Drug design and development unit recently established at Monash has patented one series of potentially useful drugs and filed provisional patents on two others.

The unit, a joint research venture between the departments of Pharmacology and Chemistry, has produced active antihistamines and pain relievers which could turn out to have fewer side-effects than presently used compounds.

Its success has encouraged the venture capital company, Pharmol Pacific Pty Ltd, to invest about $300,000 a year in its work. Using this investment and grants totalling $90,000 over two years from the Monash University Research Excellence Fund, the unit is developing rapidly and is now at the forefront of drug design, some involving the use of computers.

The research is being directed in Pharmacology by Professor Alan Boura, Dr Roger King and Dr Jean Olley who are responsible for determining what drugs should be investigated and then testing the results. In Chemistry, Professor Roy Jackson, Associate Professor Ian Rae, Dr John Cullen and Dr Algie Serelis oversee the mechanics of putting the drugs together and determining their chemical characteristics.

Much of the research work proper is being done by students, and a significant proportion of the Pharmol Pacific money has gone towards providing scholarships and supporting the work of PhD and Honors students so as to give them the opportunity to remain in research.

Professor Boura hopes the establishment of a successful drug development program could lead to an Australian drug industry founded on basic innovatory research which would provide jobs for young scientists.

"We are trying to use our expertise to further economic wellbeing and to encourage an environment in which there will be jobs for our graduates. If we are able to find useful drugs, it could help to set up research-based pharmaceutical industry in Australia and reduce the widening gap between drug imports and exports."

The stimulus for setting up the unit came from the reactivation of a 30-year-old research collaboration between Boura and the distinguished British medicinal chemist, Dr Fred Copp.

Working at the Wellcome Foundation in the UK during the late '50s and early '60s, Boura and Copp had been responsible for determining what drugs should be investigated and then testing the results. In Chemistry, Professor Roy Jackson, Associate Professor Ian Rae, Dr John Cullen and Dr Algie Serelis oversee the mechanics of putting the drugs together and determining their chemical characteristics.

The fifth of these compounds proved to be biologically active, but against asthma and hay-fever rather than depression. It has since been patented.

In addition, this compound and a second patentable group of drugs showing similar properties — developed by chemistry PhD student Fran Guyett — work against serotonin, one of the chemical messengers in the brain. Imbalances in the serotonin system have been implicated in schizophrenia, anxiety, pain, vomiting associated with the side-effects of anti-cancer drugs, migraines, depression, obesity, alcoholism, suicide, and sleep disturbance.

A third patent application has been launched for a pain reliever, which it is hoped will not be highly addictive.

None of the drugs yet has been sold to a pharmaceutical company or put through the extensive testing necessary before being produced and marketed.

Many of the unpleasant side-effects of otherwise effective drugs stem from their action on the brain. In light of this, Boura had the idea that if drugs could be modified to prevent them from getting to...
Group designs useful new drugs

From Page 1

the brain, these side-effects might be reduced or even eliminated.

The nervous tissue which makes up the central nervous system, the brain and spinal cord, is covered by a fatty sheath. This sheath, known as the blood brain barrier, acts as a filter through which any chemicals have to pass if they are to act upon the central nervous system.

So Boura's idea was to add functional chemical groups to existing drugs to make them less likely to pass through the blood brain barrier. The first candidate was mianserin.

He asked his former partner at Wellcome, Dr Fred Copp, to use his expertise to see if it could be done. Copp began work in laboratory space provided by Professor Roy Jackson of Organic Chemistry, who also became very interested in the project.

He asked his former partner at Wellcome, Dr Fred Copp, to use his expertise to see if it could be done. Copp began work in laboratory space provided by Professor Roy Jackson of Organic Chemistry, who also became very interested in the project.

The fifth compound Copp made, code-named FCC-5, fulfilled the group's expectations, except for one thing. Instead of acting on one of the receptors affected by mianserin, it affected a second. Instead of showing anti-depressant activity, it proved to be an anti-histamine. "We aimed for one target and hit the other," Boura said.

However, because of its potential for eliminating the problem of anti-histamine drowsiness, it was interesting enough to encourage Pharmal Pacific to invest in the future of the project.

The problem of drowsiness with taking anti-histamines is both serious and well-known. It forces restrictions on the lives of many allergy sufferers while they control their condition through medication. For instance, they should not drive.

Having set the ball rolling, Copp had to leave the group to return to the UK. But what he had achieved was enough to give the project a momentum of its own. "Fred was the catalyst who got the whole thing going," Jackson said.

The first problem was to provide enough information on the FCC-5 group of drugs to support a patent. Much of this work was done by Dr John Cullen. Applying modern techniques to the problem of producing the drug, he lifted the yield to high levels, easing the problem of making enough for testing.

FCC-5 has also been put through a preliminary program of pharmacological tests designed by Mrs Mary Rechtman to screen for side-effects. Now that the drug is fully patented, it has been taken to the University of California at Berkeley for further testing by Ian Leitch, another PhD student supported by the project.

One of the students working on the chemical characteristics of FCC-5 was Fran Guyett. As part of her work she decided to apply the method that led to FCC-5 to another drug with similar properties to mianserin.

She came up with a second group of distantly related drugs, just as active and now under provisional patent. But she has not stopped there, she is now trying to formalise the whole process by using computers to try to pin down the important design features that make the drugs active.

"We are using several computer programs, the main one of which comes from Columbia University in New York. It has taken us about 18 months to get the system running," Guyett said.

She said she was studying drugs which acted on a particular type of receptor in the body. The idea is to search out common design features in unrelated sets of drugs, so that eventually a generalised active 'pharmacophore' can be developed.

But the search is time-consuming and complicated, even for a computer, because each molecule can come in a mind-boggling array of forms.

A large main-frame computer can spend many hours searching through the various possibilities and calculating the lowest energy form, in which the molecule is likely to spend most of its time. Only when these forms are calculated can the comparative work begin, and the basis for that comparison still is at a rudimentary stage.

Professor Jackson says that, despite a great deal of talk, no one is yet in a position of designing drugs by computer.

"Drug companies nowadays assume they can make any simple organic compound. The difficulty is deciding which ones to make and test. That is why no one can afford to ignore the computer, and we want to be in at the beginning."

Meanwhile the work goes on. After the success of the mianserin-based compounds, the group is turning to analgesics—the pain relievers. The logic is essentially the same, though the problem is much more acute.

The best pain killers still are based on heroin, that most highly addictive of drugs. To produce a non-addictive, effective pain reliever is the Holy Grail of the pharmaceutical industry.

"In fact, a group led by Boura already introduced in the '70s a pain reliever which is less addictive than heroin, buprenorphine.

Members of the unit believe that if they are able to make a drug which cannot get to the brain, there is a chance for an important advance in the quest.

Already, a candidate compound is undergoing testing under provisional patent. The questions now are whether pain can be stemmed by a drug that solely acts outside the brain, and whether such a drug can be created free from other side-effects.

"If we created something even half as good as heroin, it would be very significant," Jackson said.

"We are now trying to sell our compounds to the big pharmaceutical companies, because to put any drug on the market these days involves millions and millions of dollars in testing.

"There is always the chance that long-term side effects could wipe out the whole thing. It is an area of high financial risk, but equally high rewards if we are successful."

Other projects in which the Department of Pharmacology is involved include a re-evaluation given recent knowledge of one of the products of the pharmaceutical company Upjohn, and a collaborative project with the Department of Gynaecology and Obstetrics on the function of the common nerve messenger substance acetyl choline in the placenta, which has no nerves.

The Pharmacology department is particularly interested in pain—its expertise to industrial use. For further information, please contact its industrial liaison officer, Dr Jean Olley, on (03) 565 4835 or Dr Paul Hudson of Monitech Pty Ltd on (03) 563 3055.

MONASH REVIEW

DECEMBER 1988
Examining the earth’s entrails

WHILE FOR MANY people volcanoes inspire fear and visions of hell, a group of researchers from Monash actually is using them as windows on to the workings of the earth’s interior.

Dr Ian Nicholls, a reader in Earth Sciences, and postgraduate students Jerry Sukhyar and Danny Vukadenovic, are using a group of volcanoes that straddle central Java to try to determine the chemical characteristics, and hence the source, of material that comes to the surface through volcanic activity.

The idea is to learn more about volcanic processes and the very plumbing of the earth.

“What we are doing is looking down the plug-hole to see what happens down there,” Dr Nicholls said.

The present understanding of the sources of volcanic material is dependent on the plate tectonic model of the earth. According to this theory, the interior of the earth is made up of several layers.

The outermost five to ten kilometres, known as the crust, together with the upper 50 to 100 kilometres of the underlying mantle, form a rigid unit. This is split into a series of plates which float on a zone of partially molten mantle material called the asthenosphere (see diagram).

Temperature differences in the asthenosphere cause convection currents — as hotter material rises, cooler material rushes in to replace it. Riding on top of all this activity, the plates actually move with respect to one another travelling at a rate of several centimetres a year. In the middle of the Atlantic Ocean, for instance, two plates are moving apart at between six and eight centimetres a year.

These moving plates can collide, sink beneath, or slide past one another, and these interactions are responsible for many of the cataclysmic events that shape the earth’s surface.

Intense buckling and fracturing occurs. The theory holds that the Himalayas, for example, were formed by the collision of two plates. And it argues plate interactions also are responsible for earthquakes and, in some regions, volcanic activity.

The Nicholls group is observing what happens in a zone where one plate is being dragged down beneath another in the process known as subduction (see diagram). Characteristic of these areas are rings of volcanoes which form island-arc systems and occur in specific belts on the earth’s surface.

The island of Java is part of one of these systems, and the research team is studying four volcanoes there — Dieng, Sumbing, Slamet and Sundoro.

Molten material thrown out by an erupting volcano is known as magma. As it cools, it hardens into rock.

According to Nicholls there has been intense speculation on the contribution from three potential sources to this material — the crust of the plate subducted beneath the volcano; the ocean floor sediment which forms a veneer on top of that subducted crust; or the mantle wedge trapped between the subducted plate and the overlying plate.

The research group is using geochemical data to try to settle the argument. Many elements, such as neodymium, strontium and lead, occur in several different forms or isotopes. The relative proportions of these isotopes will differ depending on the source of the material. They form a signature of the source material.

To obtain their data, the team used rock samples taken from creek beds on the sides of the volcanoes. But before the rock samples can be of use, they must be matched and placed in a relative time sequence using stratigraphic techniques.

Stratigraphy is based on the assumption that younger material was deposited last and therefore will overlie older material. The problem with volcanoes, however, is that eruptions may only deposit material on one side, not equally on all sides, so the sequence of deposits will be broken.

To build up an overall time sequence, rocks must be sampled from several areas and the pattern of bands matched.

Fortunately Sukhyar, who joined the team in 1985, is from the Indonesian Volcanological Survey and already had wide experience of the problems of stratigraphy in the area.

Some of the results of a study of Slamet by Vukadinovic recently have been submitted to the important weekly British science journal, Nature, and are awaiting publication.

“In brief, we have found that the primary material for the magma comes mostly from the mantle wedge, with only about one or two per cent from sediment on the subducted plate,” Nicholls said.

These results are significant in that they help resolve a dispute about whether sediment is dragged deep into the mantle during subduction, or simply is scraped off the top of the crust as it goes under. Even small amounts of sediment mixed into the mantle can modify its composition in important ways.

According to Nicholls, the group’s work provides evidence that, while much of the sediment may be scraped off during subduction, at least some is dragged into the mantle.

The team found that the chemical composition of the magma formed in the Java island-arc system suggests a shallow origin in the mantle. This contrasts with the deep mantle origin suggested by the geochemistry of the material thrown up in volcanic oceanic islands, such as the Hawaiian chain, which lie in the middle of tectonic plates.

This article is based on an account submitted by JESSICA DIETZEL for her Bachelor of Applied Science in Scientific Information Services at Victoria College.
On sex, drugs, rocks and rollers

A MONASH BOTANY department research assistant, Mr Simon Roberts, will be spending this summer at the Australian Antarctic base at Davis collecting as many algal (seaweed) species as he can.

They are of interest because they can accumulate compounds, such as polyunsaturated fatty acids, which may be useful as feedstocks for biochemical industry, and they also grow at low temperatures under low light — that is, with a minimum energy input.

The Botany Department algal research group — which includes acting chairman Dr Neil Hallam, Dr Margaret Clayton, Dr John Beardall, Dr Ingo Maier and Dr Julie Phillips — is planning to screen the species and investigate their biochemical, physiological and pharmacological properties.

"When you are talking about Antarctic algal biology, in many cases you are dealing with papers written before World War I. We feel it's time to apply modern techniques," Hallam said.

Monash is one of only a handful of universities involved in this kind of work. But it is only one facet of a significant research program on algae which includes investigating their systematics, biochemistry, reproductive physiology and even basic biology.

Algae form one of the world's significant biological resources. In fact, marine algae are the food source upon which all life in the sea ultimately depends, from shrimps to whales. Knowledge of the growth of algae therefore is critical to the fishing industry.

An important industry already is based around extracting chemicals from algae, particularly those used to manufacture the gels employed in a wide variety of chemical and nutritional products — pharmaceuticals, food, adhesives, paper additives, paints, dairy goods and textiles.

One species, grown in Western Australia and South Australia, is harvested for beta-carotene, a substance used, among other things, to color margarine yellow.

The Monash group will monitor how rapidly the Antarctic algae can photosynthesise — that is, take up carbon dioxide and transform it into compounds such as sugars which are used as biological energy stores. The efficiency with which the algae use light to power this process will also be measured.

After these basic measurements of plant performance have been taken, ground extracts of the algae, most of which are single-celled, will be passed through a gas chromatograph, an instrument which can be used to analyse what compounds the plants contain and their relative proportions. The activity of any biochemicals of interest can then be investigated more fully.

This Antarctic project will make good use of the expertise the group has built up in past research. John Beardall, for instance, has many years' experience in investigating the biochemistry of unicellular algae. The work also would be difficult without the experience which the group has acquired in algal reproduction.

"We have found that algae are a useful tool for looking at reproductive biology, particularly the behavior of egg and sperm, the chemistry surrounding fertilisation, the events of the first hours of the embryo, how it attaches, and how it decides which end is up.

"Because all of these events are essentially the same in algae as they are in more complex plants and animals, we sometimes look upon ourselves as conducting an alternative IVF research program where embryos can be thrown down the sink without moral problems."

The alga Neptunia Hallam and Margaret Clayton have used most extensively for their work has been the Southern Bull Kelp, Durvillaea potatorum, well known on Victorian beaches. It reproduces in late winter, and has separate male and female plants, which release sperm and egg cells respectively into the surf.

To form a new plant the sex cells somehow must come together and achieve fertilisation. (Human sex cells are faced with a similar problem.) In seaweeds, the mechanism involves a sex attractant chemical or pheromone released by the egg.

"At low tide in late winter in the kelp beds, you can smell the pheromone in the air. It's a faint sweet smell with a marine tang," Hallam said.

As part of a collaborative project with the Universities of Konstanz and Karlsruhe in West Germany, the Monash group succeeded in extracting the pheromone compounds from a mixture of eggs and sperm. Chemists in Germany have been able to identify the molecules involved and even to make them.

But that is only the beginning of a complex story. Having obtained the pheromone, the Monash group was able to test its effect on sperm from other species. It turns out that exactly the same pheromone as kelp is used by Neptune's Necklace, Hormosira, the common alga that looks like a string of beads. And both reproduce at the same time of year.

Hallam said: "There must be some other recognition behavior. The sperm actually touches the surface of the egg with its front flagellum (whip-like hair used for locomotion). We think there might be some form of molecular recognition occurring."

Dr Ingo Maier, a post-doctoral fellow from Germany, has come to work in Clayton's laboratory, to study just how this egg-sperm interaction happens.

As for the pheromone, Hallam said, its function may be simply to guide the sperm to the neighborhood of the egg. It is released simultaneously from a number of storage sacs in the membrane surrounding the egg. So the concentration of the pheromone is naturally higher closer to the egg. The sperm simply have to swim towards increasing concentration to find the egg.

"But if any chemical is released in the turbulent surf zone, the sperm would have
to be very close before they got the message.

At another level, Dr Julie Phillips has been investigating exactly when marine algae reproduce, how they time the precise release of their sex cells. This has to be locked into a single tide. Any cells released before or after all the others would have a lowered chance of encountering a mate, and would be swept out to sea before the next tide.

Phillips can now predict the precise tide of release. In one species, for instance, it occurs 11 days after the full moon.

The constantly changing environment in which tidal zone seaweeds live, with its rapid changeover of nutrients and oxygen, has led to several surprising and sophisticated biochemical adaptations.

It has been estimated, for instance, that the pressure of the wave surge in the average pounding surf corresponds to a wind speed of more than 1200 kilometres an hour. To withstand that level of assault, seaweeds like the Bull Kelp need to be securely fastened and constructed of material which is both strong and flexible.

Hallam, with the help of chemists from the German universities, have been looking at the chemistry of the adhesive the kelp uses to fasten itself to the rocks — a kind of biological superglue, related to the starches. They also are interested in how the structure of rocks affects adhesion.

Hallam said: "The number of the kelps varies according to differences in the rock types. Basalts, which are smooth and made up of small, black crystals, support fewer individuals than dune limestones which have many more nooks and crannies, and are porous so they stay wet for longer and don't get so hot."

The chemistry of the cell walls of the very big kelps is also of interest, because it is the basis of an important extractive industry.

The research group found that two compounds predominate, the flexible mannuronic acid and the much stiffer guluronic acid. The plant varies the cell wall content of these two from about 80 per cent mannuronic acid at its stiff base to 80 per cent mannuronic acid in its flexible fronds.

For John Beardall, the single-celled algae have proved very useful organisms in which to study the details of biochemistry of photosynthesis — that process by which plants trap the energy of the sun, thereby supplying the foodstuffs upon which all life ultimately depends.

This complex process can be studied easily in unicellular algae. It is easy to grow them in high concentrations, and to manipulate their growth conditions.

The strength of the Monash algal research effort recently was recognised in a far-reaching way, when about 450 scientists from 34 countries gathered at the university of the Third International Phycological Congress.

The site for the conference was appropriate in another way. The Heads of Port Phillip Bay historically have played an important part in the collection of algae for study worldwide. In fact, it seems that the largest seaweeds, the kelps, originated on Australia's southern coastline.
Monash company turns in a profitable year

In its first full financial year of operation, Montech Pty Ltd made a profit of $14,372 on a turnover of more than $1.1 million, the Managing Director, Dr Paul Hudson, has announced.

Dr Hudson said the company was delighted to have turned a profit in its first year of serving Monash academics and assisting them to become more entrepreneurial.

Most of the gross turnover came from contract research and development, and from consulting work. About $868,000 worth of contracts were placed within Monash.

Since its establishment less than two years ago, Montech Pty Ltd has helped to bring nearly $2 million of project funds into the university.

Dr Paul Hudson, managing director of Montech Pty Ltd

Some of the more interesting and important individual projects in which Montech has been involved include:

- The Biochemical Process Development Centre, an initiative arising out of the protein purification work of Professor Milton Hearn of Biochemistry. The State Government has committed $3 million towards establishing the centre in the Monash High Technology Precinct, and at present is financing a $50,000 product and business assessment.

- Professor Hearn also has uncovered a small naturally occurring protein which speeds the healing of wounds. It has now received provisional patent registration, and is the subject of international commercial inquiries.

- A fluidised bed steam drying system for brown coal which can increase coal burning efficiency by up to 20 per cent, thereby reducing the output of Greenhouse Effect gases, has been sold under licence to the West German company, Lurgi GmbH. Developed by a team led by Professor Owen Potter of the Department of Chemical Engineering, the process already is being used in East Germany.

- Montech has assisted a research team in the Physics Department to investigate the commercial viability of a new, transportable, low cost electron spin resonance (ESR) spectrometer, a machine which can be used in testing for food irradiation and can pick natural from artificial gemstones. The State Government has provided money to prepare a business and market analysis plan.

- Montech has helped the Department of Materials Engineering to set up an Institute of Advanced Materials Technology in an effort to expand the services provided by the department to industry each year, which now include more than 100 consultancies. The Institute already is involved in an important contract to examine the materials engineering of Pacific Dunlop Ltd’s new Pulsar battery.

- The Victorian Department of Industry, Technology and Resources is interested in the commercial significance of robot navigation technology developed by Professor Ray Jarvis of Electrical and Computer Systems Engineering. The Government has decided to sponsor a market research study, and Montech has contracted the Graduate School of Management to do it.

- The MTR group has just begun distribution of the Avtech automatic machine condition monitoring system, developed in the Department of Mechanical Engineering. Among the first Australian buyers are Alcoa (Australia), Mt Newman Mining and BHP.

Other projects to which Montech has contributed include the establishment of Micromon, the commercial arm of the Department of Microbiology; several research and development contracts in the Department of Pharmacology (see Page 1); the setting up of a Body Composition Unit at Prince Henry’s Hospital; a series of consultancies involving the Graduate School of Management and the Centre of Policy Studies; the launching of the Centre for High Resolution Spectroscopy and Opto-Electronic Technology in the Chemistry Department; statistical analyses through the Department of Mathematics and the bringing on-line of a computerised law periodical index.

The company has played an important role in promoting the development of the Monash Science and Technology Park and in the planning of the Monash High Technology Precinct.

Hudson said that companies with which Montech had worked generally were very satisfied, and often commissioned more work to be done.

During the year, Montech moved its offices to the Chisholm Technology Tower in Railway Avenue, Caulfield, and now is handling some business for the Chisholm Institute as well as the university.

Montech was set up as the gateway between the university and industry, and is able to provide consulting services, contract research and development, specialises seminars and short courses, project management and general advice drawing upon the vast expertise of the university.

It recently has been approved as a Federal Government Registered Research Agency, which means companies entering into research and development contracts with Montech are eligible for a 150 per cent tax concession for the cost of the work.

For further information, contact Dr Paul Hudson on (03) 563 5055.
Centre fights against national decay

IN JULY 1982 an explosion in the Cooper Basin natural gas field lit up the night sky near Moomba, 800 kilometres north of Adelaide.

A section of the gas pipeline supplying Canberra and Sydney had blown up, sending a two-tonne piece of steel spiralling through the air. An inquiry found that the pipe had been weakened by corrosion, and a spark had ignited the gas.

Although supply was restored before a complete shutdown of the line became necessary, the incident had an unwelcome sequel for consumers. They were forced to pay not only for 30 kilometres of replacement pipe, but also for the expensive legal battles to settle who was at fault.

As the householders affected by the Moomba explosion will attest, the cost of corrosion in Australia has reached mammoth proportions, and continues to increase. The nation’s annual maintenance and repair bill for corroded equipment, or its replacement, currently runs into billions of dollars, says Monash researcher Associate Professor Brian Cherry of Materials Engineering.

Now, as a result of a 1983 report he and former Research Fellow Dr Brian Skerry prepared for the then Minister for Science and Technology, Mr Barry Jones, a new national centre has taken up the fight to 'stop the rot'.

The Australasian Corrosion Centre, based at CSIRO’s Institute of Industrial Technologies in Clayton, was set up this year with a seed grant of $549,500 over five years from the Victorian Department of Industry, Technology and Resources. Brian Cherry is vice-chairman of the centre’s board of management.

The centre’s purpose is to educate industry and consumers on corrosion prevention strategies. It offers courses to industry, the co-ordination of national research efforts into corrosion prevention, and a 24-hour consulting and referral service.

Among the organisations whose representatives have attended the industry courses are the Port of Melbourne Authority and the Pipelines Authority of South Australia.

The centre also produces specialised publications on solutions to corrosion for factories, building sites, homes, motor vehicles and boats.

Corrosion, the environmental degradation of any material to a point where it no longer fulfils its function, can affect a range of substances, including metal, concrete, timber and synthetics.

The term covers a series of common problems, from the embrittlement of plastic guttering and downpipe by exposure to sunlight, to the chalking of paint due to the destruction of the bond which holds the pigments together.

But in most cases it is the chemical process of oxidation, the conversion of the material to stable oxides, which causes the damage.

In their 1983 report, the two engineers stressed that proper mitigation techniques could significantly reduce the cost of corrosion damage. Such techniques include better design, correct materials and specifications, protective coatings, inhibitors and cathodic protection.

If these were used today, says Cherry, the potential savings to industry and the consumer would amount to $3 billion a year.

The Australian transport industry would stand to make the greatest saving. Cherry estimates the industry could reduce its annual repair bill by as much as $1.3 billion if proper corrosion avoidance methods were used.

Similarly, the construction industry could save $390 million and the wholesale and retail trade $218 million.

But while such figures may be cause for optimism, corrosion itself will never be eradicated, only controlled, says Cherry. ‘That’s the way God made the world. We are mining stable iron ore and turning it into unstable steel. The laws of thermodynamics declare that steel must eventually turn back into iron ore. Therefore all we can do is slow the process.’

Ideally, he says, corrosion should be slowed to a point where the equipment or structure is rendered useless through some other cause first, such as wear, obsolescence, or fashion.

The role of the centre is critical to industry, says Cherry. ‘Industry will benefit directly from an increase in community awareness because many of its failures are caused by corrosion, all too frequently recognised.’

The use of incorrect mitigation techniques can have dramatic consequences. Last year in Canada more than 50 vehicles were damaged by concrete falling from the ceiling of a multi-storey carpark.

But in our own cities, the crumbling facades of large buildings pose a constant threat to pedestrians.

Poor corrosion mitigation techniques can also cause fatalities. Among the accidents that can be attributed to corrosion are an explosion at a cyclohexane plant in Flixborough, England, which killed 36 people, and the recent Piper Alpha oil rig disaster in the North Sea, which is thought to have resulted from microbial damage to pipes carrying oil from the seabed.

Some manufacturers have used design measures to compensate for corrosion, says Cherry. Unfortunately this often results in products that are over-designed, and expensive.

‘It is obviously not worthwhile spending more money on the reduction of corrosion than the amount that corrosion actually costs.’

— JOHN CLARK

Associate Professor Brian Cherry of Materials Engineering.

Cherry says it is difficult to give examples of such incidents in Australia as 90 per cent of them are before the courts. But in our own cities, the crumbling facades of large buildings pose a constant threat to pedestrians.

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— JOHN CLARK

Engineers examine a piece of the ruptured Moomba gas pipeline.
Bridging the gap between disciplines

Now that Mr Dawkins and his white-green paper have urged on us the importance of 'scientific and technological development', it seems a good time to reflect on my experience of cultural bridge-building over the past six years — as a teacher of history to engineers.

One of the early initiatives of the first Vice-Chancellor of Monash, Sir Louis Matheson, was to encourage greater understanding between the scientific and humanistic cultures by requiring Arts and Economics and Politics students to take a half course in one of the sciences, and scientists, medics and engineers to take a half course in the humanities or social sciences.

Today, all that survives of this bold plan is the requirement that a Monash engineering degree include material which will ‘... show the young engineer his responsibility for the social and economic results of technological decisions by introducing him to the wider implications of engineering’.

That is where I come in, with my chosen subject, Australian Mining History.

Surely Sir John Monash would approve of this small dose of humanism — which is what I tell students when they balk at compulsion. I say that I too was forced to take two units of a science course in my Arts degree at the University of New South Wales, and that the experience had broadened my education and saved me from some of the sillier anti-scientific attitudes.

Instead of offering the engineers a traditional history course, I thought it would be better to devise a special course with a technology bias and relevance to the present.

The resources boom of the early 1980s had aroused considerable community interest in the mining industry, so my strategy was to spend the first half-hour discussing contemporary issues and problems in the industry. In fact, throughout the course, my emphasis was firmly on problems rather than periods — a salutary corrective to the widespread notion of history as narrative and chronicle.

So, from a short exposition of, say, the global energy crisis, the greenhouse effect, the benefits and hazards of uranium (all inter-related issues in the Australian context), we moved on to consider a series of linked problems in history of the Australian mining industry.

Eureka was fun. But studying the experience of the Chinese on the goldfields proved to be more touchy, because of the high proportion of Asian engineering students at Monash and the heat reports introduce students to the problems of writing and documenting essays.

Of course, the engineering student’s timetable is very full, with little time for reading and preparation. So they expect a great deal of content from lectures and detailed references.

But most students become interested and reveal a considerable grasp of the issues, in spite of the running commentary some engage in amongst themselves during lectures.

Yet the general tone of the class is lively and exuberant, and I have even become familiar with that special engineering brand of humor.

In light of their robust spirits, it is curious to see what a source of anxiety the major historical essay can be for some students.

The teacher must be ready to counsel and assist students through the difficulties of reading for an essay and then writing it. But Arts students would be just as apprehensive about doing science, I am sure.

What have engineers gained from the experience?

At an intellectual level, students are able to develop more critical attitudes to evidence, sources and argument. And in the process, they begin to appreciate the reasons for historical discipline and method.

Many engineers also relish the chance to extend their interests, to engage in a more active social life (perhaps the voyage to the bohemian Menzies Building helps here), even (dare I say it?) to become more human.

To see that happen is one of the real satisfactions of the job. Another is the strenuous task of being forced to re-think the basics of my subject, to answer doubters and bright unbelievers.

The benefits clearly are reciprocal.

There have been enough of them to satisfy this teacher. I hope my engineering students feel the same way.

For six years Dr Brian Kennedy of History has been attempting to bring a little of the Humanities into the lives of aspiring engineers by teaching a course in Mining History. Here, he talks about his experience.