Science facts and fiction

By Rosemary Borella

EINSTEINS or Frankensteins — the public's perception of scientists varies dramatically.

This is one finding from a group of researchers who turned the tables and put a prominent community of Australian scientists under the microscope for almost three years.

Spearheading the research was Max Charlesworth, Professor of Philosophy at Deakin University, and one of Australia's most prominent academic minds in his field.

The result is the book *Life among the Scientists*, published by Oxford University Press and launched in Melbourne last Monday, October 2, by Science Minister, Mr Barry Jones.

The four authors are Charlesworth, Lyndsay Farrall, former dean of Social Sciences at Deakin and now co-principal of the Friends' School in Hobart; Terry Stokes, lecturer in Science and Technology studies at the University of Wollongong; and David Turnbull, lecturer in the Social Studies of Science at Deakin.

Under scrutiny were the 300 or so people who work at Melbourne's Walter and Eliza Hall Institute — scientists, technicians and support staff. The institute's work on immunology has gained it an international reputation as the most impressive of Australia's 16 medical research organisations, and it attracts $13 million a year in funding.

The anthropological study was conducted as though the authors were examining the beliefs, traditions and customs of some remote or exotic tribe. But, according to Charlesworth, the resulting book is not written for specialists.

"The reader we had in mind was the person who would listen to the Robin Williams Science Show on ABC radio," he said.

Prof. Charlesworth likened the way the scientists saw him as an observer in the institute to being "a cuckoo in the (scientists') nest".

"We could have written five volumes. It has taken five years, and we did almost three years just observing. There were ideas that did come off, and ones that didn't.

"We had to make it up a bit as we went along.

"We made an agreement that we wouldn't take up too much of their time, and made it clear we wouldn't engage in any kind of expose or use questionnaires and so on," he said.

The book's main aim is to separate science fact from science fiction.

"The emphasis is on how science is actually done as distinct from what scientists say they do, and what philosophers and historians and sociologists of science theorize about what they do," Prof. Charlesworth said.

"We think science, what science is all about and scientists are largely misunderstood in the community," he said.

"To use the example of the IVF quads — on the one hand, the community thinks science is terrific, on the other people think scientists can carry on in a Frankensteinian way — will they be cutting up embryos?"

"We also think scientists are selves and their projects more than ever — to get funding, they need to be able to justify their projects. (Federal Education Minister) Dawkins is saying to scientists: You've got to sell your projects in order to get funds."

"The difficulty with communicating research to lay people is part of scientists' poor image, but often even basic research that is very new, is very difficult to get across to lay people."

During the past 10 years, Prof. Charlesworth has been researching the area of bioethics — the study of the moral and social implications of the new forms of biotechnology, such as genetic engineering and *in vitro* fertilisation.

He has been a member of the Centre for Human Bioethics at Monash University since 1982, and in 1985 was appointed to the State Government's Standing Review and Advisory Committee on Infertility.

He is also a member of the newly-established National Bioethics Committee.

He recently attended the CIBA Foundation seminar in Berne, Switzerland, on the implications of gene analysis and genetic manipulation.

People were largely ignorant of science, Prof. Charlesworth said . . . "They don't even necessarily know what genes are".

The conference discussed gene mapping, he said. "With gene mapping, in cystic fibrosis and other genetic disorders, the idea is to provide a 'map' showing just what genes cause what diseases in the body," Prof. Charlesworth explained.

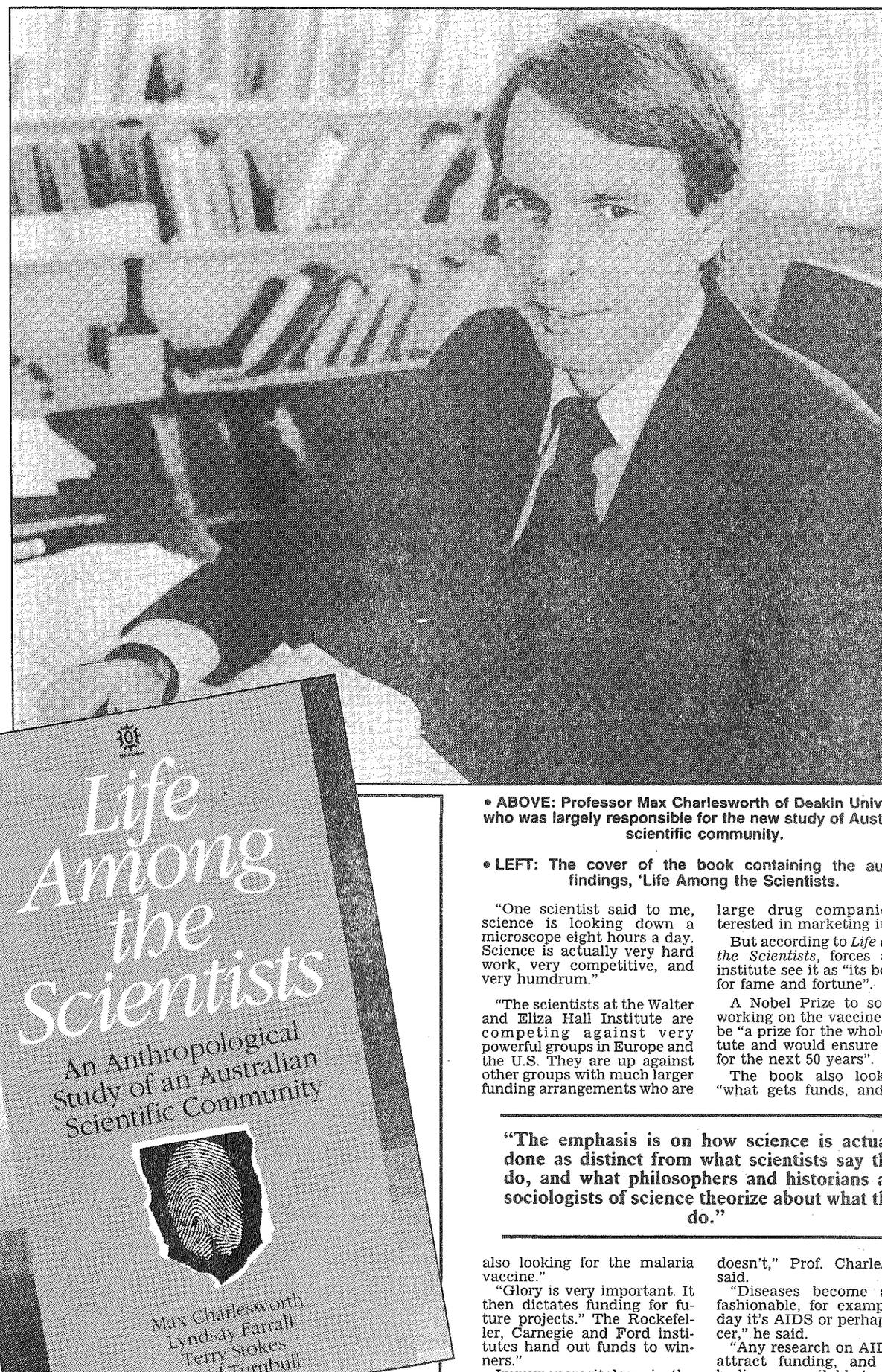
"People can react by saying scientists are playing God — that this is the work of a Frankenstein," he said.

"The idea of the conference was to get scientists, and people like me together to discuss this. The idea of gene mapping has aroused a great deal of controversy, particularly in Germany."

"The Green Party thinks this is more evidence of biotechnology causing problems and wants safeguards set up."

"For instance, if I told your intended marriage partner that you carried the gene that causes thalassaemia (a hereditary blood disorder) you can imagine what kind of moral questions this can raise.

"In future, theoretically I could hand you a print-out showing what your genetic



• ABOVE: Professor Max Charlesworth of Deakin Univ who was largely responsible for the new study of Aust scientific community.

• LEFT: The cover of the book containing the au findings, 'Life Among the Scientists.

"What you don't know about, you tend to be fearful about, and questions like these generate a lot of suspicion, about the Frankensteinian kind of activities."

The achievements of science were not well publicised, Prof. Charlesworth said.

"Yet a recent *Age* newspaper poll showed that science was top of the pops as a subject of reader interest, whereas subjects such as politics and sport were much lower down the scale," he said.

And much written about sci-

dealing with is a four-celled embryo," he said.

"People do conjure up these scenarios. They say things like, the next thing you'll have is homosexuals having babies — it's pure fantasy. Theoretically, in 500 years time, I suppose you could have the scenario of a baby gestated outside the womb by mechanical means."

Life among the Scientists attempts to counter people being 'blinded by science' by discussing — and "dero-

"One scientist said to me, science is looking down a microscope eight hours a day. Science is actually very hard work, very competitive, and very humdrum."

"The scientists at the Walter and Eliza Hall Institute are competing against very powerful groups in Europe and the U.S. They are up against other groups with much larger funding arrangements who are

large drug companie terested in marketing i

But according to *Life the Scientists*, forces institute see it as "its b for fame and fortune".

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also looking for the malaria vaccine."

"Glory is very important. It then dictates funding for future projects." The Rockefeller, Carnegie and Ford institutes hand out funds to winners."

Immunoparasitology is the branch of research concerned with finding cures for malaria and lesser-known parasitic diseases, and is the largest and most prestigious of the Institute's eight units. But honing in on a malaria vaccine, and investing a large chunk of time and money on it, is a calculated gamble.

"In the book we looked at why they're focusing on malaria," Prof. Charlesworth said.

"The group hopes eventually to get the vaccine, but it will never be as good as say, the polio vaccine, because mosquitoes can switch tactics. It's largely a Third World problem — we looked at why they got into it."

"The large drug companies aren't going to make a fortune

doesn't," Prof. Charle said.

"Diseases become fashionable, for examp day it's AIDS or perha cer," he said.

"Any research on AI attract funding, and bodies are available to In the 1920s, people dying of tuberculosis, a still a problem in Third countries, but not for u

The idea for *Life amo Scientists* began with Charlesworth, but he keen to take the credit calling the result "an contribution" by the au

Head of the Walter an Hall Institute, Sir Gusta sal, asked Prof. Charle to be guest speaker at its weekly seminars.

"I decided to tell then was going on in my field Charlesworth explained

"I told them the a pological technique trend in my field, and co used to observe how gro scientists worked. I

What's up, Docs!

What are scientists like? Gods in white coats unlocking the secrets of the universe, or ambitious professionals as susceptible to fame, flattery and the stresses of peer pressure as any lawyer or politician? SANDRA HALL tries to find out while taking a look at the goals and achievements of scientists at Melbourne's Walter and Eliza Hall Institute

[Macfarlane] Burnet's idea, that science is a game involving a certain amount of boyish competitiveness, seems to obscure the fact that science is very often concerned with power and the struggle for power.

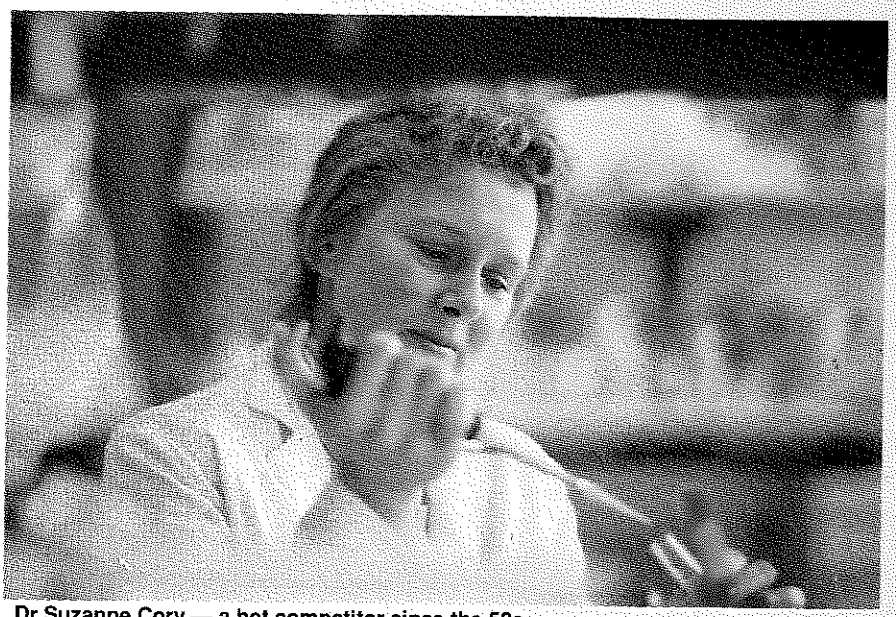
From *Life Among Scientists: An Anthropological Study of an Australian Scientific Community.*

Jerry Adams and his wife, Suzanne Cory, are molecular biologists — masters of the genetic-engineering techniques which flowed from the momentous discovery of the structure of DNA in the early 50s. As heads of the Molecular Biology Unit at Melbourne's Walter and Eliza Hall Institute, Adams and Cory have chosen to use these techniques to study the molecular basis of cancer, making ground-breaking discoveries which have put them in touch with some hot competition around the world.

Early on in their work, for example, they made a highly significant discovery about the behaviour of certain cancer-provoking genes called oncogenes, at a time when several American groups were racing towards the same conclusion.

In December, 1982, they and their co-workers were ready to publish their finding and sent a paper off to the journal of the US National Academy of Sciences. Unfortunately, because the margins of the typescript were too narrow, publication was delayed for nearly five months. Meanwhile, five other papers had appeared on the same subject. This incident is recounted in *Life Among Scientists*, a study of the history, heroes and mores of the Hall Institute, which is published this month by Oxford University Press.

Suzanne Cory, an attractive woman with a direct manner, and what seems to be a natural distrust of anyone trying to make drama out of science, wishes the incident had been forgotten. She thinks the book's authors — Max Charlesworth, Lyndsay Farrall, Terry Stokes and David Turnbull — make too much of the competitive element. Seven years after the disappointment of losing that particular race, she feels that it wasn't so important after all. "What really matters," she says, "is how often your voice is heard."



RON ROBERTSON/IMPRESSIONS

Dr Suzanne Cory — a hot competitor since the 50s

The Hall Institute is Australia's oldest private research institute, founded in 1915 with trust money from the estate of Walter Hall, a senior partner in Cobb and Co and a principal shareholder in Mt Morgan goldmines. It costs $13 million a year to run — money provided by a block grant from the Federal Government agency, the National Health and Medical Research Council, together with funds from the Victorian State Government, private organisations and foundations. It is closely associated with the Royal Melbourne Hospital and the University of Melbourne. Under its former director, Sir Macfarlane Burnet, and his successor, Sir Gustav Nossal, its work in immunology has gained it an international reputation as the most impressive of Australia's 16 medical research organisations.

The size of its block grant has also attracted a certain amount of back-biting from those at lesser institutions ("Gus Nossal's sheltered workshop", is one such quote from *Life Among Scientists*) and its scientists are often criticised for having "a well-developed superiority complex" — an issue Charlesworth and his co-authors have explored in the book by tactfully using invented names in reporting the bitchier comments and anecdotes. Here is a sample (with names changed):

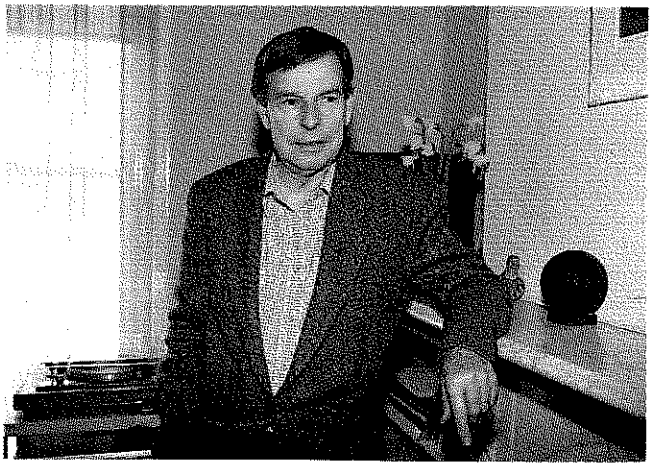
Betty Askew...speaks very critically of the arrogance and aloofness of her scientific superior, Angus Pollard. "When something goes wrong," she says, "he doesn't speak to me directly about it: he just goes into a sulk and I'm supposed to work out where I have failed. Again, there is no hope of me participating in the work. He simply takes the results and that's that."

The question of attribution and credit comes up repeatedly in scientific teamwork. "It's then," according to the book, "that...people bare their fangs."

Whether or not Charlesworth and his co-authors have over-emphasised the importance of the competitive instinct in a scientist's life, it provokes plenty of discussion during conversations with the institute's scientists. You can get into an argument, as well, on the question of whether or not the winner takes all in the race to a new discovery. Several agree with Cory, saying that the spirit of collaboration is much more prevalent than the urge to win. Others, like Jacques Miller, one of the most experienced and respected of the

ethic, safety and propriety. But Nossal was taken aback when the assembly recommended to the university that the research be shut down until guidelines could be established for the handling of recombinant DNA organisms in the laboratory.

The recommendation was not accepted — mainly, he says, because the university felt it did not have jurisdiction over the institute as a free-standing organisation. And since the US Academy of Science had already established the guidelines being contemplated, the heat went out of the issue. (The Australian Academy of Science later set up an overseeing authority.)



JOHN KRUTOP/IMPRESSIONS

Prof Max Charlesworth — dismissed as hopelessly trendy

However, Nossal, who had been impressed by Charlesworth's popular writing on the history of science, started thinking it might be a good thing if the philosopher became more familiar with the routines and practices of the scientists' world. Charlesworth was asked to be a guest speaker at one of the institute's weekly seminars, a book was proposed and before long Charlesworth and his co-authors had embarked on a project which was to keep them, peering over the shoulders of the Hall Institute's staff for the next two years.

From all accounts, it was an interesting relationship — a prolonged and sometimes baffling encounter between friendly species from different environments doing their best to understand one another's language. Charlesworth says that those scientists who have read the book have been polite about it — at least to him. Nossal praises its authors for their "scholarly and gentlemanly" approach, then adds, with a hint of acid, that he still detects a "slight anti-science" bias in their tone. He may be over-sensitive. The book is studded with so many reflective passages in which the authors stop to examine their own motives and prejudices that the reader is encouraged to question their every conclusion.

Charlesworth admits that they set out with various preconceptions: "Two of our group had semi-marxist leanings and wanted to give the institute's proletariat a fair go — the technicians, etc...We had also planned a big thing on the status of women." But the institute turned out to be less feudal than similar organisations in the US and the authors found themselves abandoning their original themes and being drawn into others.

The main conclusion they reach is that scientists are reassuringly human — neither members of a sinister and secret society, nor gods in white coats. They do, however, find a contradiction between the ideals of science and the competitive spirit. "The 'winner takes all' ethos of the new biology, which began definitively with Crick, Watson and Wilkins' discovery of the structure of DNA...has been exacerbated by the commercialisation of recombinant DNA and other forms of biotechnology."

Nossal argues strenuously against this point of view, saying that US scientists have managed for years to work harmoniously with industry without compromising. Cory agrees: "You have only to compare the US with Russia — as a result of competition, the US is much stronger in research." So does Graham Mitchell, Head of the Immunoparasitology Unit.

Immunoparasitology, which is the branch of research involved with finding cures for malaria and lesser known parasitic diseases such as leishmaniasis and schistosomiasis, is the largest and most glamorous of the institute's eight units. Financed by the resonantly named Great Neglected Diseases Program of the Rockefeller Foundation, it is — in Charlesworth's words — "the institute's gesture to the Third World". It also represents a calculated gamble of some magnitude, since much of its funding is concentrated on the search for a malaria vaccine.

The stakes are high. Malaria affects hundreds of millions of people, many of them in Papua New Guinea where the institute's scientists collect their data. According to *Life Among Scientists*, it is seen by some at the institute as "its best bet for fame and fortune". A Nobel Prize to someone working on the vaccine would be "a prize for the whole institute and it would ensure grants for the next 50 years". It has formidable competition from groups in the US, Stockholm, Edinburgh, the Wellcome Laboratories in the UK and the Institut Pasteur in Paris.

They are all fighting a bug of some cunning and sophistication. As the authors of *Life Among Scientists* explain it, plasmodium, the malaria parasite, "has obviously developed an ingenious strategy of living off human red-blood cells without being recognised easily and attacked effectively by the immune apparatus...the single-cell parasite undergoes an astonishingly complex series of changes and transformations as it goes through its life cycle".

Nossal admits that the Hall Institute is up against great odds in its effort to be the first to find a commercially viable vaccine. Even so, he believes that the discoveries made by the team about the scientific basis of drug resistance to malaria have justified the money spent five times over.

"While [Federal Minister for Industry, Technology and Commerce] John Button will be pretty mad at me if I don't have a malaria vaccine within three years or so," Nossal says, "I now have the best basic team of malaria researchers in the world and there is no doubt that they will generate new knowledge."

In contemplating the possibility of failure, he is comforted by the thought that almost certainly there will not be one vaccine but a succession of them, each an improvement on the last. He uses what seems to be a favourite quote of the institute's scientists — one that *The Bulletin* heard at least three times in 24 hours. In the words of Isaac Newton: "If I have seen further, it is because I have stood on the shoulders of giants."

But governing this talk is the understanding that nobody tells anybody anything until the information in question has been published. Results are discussed; intentions never. Yet such collaboration is vital: in the intricate process of using new facts to forge another. Great shortcuts are possible if another's finding can be used on trust, without the need for verification.

Some of the institute's scientists argue that winning the respect of your peers is much more important than competing against them. Nossal gives these two motives equal weight and adds a third — "the joy of puzzle-solving and the satisfaction of your own curiosity". Money, it seems, is not a factor. If you want that, you go off to the US and try to get a job at Genentech.

As for whether or not the director has a grand vision for the institute, one answer to that emerged indirectly when Nossal was explaining why the institute has chosen not to compete against the Institut Pasteur and the US National Institutes of Health in the race to find a cure for AIDS. "The Hall Institute does not embark on an area of research unless it believes it has a sporting chance of being the best in the world...We don't want to jump on other people's bandwagons. We like to make bandwagons of our own."■

institute's scientists, say regretfully that winning the race matters enormously. For one thing, getting there first gets you funding for the next race.

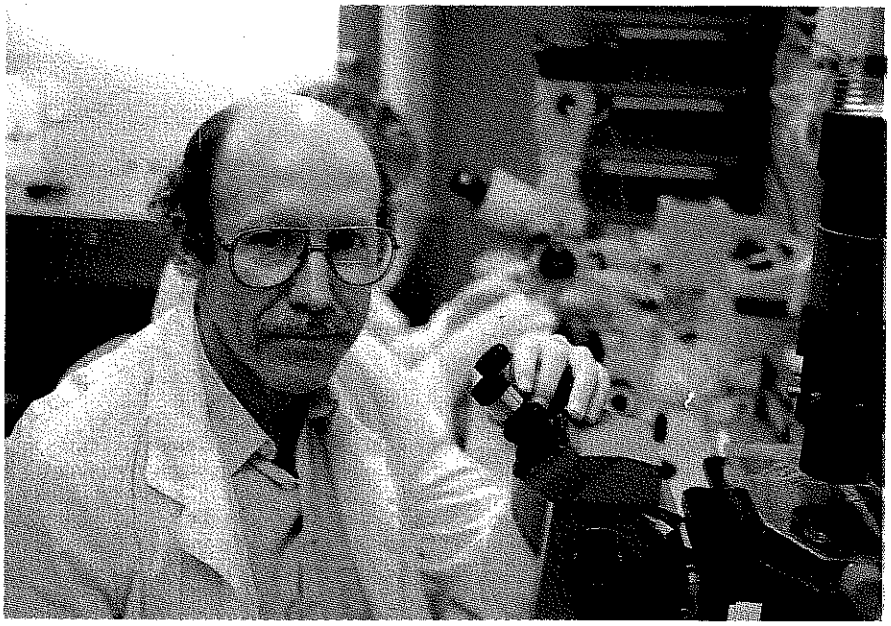
The son of a French banker who brought his family to Australia when Jacques was 10, Miller began his international scientific career in 1961 with a brilliant discovery about the importance of the thymus gland to the body's immune system. (*The Lancet* report of the finding decorates his office wall.) At the time, he was finishing his doctorate in London and four years later, he accepted Gus Nossal's invitation to come back to Australia and help set up a new unit at the institute.

During those early years in Melbourne, he and his PhD student, Graham Mitchell (now head of the institute's Immunoparasitology Unit), made further fundamental observations about the interaction of the B cell and T cell, two types of lymphocyte (a class of white blood cell vital to the immune system).

More recently, such spectacular achievements have been rare and funds accordingly hard to come by. The last great discovery in the field was made in the US; the one before that came from a rival team at the John Curtin School of Medical Research in Canberra. Of this last work, Miller says simply: "I should have made that discovery, but I didn't." He speaks admiringly of the scientists who made the breakthrough and nominated them for several scientific prizes, which they won. Ironically, as happens often, the discovery came about by accident. The team ran out of a particular strain of mice with which they had been experimenting, decided to use another and achieved a result very different from any they had had before. As they explored the reason for the variation, the discovery was made.

Miller and scientists like him are working at the outer limits of biological science. They cannot promise, or even realistically speculate, about the prospects of cure for any single disease. Yet the questions they answer and the puzzles they solve about the basic mechanisms of the immune system are contributing towards an eventual understanding of why it breaks down in many illnesses, including diabetes, rheumatoid arthritis and multiple sclerosis. Miller's 1961 finding about the T cell, for example, now plays a fundamental part in AIDS research.

The Hall Institute tries to maintain a delicate balance between the demands of basic immunological research and the kind of applied science project which is more successful in attracting grants from funding agencies because it can hold out the promise of more immediate rewards.



RON ROBERTSON/IMPRESSIONS

Dr Graham Mitchell — glittering prizes await the mosquito's conquerors

Gus Nossal, who took over from Burnet in 1965, is renowned for having a nose for scientific talent, a genius for recruiting and promoting it, and a keen instinct for sensing where the next scientific wave is going to break. It was partly because of his desire to have the business of scientific research more widely understood that the idea for *Life Among Scientists* came about.

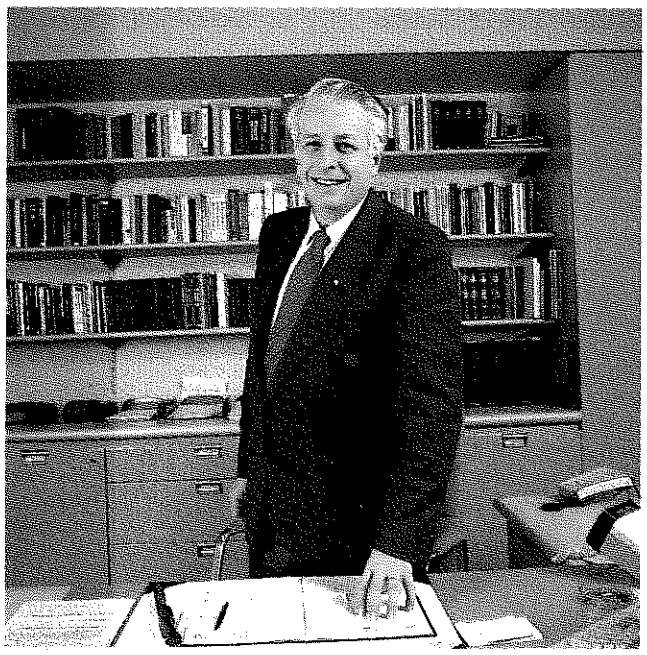
The book examines the lives of the 300 or more scientists, technicians and support staff who work in the institute's fashionably post-modern building next to the Royal Melbourne Hospital, as if it were contemplating the beliefs, traditions and customs of some exotic tribe.

Charlesworth thinks his peers may dismiss it as hopelessly trendy. Even so, he doesn't see why looking at a scientific institute, the judiciary, or any of the groups making up a nation's social establishment, should not be just as important to our understanding of the way the world works as, say, an anthropological study of a Samoan village or inner-city slum.

The idea for it was born in the late 70s out of the debate surrounding the ethics and safety of genetic-engineering experiments. Breakthroughs in gene-cloning had been made in the US and, with the work of Cory, Adams and others, the Hall Institute had become the first Australian scientific organisation to pursue the work. It was an issue of obvious appeal for a philosopher like Charlesworth, with a growing interest in the history and ethics of science. There was also his long-standing friendship with Nossal.

"Max Charlesworth and I had been friends for some 20 years, so I was just a touch surprised," says Nossal, leaning on the phrase, "when he used his position as a leading member of the Melbourne University Assembly to commission an inquiry into our work."

Nossal adds that the Hall Institute itself had initiated debate by inviting the assembly members to see the kind of research it was doing. This led to a lengthy discussion about its



RON ROBERTSON/IMPRESSIONS

Sir Gustav Nossal — of "Gus Nossal's sheltered workshop"

THE ETHICS OF YUCK

Science fiction is becoming fact in the brave new world of medical research. Jane Clark reports on the dilemmas facing scientists. Photograph by David Johns

MEDICAL RESEARCH is leading ɔ frightening potential in human genetic ngineering and one way scientists gauge how ır they can go is by using the Yuck Principle – an unscientific, but telling, measure of /hether society will find an experiment accept-ble. An example of this is the possibility of sing tissue from an aborted foetus to improve ıe health of the mother.

Professor Sir Gustav Nossal, director of the Valter and Eliza Hall Institute, says the Yuck rinciple is a legitimate tool in the series of hecks and balances that scientists can use.

"It's not a strictly scientific principle, I'll ad-ıit," he says, "but it's one well worth listening ɔ. Society changes, and so do its perspectives ıd ethical views. There will always be times /hen scientists find some ideas and practices to e abhorrent. Scientists are just as influenced by ıe whole spectrum of human emotion as any-ne else. Knowing this gives me great confid-ıce that the future is in very good hands."

Dr Tom Mandel, a scientist at the Hall Insti-ıte, gives an example that registered high on is personal Yuck scale. A pregnant New York 'oman suffering from diabetes heard that the ıstitute was researching healthy foetal tissue ɔr the ultimate purpose of transplanting it into nhealthy adults. She asked Dr Mandel to abort er foetus and use its insulin-producing cells to ive her the cure she wanted.

Dr Mandel says the idea was anathema to im, and even to consider it would be far eyond the role of the scientist. He would not ndertake such a commission, even if his re-arch had reached the stage where he could uarantee a successful transplant.

Dr Mandel and his associates take the moral ıd ethical implications of their work seriously. he popular conception of scientists as de-ched, objective seekers after truth — without gard to the consequences — is clearly wrong.

Professor Nossal is not surprised that a scien-st should feel horror at the thought of a oman using her own foetus for medical pur-ɔses and to illustrate the way research is really ɔnducted he allowed the Hall Institute to be ɔen to observation.

The noted academic and science philosopher rofessor Max Charlesworth spent five years researching this issue. He and three colleagues studied both the scientists and the practice of science, using the Hall Institute as their test tube. Their book, *Life Among the Scientists* will be released later this month.

"People have very polarised and incorrect views on scientists," Professor Charlesworth says. "They are perceived to be either Albert Schweitzers, giving their lives for the benefit of mankind, or they are Frankensteins, dabbling in areas best left alone. Neither view is correct. They are members of the community like everybody else. They can be just as subjective, and often are. Their work is often repetitive, humdrum and mundane, and they have to wait years to see results."

Scientific research is endlessly fascinating, opening the mind to areas of potential knowledge that can be of great benefit to mankind. But with this knowledge comes responsibility, and the need to be vigilant. The use of human foetal tissue for research work is being strongly debated at the moment. Such tissue is not used at the Hall Institute, partly because of the differing ethical views and, on a more practical level, because it is hard to come by in the quantity and quality needed.

But according to many scientists in the medical research field, it is essential for study. Foetal tissue is still in the development stage, and therefore has the potential for growth. This potential, absent from many adult cells, becomes important to scientists working in the area of transplants.

FOR a full understanding of how the body works, it is also necessary to see how it develops. This knowledge equips scientists with the ability to control and manipulate the system, fine-tuning it both to fight disease and correct nature's mistakes.

Scientists say the fear of large-scale farming of foetuses is nonsense. "So is the belief that abortions will be performed just to get hold of foetal material," says Dr Mandel. "Apart from the legislative protections that are in place to prevent abuse, the thought is so horrifying that nobody would touch it."

Dr Mandel uses pig foetuses for much of the research he is doing into insulin-producing cells. These are acquired from abattoirs, and would be discarded anyway, but he admits there are still some people who regard this practice as unacceptable. The results of his work, and that of many other scientists in the same field, could benefit diabetics. He says transplanting healthy insulin-producing cells into diabetic patients is a long way off, but tests on diabetic mice, using cells from pig foetuses, have shown encouraging results.

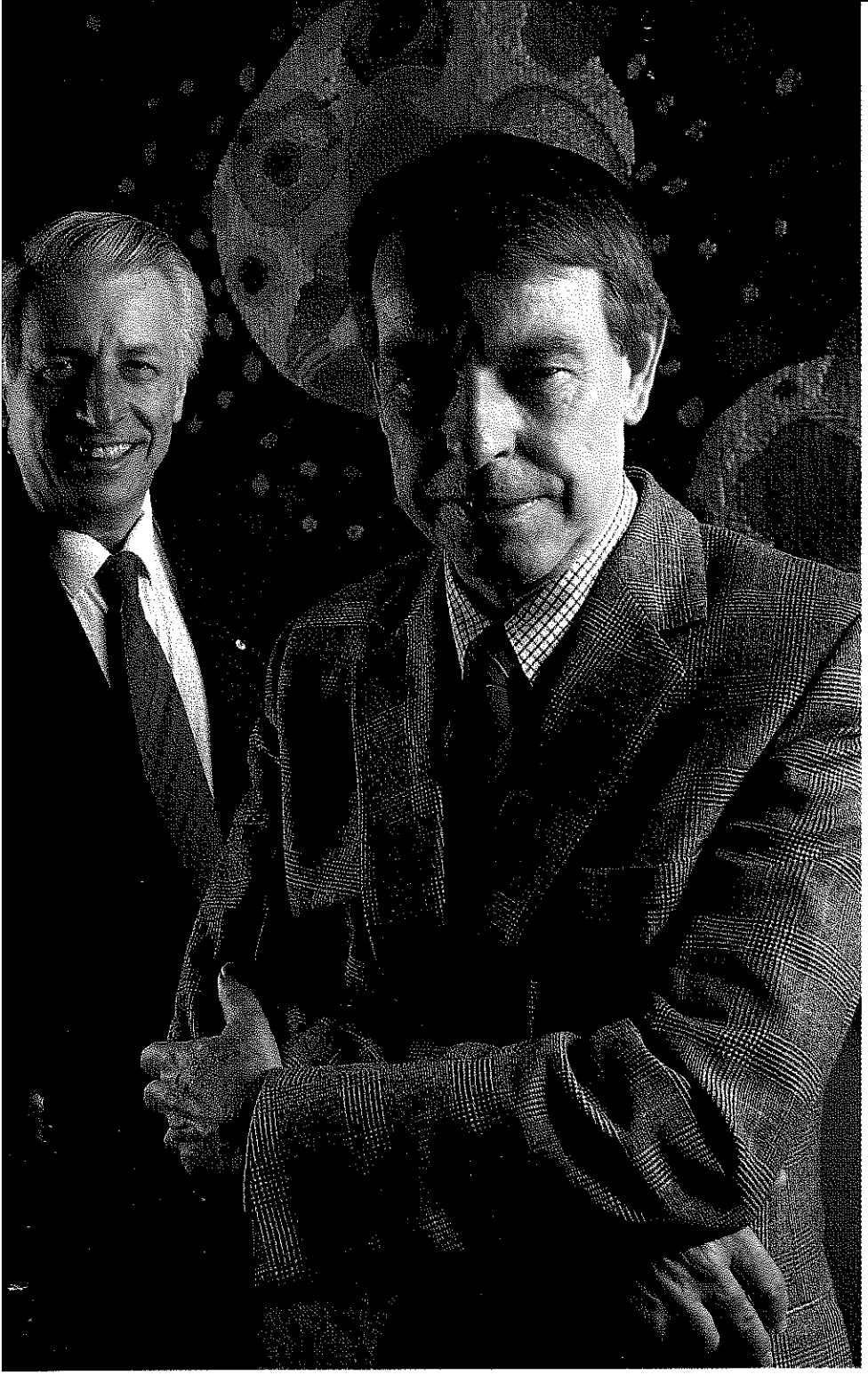
"There have been reports of transplants into humans from countries like Russia, but it is very hard to see the raw data," Dr Mandel said. "The claim is that these transplants have been successful, but until I go over and see the data for myself, I'll remain sceptical."

Dr Perry Bartlett, head of the institute's Laboratory of Neuroimmunology, also uses foetal tissue in his research on the workings of the brain. Ultimately, research of this nature could lead to brain transplants being successful. Science fiction would have whole brains transplanted from one human to another. Science fact could not be further from the truth.

Scientists are still trying to fathom just how the brain works but, as in the case of insulin-producing cell transplants, there have been claims that brain cell transplants have been performed successfully. The claims emanate largely from Mexico, and like Dr Mandel, Dr Bartlett is extremely sceptical of them.

"It has been reported that clinicians have replaced the cells that cause Parkinson's disease with healthy cell transplants. Since we don't know yet how the brain functions in all its aspects, it would seem a waste of time to put any research to clinical use. If we haven't got the basic biology right yet, I can't see how there could be any form of successful transplants," Dr Bartlett says.

"What we do know, however, is that the brain is not a privileged organ, different from all the other organs. Theoretically, it should be possible to remove damaged tissue and replace it with healthy cells. Theoretically, it should also be possible to implant foetal tissue cells, with their potential for growth, into a severed



Professor Sir Gustav Nossal and Professor Max Charlesworth at the Walter and Eliza Hall Institute: Scientists are people, too

pine. Certainly people are trying to do this, but I would be very surprised if the success is as has been claimed."

Nothing frightens people more unnecessarily than genetic manipulation. Professor Charlesworth says there is every reason for caution and questioning, but he says that fears held only a decade ago — of monster animals and such like — have been largely found to be groundless.

Scientists are required to justify the reasons for their research before being funded, and then are monitored closely by a range of bodies. But these controls are no cause for apathy. In the United States, scientists are trying to map the entire genetic structure of the human system with the ultimate view of correcting, and indeed controlling, genetic "mistakes". A full understanding of how genes interact to produce certain characteristics is a long way off, as is the complete map. But the example of cystic fibrosis demonstrates the thinking behind this kind of research.

"In cystic fibrosis, for instance, the ideal would be to be able to remove the gene that causes it from a parent and implant a healthy gene, thereby ensuring the child is not affected," Professor Charlesworth says. "Many scientists agree that this could be interrupting the very process of evolution. What seems to us to be a disease may in fact play some role in the greater scheme of things. We just don't know what, so questions like this have to be asked, and asked by everyone."

Professor Charlesworth is at pains to point out that scientists are not a breed apart, living in a vacuum and isolated from the rest of the world. "You only read about the great successes in science but, in fact, science is far less glamorous than that. So are scientists. They have their own prejudices and biases, just like everyone else, and they bring these subjective views with them into their work. They suffer the same stresses that all of us do, and in some cases more, because the competition for funding is tough and so are the demands put on them to produce. When we started to research them, I think we really believed there was some kind of method and even some kind of scientific temperament, but there isn't."

Professor Charlesworth says there is no area of human endeavour that is not affected by science. That is why it is so important to understand both the practitioners and the process.

"There is a general misconception that scientists move on ethical questions only when the community forces them to," he says. "That isn't true. Being part of the community, they sense and are informed by whatever mood may be prevailing. So you find that scientists themselves agonise over ethical questions just as much as everybody else.

PROFESSOR Nossal has no qualms about letting the institute be the target for scrutiny. "Society generally wants the same things that scientists want, and asks the same questions. If there were more input from people generally then single-issue groups would not have the power they can sometimes exercise," he says.

One question frequently asked of research scientists — and the Hall Institute is a research body — is how much control do they have over the results of their work? Pure research may have uses not previously thought of, and the best example of this is the difference between splitting the atom and creating the atomic bomb.

Scientists at the institute realise they can act as an "opening up" agent, which is why they feel that good communication is so necessary. They say that the community should be informed about the status of research work, to dissuade clinicians from putting into practice work that is not complete.

Researchers in Australia have good relations with clinicians, sit on committees with them and interact in numerous ways. This gives them considerable influence over what is done with their work, allowing them to put the anchors on premature practices. There are also legal and ethical requirements to be met before pure research can be turned into medical reality.

But there remains no certain way of protecting research and ensuring that it is used only for beneficial purposes. The best safeguard is to have a community that is well-informed about the realities of science and that can join the rigorous questioning that should precede any scientific effort. It is a healthy start to see science for what it really is without the distortion of glamourising it. ●

'Life Among The Scientists: An Anthropological Study of an Australian Scientific Community' by Max Charlesworth, Lyndsay Farrall, Terry Stokes and David Turnbull (Oxford University Press, $19.95) will be launched in Melbourne on September 25.