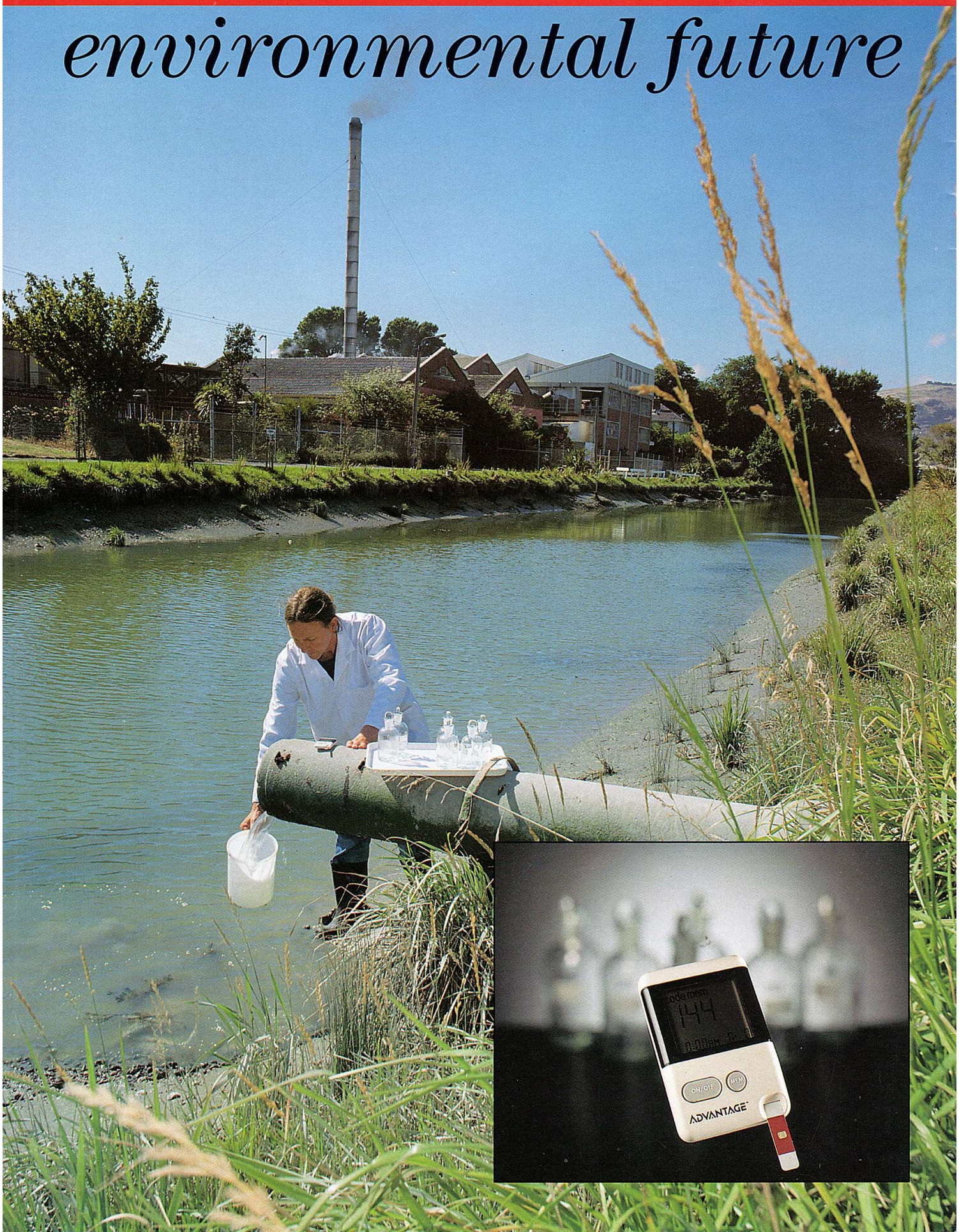
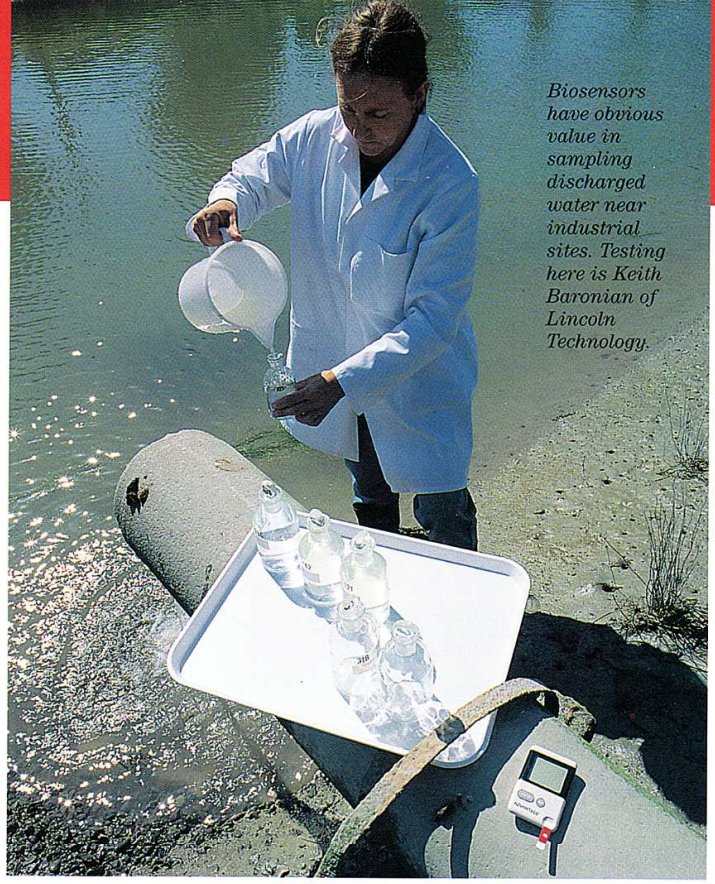
Biosensors key to environmental future



Imagine simple hand-held devices that can instantly indicate when an industry is polluting, when cattle are becoming stressed, or pinpoint the exact time that a woman is ovulating.



Biosensors have obvious value in sampling discharged water near industrial sites. Testing here is Keith Baronian of Lincoln Technology.

The day of the biosensor is drawing near. At Lincoln Technology, part of Lincoln Ventures Ltd, researcher Dr Neil Pasco and his team are currently researching an affordable, easy to use range of biosensors that will help change how people monitor their environment, products, and even themselves.

Under the Resource Management Act, local councils and businesses are finding that fast and accurate environmental monitoring is more important than ever. For example, if someone suspects that a river has been contaminated, the current procedure is to collect water samples and send them away to a laboratory for testing. However laboratory testing is expensive, and because it takes five days for conclusive results, the environmental damage may already be done. If it is a one-off con-tamination the water will have already flowed into the open sea, and the source of the spill might be difficult to locate.

One of the biosensors Dr Pasco's group is developing in conjunction with Lincoln University and the Christchurch Polytechnic is the Biochemical Oxygen Demand biosensor which will be so simple to use that even a non-scientist will be able to take an immediate and accurate reading on a water sample. This means that when water contamination is suspected, a few simple biosensor readings will not only confirm contamination, but may help to quickly pinpoint the source. Better still, businesses can use these biosensors as a type of early detection device for accidental discharges before they reach and harm public waterways.

"The earliest and simplest biosensor was the canary in the coal mine", says group member Keith Baronian. "The canary detected the gas and died, and the reaction warned the observer". Today's sophisticated offspring are hand-held devices or test strips and are used in a number of applications including food analysis, the monitoring of medical patients, and the detection of pesticides and pollution in the environment.

Biosensors have evolved from the marriage of two distinct fields, biology and electronics. One part contains a biological component, such as an enzyme, antibody, or whole cell, that recognises and responds to an introduced chemical in some way. The other part of the biosensor is generally called the transducer, which converts the signal from this chemical change into an electrical signal which can be displayed and observed.

The potential applications of biosensors are as varied as the molecules that they incorporate. In the case of the unfortunate canary for example, Dr Pasco explains, "It could have been killed by a lack of oxygen or a toxic substance. There could be multiple causes. In contrast, specific biosensors respond to sulphide, cyanide, or can measure the oxygen levels. These biosensors can pinpoint either the presence, or the absence, of a particular chemical substance".

It is this high level of specificity in detection that make biological sensor components more suitable than chemically manufactured substances. This selectivity also gives Pasco's research an innovative, and uniquely New Zealand edge in biosensor development. Working closely with Waikato University, Dr Pasco has been experimenting with an unusual class of biological material called thermophile enzymes, the source of which is mostly found in the thermal pools of Rotorua.

These resilient and highly stable enzymes may prove invaluable in animal management, particularly the assessment of animal stress. Recent changes in trade tariffs mean there is more responsibility on agricultural producers to guarantee the quality and safety of their products. Dr Pasco refers to this as the 'gate to the plate assurance', where tests are necessary throughout the entire chain of production to check for pesticide levels, bacterial contaminations, or disease. But there has also been a growing concern over the treatment of livestock and how stress levels affect the overall health of the animal. Currently, the measurement of animal stress is very difficult to quantify objectively; the method involves constraining the animal and hooking it up to a dialysis circuit to measure chemical changes in the brain, all of which is a considerable source of stress in itself. In collaboration with The Meat Industry Research Institute of New Zealand, Dr Pasco is looking at the feasibility of developing a biosensor that can actually be fitted to the animal as it wanders freely in its group. The device can then be interrogated remotely for a much more valid measurement of stress.

In an independent assessment of the biosensor programme, Dr. Alan Bond, a professor of chemistry and Fellow of the Australian Academy of Science stated, "I am very attracted by the creativity of the work and it does, indeed, have a unique flavour which is very unlikely to be duplicated elsewhere".

Also in the early stage of development between Lincoln Technology, Hong Kong University, and Canterbury Health is a biosensor which can detect the exact moment of ovulation. By tracking the appearance and disappearance of two particular hormones, a woman will be able to pinpoint the time when she is most likely to conceive. Once again, the entire process can be done without the inconvenience or costliness of a laboratory.

"If there is a woman in Methven for example, who is finding it really hard to conceive and wants to pinpoint ovulation to maximise the chances of conception, then it currently means a trip into Christchurch", says Keith Baronian. "Now if we shift that test into a biosensor format, it could be a take home device and she could conduct the test herself". ■