor in animal life, but because of the water clarity, which encourages photosynthesis, there is an incredible plant population."

Hydrocotyle verticillata, which normally grows as a bog plant or a half submerged aquatic, is found at Ewens Ponds as a completely submerged plant growing down to depths of three to four metres below surface level.

From water edge to a depth of approximately two metres the vegetation is made up of a complex of Triglochin procer and other plants forming a dense intertwining mass of vegetation.

Below this level, down to the vegetation limit at four metres below surface level, is a band of Ranunculus inundatus and Lilaepolas poyntana. The stolons of the two species can be seen spreading into the finer silts below five metres. The slope of the ponds below water level is 45-50 degrees, and the plants serve to consolidate this underwater slope.

At the bottom of each of the three ponds, Hallam says, faulted limestone can be seen and springs bubble in through cracks between the limestone slabs and rubble.

On the surface of the rocks blue-green algae and two mosses, Cratoneurops relaxa and Fissidens rigidulus form their own microenvironment from organic detritus at the rock surface. The white calcareous sand at the bottom of the ponds are full of the Miocene fossil shells of moluscs and foraminifers.

The channels between the ponds vary from 30 cm to 1.5 metres deep and are colonised by water-cress, water-parsnip, and a species called Elaeochoris acuta.

Water-cress, he says, can be seen flowering underwater in the channels, the petals half open with an air bubble between the petals.

Apparently, self-pollination takes place underwater, he says, but the plants may in fact be functionally sterile under these conditions as seed release, even if seed set occurred, would not be possible in the normal manner. The fruit would never dry out to release the seed when mature.

Investigating the food chain in the pond system, Hallam found that phytoplankton (the free-floating or motile algae which normally form the basis of the food chain) are rare, if not completely lacking, in the ponds. This may be because they are swept out by the rapid turnover of water.

The plants that grow in the ponds are anchored by roots into fairly rich peaty soils. The food chain, he says, starts, not with phytoplankton, but with shrimps, small fresh water snails and the larvae of insects that inhabit the surface of the plant.

Hallam says the scanning electron microscope reveals a whole complex ecosystem on the leaf and stem surfaces of aquatic plants.

Large numbers of diatoms (microscopic algae) are found on all the aquatic plants of both pond systems.

"It is possible," he says, "that in waters that are low in phosphate and nitrate the diatoms obtain the nutrients as they leach out of the anchored plants. The plants, in turn, obtain the phosphate and nitrate from the nutrient rich peats in which they grow."

As Piccannini Ponds is part of a national park, activities there are controlled by the South Australian government. Permits are required if you wish to dive, and, for reasons of safety, are usually restricted to members of the Cave Divers Association of Australia, who have the skills and the training to undertake the hazardous dives.

There are no controls at Ewens Ponds, which is also hazardous for divers, and, also, is being threatened as a diving spot by commercial interests. Because of that, Hallam and the Cave Divers Association have recommended to the South Australian government that Ewens Ponds also be included in the National Park, so that activities there can be regulated. Hallam's submission, which was requested by the South Australian Department of Lands, is at present being considered.

"Ewens Ponds should be preserved," he says, "if for no other reason than the number of interesting fresh water algae that grow there.

"Most interesting of all is a red alga, Batrachospermum, which is a fairly rare 'beast' — almost all the red algae are marine."
Rock research could aid oil search

RESEARCHERS in the Monash department of earth sciences have made important progress toward understanding the evolution of hydrocarbon reservoirs in Bass Strait.

Their research, which aims to predict the porosity character of rocks, should, with further development, be an important aid to oil exploration.

Largely funded by Esso Ltd., this work is being done by Mr Vic Wall and Dr Ray Cas, of the earth sciences department, and a Ph.D. student John Bodard, from Canada.

Wall, who is leading the research, says the two most important characteristics of hydrocarbon-bearing rocks are their porosity and permeability — that is, the holes in the rocks and their ability to transmit fluids. To be economic, hydrocarbon reservoirs need more than about 10-15 per cent porosity.

Permeability is necessary for the migration of hydrocarbons from their source rocks to suitable porous traps — the reservoirs. Although there is often a close relationship between porosity and permeability, there need not be. Hydrocarbons cannot be economically extracted from some reservoirs because of low permeability.

There are two types of porosity, Wall points out. They are primary and secondary porosity. Primary porosity dates back to the time the sandstone sediments were first deposited (between about 36 million and 90 million years ago). Secondary porosity develops after deposition.

Traditionally, porosity has been regarded as declining with depth. The Monash research shows, however, that much of the porosity in the Gippsland Basin has been generated at depth — a finding with important implications for oil exploration.

The Monash team has found to its surprise that many, if not all, of the major reservoirs in the Gippsland Basin owe their oil- and gas-bearing character to secondary porosity.

"In many of these reservoirs," Wall says, "the holes in the rocks are not the original holes. They have developed millions of years after the sediments were deposited.

"The original holes in large volumes of Gippsland Basin sediments were largely cemented up as a result of processes such as dolomitisation — the precipitation of calcium-magnesium carbonate within them. At some later stage in the rock's history the dolomite cement was dissolved. Dissolution of this cement and other rock components created new holes."

The Monash team found that dissolution of dolomite cements was largely responsible for the exceptionally high porosity and permeability of the Snapper, Marlin, Tuna and Flounder fields, and was probably a major cause of porosity in other large hydrocarbon fields as well.

Another important form of secondary porosity, developed in sandstones lacking evidence of extensive dolomitisation, results from the dissolution of clay matrix and other rock components. This appears to have contributed significantly to the reservoir quality of the Mackerel, Hapuku, Kingfish and Halibut fields. Interestingly, secondary porosity development appears to be closely related to oil and gas emplacement in the hydrocarbon fields.

The Monash researchers have examined more than 600 core samples from 33 wells in the Gippsland Basin, and used a variety of techniques to "map" the geochemical and petrophysical evolution of Gippsland Basin sandstones.

"Emphasis was placed," Wall says, "on the development and dissolution of the dolomite cements, the key factors affecting reservoir evolution and quality throughout much of the Basin."

In addition, preliminary chemical modeling of dolomite-pore fluid interaction and the results of other investigations, such as stable isotope studies, provided important insights into the processes involved.

"We need to understand the processes which affect porosity if we are to predict its occurrence in unexplored parts of the Gippsland Basin," he says.

"As a result of our research, we now have an initial model for the distribution of porosity and permeability throughout the Basin.

"We also have a fairly good idea where porosity is likely to be high and where it is likely to be low, and the reasons why.

"Further research will lead to better models for predicting porosity trends, reservoir quality and favourable locations for hydrocarbons in the Gippsland and other sedimentary basins.

"As significant in the long term, is what we are learning from our more fundamental work on fluid migration, fluid-rock interaction and fluid chemical evolution in sedimentary basins."

Until recently, Wall notes, research in this area has been neglected in Australia. It is now becoming of greater importance as the search for oil and gas deposits turns toward more subtle, or deeper hydrocarbon traps in already well explored areas.

In addition to its already substantial funding, Esso Ltd. has agreed to give $10,000 a year for three years to fund a Ph.D. scholarship. Monash is also supporting the research through its graduate scholarship scheme.

A paper summarising this work to date was presented at the recent conference in Hobart of the Australian Petroleum Exploration Association. It has also been published in the APEA Journal.
Indonesian films — a ‘propaganda weapon’

THE Indonesian film industry has become a powerful and subtle propaganda vehicle for the Suharto government, according to a recent study by Krishna Sen, a Ph.D. candidate in the Centre of South-East Asian Studies.

The Indonesian cinema is not used as a means of direct propaganda, she says, but as an instrument for shaping those social attitudes and values which assist and legitimise the military regime.

"As the propaganda is introduced as part of the story," she says, "it is not seen as propaganda. And not being noticeable it is all the more effective."

Sen, who speaks Indonesian fluently, lived in Indonesia for more than two years. Her study is concerned mainly with the development of the Indonesian cinema since 1965, the year that President Sukarno was overthrown and the Suharto military regime took over.

Although the lucrative film import business is largely controlled by "cronies of the Suhartos," and some direct propaganda films are funded by the government, there is a fairly big private film production industry. Not only are the ideas and story line of these films exercised by the Censor Board, which, she says, ensures that nothing is passed that can be directly, or indirectly, construed as unfavorable to the military regime.

A film is censored three times. The story line is censored, then the script, and finally the film.

"A film will not be passed by the Censor if there is the slightest hint of criticism of the government," she says. "But films are also rejected for reasons which, at first sight, do not seem to have anything to do with the government or with politics."

As an example of the latter, she cites the film "Petualang Petualang" ("Adventure") which she saw at a special screening before the Censor Board. The film has been before the Board of Censors for six years. It tells the story of a large firm and its owners, and the frustrations of a young man and woman with nothing to look forward to who are driven finally to murder and suicide.

Despite a change of title and four revisions of the story, the Board has consistently refused to pass the film because of its "negative analysis of society."

"As a result of this strict censorship, producers play safe and concentrate on "innocuous, repetitive love stories with a stereotyped middle-class view of society."

Problems are usually minor and personal and are resolved in the end on the moral rather than the social plane.

Where poverty is shown it must be romanticised. Usually the theme is "poor boy makes good," or "poor girl marries a rich and loving husband."

Sen says the message is clear. "You (the viewer) can have all this too, provided you work hard, you don't drink, and you support the Suharto regime."

While the Suharto regime is just as authoritarian as the Sukarno regime which it replaced, she says, the two regimes differ in the "quality of authoritarianism" and in their approach to film censorship.

The Suharto regime is an elite military bloc detached from the people. Sukarno's power, on the other hand, was based more on his personality. He was closer to the people and more sensitive to different perceptions existing in society and the need to balance them.

Censorship was strict under the Sukarno regime, she says, but it was a censorship more sensitive to the reactions of the general population. It was more sensitive, for example, to issues such as private morality.

Islamic moralism discouraged kissing on the screen. Left wing protests led to the banning of American films in the later years of the Sukarno regime.

In contrast to the Sukarno years, Sen says, the Suharto regime has been far more liberal on matters of private morality, but much more restrictive on the type of political message it permits in a film. Its aim, through the Censor Board, appears to be to preserve those ideas which legitimise the military regime.

A dramatic example of the differences in approach of the two regimes, she says, is their attitude to the so-called Hollywood "jungle movies" which were traditionally set in Asia or Africa and depicted "the great white adventurer rescuing someone from the barbaric Asians or Africans."

Under Sukarno this type of film could not even be imported into Indonesia. With the advent of the Suharto regime, however, the attitude changed. Indonesian film producers are now themselves making this sort of film because of its ready market, particularly in Europe.

Some scholars have noted that today's ruling generation in Indonesia, commonly known as the '1945 generation', which came to adulthood through a period of revolution, is more concerned with nationalism than with social justice. The latter issue is the driving force behind the unrest of the younger generation (the post-1965 generation).

This unrest of the young came to a head in 1974 with violent demonstrations against the planned visit to Indonesia of the Japanese Prime Minister, Mr Tanaka. But the Suharto regime could not see the students' violence for what it was — hostility to foreign capitalism and the demand for social justice. The Government, instead, blamed the old political parties.

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Krishna Sen

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"Indonesian films go one step further," Sen says. "You would not know from any film made in Indonesia since 1974 that there was such a massive student revolt in Jakarta.

"What is in fact a political difference between the ruling and the younger generations is depicted in films as a moral difference. By treating it this way, the Suharto government can call on traditional relationships between parent and child to justify its position."

Where women are concerned, there seems to be a "conscious effort to produce women in the mould of the male idea."

She cites as an example two recent films, "Tangan Tangan Mungil" ("Little Hands") and "Gadis Penakluk" ("Rebellious Girl") which were made in successive years. They deal with the "problem" of female children who do not "behave like girls". In the first film, the "problem" is overcome with the help of a psychologist, in the other, by the patience of a school-teacher.

"What is surprising in Indonesian films," Sen says, "is the aggression with which ideas related to women's equality with men have been distorted and mocked."

Even in a so-called women's film (written and directed by a woman) female characters are shown, both visually and psychologically, from the male point of view.

Sen says that since 1965 the isolated professional woman has appeared in a marginal role in an Indonesian film and has been treated neutrally, or, on occasions, even positively. But wherever the central focus of the film has been a professional woman the treatment has been negative in the extreme, with very few exceptions, if any.

Domestic service, she says, seems to be the accepted area of female work. Maid servants are portrayed as loving and loyal and at times funny. If a male servant appears in a film he is inevitably a comic. It is the upper-class working woman in professions and in business, regarded as a male sphere, who bear the brunt of the attack.

Sen says her thesis is concerned with the political and social implications of Indonesian cinema. She did not set out to judge the technical quality of the films or the quality of the acting. Much of the technical work is done abroad, she says, and it is difficult to judge the quality of acting because "such things are so culturally-bound."

However, if the popularity of film-stars is an indication, Indonesians must find the acting convincing, she says.

Actors and actresses receive star treatment wherever they go. They usually travel around the packed streets in open cars when they attend the annual film festivals, which rotate in different cities.

Despite the popularity of film-going, production of Indonesian films has declined in recent years. It reached a peak of about 120 films a year in 1977, but since then has declined to an average of about 50 to 70 a year.

The local product is supplemented by about 100 Chinese and Indian films a year and about 200 foreign films from the United States. This, however, is well down on the 700 films a year which flooded in from the United States when the doors were opened to foreign films in the early years of the Suharto regime.

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"One of the Centre's most important interests is the advancement of the study of interferons — a whole new family of substances that are finding uses in a wide range of medical situations, such as the treatment of viral diseases, cancers and degenerative conditions such as multiple sclerosis."

"The cancers being investigated by the Centre's staff include those of the intestine, which are among the most common in Australian society. Another major activity is concerned with blood clotting, which is implicated in a wide range of medical problems related to the functioning of the heart, brain, arteries and veins."

Linnane says members of the Centre's staff will be undertaking important industrial contracts with leading Australian concerns.

Last month, the new Centre hosted a two-day scientific meeting, attended by overseas and interstate guests, at which work of interest to the Centre was reviewed.
Foetal research could save lives

IN most developed countries during the past decade there has been a steady decline in infant death rates in the perinatal period — the critical period shortly before, during, and shortly after birth.

The mortality decline is believed to be due largely to improvements in obstetrical and neonatal care, and to the better management of respiratory, nutritional and other problems in very-low-birth-weight infants.

The improved management of low-birth-weight infants (infants weighing less than 1500 grams) has been made possible by recent advances in foetal research.

Despite these gains, about 4000 babies still die in Australia in the first year of life, most of them within the first month, and about three per cent of all newborn infants are classified as small-for-gestational age.

Further reductions in mortality rates are expected to come from a better understanding of the normal physiology of the foetus and the newborn and the effect on the foetus of stressful conditions such as hypoxia (reduced oxygen supply), hyperthermia (excessive heat), and reduced uterine blood flow.

These are research areas central to the work of the Monash foetal physiology team, led by Professor Geoff Thorburn.

The Monash research, which is backed by a NH&MRC Program Grant over five years, has already revealed a fascinating glimpse into the intra-uterine life of the foetus.

By implanting sensitive recording devices in the foetus of a sheep, the Monash team has been able to monitor the development of the foetal lamb from 100 days gestation to birth at 150 days.

An important and unexpected finding relates to the foetal pattern of swallowing.

According to NH&MRC Senior Research Fellow, Dr Richard Harding, a senior investigator in the team who is conducting the research in this area, the swallowing pattern in the foetal lamb is very similar to that in the newborn.

'Further reductions in infant mortality rates are expected to come from a better understanding of the normal physiology of the foetus and the newborn, and the effect on the foetus of stressful conditions.'

It occurs in 'discrete episodes' several times a day.

There are two well-defined foetal sleep states, he says. They are quiet sleep and REM (rapid eye movement) sleep. But the foetus is in neither state when it swallows. It appears to be 'aroused and very active.'

During the swallowing episodes, he says, the foetus swallows a substantial quantity of fluid — on average, about 100 mls to 500 mls per day in the last few weeks of gestation.

The swallowed fluid is a mixture of amniotic fluid (the fluid in which the foetus floats) and fluid produced by the foetal lung at the rate of four or five mls per hour per kilogram body weight.

"The lung fluid passes up the trachea and into the mouth of the foetus," Harding says. "It can be passed out into the amniotic sac or swallowed. It seems that the proportion of lung and amniotic fluids in the highly viscous fluid swallowed by the foetus is variable, but on average it is about 50 per cent of each."

Why the foetus swallows the liquid is a mystery. It may be of nutritional benefit (the amniotic fluid is known to contain protein, but there is little in the lung fluid).

The Monash team is investigating a second possibility — that the fluid contains hormones essential for the development of the mucosa, muscle or enzyme systems of the gastro-intestinal tract.

At birth, the newborn baby has to be able to digest adequately the milk that it suckles and swallows. The gastro-intestinal tract, accordingly, has to be in a well-developed state.

Harding says it has been known for some years that the lungs secrete a liquid during foetal life.

"Embryonically," he says, "the lungs appear to be very similar to the stomach. Their origin is the same and the secretion of foetal lung liquid is similar to the secretion of acid by the stomach."

As far as is known, the lung fluid, which is slightly more acidic than the amniotic fluid, is secreted throughout the development of the lungs. It seems to be involved in expansion of the lungs, which, in turn, seems to be necessary for lung development.

The Monash team is currently studying the way in which lung expansion is regulated by the muscles of the larynx.

With the onset of labour, secretion of fluid by the lungs is switched off by hormones from the adrenal gland. Instead of secreting the fluid, the lungs start to absorb it. Very little lung fluid appears to be secreted after birth.

"It's not a clearly understood mechanism," Harding says. "but, obviously, it's very important for our post-natal survival that lung fluid is absorbed at birth and is no longer produced in any quantity."

One of the problems for obstetricians is how to recognise a foetus that is in distress or is likely to develop problems such as hypoxia (oxygen deprivation).

Foetuses normally have only small amounts of oxygen in their blood, and if their oxygen supply is diminished, problems can arise.

Harding says the foetus has several strategies to cope with short-term reductions in oxygen supply. Blood is re-distributed, so that the vital organs, the heart and brain, receive a larger than normal share, unnecess-
sary breathing and body movements are switched off, and the foetus switches to a state of prolonged quiet sleep.

Absence of breathing movements, reduced activity, prolonged quiet sleep and elimination of the slight accelerations in heart rate which are normally associated with body movements on, are all clues therefore to a state of oxygen deprivation which may lead to foetal distress.

The Monash team has been studying foetal responses to hypoxia of two and four hours duration.

Using an intra-vascular oximeter, a device which monitors the mother's change of posture, and the activity of the foetus itself, all tend to depress the foetal oxygen supply.

"The foetus is utterly dependent on the placenta for its oxygen supply." Harding says.

"It has no way of increasing it in times of need."

"When it is active during periods of arousal it doesn't seem to be able to increase its oxygen supply. As a result, oxygen levels can plummet quite dramatically."

Harding believes that this could be the limiting factor to the amount of activity a fetus can engage in.

Chronically hypoxic foetuses, or foetuses deprived of oxygen for long periods, appear, in many respects, normal, he says. The foetus finds some way of coping with the low oxygen levels.

The challenge facing the Monash team is to detect the subtle changes that take place as a result of chronic hypoxia, and so enable them to identify the foetus at risk.

The Monash research is funded by the NH&MRC Program Grant, which will provide approximately $1,600,000 over five years. The Victorian Sudden Infant Death Research Foundation has provided funds for several specialised pieces of equipment, including the oximeters.

Reports on the research to date have appeared in a number of journals, including the Journal of Developmental Physiology, the Journal of Physiology, the Quarterly Journal of Experimental Physiology, and the American Journal of Obstetrics and Gynaecology.

Collaborating with Harding on these projects are Dr D. W. Walker, Dr J. N. Siggers, Mr P. J. L. Wickham and visiting Canadian obstetrician, Dr A. D. Bocking.

THE Monash IVF team at the Epworth Hospital and Queen Victoria Medical Centre has achieved another world first — the first authenticated birth of a normal baby from a frozen-thawed embryo.

The baby, a girl, Zoe, was born to Mrs Loretto Leyland at the Queen Victoria Medical Centre last month. Both mother and baby are well.

"The first authenticated birth from a frozen embryo." Harding believes that this could be the "limiting factor to the amount of activity a fetus can engage in."

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Collaborating with Harding on these projects are Dr D. W. Walker, Dr J. N. Siggers, Mr P. J. L. Wickham and visiting Canadian obstetrician, Dr A. D. Bocking.
Tracking the effects of Melbourne’s smog

ATMOSPHERIC pollution significantly reduces the amount of short-wave solar radiation reaching Melbourne, according to a paper recently presented by Monash geography department researchers to the 8th International Clean Air Conference in Melbourne. The reduction in Melbourne is comparable to other large urban centres.

The paper by honours student Daniel Lehrer and Dr Nigel Tapper, based on Lehrer’s honours research, is the first attempt to quantify the effects of pollution on solar radiation in Melbourne.

The research involved determining pollution effects on direct beam solar radiation on eight occasions when conditions permitted during the autumn and winter of 1983.

Direct beam solar radiation is that part of the sun’s radiation that is not absorbed or scattered by gases and aerosol in the atmosphere and reaches the ground directly.

In the research, a number of instrumented automobile “traverses” were made across Melbourne. Solar radiation measurements were correlated with actual or estimated EPA airborne particle index (pollution) readings for various stages of the route.

Starting at Rockbank, the traverse proceeded into the city along the Western Highway, through the city centre, then along the South Eastern Freeway and Bunyip Highway, terminating along the Mt Dandenong Tourist Road, near Sherbrooke Forest.

Radiation readings were converted into “atmospheric transmissivity” readings, which express the proportion of direct beam radiation that would penetrate the atmosphere with the sun at its zenith.

As such a measure is independent of time and latitude, Tapper says, it is a very useful measure for the examination of urban effects on the transmission of solar radiation.

The highest average transmissivities, 0.780 and 0.747 (an indication of light pollution) were recorded at Sherbrooke and Rockbank, on the rural “fringe”.

The lowest average transmissivity, 0.720 (an indication of moderate pollution) was recorded in industrial Footscray.

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Frozen embryo

It will improve the efficiency of the IVF procedure by reducing the risk of multiple pregnancies and reducing the need for repeated egg collection.

“Freeze thawing will also assist embryo donation,” he says, “as better matching of donors and recipients will be possible by storing donor egg-embryos in banks.”

“In potentially serious diseases affecting women, fertility may be ensured by storing embryos for future use.”

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Urban atmospheric transmissivities were reduced, on average, by about six per cent compared to surrounding rural areas. Tapper says, this is equivalent to a reduction in direct beam solar radiation of 10 per cent.

The maximum reduction in transmissivity of 10 per cent (equivalent to a reduction of 18 per cent in direct beam solar radiation) occurred in conjunction with the highest levels of pollution observed.

Tapper says the influence of wind is shown by the traverse of May 22 illustrated on this page. Under a general E-SE air flow, pollution levels increased gradually through Melbourne’s eastern suburbs and central city area, rising rapidly to a peak west of the city centre, then tailing off into the outer western suburbs.

Atmospheric transmissivities were an almost perfect inversion of this pattern. The maximum depletion of solar radiation (0.684) occurred in Footscray, immediately west of the central city.

“Advective influences such as these may have important implications for Melbourne’s eastern suburbs given the relatively high frequency of winds from the north and west, especially in winter,” he says.

Tapper says the effects of pollution on solar radiation are a matter of concern for a variety of reasons. Apart from the climatic effect, the absorption and scattering of radiation is important in terms of visibility, lighting and colour perception.

“Similarly a reduction of short-wave radiation (especially in the shorter wavelengths),” he says, “if severe enough, could reduce plant photosynthesis and affect the body’s production of Vitamin D, but a possible benefit could be a reduction in skin cancer.”

“Depletion of short-wave radiation also has a detrimental effect on the efficiency of solar collectors in urban areas.”

Tapper stresses that the results of the research are based on a limited number of traverses and, as such, can only be regarded as a preliminary attempt at quantifying the effects of Melbourne’s pollution on solar radiation.

“Future work will seek to expand this rather meagre data base,” he says, “and will consider pollution influences on diffuse radiation as well.”

“Diffuse radiation is that part of solar radiation that is scattered downwards to the ground by gases and aerosol in the atmosphere and tends to increase as direct beam solar radiation is depleted by pollution.”

“Future research will also examine the effect of pollution on different wave-lengths of short-wave radiation.”

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