The Fairley Lecture

# Regional Victoria in a time of changing technology

Adrienne E Clarke AC La Trobe Chancellor

ABSTRACT In a world which is in transition, what on-going and new challenges will rural communities face in the next ten or twenty years? How will new and emerging technologies such as robotics, 3D printing, biotechnology and information technology affect these challenges? What changes can we expect consequent to climate change? These and related questions will be explored.

I'd like to begin by acknowledging the traditional owners of the land on which we meet and pay my respects to their elders past and present.

It is a great honour to be invited to present this fourth Fairley Lecture and to follow such distinguished Australians as Sir Rupert Myer, Mr Mark Scott and Mr Alan Myers QC.

The lecture is in the memory of Sir Andrew and Lady Fairley and their many achievements and contributions to the Shepparton community. Sir Andrew's leadership as Mayor and Chairman of the Council's Public Works Committee was critical to the development of Shepparton as was his success in building the Shepparton Preserving Company (SPC). He and Lady Fairley were also notable philanthropists. Much of what we enjoy today in the beautiful gallery can be attributed to their foresight and generosity. Apart from the art gallery, the Sir Andrew and Lady Fairley Foundation continues to benefit communities in the Shepparton area.

The Myer family is also well known for its philanthropy. Recently the Shepparton Art Museum was given a major boost from promised donations of art works from Carillo Gantner, a member of this family.

The Fairley and the Myer families were two of the families that built this tradition of philanthropy in Victoria. The bequests and donations that they made really changed lives, helped build communities and gave people a chance to do something differently. The effects of philanthropy endure and are often felt well beyond a generation.

I personally benefited from the philanthropy of this time as an undergraduate student at The University of Melbourne in the 50s living in Janet Clarke Hall. This Hall of residence was established by Janet, Lady Clarke, the second wife of Sir William Clarke, at that time one of Victoria's largest landowners. It was a Hall for women students mostly from rural Victoria.

My rural credentials are that as a child I lived in New Gisborne, now suburban, but then entirely rural. We roamed the district on our ponies, swam unsupervised in creeks and dams, earned pocket money rabbiting, and did all the things that country kids did in the forties and fifties in the aftermath of the Second World War.

After school came the excitement of University in Janet Clarke Hall. The parents were comforted that, although it was not boarding school, we were kept under pretty close supervision. We were allowed out two evenings each week. The destination, identity of escort and the time of return were all recorded. The latest leave was until 1am, and that was only once a week and only in first and second terms. Of course, there was a busy trade with the girls who lived by the fire escape to enable late returns and ghost sign ins. However the parents believed we were well supervised and indeed we were.

There was another added attraction for the parents. We all had to become proficient at cooking and housekeeping as a precondition to starting our academic studies. This was the result of the enduring legacy of another philanthropic bequest from Mr W T Manifold. Under the terms of this bequest, all the incoming students were to pass an examination in Domestic Economy. Mr Manifold believed that notwithstanding having an academic education, girls should be able to run a household efficiently, as this was likely to be their eventual occupation.

So we came into JCH (Janet Clarke Hall) two weeks before University lectures started to study cooking and housekeeping. The bequest set out that we should reach a degree of proficiency in Domestic Economy and pass an examination proving amongst other things that we were able to:

1. a. Carry out plain methods of cooking meats, vegetables and simple sweets
   b. Understand simple invalid cookery and simple cooking for children
   c. Know how to direct the ordering, preparing, cooking and serving of a four course meal for ten people (including children)
2. To carry out ordinary household work such as:
   a. Equipment and care of rooms

b. Arrangement of tables for meals
c. Planning of the week's work for domestic staff
d. Care of silver, china, furnishings, woodwork etc.

3. To understand keeping of simple household accounts, the making out and receipt of bills, the keeping of a bank account, writing cheques, etc.
4. To understand and conduct the essential matters of household hygiene.
5. To understand how wearing apparel may be preserved and cleaned.

How amazing, looking back that we accepted this quite happily. No one complained, no one thought it was sexist or discriminatory, we all just did it and had a lot of fun doing it. I recall the exam paper on housekeeping focused on questions of "Care of the Household Linen" and "Removal of Common Stains". For cooking, we had to prepare vegetable soup, then beef olives and vegetables as a main course and an apple pie and custard for dessert. What a piece of history and all in one lifetime.

The legacy of Mr Manifold endures to this day in the building that bears his name, but the requirements for being skilled in the domestic arts were unwound in the 1960s. The segregation of girls in JCH and the boys in Trinity was also unwound so today both Colleges are co-ed.

From this piece of history there are two clear points, the first is the crucial importance of philanthropy in changing communities and creating opportunity. The other clear point is the pace of social change. Today, girls and their parents have different expectations - they expect that the girls will earn their own living and experience shows that they will be, at least in part, or often fully, financially responsible for raising their children.

Social changes have to some extent been driven by changes in technology – for example R & D resulting in availability of "the pill" for birth control in the 1960's changed women's lives dramatically. The dangerous illegal abortions, forced adoptions, forced marriages and the lengths that society went to avoid these situations became history. Girls had unprecedented control over their reproductive lives. Today, they plan to have an interesting career and a family - even though it is not necessarily easy.

Apart from social change, technology has driven changes in almost every facet of our lives. I entered University to study chemistry and biochemistry with a brand new slide rule for calculations.

There were no computers, no internet, no mobile phones and no GPS. Antibiotics were quite new. *In vitro* fertilization and organ transplantation were unknown. A whole range of diseases such as AIDS, SARS, West Nile virus, Lyssa virus and many others had not emerged.

Could we have predicted these changes? I doubt it. Even the experts of the time were way off target. For example, Howard H Aitkin in 1952, a pioneer of computing in IBM, thought that "half dozen large computers in this country (USA), hidden away in research laboratories, would take care of all requirements we had throughout the country". Across the Atlantic in the UK, Cambridge mathematician Professor Douglas Hartree had similar views. He had built the first differential analyzers in England and had more experience in using these very specialized computers than anyone else. He was a true expert. He predicted in 1951, "that all the calculations that would ever be needed in this country could be done on the three digital computers" which were then being built - one in Cambridge, one in Teddington, and one in Manchester. No one else, he said, would ever need machines of their own, or would be able to afford to buy them[1]. However, the fast shooting and intelligent fictional police detective, Dick Tracy was more accurate. He was well ahead of his time and much more prescient as he used a "2-way wrist radio!!" in 1947. This was pure fantasy then[2].

Developments in other emerging technologies also took unexpected and unpredicted twists. For example, in the early days as mobile phone services were expanding, the operators focused on voice services. They were astonished at the wide take-up of messaging. Now 75% of all mobile phone users are active SMS users. [3]

From all these and many other examples, we can say that it is extremely difficult to predict the future impact of developing technologies with any confidence or accuracy.

My most enduring lesson about this unpredictability came from my undergraduate days. I studied biochemistry and chemistry. One of our set papers was the 1953 paper by James Watson and Francis Crick which set out the structure of DNA, for which they ultimately won the Nobel prize. At the time, our Professor said "this is the most important discovery of this century". As students we asked what this could mean. He replied that no-one could say what it meant or predict what impact

[1] The Experts Speak, C Cerf and V S Navasky 1984 and Facts and Fallacies, Morgan and Langford
[2] NAS at 150: Science and its Impacts, Ralph J Cicerone, President, NAS, 29 April 2013
[3] Brader, Mark (July 10, 1985). "Only 3 computers will be needed..." (Forum post). net.misc. Citing Lord Bowden (1970). American Scientist. 58: 43–53)

it may have. But, because it went to the very fundamentals of how genetic information was coded, it would be revolutionary.

Our Professor could not foresee and nor could we, as undergraduates, the revolution that followed. Forensic science has been changed forever. Traces of DNA are very reliable silent witnesses. The DNA sequence has no problems with fading memories or flawed recall. Reproductive technology today allows detection of genetic defects in embryos so that families can, if they so choose, avoid the tragedy of children with certain genetic anomalies needing life-long care. It took a billion dollars and thousands of scientists working together across the globe to establish the first sequence of the human genome. Today individuals can get their genetic blueprint, that is their own genome sequence for about ten thousand dollars and it is becoming cheaper with time. This information is being used as a tool of diagnosis and treatment of disease and we are now entering the era of personalized medicine based on individual genome sequences. Even dog genomes are sequenced routinely so that owners can understand the parentage of their dog.

The impact of genetic technologies on agriculture is also dramatic. Globally, there are now 170 million hectares of genetically modified crops sown in 28 countries. The four main crops soyabean, cotton, corn and canola account for nearly all the GM broad-acre crops. More than 80% of all the soyabean and virtually all the cotton sown in the world, is now GM. The most popular traits that have been created by genetic modification are those that confer herbicide tolerance and/or insect resistance on the crop.
Farmers constantly battle weeds and insect damage to their crops and this technology gives them powerful tools. There are new products in the pipeline – golden rice, fortified bananas, drought resistance and many others. Between 1996 and 2011 farmers using GM technology have avoided spraying 474 million Kg of pesticides; the savings in CO2 emissions was 23.1 billion Kg which is the equivalent of taking 10 million cars off the roads.[4]

Going back to my student days, our Professor was right, no one could have foreseen these developments at the time of discovery of the structure of the DNA double helix by Watson and Crick.

Nonetheless, there is a time when those doing the Rand D, who are literally creating the future, can see what might be possible.

[4] James, Clive 2012 International Service for the Acquisition of Agri-biotech Applications, Brief 44

My field of research is plant biology. In 1982 I was at a meeting in the USA when the breakthrough of successfully transferring a gene into a plant was announced. I was so excited. I came back from the meeting and thought “this is absolutely revolutionary - people will be amazed back home”. I recall preparing slides for lectures anticipating great interest in this new technology and found - absolutely none. It was another decade before this technology drifted into the public consciousness. During this time though, the scientific community was busily engaged with its development-literally creating the future. It was more than 20 years after the breakthrough discovery, that the first GM crop, cotton, was planted in Australia in 1995.

One of the lessons we learnt from the planting of the GM cotton in Australia was the power of the ownership of the technology. The owners of the intellectual property can essentially set the margins for the farmers. The owners can price the technology differently in different jurisdictions so that the relative profitability for the farmer can be skewed by the pricing of the technology. Another lesson we learned is that the regulatory framework generally lags the R and D.

This is generally true of all emerging technologies. Because the technology itself often has its own language which is quite incomprehensible to most citizens, officials often need access to expert and unbiased advice. This is usually from experts within the Universities.

This is now an appropriate moment to pause and pay tribute to a great Australian who sadly died this year. Professor Nancy Millis AC, former Chancellor of La Trobe University developed the regulatory regime for gene technology for Australia which became the model for our region. She also made major contributions to water management, waste management, agriculture and the environment. She left a remarkable legacy of contributions which endure –in this case her legacy was intellectual rather than philanthropic, but like philanthropy, her work has an enduring affect in Australia.

From the experience in the development of genetic technologies and others, it’s probably fair to say that although we cannot predict accurately how new knowledge will develop and be used, we can make educated guesses once the technology is established and the very beginnings of its application start to appear. The people who are most likely to see the development path are the people engaged in and connected to the work going on in the field. (Although this is not necessarily so, as applications take unexpected twists and turns!)

However, if we want to understand and take advantage of newly developed technologies in a regional centre, it would seem important to focus on having concentrations of people skilled in these fields and connected globally into a network of like-minded people.

So what are some of the technologies that we can cautiously predict are likely to make a difference to regional Victoria?

3D printing is one possiblity. This is the process of making an object of virtually any shape from a digital model. Essentially successive layers of material are laid down by the printer until the object is built. This technology is already used extensively in manufacturing of automotive and aerospace components, as well as medical and dental devices and many other objects. It's also used for creating jewelry and trinkets – things for fun! So designers can create their design on a computer and then print the object – a desktop printer Makerbot, can be purchased for about $2,000. Skills in design and the arts are thus very important in creating uses for this technology.

It seems very likely that 3D printing will change manufacturing but exactly how is not clear. Generally, it seems that it will be more useful in creating objects with limited production runs, rather than mass production. One effect is that it should not be necessary to keep inventories of spare parts or send off to the city or overseas for replacement parts, once they can be manufactured cheaply on site. Of course, 3D printing still requires input of materials. This is in itself, another rapidly developing technology. We now have superlight and strong alloys, light emitting polymers, and materials with amazing viscoelastic and biocompatible properties available and more in development.

Robotics is another rapidly developing field. Traditional large scale, factory-based manufacturing is increasingly being taken over by robotics because of their speed, accuracy and ease of use. Some believe that the factories of the future will be largely run by robots. People will still be involved in manufacture, but they may be more likely to be in offices near the factory doing design and engineering work.

Together robotics, 3D printing and new materials will probably have profound effect on manufacturing. There will likely be new opportunities for regional Victoria as these technologies take hold.

Changes in ICT have already had a major impact on regional Victoria and no doubt this will continue.

It is amazing to think that the Internet was only commercialized in 1995-less than 20 years ago. Before that, it was really a research tool. Could we have imagined the ongoing effects this would have? Could we have predicted Skype in 2003? Facebook in 2004, Twitter in 2006 and Instagram in 2010? The effects on communications are obvious, and the effects on our traditional retailing, advertising and other businesses are revolutionary. The pace of change is amazing with whole new languages evolving to describe them.

It is extraordinary to think that the users of these technologies, children and adults, have no need to understand the electronics, software and new materials that are required to build them, or even to know that satellites orbiting the earth enable these phones and the GPS. You just press and swipe.

The effects of changes in ICT on education, without the need for understanding the technical details, are profound. Children today are of the "born digital" era. They learn to navigate phones and tablets before they can speak. The phones seem to be just the right size for little hands.

Computer-aided learning is now integrated into education at all levels. Regional Victoria has real strengths in this developing field. For example, Bendigo Senior Secondary College has created fully on-line VCE courses in Maths, Maths Methods and Physics that "can be delivered to students anywhere at any time." These courses are delivered to 28 schools across regional Victoria and enable students who would otherwise be unable to study these subjects because of lack of access. Each course has cost over $200,000 to develop and the students get excellent support from on-line teachers. This innovation won the Victorian Education Excellence Award in 2013 and is the only course of its kind in Australia. Environmental studies at the VCE level is also delivered on-line. The Secondary Teacher of the Year Award was Ms Britt Gow who delivers this course on-line to schools from her base at Hawkesdale College. Mr Andrew Douch, a teacher at Wanganui Park Secondary College is an acknowledged expert in innovative uses of technology particularly for teaching biologies. Ms Louise Duncan of the Shepparton High School has an international reputation in the use of designed e-learning programs for schools. I apologise for omitting the many others in regional centres who have made great contributions in this field. The point though is, that in spite of distance from the major cities, or maybe because of the distance, there has been

exciting and successful innovation by talented and committed members of the regional communities. However, there is a way to go. As of last year, students in the sciences and maths based in rural Victoria did not perform as well as their metropolitan Melbourne counterparts. One measure is the percentage of students achieving a study score of 40 or above. Across the sciences and maths, about 10% of students in metropolitan Melbourne were in this group while only about 5% of students from rural Victoria were in this top group. We see a similar relatively low level of achievement compared with metropolitan students in the NAPLAN results for primary school.[5] We could ask why? If we break the figures down a bit further, our rural students on average do about as well as the students in our lower SES metropolitan regions. Presumably both these cohorts could have an improved performance with careful nurturing. The access to more on-line teaching may well have an impact.

The on-line courses also affect the cost of teaching. For example, in the US, traditional school models have an average per pupil expenditure of $10,000, a fully on-line model is $6,400, and a combination or "blended" learning model is $8,900.[6] So the drivers for further development of these courses will include financial considerations as well as access, which was perhaps the primary motivation for regional Victorian courses.

At the University level, we are also seeing rapid change. Several of LaTrobe's most successful courses, such as Teacher education at Shepparton and Wodonga are predominantly through on line and interactive media based technology. LaTrobe University is also working on a project with Charles LaTrobe College and INTEL called "Classroom of the future" to understand the impacts of these new modes of learning on outcomes.

The MOOCs, Massive Open On-line Courses, are another vehicle. In 2012, Stanford University launched three MOOCs each with enrolments of over 100,000. Since then, there has been a proliferation of these courses. It is still not clear how successful these will be in the long run, to what extent they will replace traditional University campus learning, or how they will be monetized. At present it seems most likely that these forms of teaching will merge with traditional face-to-face teaching. At La Trobe University, we have very successful iTunes U offerings in children's literature, physics, sports economics and ancient history with over 325,000 subscribers. The 'Ancient Rome' course has proved immensely popular with over 100,000 students.

[5] VCAA data 2012.
[6] Battaglino, Halderman and Laurans 2011 The Costs of Online Learning. The Thomas Fordham Institute

It has been said that students go to University for the three M's, Mind, Money and Marriage. For their mind, a combination of MOOCs and inspiration from accomplished teachers, for money, a sound set of intellectual and practical skills, and for marriage, well I guess many people do it on-line these days, but the tried and true methods are still required. Campus life experience will probably still be a valued part of the transition from school to workplace for many young people

La Trobe has campuses at Bendigo, Shepparton, Albury and Mildura. In each city, the University community is a major employer; Our staff and students live in the community and contribute to the life of the town. This table shows the total numbers of staff and students that La Trobe University brings to each of our regions:

| | Total Staff – full time/casual | Students | TOTAL |
|---|---|---|---|
| Albury-Wodonga | 226 | 818 | 1044 |
| Bendigo | 1011 | 4880 | 5891 |
| Mildura | 135 | 438 | 573 |
| Shepparton | 70 | 502 | 572 |

More than mere numbers and the economic activity that comes with that, we offer tertiary education to students close to their homes. Our experience is that many of the students such as those trained to be teachers and health professionals, find work in the regions. We are planning to expand our offering to train rural medical practitioners. We have a proposal jointly with Charles Sturt University to teach medical students, the majority of whom will come from rural secondary schools, into a course which is tailored to the needs of these communities. At present, the

communities rely to a large extent on doctors recruited from other countries. This is not sustainable in the long run and many would say is morally questionable. We are hoping that the incoming government will commit to funding this proposal. This would complete the health faculty courses which we currently offer of dentistry, pharmacy, physiotherapy, occupational therapy, paramedical training and nursing at Bendigo. The students would do their clinical training in hospitals across rural Victoria and NSW.

Agriculture and food are key industries for the regions. La Trobe has major new infrastructure and initiatives in these fields. We opened our $380million AgriBio facility this year and La Trobe, together with RMIT, will host the Food Industry Innovation Precinct for Victoria at the La Trobe University R&D Park. Access to and connections with these facilities will be very important for regional Victoria. This will enable regional Victoria to keep abreast of newly emerging trends and also to bring issues requiring research to these facilities.

Then there are the really big challenges facing the world which do have implications for regional Victoria. These are the population/food relationship and the energy/climate/water relationship.

During my lifetime global population has gone from 2 billion to about 6.8 billion. It is anticipated that the population may flatten off at about 9-10 billion. This growth is not uniform. In Western nations the growth is minimal or negative and we have an ageing population. The population is relatively young and growing rapidly in India, parts of Africa and South America. These changes in population and the emergence of middle class in India and China is accompanied with a demand for energy and a demand for a higher protein based diet. Humanity now consumes 1.5 times the output of the earth's renewable resources. This is clearly unsustainable. Since 1970 we have lost about 30% of our known flora and fauna species and the effects on the freshwater biome is even worse. This loss of biodiversity is due to human activity, destruction of the forests, pollution of the waterways and the atmosphere, and so on. Economic growth must be decoupled from destruction of our natural world. However, so far, all efforts to adjust our social and economic systems to live within the earth's biophysical limits have failed[7].

Regional Australia is largely sheltered from the immediate effects of these global changes except that it cannot escape changes in climate. The regions will need to adapt to changes in such things as changes in weather patterns, water availability, crop suitability, insect populations and so on.

[7] ATSE Sustainable Water Management, Number 172, June 2012

In the face of all the changes and uncertainty being driven by technology and given the difficulty of predicting the future very far out, how can regional Victoria best position itself?

Perhaps the best way is to build a strong intellectual infrastructure, that is, a community of creative, connected people with access to diverse knowledge bases. Science and technology are critically important to the future, but so are the creative arts – graphic art, design, theatre photography, music and so on. The two come together to create content for communications, games, films, viral marketing and so on. The advent of 3D printing as I mentioned gives another opportunity for designers to create objects limited only by their imagination.

Building the intellectual infrastructure starts with building a culture of valuing education across all sections of the community. This means raising the achievements in literacy and numeracy in the primary schools, ensuring that all the secondary schools are connected through the best technology to the best teaching materials to inspire and excite the students. LaTrobe is committed to providing the best education at the tertiary level and to working with the TAFE sector to do provide the best possible access. It is an exciting time of change in the world and in regional Australia. Times of change are times of great opportunity. By building a culture of valuing and investing in education, the regional centres can enhance the capacity of their communities for innovation in this time of change. Opinion formers in these knowledge-based communities can get insights into both what is happening at the frontiers of knowledge and how new knowledge can be adapted to their own communities. In the end, all communities can play a part in seizing opportunities and creating their own futures when they are informed and connected to the broader communities which are at the forefront of technical change.

Thank you