This tangled mass of steel is a disturbing reminder of the carnage on our roads. Two projects launched at Monash recently are looking at the problem (which last year claimed 3683 lives and caused misery and suffering for perhaps 20 times that number injured) from two separate, but related, standpoints... CAUSE and EFFECT.

CAUSE:
Misadventure or misbehaviour?

One of the biggest research grants ever to come to Monash is to support a study on "Road user behaviour as it relates to accidents".

With a grant of nearly $138,000 from the Australian Department of Transport, Professor Ron Cumming and Dr Tom Triggs, both of psychology, will direct the work. As well as being psychologists, both Cumming and Triggs are professional engineers.

Their double qualification and interest are relevant to this investigation because, they say, the driver is set in an engineering context: his vehicle, the local geometry and state of the road, the state of the traffic, and the established rules for operating the system.

Since all accidents involve actions by drivers and/or other road users, it is widely assumed that the key to reducing accidents is to modify the road users' behaviour.

But, say Cumming and Triggs, an accident involves other things—including many factors in the local environment, the engineering context.

In their view, it is easier and more effective to attempt to change behaviour by working on the environmental factors than by persuading road users to mend their ways.

In this they run counter not only to popular assumptions, but also to official views expressed by other experts on accidents. Nevertheless, the transport authorities, by making the grant, are supporting this attempt to look at the facts in a different way.

So, Cumming says, they must get the basic data by systematically looking at observable features of behaviour.

If, say, the team could be on the spot, and could "read" the behaviour a few seconds before each accident, they would quickly get their data: the relation between behaviour and the local circumstances and the observed accident.

Statistically rare

But, as Cumming points out, accidents are statistically rare events, so rare that other methods of observation must be employed.

By going to known risky kinds of location, at times expected to yield known risky conditions of traffic, they will conduct systematic observations of the behaviour of drivers as they approach and pass through the risky sites.

Of the many situations that will have been observed, some will be non-events, some will be events handled safely, others will be lucky escapes—misses or near misses; it is unlikely that any would finish as accidents.

Systematic observations, Cumming says, are those that can be recorded, counted and measured, and that will therefore yield numbers, and so can be analysed in terms of numbers.

Mobile laboratory

For that purpose, the department will have a mobile laboratory with filming, timing and recording gear; it will be set up for observing behaviour associated with particular sites.

They will also have an instrumented car that can move with the traffic to observe the risky types of behaviour associated with lines of traffic, such as cutting in on hills, overtaking on curves.

Dr Bob McKelvey, of Rhode Island, USA, has been appointed to lead the work and the analysis. He has had a distinguished research career in aviation and in behaviour on the roads in the USA.

After two years, possibly three, Cumming, Triggs and McKelvey hope to discover quantitatively the principal factors associated with behaviour in the variety of technical, environmental circumstances that, according to the records, have led to accidents.
From that analysis, the team hopes

- To identify patterns of behaviour that lead to accidents.
- To determine the extent to which those aspects of behaviour are affected by the local environment (or are associated with identifiable groups of users).
- To offer recommendations for changing the environment, the system, so as to improve the response to it, the behaviour—changes for example, in the road’s layout, the traffic rules, the signs and signals, the lighting, the vehicles themselves.

Professor R. W. Cumming, who heads the Monash road accident research project.

- In the end, possibly, to suggest the need for special training and/or licensing for specific groups of users.

Because, as Cumming and Trigg admit, whatever improvements are made to the engineering so as to make it easier for the user to do the right thing, the user still has enough choice in his control and manouevre to break any established system.

"When better engineering reduces that group to its hard core minimum, that is where persuasion should begin."

EFFECT:

Traumatic injuries

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A wounded person may suffer more injury than the wound itself. Thus the phrase traumatic injuries is no tautology, but a useful technical term meaning the wound and its consequences.

Now, at the prompting of a plastic surgeon in Melbourne, a trust has been created at Monash, to be known as the Trauma Research Foundation, for (to quote its trust deed) "teaching and research in the field of wound repair and reconstruction, with particular emphasis on traumatic injuries, their causation, treatment, effects, avoidance, relief and rehabilitation."

Of the four trustees, two represent Monash—Professor J. Bornstein of biochemistry, and Professor P. G. Nash of law; the other two are Mr John Rezak, a company director and public accountant, and Mr Maxwell Marriott, public trustee and solicitor.

A typical project that has been proposed is an investigation into the social and psychological background of people injured—through any cause, though industrial and road accidents loom large in the foundation’s mind—the treatment, the legal consequences of the event, and the final rehabilitation and readjustment of patients into community life.

Funds so far subscribed to the Foundation would only be adequate for a single short-term project in 1974.

Professor Bornstein points out that his role as a trustee is not as a biochemist but through his personal interest in the founder’s concept—a lack of funds available for research in these areas.

Some generous contributions have already been received. Further gifts (which are tax-deductible), enquiries and suggestions would be warmly welcomed by the trustees.

On Saturday August 10, Monash will be on display to its friends, its well-wishers, and its critics, that is to the public.

The laboratories will show their wonders in science, engineering, medical science, with working apparatus, demonstrations and displays.

Old-timers and parents, puzzled by the marvels and the mysteries, will, as likely as not, get an explanation from their school-age youngsters: undergraduates can be relied on to fill in the detail, leaving the philosophy and first principles to the professors and Ph.Ds.

Glassblowing in chemistry, the lasers in physics (don’t watch the beam), the electron microscopes are always popular; but they are only a part of it: the wind tunnel and anechoic chamber in engineering; the chemistry of life in biochemistry, life itself in zoology and botany, physiology, microbiology, and anatomy.

There will be music in Robert Blackwood Hall and in the Religious Centre, and entertainments in the Alexander Theatre and Union Theatre (films for children) and by the clubs and societies in the Union, promoted by the Union’s inside radio station 3MU. For the really young in heart, we will have the model railway on the north lawn.

For quiet contemplation, the departments in the humanities will offer talks, discussions and counselling, films and displays of artefacts, arts and crafts of other places and other peoples.

The libraries will be open for inspection. The main library will display some of our rare books.

Around it all will be the lovely Monash gardens, despite winter, with its native plantings, its native birds (some 80 species have been seen), including possibly a streaking pair of brush turkeys recently gone abroad from the Jack Marshall Reserve.

For the enlivened spirit in a flagging body, cups of tea or coffee or similar light revivement can be had in the Union.

It is recommended that visitors arrive not before 10 a.m. and not much later; displays will shut down at 5 p.m.

AS OTHERS SEE US

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MONASH REVIEW

JULY, 1974
Take one drachm of indigo . . .

How can microwaves have anything to do with dyes, dyestuffs and the dyeing of fibres?

Microwaves are post-radar, but the dyeing of fabrics and fibres, like the cooking of food and the fermenting of wine, is one of man's oldest arts. With time, the art has graduated from recipes to chemistry, from steeping in pots to modern industry.

Yet, according to Dr Tom Smith, in Monash's chemistry department, the chemistry of the dyeing process is by no means fully understood.

Since 1965 Dr John Pilbrow and (later) Dr John Boas, both of physics, have been working with Smith in the study of chemical complexes in a wide range of chemical systems, including dyeing.

It all looks so simple they say: the dye is carried in a solution, commonly in water, sometimes cold sometimes hot; the molecules of the dye pass out of the solvent into the fibre.

But the dyer's questions are: how are the molecules of the dye fixed to the fibre; is the fixing weakened by subsequent treatments given to the fabric—exposure to light, to heating, washing, detergents, pre-shrinking and the rest?

Smith says that, though most of the chemistry is known for the older organic dyes (relatively simple in their molecular structure), he is interested in the behaviour of the modern synthetic dyes—complex organic molecules attached to metal atoms (see Organometallics in Review of May 1974).

Similarly, though the chemistry of plant fibres (like cotton, sisal and flax), being the chemistry of cellulose, is well known, the animal fibres based on the long-chain molecule keratin are more difficult; Smith is particularly interested in wool with its curious scaly structure. Incidentally, he claims to have been the first to dye a spider's thread, whose molecule, like silk and wool, is also keratin.

(Synthetic fibres are altogether different, he says, and will be the subject of later investigation.)

To Smith, the essential research problem was how to trace or follow the molecule of the dye in its migration from solvent to fibre, and how to detect its final resting place and the form of it in the fibre.

"Dyeing is not only molecular chemistry," Smith says; "when you investigate the binding of the dye to the molecules of the fibre, you are also in molecular physics—the physical attachment (adsorption) of one kind of molecule to the surface of another."

Molecular physics is the special interest of the other members of the team, Pilbrow and Boas, in the physics department, working on the action of microwaves on substances that are slightly magnetic. (Microwaves are radio waves in that region of high frequencies that includes radar.)

When such a paramagnetic or slightly magnetic substance is suitably excited in a magnetic field (by being placed between the poles of an electromagnet), certain electrons in the molecules of the substance change their motions.

The motion takes the form of a resonance, called electron-spin-resonance, in the microwave region, that can be detected by suitable circuitry.

It turns out that for a given resonant frequency, the strength of the magnetic field producing it in the substance is unique to the molecule of the substance. Here then, by remote control, is a form of detection, observation and analysis, that can observe molecules in a fibre as thin as 1/10,000 cm.

**Paramagnetic**

So we answer the opening question: microwaves (like the phases of the moon) have nothing to do with dyes, dye stuffs and the dyeing process; but, by suitable tuning of a magnetic field, on say a sample of dyed fibres, and by using a high speed computer to interpret the electron-spin-resonance, it is possible to discover not only the molecules in the substance, but information about the structure of the molecule, and its attachment to other molecules.

But here is a proviso—the substance, the dye in this instance, must be paramagnetic, able to respond to the magnetic field.

To meet that requirement, Smith, assisted by Miss Joan De Bolfo, research student in chemistry, makes his own dyes, selecting those with metal atoms that can be readily traced by this technique of electron-spin-resonance. Incidentally, he says, he can thus ensure that his tailor-made dyes are chemically pure.

The crossing of disciplines in this way, say between physics and chemistry, is of course not new at Monash. But this particular conjunction is new in the science and art of dyeing.

Smith, Pilbrow and Boas hope to extend these chemical/physical techniques to materials other than dyes, that, when added to wool, would modify and perhaps improve its properties. But, they admit, that would be another story.
Wheat seed's defences

"They plough the fields and scatter the good seed on the land".

Take for example the humble grain of wheat; each year man sows millions of millions of them, and hopes to harvest 20 times that number to make his bread, his staff of life. He relies on the gentle rain from heaven, and the earth beneath, to give him that 20-fold increase.

Yet, according to Dr Tony O'Brien, Reader in Monash's botany department, when you consider the risks against it, it's a wonder that so much comes to harvest.

Once a seed of wheat is put into the soil, it is under attack. "If wheat is good for man", O'Brien says, "it is good for other things too, including fungi that live in the soil, and indeed, fungi that, before the seed is sown, inhabit the outermost dead layers of bran."

How does the germinating grain hold off that attack?

The answer, he says, is in the aleurone layer, in the wall that encases the aleurone cells.

These cells may be likened to the pancreas, producing digestive ferment (enzymes) that transform the stored starch and protein in the rest of the endosperm of the seed into the nutrients needed for the growing root and stem.

It is a particular one of those ferments that the barley malsters select for brewing beer, the others being destroyed by heat.

These aleurone cells must not only produce and release the enzymes in the course of digesting the starch and protein, they must also protect themselves from digestion by the very enzymes that the cells produce.

For soil fungi, or fungi on the skin of the seed, to pass into the interior of the grain—and so to consume the starch and protein store reserved for the growing root and shoot—those fungi too must produce digestive ferments that will allow them to attack and penetrate the cell walls.

Since this fungal attack doesn't usually happen (otherwise, no germination, no growth, and no harvest), O'Brien suspected, as had others, that something was continually protecting the aleurone cell walls from attack, while allowing the release of enzymes needed for germination.

With Gary Fulcher, research student in botany, O'Brien set out to identify that material.

As with many other ventures in modern science, some described in recent issues of Monash Review, O'Brien and Fulcher were working in a very small space—the cells on the inside of the 'shell' of a grain of wheat.

Visual inspection with the optical microscope, and with the electron microscope, had already established the structure of the layer and its cells and cell walls: that much was known.

What they wanted was a method of inspection by some kind of irradiation that would reveal the chemical composition (not merely shape, size, or structure) of small sections of material.

Irradiation with electrons, yielding x-rays, or with ions, yielding light (both mentioned in Review, March 1974), or with microwaves in a magnetic field (this issue) were not appropriate.

But fluorescence, the visible response of a substance to irradiation with (invisible) ultraviolet light, though seldom used in botany, was possible.

It turned out that the cell walls of the aleurone layer, when viewed through a microscope illuminated with ultraviolet light, were strongly fluorescent—that is, became visible at an identifiable wave length or color; and that color, it was hoped, could be matched to some known material.

That result, coupled with viewing the walls when stained in appropriate ways, suggested that the aleurone layer contained phenolic substances.

But, says O'Brien, the living world is full of phenols (carbolic acid is one, found in most kitchens and medicine chests); he therefore faced the grinding task, by trial and retrial, of finding which one.

A chance remark by J. W. Lee, of CSIRO's Wheat Research Unit, Ryde, NSW, at a professional meeting, gave O'Brien the clue.

Lee had said that ferulic acid (a well known phenol) had been found as a constituent of wheaten flour. Right, said O'Brien, if in the flour as milled then why not also in the aleurone layer before the flour was consumed in the germinating process.

O'Brien and Fulcher followed that up. Using the department's microspectrofluorimeter, they measured the fluorescent spectrum from one millionth of a square millimetre of aleurone cell wall, and compared it with the fluorescence of a correspondingly small crystal of pure ferulic acid.

The result, without doubt: the substance of the cell walls of the aleurone layer was the phenol, ferulic acid.

And ferulic acid was known to be a strong inhibitor of the fungi but could and would attack the seed's store of starch and protein.

And so the science of cell biology makes its slow advance.

"We see in this system", says O'Brien, "a nice example of an important biological principle: once mutation has produced by chance a useful product (in this case, ferulic acid), biological systems exploit it to serve several purposes."

"In this instance, the one compound protects the aleurone layer against its own digestive enzymes, and at the same time resists the attack of would-be parasites."

MONASH REVIEW is produced five times yearly by the Information Office, Monash University, Wellington Road, Clayton, Victoria, 3168. Inquiries should be addressed to the Editor, c/o the Information Office.

Printed by Brown Prior Anderson for Monash University, Melbourne

MONASH REVIEW

JULY, 1974