Where crabs control the forest

EACH YEAR in early December about 120 million adult red crabs living in about 100 square kilometres of rainforest on Christmas Island move to the seashore to breed.

Full grown crabs are of considerable size — about 11 to 12 centimetres across the shell — and very little deters them during the migration; certainly not human habitation or works. In fact, about a million of them die on the island’s roads each year — but not before some have left their mark in punctured tyres.

At the height of the breeding season millions of females congregate beside the ocean and all release eggs into the water at the same time.

“The dramatic annual mass migration of the red crabs is one of the great sights of the natural world,” says Dr Sam Lake of Zoology who, with Dr Dennis O’Dowd of Zoology and Botany, recently has completed the first ecological study of the Christmas Island red crab (Gecarcoidea natalis) and its interactions with the rainforest.

Isolated, oceanic islands such as Christmas Island have been used, since the time of Charles Darwin, as important testing grounds for studies in ecology and evolution. This is because they tend to have a simpler biology, supporting fewer species. In addition, unique species and relationships can evolve on them in isolation.

Christmas Island, 134 square kilometres of Australian territory in the Indian Ocean about 360 kilometres south of Java, is a good example. Best known as a source of phosphate fertiliser for Australian and New Zealand farmers, its ecology is very distinctive — and not only because it is the sole known breeding place for that spectacular and rare seabird, the Abbott’s Booby.

Relative to the forests on Java, the rainforest is less complex, but it includes several unique species. Beneath that forest canopy dwells a bizarre community of large, terrestrial crabs. In fact, with more than one adult crab a square metre, Christmas Island is probably the crabbiest place on earth.

The red crab study, which was financed in its first year by a $10,000 grant from the Australian National Parks and Wildlife Service, aimed at determining the potential of red crabs to affect the structure of the rainforest. Because of their prodigious numbers and capacity for eating almost anything, the crabs could be crucial in determining the forest’s composition and regeneration pattern.

The research was important not only for its contribution to ecological theory, but also because it could provide information which would be useful in helping to manage the national park which comprises much of the island. And that national park looks as though it will play an important role in the island’s future, as the mainstay of its economy switches from phosphate mining to tourism.

What the researchers found was that almost everything that reached the forest floor, including fallen leaves, fruits and seeds, was investigated and handled by crabs. “So great is the crab activity that the forest floor is bare — an unusual condition in tropical rainforest,” Lake said.

O’Dowd said that the mass of red crabs living on Christmas Island amounted to about 800 kilograms a hectare. For comparison, at Lake Hattah in Victoria’s Mallee where kangaroos are living in high enough densities to have a considerable effect on the vegetation, their combined mass amounts to only about nine kilograms a hectare.

So the crabs certainly have the capacity to determine the proportions of particular plant

Continued overleaf

• The workers in the rainforest: Dr Sam Lake (left) and Dr Dennis O’Dowd

• The Christmas Island red crab: meat has a “lingerirng afterburn of compost”
Where the crabs control the forest

From Page 1

species that become established.

The study was carried out during two visits in 1986: late March (late wet season) when O'Dowd visited the island on his own, and early December (early wet season) when both investigators were there.

During these times the scientists made observations and conducted experiments at three sites representative of different rainforest habitats and soil types. "It took a while to get used to working in such an alien environment," O'Dowd said. "The forest is very quiet — except for the sound of scuttling."

Initially, Lake and O'Dowd monitored the activity patterns of the crabs, estimated their numbers and investigated what their burrows were like. After examining the structure of the rainforest and the plant species involved, the researchers collected fruits, seeds and seedlings of rainforest plants and used them in a series of experiments.

They put a range of fruits out on trays to determine which ones the crabs removed and how quickly. In this selection, they also included "inert" foreign objects — spherical plastic beads.

The crabs handled and were capable of taking every different type. Some were eaten, some destroyed and many were taken back to crab burrows. "Surprisingly, the plastic beads disappeared more rapidly than some of the seeds," O'Dowd said.

The researchers were able to gain some indication of how strongly the crabs could grip with their claws (chelae) by studying the marks or indentations left in the plastic beads. They then measured how much force it would take to leave similar marks in similar beads, and concluded that among crustaceans, only the American lobster has a stronger grip.

They subjected island seeds to such forces, and found that the seeds of most species were scarred, and some even cracked. But until longer-term studies are carried out, it is impossible to gauge the impact of such a strong grip on seed distribution and germination.

In another experiment, seedlings of 18 different rainforest species were grown inside cages at the various study sites to test the impact of crabs grazing upon them. Comparison of caged and uncaged seedlings showed that the crabs would eat many different seedlings, but have definite grazing preferences, even to the point of eliminating some species. Interestingly, their tastes seemed to vary seasonally.

O'Dowd said: "There was differential damage. Some seedlings were relatively immune to grazing, but the crabs knocked off others with great rapidity. This information could be important in the context of forest regeneration, but we need to know much more about how the forest is established."

It was also apparent, from comparisons of the amount of forest litter accumulating in traps set above the ground with the amount actually on the ground itself, that the crabs play a large role in processing litter.

In fact, it appears that the crabs drag leaves and twigs back to their burrows, so that there is a significant build-up of litter around the soil there — just at the point where discarded seeds may be deposited.

The reason why red crabs occur in such large numbers on the island may be associated with this very taste for decaying vegetation. According to Lake, it could keep them safe from predators, including humans.

"It's strange meat, not the firm white flesh usually associated with crab meat, and it has that lingering aftertaste of compost." The islanders certainly eat two other less numerous crab species on the island, to the point where one of them, the blue crab

• Each year, at the start of the wet season, 120 million crabs hit the road for Christmas Island's shore. Some leave their mark in punctured tyres
A postgraduate student in physiology has found a solution to a problem that has plagued some of the brightest minds in chemistry and biochemistry for years. He has received some extraordinary accolades from the leaders in his field.

Student solves intractable problem

The editors of the world's important scientific journals are a formal lot, who often act as if displaying emotion would detract from their roles as the arbiters of science.

That is why the enthusiasm expressed by the editor of the Journal of Theoretical Biology, in accepting the Monash Centre for Biomedical Simulation's first submitted paper, was something of a surprise — even more so, when one learns that the author was neither a professor nor a prominent researcher, but a student in his first year of postgraduate work.

Jon Wagg's paper, however, is no ordinary effort. He has managed to solve a problem which has been plaguing chemists and biochemists for years. And in the process, he has come up with a general mathematical technique which for the first time will allow researchers to simulate the flows of molecules through a series of linked reactions.

Wagg's supervisor, the director of the centre, Dr Brian Chapman, said: "Now for the first time we can simulate the full complex behavior of an enzyme system. We have a satisfactory answer to the way molecules flow through the reaction system. This is a powerful technique which applies to the workings of all chemical or biochemical reactions in the steady state."

The work also has been praised by several prominent US scientists, a couple of whom expressed surprise that research of such quality had emerged from someone so early in his career.

Chapman said that until now there has been no accurate theoretical basis for interpreting how molecules flowed in one direction through a series of biochemical reactions such as, for instance, through the widespread enzyme transport system whereby sodium is pumped out of cells.

"You could only describe such a system mathematically by using simplifying assumptions to make the calculation more tractable. There was no mathematical technique to solve the problem."

But with the aid of such a simplifying assumption — that charged particles are taken up and leave the enzyme which transports them in a particular order — Chapman was able to demonstrate that the standard interpretations of how the system worked were wrong. They took little account of the fact that the system was completely reversible, and that sometimes the transport enzyme took sodium back the other way, he said.

Chapman went further, in fact, and suggested that because particular simplifying assumptions became routine and commonplace, researchers began to forget they were dealing with simplified systems and to base theory around those systems, as if they were reality. "Textbooks have been written which perpetuate these myths, and biochemistry and physiology students were brought up on them," he said.

Then along came Jon Wagg, whose PhD project involved looking at a scheme of linked biochemical reactions and determining what molecules were formed along the way, however briefly. "Jon recognised there was a functional gap in the general theory, that there was no mathematical way of treating these complicated reactions adequately. Even the simplest mechanisms couldn't be treated exactly, let alone blown up with all their intermediaries."

Chapman told Wagg that this was a problem that had been occupying great minds for decades and advised him to leave it alone and find a way around it like everybody else.

But Wagg was like a dog with a bone. "I kept thinking about it," he said, "and then I realised that the way in which I was approaching the problem was one of two different ways, and no-one had approached the problem in the second way."

After more brow furrowing, Wagg reached the conclusion that his alternative method would give an answer, but had no idea about how to work it out. "I'm not very expert at mathematics," he said.

So he went to the Mathematics Department seeking help and someone suggested he talk to Dr Rod Worley. Worley looked at the problem and put forward a solution. "I tried it and it didn't work immediately, for four reasons."

But Wagg was not deterred. He kept on at it, and eventually found ways around all four roadblocks. And by the time he had finished, he began to realise that he had not only solved his own problem, but had discovered a general solution.

He had little trouble in convincing Brian Chapman, but, just to be sure, they took the work to Dr Ian McKinnon in Chemistry. Within a couple of days, McKinnon confirmed their view, and he and Chapman advised Wagg to get into print as soon as possible. They were the first of a long line of researchers to be impressed by the work.

In March, Jon Wagg presented an hour-long paper on his work at a conference at the US National Biomedical Simulation Resource at Duke University in North Carolina. The director of the resource, Dr Mailen Kootsey, was so impressed, he gave Wagg the floor for another hour, later in the conference.

Then, when resource software engineer, Miss Susan Wood, visited Monash to install software to launch the Centre for Biomedical Simulation, she began to work with Wagg on a computer program, which would calculate the molecular flows in any chemical reaction scheme automatically. The Wagg method is now available as a sub-package of the standard simulation software available for use at the Duke-based resource.

"You don't have to know anything about the mathematical processes involved in solving the problem. You simply plug in the reaction steps, nominate when enzymes pick molecules up and where they drop them and how fast the reactions take place and the computer does the rest," Chapman said.

The paper detailing Jon Wagg's work is entitled "A method for defining steady-state unidirectional fluxes through branched chemical, osmotic and chemiosmotic reactions" and will be published in the Journal of Theoretical Biology.

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Network provides a graphic solution

Computer graphics has become much more than a tool for creating movie scenes, television network logos and video game backdrops, and Monash has more than $400,000-worth of equipment to prove it.

In the past year, the university has bought a total of 24 Apollo workstations which are specially geared to graphics work — 17 for Mechanical Engineering, three for Computer Science, one for Electrical Engineering, one for Earth Sciences, one for Mathematics and one for general use in the Faculty of Engineering.

The move, which was given impetus by the Mechanical Engineering's desire to incorporate greater knowledge of computers into undergraduate courses, has stimulated research in areas as diverse as underground mining, aircraft longevity and human movement.

"Computing in engineering cannot be done without graphics," says Mechanical Engineering lecturer Mr Ray Maxwell who headed the team which sought out and chose the new equipment.

"It was only when sophisticated graphics technology became available that engineers began to see the contribution computers could make to their work, particularly in terms of interpretation and presentation of information."

And that is pretty typical of the story of the graphics revolution, according to a member of the Computer Science Department's new graphics laboratory, Mrs Marian Cottingham.

"Historically, graphics started because business had too much information to handle. Management demanded more and more information and computers were happy to churn out more and more numbers, but numbers are difficult for most people to handle. It is much easier to represent things graphically as a picture."

The success of that approach led to the production of hardware geared specifically to handle the problems of graphics, an area of computing which involves huge calculations and generates copious amounts of data. The time it took to produce images was cut from many minutes to a few seconds, and the applications for graphics grew accordingly.

For instance, development of drugs has been aided by being able to draw molecules in three dimensions, remote sensing has been revolutionised by the ability to process images, and training practices have been changed by the advent of simulators.

Now computer graphics has begun to take on a life of its own and has become a discipline in its own right. It has begun to create, and solve, its own problems.

According to Ray Maxwell, choosing the level of equipment in which the university would invest was a difficult enough job, balancing the needs of education and research with a limited budget. But it was made all the more tricky by the concurrent rapid development in graphics-based hardware.

"When we first sat down in 1983 to do an evaluation of the hardware available, we came to the conclusion that the performance to dollar ratio wasn’t good enough — you wouldn’t be able to sit enough students down at machines for the money we had to spend."

But that wasn’t the only problem. "The biggest hassle for the engineering profession at the time was maintaining the huge data base of hanging files of engineering drawings. There were huge amounts of information stored in the form of drawings of the shapes and sizes of components and buildings."

"Computers staged a revolution in that area. Using computer graphics you can store such information on disc or tape with fewer errors in a form which is simple to correct or update. And you can maintain engineering standards with far more rigor using standard lettering, labelling and presentations. It tends to rule out individual interpretations of engineering codes."

But what it also meant was that initially most engineering software amounted to little more than automated drafting packages, with no analytical tools built in — and therefore were of little value in teaching engineering students about design.

Maxwell began to realise that true design capability would demand computers with more power than standard personal computers. "The people doing engineering design on computers were using the next higher level of hardware. The problem was speed. A professional engineer would just get up and walk away from a PC-based system because of the response time — he could do things more quickly with a pencil and paper."

• Mr Ray Maxwell of Mechanical Engineering

• Molecular structures with a metallic sheen, constructed by postgraduate student, Damian Conway
By last year, the right equipment had come along at the right price, and there was a bonus — networking — the ability to link computers together to share information and resources, like memory and printers.

In fact, the mechanical engineering machines are linked together into a high-speed information passing ring. Of the 17, only the two which manage the network have more than a token amount of memory. The other 15 all rely on them, and can be linked in various ways. Each can work independently, or the whole 17 can work on one problem together with the computing power of a much more expensive mini-computer.

The whole system is fitted with a $500,000 package of engineering design software developed in America by the Structural Dynamics Research Corporation. "It's the only place in Australia with the whole suite. We acquired it through the efforts Dr Len Koss, and are the Australian showroom for the software."

The whole exercise has begun to pay dividends not only in teaching, where third and fourth-year students in mechanical engineering now use the system in extensive units in the theory and application of computers to problem-solving, but also in research and consulting.

For instance, in mechanical engineering, Dr Yee Cheong Lam and his postgraduate students have been using the network to investigate such things as cracking in rollers in steel hot rolling mills and how to prolong the life of aircraft (see story overleaf). In Earth Sciences Dr Steve Edwards has been developing software for CAT-scanning underground (see Monash Review 3-87) and in Electrical Engineering Dr Lindsay Kleeman is designing microchips for testing computer hardware (see story overleaf).

As part of a joint CSIRO Division of Manufacturing Technology-Monash University project, Mr Khoa Ho-Le has made a major contribution to the analysis of computer-generated three-dimensional models. It has application to all areas of engineering where stress, heat transfer and fluid flow are important.

Ho-Le has come up with a new automatic method of mesh-generations, the manner in which the computer breaks up three-dimensional models for analysis.

In order to construct the mesh for analysis, the new software creates brick-like elements and fits them into the three-dimensional model. At the surface of the object where rectangular bricks do not necessarily fit the surface edges, the new generator rounds things out with compatible tetrahedral elements.

"The new method generates meshes efficiently, and makes subsequent analysis considerably more accurate," Maxwell said.

In the computer science graphics laboratory, the three most active researchers — Mrs Marian Cottingham, Dr Binh Pham and Mr Anthony Maeder — are involved in a series of research projects ranging from animation to determining image texture.

Cottingham is interested in designing a system to simulate human movement in three dimensions. "There's an obvious application in animation and for advertising, but there are also medical spinoffs. If we could simulate the movements of sportsmen and women, we could help them learn to throw balls with less back strain, for instance."

At a more theoretical level, Cottingham also is working on the problem of how to store images of solid objects most efficiently. This has an important application in industry. Image storage which demands less use of memory and less calculation means less powerful machines would have to be used, and hence, the possibility of moving computers onto the factory floor.

"The most commonly used data structure for recording three-dimensional images stores information about each corner, then information about edges and information about faces. I'm developing a compressed data structure which only stores corners - the information about the edges and faces is implied in the order of storage of corners. Cottingham said her system was too simple to handle objects generally, but it was quite adequate for storing objects created by computer-aided design (CAD) packages, and it demanded a fifth of the storage space.

Pham and Maeder are more interested in image processing, particularly in texture — how to use the computer to create and recognise things of different texture, such as clouds or bushes or grass, and what gives the appearance of roughness, shininess and grain.

"If you want to classify crops on Landsat images by computer, for instance, you have to be able to discriminate between their various textures," Dr Pham said.

Maeder added: "Originally flight simulators showed grass just as a rectangle of green. Now people are demanding better backgrounds. You have to be able to synthesise grass texture to be able to generate natural scenes."

Another spinoff of this research is that texture patterns can be used to match images taken at different times or from different angles. For instance, a sequence of Landsat images across a grain growing region could be oriented by matching the texture patterns of the fields, or the progress of forest dieback could be followed by texture changes on a time series of images. At the moment such work is done by skilled human interpreters.

And, using the computer, changes in texture could be measured, so that the progress of something like a flood could be quantified. There are even possibilities for constructing three-dimensional pictures from stereo images, and making accurate measurements from them.
Keeping aircraft in crack condition

IT IS POSSIBLE to build an aircraft that will not develop cracks under the normal stresses of flying, but it would be too heavy to fly.

So, given that cracks are inevitable, the study of how and where they form, how fast they spread, and particularly, how to retard them, becomes very important. And that is where the Apollo computer workstations and Dr Yee Cheong Lam of Mechanical Engineering and his postgraduate students come in.

"We are searching for a way to prolong the life of aircraft by slowing stresses of the metal in the region around where the crack forms," Yee Cheong said.

He said that the Aeronautical Research Laboratories (ARL) already applied crack retarding measures successfully to taxpayer millions of dollars.

ARL has decided to support further basic research in the area with a grant of $8000 to Dr Yee Cheong. This has been supplemented with $13,000 from the Australian Research Grants Scheme (ARGS) and $5000 from the Monash Special Research Funds, enough money to enable postgraduate student, Lian Kee Siong to pursue a PhD on the topic.

Cracks in aircraft are the result of metal fatigue - - the weakening of the metal due to the pressure of constantly changing forces such as the vibration of the wings as the aircraft flies. Bending a wire up and down till it breaks is a simple example of metal fatigue.

The idea of the project is to study how stressing of the internal structure of the metal, in which a crack is spreading, slows the growth of that crack. The internal structure can be stressed by deforming it, either by heating or punching.

In this study, the researchers are taking a piece of flat three millimetre-thick aluminium sheet about 7.5 by 30 centimetres and deforming it with a known force using a metal punch. A small crack is started in the material using a diamond saw; and the sheet then is put into a testing machine and subjected to changing force of a pull-release nature. In this way, crack growth can be studied and measured under varying conditions.

It is in the analysis that the computer comes into its own. It used to be extremely difficult to analyse complex shapes because the mathematical calculation was so hard.

Now, using the sophisticated I-DEAS computer-aided design (CAD) package which Monash acquired from the Structural Dynamics Research Corporation in the US, an accurate model of the sheet can be drawn up quickly in two or three dimensions. The software then can take any section of the model and analyse the stresses within automatically by breaking it up into smaller "elements", for which it is easier to calculate the stress. (It is a bit like a largescale form of calculus.)

But this process produces too much data to comprehend easily, particularly as a series of numbers. So the computer puts it all together into a graphical solution, plotting a contour map of the internal stresses.

It is just such an approach which has been used in pursuing a project, which will help BHP manage its steel hot rolling mills.

The metal rollers which shape steel in hot rolling mills are prone to developing stress fractures or cracks. Here, the problem is one of heating and cooling rather than vibration.

The cause is simple. As one side of a roller comes into contact with the hot steel, it heats up very quickly, but as it rolls around it is cooled by a water spray on the other side until it rolls back into contact with the hot steel again.

So, the one side of the roller is always hot compared to the other side and the stress of expansion-contraction starts the crack. But, as postgraduate student Richard Fraser has found, it is the bending stress which causes the crack to grow.

By using the computer to analyse the stresses involved in the cracking process, Fraser has been able to determine where the cracks are likely to occur and how fast they will grow under varying loads of steel.

This would allow the company to fine tune its maintenance, which involves taking the rollers out of service and grinding them down to below the extent of the crack. Fraser also will try to determine how far the rollers can be ground before they have to be replaced.

Many other problems can be tackled in a similar way. A project recently completed for the State Electricity Commission of Victoria was to determine the critical stresses inside a pressure vessel where superheated steam was cooled using water.

Yee Cheong and ARL also are interested in studying how to reduce cracking around holes drilled in metal. One way of doing this by lining the hole with a ring of a different material, fitted under stress.

Researcher designs chips to limit computer crashes

IT SEEMS LIKE it's always just as you reach the head of the queue at the bank, that the teller turns round and announces that the computer has gone down.

In almost all cases the problem is something to do with the programs written to drive the computer, but every so often something goes wrong with the machine itself -- and sometimes it's a problem that cannot be eliminated and is virtually untraceable.

That problem is known as metastability. It occurs at random, and is a consequence of the fact that on computer chips things are happening at close to the molecular level.

Dr Lindsay Kleeman of Electrical Engineering said: "Metastability is a well-documented problem, and the source of unavoidable computer failure. You can improve things to some extent by minimising the chance of it happening, and that is an important design issue."

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Kleeman is using computer graphics to help design chips in a way which will reduce the problem to a negligible level and localise it to well-understood regions of the circuitry.

He is also trying to produce an instrument which will evaluate components of computer hardware for metastable reliability.

"Another idea is to fabricate chip designs which incorporate additional test circuits which can determine performance automatically."

The research is being supported by a grant of $4000 from the Australian Telecommunications and Electronics Research Board. Telecom are very interested in the outcome and have given a lot of co-operation because metastability affects digital telephone exchanges.

At base level, computers are machines that store and manipulate data represented by patterns of electric switches which are either on or off. In computer jargon these switches - which are really a kind of transistor allowing or interrupting the flow of electric current - are called gates.

Occasionally a gate will get stuck half-open — the switch left half-on. Not only can this disrupt the information patterns in space, it can also disrupt them in time.

Because a computer works by changing the patterns of gates in steps, there must be a point at which the new pattern of the next step is revealed simultaneously across the whole computer. In fact, this happens millions of times a second, synchronised by a clock.

Metastability occurs at random, hence at any time, changing the pattern from its normal synchronous course, and bringing the whole system down.

One problem is that the more you guard against metastability, the more checking needs to be done — and that slows down the computing process — so there has to be a trade-off between speed and reliability.

It is really only since the advent of high quality computer graphics and sophisticated fabrication technology that the complicated work involved in the manufacture of modern chips has been possible.

The development program for the AVM system is continuing.

The Department of Electrical Engineering through Montech is offering for sale an industrial vision system which rapidly creates and measures three-dimensional images of objects.

The system (see Monash Review 6-86) has many industrial applications, such as in quality control of windscreen manufacture, computer aided design and the development of robot vision.

It also has particular application to medicine and, in fact, originally was developed as a reliable and rapid method of screening for curvature of the spine.

And organisations wishing to discuss specific applications are welcome to contact Montech.

Researchers in the departments of Physics and Chemical Engineering have come up with an automatic method of measuring the zeta potential of particles in suspension, which reduces the measurement time from a matter of hours to minutes.

A solid particle in a liquid solution tends to adsorb charged atoms and molecules onto its surface. The electric potential generated by this surface charge is called the zeta or electrophoretic potential.

It is of particular importance to industrial processes where solids are suspended in liquids, for instance mineral flotation, water treatment, and the pumping of coal slurries.

The new device, which has been patented by the university, uses lasers to measure how quickly a charged particle moves towards a positive or negative electric terminal, a property which depends on the size of its surface charge.

Further work is necessary to transform the existing equipment into a commercial prototype.

Scientific instrument companies can contact Montech for more information.

For further information, please call Paul Hudson at Montech on (03) 565 3038.

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**THE MONTECH FILE**

A SYSTEM WHICH automatically monitors the deterioration of machine bearings, developed in the Department of Mechanical Engineering, is being released to the industry through Montech.

The microcomputer-based AVM system (see Monash Review 5-86) has the potential to save companies hundreds of thousands of dollars by helping them to plan more cost-effective programs of preventative maintenance for machinery ranging from mining and smelting equipment through to railway, stock and motor cars. Such programs are essential to prevent the structural damage and financial losses arising from machinery breakdown.

The AVM system also provides an alternative to expensive routine checking and replacing of machinery parts.

The new system was developed over three years with the help of company sponsorship by a research team led by Mr Bruce Kuhnell. It allows sensors to be clamped permanently to bearings for continuous assessment.

Each of these sensors is linked through an interface, called an acquisition multiplexer, to a single storage system capable of handling 4096 signals simultaneously. The signals can be transmitted to the computer via telephone.

Incoming signals are processed and displayed graphically in a way which allows the engineer to determine the amount of wear left in a bearing.

The development program for the AVM system is continuing.

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**A section of the design for a silicon chip**

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**Mr Bruce Kuhnell at work on the automatic bearing monitoring system**

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When home can be a sweatshop

A Sociology department study suggests the common idyllic view of working from home in the electronic age may be far from the truth.

Senior lecturer, Dr Belinda Probert, says that while working from home, or "outwork", can be very satisfying for people who have skills which are in high demand, those with less marketable skills often find that it is like a modern equivalent of the traditional piecework sweatshops, and that it tends to reinforce rather than break sexual stereotypes.

In 'Future Shock', author Alvin Toffler argued that the "electronic cottage" would be the way of the future. According to him electronic technology would allow families to work from their homes as small production units.

Among the benefits for workers Toffler listed flexible working hours, less strain and fewer interruptions. He also felt that working from home would alter men's perceptions of housework and make them more willing to contribute.

To investigate some of these assumptions, Probert and Dr Judy Wajcman, a colleague from the University of New South Wales, surveyed two groups of outworkers - highly skilled computer programmers and relatively unskilled word processor operators.

Probert says the study showed Toffler accurately described only those workers who could combine work at home and on site, possessed skills which were in high demand and had few interruptions to distract them at home.

She thinks that in the future there will be fewer full-time jobs and that companies could pressure employees to take up unregulated, part-time employment.

The employment generated, however, will not compensate for the jobs lost, she argues. "My work suggests that outwork can't take up the slack."

"Much of the research in this field until now has been speculative, with lots of talk about how working from home makes people less pre-occupied with work and more interested in their family," Probert said.

"But those people who see outwork as changing family relations aren't right either, because the position of women will still be dictated by their primary responsibility - the family. That is the distinguishing feature. In fact, we might find that the phenomenon of women working from home may reinforce, rather than change, the sexual division of labor."

Nearly all the programmers in the study were men with few family responsibilities. They occasionally worked from an office as well as from home.

The majority of them found outwork very satisfying. "Interestingly, it was the combination of working from two places which appealed to them."

Their partners, however, claimed the programmers had become more obsessive.

towards work. Many were now working much more than 40 hours a week.

"Probert argued that if the men were putting in longer hours working, the amount of housework done by them would not alter. And the sexual division of labor would remain the same as it was before the programmers began outworking. The research confirmed this."

"In contrast, word processor operators were less satisfied with outwork. Unlike programmers, whose services were in demand and had regular work, processor operators complained of sporadic work and poor pay. Most were women with small children."

"One reported feeling trapped in the home after unsuccessfully trying to re-enter the workforce, while others saw outwork as the only way of combining employment with small children."

"Probert concluded that word processor operators had much in common with traditional sweatshop labor. "This is where the benefits accompanying a job in an office, such as friendship and social contact, are cut off, and the employer exploits the workers by shedding on-costs, such as sick leave and holiday loading."

"This dismal view also includes lower income for workers. We chose to survey the word processing workers because they looked the most likely to be exploited," she said.

"An astonishing fact was that only one-fourth of all people surveyed believed outwork had made them less work- and more family-oriented. "All these were females."

In the majority of instances, word processor operators said they were less addicted to work, while programmers reported the opposite. "It appears as if outwork only exacerbates the ideas and feelings of the workers before they worked from home. Most of the men enjoyed their work, while the women saw it as a necessary part of bringing up a family."

Many people from both groups were self-employed and were working to pay off the computer equipment. "It is a critical fact that these people are considered in the Australian statistics as self-employed. They set up their own companies for tax purposes or are self-employed contractors."

"This meant financial success relied on their bargaining status on the labor market, and hence word processor operators barely made a living, she said. "Also, it is ironic that the programmers are producing software which could make them redundant. Their success may only be short-lived," Probert said.

The workers typically pay between $10,000 and $15,000 for their equipment. This made computer outwork an option for an affluent minority only, Probert said.

An average hourly typing rate for a word processor is $12. Given these figures, Probert said she could not see how word processor operators would be able to make a living.