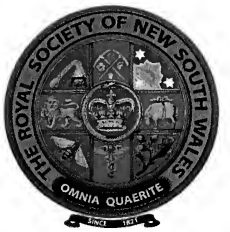

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"... for the encouragement of studies and investigations in Science Art Literature and Philosophy ..."

The Society traces its origin to the *Philosophical Society of Australasia* founded in Sydney in 1821. The Society exists for "*the encouragement of studies and investigations in Science Art Literature and Philosophy*": publishing results of scientific investigations in its Journal and Proceedings; conducting monthly meetings; awarding prizes and medals; and by liaising with other learned societies within Australia and internationally. Membership is open to any person whose application is acceptable to the Society. Subscriptions for the Journal are also accepted. The Society welcomes, from members and non-members, manuscripts of research and review articles in all branches of science, art, literature and philosophy for publication in the Journal and Proceedings.

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Editorial

In September this year the Society, in conjunction with the four national Academies, sponsored a Forum at Government House in Sydney on the challenging topic of the future of work. Coincidentally, the event occurred on the same day that Australia's governing Liberal Party decided to change its leader and hence the Prime Minister. This was certainly a propitious occasion to be discussing and debating a topic that is central to our very existence as a society and as a civilisation! This issue of the RSNSW's Journal is largely devoted to papers written as a result of these deliberations, some from the speakers at the Forum and others from the audience.

Hosted by the 38th Governor of NSW, His Excellency, General The Honourable David Hurley, and with speakers including the Presidents of the Academy of Science and the Academy of Technological Sciences and Engineering (and future Chief Scientist), the roll call for the Forum makes for impressive reading.

Central to the discussion was the expectation that within a decade or two the effects of automation will have transformed the working environment. This is not simply the automation of manual jobs brought about by mechanisation, it is the impact of computerization on activities once thought to be solely the domain of thinking humans – people capable of making complex decisions based on the circumstances they confront.

Undoubtedly new opportunities would arise, though likely in arenas that are quite unanticipated. For instance, how many of us envisaged a decade ago the effect that then emerging Smartphone apps would have on the service industry, such as the accommodation and transportation sectors?!

Whatever does occur in relation to jobs in the future, those trained with skills in science and technology would appear best placed to succeed. However, the society we live in could be a very different place as a result, and not necessarily a better one. Or, at least, not if we don't take steps now to try and identify the changes that may occur and enact policies to ensure that they are not detrimental to our future well-being.

This was just one part of the debate that the Forum facilitated, some of which is taken further in the pages ahead. We hope you find it stimulating, even if not necessarily comforting.

However, to start this issue we have a very different article, written by the 37th Governor of NSW, Dame Marie Bashir, following the address she gave to the Society at its annual dinner. The subject is the life and legacy of the 5th Governor, Lachlan Macquarie, the person who did more than any other to turn Australia from being just a penal colony into a vibrant nation. A nation that is able to contemplate the grand challenges that lie ahead and to consider what its future actions should be in order to meet them and to advance its society.

Michael Burton
Hon. Secretary (Editorial)
31 December, 2015

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Lachlan Macquarie, 5th Governor of New South Wales: His Life & Legacy to Australia

Professor the Honourable Dame Marie Bashir AD CVO

Speech given at the
Royal Society of New South Wales
Annual Dinner

The Union University and Schools Club
Sydney

5 May 2015

Abstract

This is the transcript of a speech on the life and legacy to Australia of Lachlan Macquarie, the 5th Governor of New South Wales, that was given at the annual dinner of the Royal Society of New South Wales in 2015 by Professor Dame Marie Bashir.

Dr Donald Hector, President, Royal Society of New South Wales and Ms Sandra Ollington, wife of Dr Hector.

Professor Brynn Hibbert, Vice President, Royal Society of New South Wales.

Dr Mary O'Kane, Chief Scientist of NSW.

Society Fellows, Distinguished Guests and Colleagues.

It is indeed a great pleasure to join you all tonight with my husband Sir Nicholas Shehadie for the Annual Dinner 2015 of the Royal Society of New South Wales.

And may I at the outset affirm my deep respect for the traditional owners of this land on which we meet, the Gadigal people of the Eora nation, their ancestors and descendants, indeed for all Australia's Aboriginal people who have nurtured this great continent for tens of thousands of years.

Dr Hector, indeed all distinguished contributors to the Royal Society and Fellows of New South Wales, I would like to assure you of my considerable sense of humility, surprise and certainly quiet gratitude on receiving your communication regarding the fellowship with which I have been awarded tonight. And what a privilege I deem it to join your ranks as a fellow.

Since my adolescent years, I have been aware of the august traditions of the Royal Society in Britain and that our New South Wales Society occupies a unique place in the cultural environment of this state as it spans such a

wide range of interests, not only scientific but also philosophical, medical, historical, musical and artistic.

As you know, the Royal Society dates back to the early days of intellectual development of the Colony. Indeed, history records that its precursor was established on 27 June 1821 in the form of the Philosophical Society of Australia. This is a mere 33 years after Governor Phillip first set foot on this land. The legacy of enlightenment of the previous century, I believe, continued well into the 19th century, to our Australian colony. Driven by a trust for continuing engagement despite the distance from Europe, the foundations of widespread enlightenment were laid by Lachlan Macquarie who was succeeded by Sir Thomas Brisbane on 1 December 1821. The 6th Governor of New South Wales, Sir Thomas Brisbane, was offered and accepted the position of inaugural president of the Society.

But we can surely claim that the stage, the cultural direction, here 200 years ago, was set by that 5th Governor, Lachlan Macquarie, whose term of office had concluded and about whom I have the honour to speak tonight.

Increasingly, Australians have come to acknowledge with gratitude the antecedents of modern Australia's success, the builders of this nation. And as we commemorated in 2010, and across this decade, the bicentenary of Lachlan Macquarie's term as Governor, continuing research and studies of the Macquarie era are revealing the extent and richness of this Scotsman's contribution – indeed his enduring legacy to Australasia.

This is a legacy, which has contributed significantly to what we proudly claim to be a distinctive Australian identity.

Following Macquarie's appointment as Governor of New South Wales on 8 May 1809 in London, he arrived at Sydney Cove on 28 December that year. Four days later, on 1 January 1810, he began 12 momentous years in office.

Today, as we look back on Macquarie's life and career, it is striking to note how much of its character remains relevant to the concerns of modern Australia:

- Community inclusiveness,
- The wellbeing of the nation's indigenous people, including access of their children to education,
- The health of the people, including mental health,
- Investment in architectural quality and town planning.

These are but a few aspects of his legacy.

However it is doubtful whether Lachlan Macquarie himself would, or even could have envisaged the high regard – indeed the gratitude – in which he is held today.

It has been remarked before that an aura of failure, frustration and rejection has too often been the reward of many of Australia's early leaders. It was certainly true of many of the best known colonial Governors.

The first Governor, Captain Arthur Phillip who in 1788 brought the first British settlement comprising a fleet of 11 ships, with 759 convicts, and 886 crew, marines and family members to Botany Bay and Sydney Cove[i], left office a dispirited and exhausted man. Macquarie's predecessor, the 4th Governor, William Bligh (of mutiny on the Bounty fame) had been overthrown in a military coup and, after escaping from house

arrest in Sydney, was living in exile on a ship off the port of Hobart in Tasmania. And sadly, it must be acknowledged that Lachlan Macquarie was another victim of misfortune, denigrated by many of the influential and powerful during his term of office in New South Wales.

And later, following the commission of enquiry, called in 1819 by the British Government because of his humanitarian policies and civic development, he was discredited unjustly in official circles in Britain.

Yet Macquarie stands today as one of the greatest of Australia's leaders, certainly one of our greatest Governors, a true pioneer of the nation, unmatched for vision, magnanimity, compassion, and zest for accomplishment. Many will say the founder of modern Australia. Indeed, he was the first Governor to refer officially to 'Australia' by that name, in 1817, endorsing the name first used by the young explorer Matthew Flinders following Flinders' circumnavigation of the Australian continent (1802-1803).

He was the first to give official recognition to Australia Day. In 1818, he decreed that this date, January 26, which he entitled Anniversary Day, would be a public holiday for government workers. Like so much of his legacy, that observance has endured.

Certainly no Governor came to office with a richer fund of experience nor a deeper apprehension of life's trials and hardships. He was born on January 31, 1762 in modest circumstances in Scotland on the isle of Ulva (in the Hebrides), where he later worked on the family farm. His father was a cousin of the last chieftain of the clan, whom Dr Samuel Johnson and James Boswell had visited in 1773. Some years later, these travellers recorded that the family had fallen on hard times, requiring them to sell the island which had been in the family's possession for 900 years. [ii]

Macquarie's father had died when Lachlan was 14 years of age, but his maternal uncle, Murdoch Maclaine, Baron of Moy, had ensured that he received some formal education in Edinburgh. However, the outbreak of the American War of Independence in 1776 brought an end to his schooling, and the following year he received an ensign's commission to serve with his cousin's regiment in North America. At war's end, he returned to the family farm at Mull before leaving three years later to return to the army.

Scholars researching Macquarie's character are convinced also that ideas and values of the Scottish Enlightenment were influential in Macquarie's maturation of character, his humanitarian attitude to convicts and to the marginalised, and influential also in his commitment to civic planning. [iii]

These Australian academics and researchers have sought to identify the pathways whereby such qualities had developed – those qualities which resonated with the Scottish Enlightenment; for Macquarie's years of military service had not allowed time for reflective studies.

It is noteworthy, however, that association by Macquarie with certain individuals imbued with these ideals and values would have been highly significant.

In particular, mention should be made of Sir James Mackintosh, who had spent 7 years (1803-1811) in Bombay, India, serving as Recorder (that is the senior judge). Macquarie had encountered Sir James during his second

period of service in charge of the British garrison at Bombay, as military secretary to the British Governor there, Jonathan Duncan. As a brilliant and scholarly schoolboy, young Jamie Mackintosh had been described as "a prodigy of learning and talent". [iv]

Mackintosh went on to study medicine, practising as a doctor for a few years, subsequently directing his studies to law, a profession through which he believed he could help more individuals. Mackintosh distinguished himself in academia, in philosophy, as an author, and through his involvement in a number of celebrated cases, as well as serving as a member of the British parliament. Mackintosh's friendship with Macquarie endured over their lifetime and he steadfastly remained supportive after Macquarie's return to Great Britain from Australia to confront the criticism of the British Parliament after Commissioner Bigge's enquiry.

In 1807, whilst in India and contemplating new horizons, Mackintosh had written of his desire to be and I quote "...the lawgiver of Botany Bay. If I could rescue at least the children of the convicts from brutality and barbarism by education ..... With a store of school masters from Lancaster, with some good Irish priests for their countrymen, and good Methodists for the rest, I should most joyfully endeavour to introduce law and morality into that wretched country, and give it .... the fit constitution for a penal colony, which was to grow into a great and prosperous community....". [v]

Macquarie was 15 when he joined the army as a volunteer. He served during the American War of Independence in New York and Charleston, – in the 71st Highland Regiment – also in Canada and Jamaica. Later he served in Egypt, in late 1801 against Napoleon's armies – after having accompanied his regiment on his first posting to India in 1788 (the year the Australian colony was born). There, in 1793 he had married his first wife, Jane Jarvis, whom he had met in Bombay. But with the deterioration of her health from tuberculosis, they journeyed to Macau in the hope that the change of climate would bring about improvement. Sadly, her deterioration continued and Jane died in 1796. [vi]

By the age of 40, Macquarie was already a seasoned traveller – hardened by war, very much a man of the world, and well known in influential circles in London. Returning to Britain in April 1807 after a further period of service in India, he narrowly escaped drowning when a freak wave capsized the small ship into which he had transferred in the Persian Gulf. He came ashore extraordinarily, at a place called Büshehr. [vii]

Unable to travel through the Mediterranean because of the war with France, Macquarie journeyed overland via Baghdad, through Persia and north to St Petersburg where he called upon the Czar, Alexander I, then via Denmark and Sweden to London. Clearly, he was a man of high resilience and an exceptional immune system. After such adventures, a mere six-month voyage to New South Wales would have seemed almost routine.

Yet for all his outstanding qualifications, he was not the British Government's first choice for the job. The man chosen as Governor Bligh's successor was Major-General Miles Nightingall, who had resigned his appointment citing health problems before his departure for New South Wales.

Macquarie, already designated to be Lieutenant Governor to the Colony, offered

himself as Governor and was subsequently appointed. He was now 48 years old. In November 1807, he had married his second wife Elizabeth Campbell, who would prove to be an ideal partner.

Elizabeth Henrietta Campbell was born in 1778 at Airds in Argyll. Elizabeth's older sister Jane was married to Macquarie's maternal uncle Murdoch Maclaine who had been so significant in ensuring Macquarie's education and his subsequent entry into the army. Fatefully, Elizabeth and Lachlan had first met in 1804 at the bedside of his dying uncle Murdoch, the last Laird of Lochbuy. The following year 1805, Macquarie returned to a further posting in Bombay. However, he remained in contact with the intelligent and independent highland girl who had won his admiration and his affection. On his return to England at the end of 1807, they were joined (November 1807) in a marriage that was to be mutually enriching throughout their lives. Eighteen months later, on 22nd May 1809, they sailed from Portsmouth bound for Sydney Cove.

Macquarie's 12 years of service was the second longest term of any Governor in Australia's history.

In assessing Macquarie's achievements – and his legacy – we must take account of the Colony as he found it — chaotic, demoralised, divided — following the coup d'état by Lieutenant George Johnston and the New South Wales Corp, against the 4th Governor, Captain William Bligh. Bligh, whose reputation from his role in the mutiny on HMS Bounty, as a dictatorial and volatile Captain had preceded him, had been humiliatingly placed under house arrest for attempting to curb the excess of the New South Wales Corps members, and their wealthy land-owning friends, such as John Macarthur.

Of particular concern to Bligh, had been the flagrant importation of, and trade in rum and other spirits, an alternative to currency! Understandably this anarchic event has been termed "the rum rebellion", and the New South Wales Corps "the Rum Corps". A state of virtual anarchy existed, with members of the Corps illegally acquiring substantial land grants.

In Macquarie's own somewhat dismissive words, the Colony "was barely emerging from an infantile imbecility."

M.H. Ellis, one of the Macquarie biographers, has written:

"The country was divided by faction as a result of the Bligh rebellion, and was almost starving; its morals were in 'the lowest state of debasement'. Public buildings were in ruins; roads and bridges were impassable. There was no 'public credit or private confidence'. Macquarie's first step towards mending these depressing conditions, Ellis went on, was to bring together the warring sections of the Colony through the institution of official gatherings and community functions, among which the Colony's first horse races and agricultural fairs were notable." [viii]

That was Macquarie's way two centuries ago – reflected still, I believe, in the Australian preference for conciliation and consensus, for negotiation, discussion and community involvement rather than the brute exercise of authority.

Deeply depressing conditions, however, existed in the Colony he inherited, which he immediately set about transforming. In the years that followed, he led the Colony into a

period of unprecedented progress. And in many ways, he set the pattern, and defined the priorities of enlightened public administration for the modern era.

He built schools, hospitals, roads. And a beautiful lighthouse at the ocean approach to Sydney Harbour. Indeed, he built on a scale not seen before. It was he who instituted a system of public and private education. And his influence can be seen today in the continuing emphasis given to education by all Australian governments. Indeed, two hundred years ago, he saw the critical role of education in building a nation, and made it one of his first priorities. At the end of his period as Governor, one-fifth of the Colony's revenue was being spent on educational services. It is so appropriate that a fine and progressive university in Australia now bears his name.

To a large extent, Macquarie established the nation's economy – encouraging free enterprise and creating an environment in which commerce and manufacturing could flourish.

In 1813, he introduced coinage. He arranged the purchase of 40,000 Spanish silver dollars valued at £10,000 pounds. Cutting out the centre, two new coins were created – a holey dollar and a dump with a value of 15 pence.

In 1817 the Colony's first bank – the Bank of New South Wales – opened its doors. The highly successful Macquarie Bank, established in 1985, creatively has adopted Macquarie's 'holey dollar' as its defining emblem.

Under Macquarie, the Colony acquired its first courthouses, its first magistrates – some emancipated convicts – its first places of public worship, its first independent newspaper. When he left office in 1821, he could point to 265 public works carried out during his term, many designed by Francis Greenway, the former convict appointed civil architect:

- Hyde Park Barracks,
- The Governor's stables (Greenway's plan), now the Sydney Conservatorium of Music,
- The lighthouse near the entrance to Sydney Harbour.

Roads to Parramatta and the Blue Mountains were constructed, and the five planned Macquarie towns – Richmond, Pitt Town, Castlereagh, Wilberforce and Windsor – built beyond reach of floodwaters from the Hawkesbury River. Wilberforce he named after the great reformist whom he admired. Campbelltown, now a satellite city 50 km beyond Sydney, was established and named after his wife.

On looking around the city of Sydney, one sees evidence of his creativity and zeal. Many of Sydney's streets bear the names he chose, including the fine thoroughfare named after himself, which faces the Botanic Gardens, Parliament House, the State Library and the elegant colonial buildings constructed in the Macquarie period. And across the State, in rural areas the Macquarie name is proudly enshrined – Port Macquarie, the Macquarie River, the Macquarie Marshes – to name but some.

It is already acknowledged that Elizabeth's taste and influence in these developments were substantial. Research suggests that Elizabeth may have brought with her to the Colony one – or even two – architectural pattern books by Edward Gyfford, 'designs for elegant cottages and small villas' printed in London in 1806, and also 'designs for small

picturesque cottages and hunting boxes' published in 1807. [ix]

But Macquarie's vision extended far beyond Sydney. He encouraged exploration to expand the supply of pastoral land – famine being an ever-present threat in a Colony still relying on shipments of food.

Following several failed earlier attempts, but with continuing encouragement, the successful crossing of the Blue Mountains had been achieved in 1813 by Blaxland, Lawson and Wentworth. The road was commissioned the following year and built in an extraordinary six months as a gateway to the pasture lands beyond, heralding the future of a prosperous rural Australia. Further exploration flourished. It can be claimed that the inland city of Bathurst, named after Earl Bathurst, the British Minister of State for War and for the Colonies, was essentially Macquarie's creation.

Macquarie's journal recording his first view of this region gives indication of his delight, as he rode with Elizabeth over the Blue Mountains and looked down upon the plains "expanding for many miles on both sides of the Macquarie River, and surrounded at a distance by verdant hills, is truly grand, beautiful and interesting, forming one of the finest landscapes in any country I have yet visited". [x]

I quote Ellis again – "Macquarie promoted many cultural and civil amenities… he can be accounted the first vice-regal supporter of local literature as well as art" and artists including former convict Joseph Lycett – "and the only Governor in history to appoint a "poet laureate – Michael Massey Robinson, whose stipend was the welcome annual gift of two cows".

In regard to an association of Macquarie with New Zealand and adjacent Pacific Islands as implied in the word Australasia, Macquarie's domain of responsibility as Captain-General and Governor in Chief of New South Wales included the whole of Eastern Australia, Van Diemen's Land – Tasmania, the adjacent Pacific colony of Norfolk Island, and New Zealand.

Indeed, it may be claimed that Macquarie had a direct connection to the establishment of the New Zealand dairy industry.

In 1814, the Reverend Samuel Marsden, with missionary zeal, travelled again to New Zealand to meet with Maori tribes. [xi] He took with him the first dairy cows introduced into the country. These cows were shorthorns, known at the time as durhams and were taken from the New South Wales crown herd, a gift from Governor Macquarie. For many decades afterwards, this was the most popular breed in New Zealand, and therefore a precursor of New Zealand's rich dairy industry. [xii]

Another of Macquarie's priorities – another link with the Australia of today – was his emphasis on public health. He showed a concern for the sick, the poor, the neglected and the marginalised far beyond anything required by the duties of office.

With the inspirational support of Elizabeth, he took a particular interest in the welfare of children, especially the destitute and abandoned.

These children represented all groups within the wider community, the children of convicts, children whose parents had died en route to Australia, even Aboriginal children referred by colonial clergymen. A beautiful site for the Female Orphan School was

chosen, with views sweeping down to the river, a scene which evoked in Elizabeth memories of Airds, her home in Scotland. And from the architectural pattern books of Edward Gyfford, a gracious building was chosen which stands today restored to its original beauty, proudly part of the campus of the University of Western Sydney.

The Female Orphan School was the fledgling Colony's first building created for a charitable purpose, and on land originally granted by Governor Phillip to surgeon Thomas Arndell in 1792. It is said that Elizabeth and Lachlan even designed the pinafores for the children.

There can be no doubt that Macquarie and his wife were aware of the links between poverty, disadvantage, sickness and crime. Elizabeth's intellectual independence and acumen proved major strengths in the implementation of Macquarie's reforms. His undisguised admiration for his wife's abilities was evidence, I believe, of the value he placed on women as equal partners in both marriage and society at large.

Early in his administration, encouraged by the Reverend William Cowper, of St. Philip's Church (Church Hill, Sydney), he presided over a meeting to set up the Benevolent Society, which was later detached from the church to function as an independent agency. The Society's aims were "to relieve the poor, the distressed, the aged and the infirm, and to encourage industrious habits among the indigent poor …"

To this day, the Benevolent Society serves the community with diligence and compassion, and for many years, this responsibility included the provision of a university teaching hospital in obstetrics, a centre of excellence.

For a contemporary Governor, especially one with a professional interest in mental illness and the plight of the traumatised, Macquarie's example continues to be an inspiration. In 1810 he established the Colony's first psychiatric hospital, the Castle Hill asylum, which received its first 30 patients from Parramatta Gaol. It is remarkable that, 200 years ago, Australia had a Governor with an insightful and sympathetic understanding of the needs of the mentally ill, and the not infrequent association of mental illness with imprisonment.

Macquarie's attitude to Aboriginal people was similarly enlightened, though it is important that this not be exaggerated. He established the first school for Aboriginal children, and made the first official attempts, though unsuccessful, to settle native people in agriculture; and he awarded a certificate of merit to those who had responded appropriately. But it must be remembered that Macquarie was a military Governor, a man of his time, and in the words of his biographer Ellis, "he did not hesitate to instigate military measures against the Aborigines in 1816 when they mistook his friendliness for weakness."

With an escalation of attacks on settlers and the burning of some farms, Macquarie ordered retaliation, hoping to discourage continuing provocation. One of the most regrettable of these retaliative expeditions took place in 1816 at Appin, south-west of Sydney, resulting in the death of 14 Aboriginal people.

John Ritchie, another of Macquarie's biographers, has given a touching account of Macquarie's final parting, just prior to leaving Australia – his parting from the aboriginal chiefs he had grown to know and respect. In the last days of his Governorship, he went

with Elizabeth to say goodbye to the clans gathered at Parramatta. Ritchie wrote: "as the Aborigines feasted on roast beef washed down with copious draughts of beer, he examined the children of the native institution [which he had established at Parramatta in 1815]. He knew that the rapid increase in British population and the progress of British agriculture had driven these people from their ancient habitations";..... and "how contact with Europeans in the townships had degraded the blacks". [xiii]

I believe that Macquarie felt a sense of shame for the plight of Australia's Aborigines, subject to the effects of colonisation, and that those sensibilities set in train the long process of reconciliation, culminating in the historic apology of 2008, made on the nation's behalf by the Australian prime minister of the day with the support of all political parties. Some may claim perhaps that there was condescension and even calculation in Macquarie's treatment of the first Australians. But there was also, I believe, a genuine benevolence, an innate goodness of heart.

It was, however, Macquarie's treatment of the convicts in his charge that earns continuing respect and admiration today. This was more than humanitarianism; it was nation building based on merit. The Colony was in need of a workforce, the larger the better, and Macquarie believed that when a prisoner had discharged his debt to society he should be "eligible for any situation which he has, by a long term of upright conduct, proved himself worthy of filling." [xiv]

It is noteworthy that Macquarie's predecessor, Governor William Bligh, had granted only two pardons during his term as Governor. Macquarie, between 1810 and 1820, granted 366 pardons, 1,365 conditional pardons and 2,319 tickets of leave.

According to the biographer Ritchie, the policy of emancipation was "the child of Macquarie's heart, more instinctual than theoretical". "In his softer moments" – Ritchie wrote in 1986 – "he viewed the convicts as children of misfortune. Believing in the intrinsic worth of individuals, he offered them hope; he aimed to encourage redemption, to promote self-respect and, ultimately, a social regeneration. He nurtured a dream of what the new country might become ... in raising people to positions of trust and authority, he drew no distinction between the free and the freed; his object was to eliminate faction and to introduce harmony." [xv]

And in such an environment considerable prosperity grew, including for many emancipated convicts, such as Simeon Lord, who became an international trader, which in turn contributed to the burgeoning wealth and stability of the Colony.

In Macquarie's example of tolerance and humanity, I am convinced that we can see the beginnings of the Australian tradition of the 'fair go' – the spirit of egalitarianism, the sense of fair play that many regard as our defining characteristic as a people. He believed that everyone deserved a second chance, whatever his past deeds or reputation. However, to a large extent that belief was his undoing. And destructive repercussions to his reputation and visionary leadership would emanate from an unexpected source.

For despite the relief and jubilation in Britain engendered by the victories over Napoleon by 1815, and the end of years of war with France, there were significant negative social consequences for the victorious nation.

Hundreds of men who had been pressed into army and naval service to counter Napoleon's aggression, now found themselves without employment, without income and consequently vulnerable to criminal behaviour for survival. The British Government expected and hoped that the spectre of transportation to a cruel and punitive convict colony would act as a harsh deterrent to criminality. They could not countenance that their penal colony, offering emancipation and humane opportunity, would represent an attractive alternative.

Continuing complaints were sent to London by the Exclusives – free settlers, from the Reverend Samuel Marsden known justifiably as the flogging parson and an implacable enemy of Macquarie, together with affluent land holders including John Macarthur, father of Australia's wool industry but described by some as a "dedicated troublemaker". [xvi]

A list of Macquarie's enemies from the Governor's dispatches of 1817, is held in the archives of the State Library of New South Wales and includes many of these seditious individuals.

Eventually a combination of many factors led to the appointment in 1819 of J.T. Bigge as Commissioner, to conduct an inquiry into Macquarie's colonial administration.

Bigge had been given explicit instructions by, the British Secretary for the Colonies, Earl Bathurst: "……. transportation should be made an object of real terror and any weakening of this by ill considered compassion for convicts in the humanitarian policies of Governor Lachlan Macquarie should be reported".

Bigge's damning report (the most censorious elements of which included judgemental accusations about the Governor being too compassionate and spending excessively on building construction) was deeply wounding to Macquarie's pride and reputation. But never did he abandon his faith in human decency and the principles of fairness for which he stood throughout his term.

Generosity to others was also a mark of his character and in many ways the central theme of his administration.

One aspect of Macquarie's legacy which is infrequently described, was his ecumenical spirit, and particularly his attitude to the dissenters, and the Catholic citizens of the Colony for whom the Exclusives showed neither acceptance nor respect. Research of historical documents reveals that Macquarie provided land at Parramatta for the first Wesleyan chapel. [xviii]

And as early as 1810, the first year of his Governorship, Macquarie had already acknowledged the importance of St Patrick's Day to the Irish immigrants and exiles, and had instituted an annual celebratory dinner. Indeed, it is reported that at the request of the leader of a gang of around 50 Irish convicts engaged in work at Government House, Elizabeth granted permission for a short break for them to observe St Patrick's Day. On their return later they were greeted with a table of traditional Irish fare of stew, molasses pudding and "weak grog" – a touching example of Elizabeth's humanity, and so early in the Macquaries' term of office. [xix]

And further, on 3rd May 1820, Fathers John Therry and Philip Conolly arrived in Sydney to celebrate mass officially for the first time since 1804 following the rebellion of the Irish convicts and the battle of Vinegar Hill on the outskirts of Sydney. Later, "Macquarie gave land for their chapel in Sydney, donated 20

guineas to the building and laid its foundation stone……. on the 29th October 1821". Promising to support the religious liberty of Father Therry's flock, this was met with spontaneous applause. [xx]

Perhaps the true grandeur and pathos of Macquarie's story are best summed up in his own words. All that he passionately believed about his policies of emancipation, the motivating impulse of charity and love that underlay all his actions, were poured out in the submission he wrote to commissioner Bigge.

Here, I present, part of what he wrote to Bigge – "At my first entrance into this Colony, I felt as you do … that some of the most meritorious men … most willing to exert themselves in the public service, were men who had been convicts! … Do you not know that above nine-tenths of the population of this Colony are or have been convicts, or the children of convicts. You have yet perhaps to learn that these are the people who have quietly submitted to the laws and regulations of the Colony, altho' informed by some of the free settlers and officers of government that they were illegal! These are the men who have tilled the ground, who have built houses and ships, who have made wonderful efforts … in agriculture, in maritime speculations and in manufactures. These are the men who, placed in the balance … in the opposite scale to those free settlers …you will find to preponderate [in character, both moral and political]." [xxi]

Macquarie's words would have little effect on Bigge's decisions. Bigge had been influenced by the malcontents and the disgruntled. Increasingly dispirited, Macquarie had tendered his resignation on three occasions. This eventually took effect in 1821.

But there is a pleasing irony in the thought that were it not for the conflict of these men, New South Wales might have waited much longer for the rudiments of a parliamentary system. Bigge recommended that no future Governor should be allowed to rule as an autocrat, so a Legislative Council was appointed to advise the next Governor. (However it was not until 1856 that the Council was granted legislative powers).

Reflecting upon Macquarie's submission to Commissioner Bigge today, one senses not only the depth of its passion and sincerity; one hears, in the cadences of his prose, with its measured repetitions and rhetorical emphases, the language of modern political discourse. As in so many ways, he was ahead of his time. Macquarie had committed himself throughout his years of office to a vision of what Australia could become and in doing so he laid the foundation for the harmony and the prosperity that would follow.

At the inauguration of his successor Governor Thomas Brisbane on December 1st, 1821[xxii] Macquarie farewelled the Colony which he had come to love, beginning with the words "fellow citizens of Australia…". He predicted that Australia would, in less than 50 years, become "one of the most valuable appendages of the British empire". Further, he declared, "I shall not fail on my return to England, to recommend in the strongest manner I am able, to my Sovereign, and to his Majesty's Government, their early attention to the amelioration of this valuable rising Colony, and to extend to it their paternal support and fostering protection." [xxiii]

By 1880 it was estimated that Australia had "the most fastest – growing economy and the highest per capita income in the world". And

that "almost 40% of Australia's borrowed capital came from Scottish banks". [xxiv]

On the eve of his departure, February 11, 1822, thousands gathered in the streets and around the coves of Sydney to farewell him, described by the Governor himself in these moving words – "...a most affecting scene, and could not be viewed by Mrs Macquarie or myself without the deepest emotion, after a residence of upward of twelve years amongst these poor attached people". [xxv]

In my years as Governor – the 37th – and in the months that have passed since that period, as I travel the length and breadth of the state of New South Wales in various duties, I see the legacy of Lachlan Macquarie in so much of our lifestyle and shared values. I have seen it in the courage of our farmers, the men and women on the land as they contend with drought and other trials and misfortunes who never give up. I see it in the spirit of our service men and women, peace keepers abroad, who, like Macquarie, serve their country with respect for others, with dedication and professionalism. I see it in the character of the Australian people — their warmth, their lack of pretension, the absence of artificial social boundaries, their pragmatism, their rejection of vainglory and superficial status, the belief of most in the 'fair go'.

The Australia of today, whatever the challenges, would have been a source of great satisfaction, indeed of pride, to Lachlan Macquarie. Sadly, however, with Elizabeth and young Lachlan, he returned to Britain a broken-hearted man and died exactly two years later in London on 1 July 1824.

The news of Macquarie's death, received some weeks later in Sydney, produced outpourings of sadness and four days of official mourning were announced. And on the same day, news was also received that the parliamentary bill which would restore civil rights to emancipists had been given the Royal Assent. Little wonder that convicts and former convicts were calling:

> "Macquarie was the prince of men!
> Australia's pride and joy!
> We ne'er shall see his like again.
> Bring back the old viceroy!" [xxvi]

And, in The Australian newspaper of the 11 November 1824, the newspaper established during Macquarie's term, William Wentworth – who is often referred to as 'Australia's greatest native son' – quoted these lines of Alexander Pope in homage to the late Governor:

Statesman, yet friend to truth! Of soul sincere,
In action faithful, and in honour clear,
Who broke no promise, serv'd no private end,
Who gained no title, and who lost no friend.[xxvii]

It was a fitting tribute to a man who turned a squalid penal colony into an infant nation – a fledgling democracy, robust, self-confident and proud – and whose life and legacy is being remembered with gratitude in this decade of his bicentenary.

May I again, in conclusion, thank the Royal Society of New South Wales for the honour they have paid me in creating me a Fellow and in accepting this presentation of a most outstanding individual. And may I also thank the many Australians, some with us today — members of the Macquarie 2010 Committee, as well as those historians, researchers and teachers who are determined that the Macquarie legacy will not only be remembered, but will serve to light the way in

whatever challenges lie ahead for our nation, Australia.

I thank you all.

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The Royal Society of New South Wales and Four Academies Forum:

The Future of Work?

His Excellency, General The Honourable David Hurley AC DSC

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Vice-Regal Patron of the Royal Society of New South Wales

Abstract

This is the opening address given by His Excellency the Governor, Patron of the Society, to the Royal Society of New South Wales and Four Academies Forum on the Future of Work. The Forum was held at Government House in Sydney on Tuesday, 14th September, 2015.

I would like to pay my respects to the traditional owners of the land on which we gather, the Gadigal people of the Eora Nation.

I affirm my respect for their elders, ancestors and descendants – and all Aboriginal people. I recognise their living culture and their knowledge, as the world's oldest continuing culture, which has sustained this land for tens of thousands of years.

As Patron of The Royal Society of New South Wales, I am delighted to welcome all delegates and attendees to this *Royal Society and Four Academies Forum: The Future of Work.*

This Forum, which will take the form of a series of seminars, followed by a panel discussion, will consider the work environment over the next 20-30 years and identify challenges and opportunities in the present, and in the next wave of technological, social and economic change.

I thank you for your eminent contributions to this Forum, being jointly held by The Royal Society and the New South Wales Chapters of Australia's four learned Academies – the Australian Academy of Science, the Australian Academy of Humanities, the Australian Academy of Technological Sciences and Engineering and the Academy of the Social Sciences in Australia.

I think I can safely say this is perhaps the most significant gathering of eminent and esteemed thinkers Government House has seen in my time as Governor – and considering the large number of significant events held here, this is, rightly, high praise, indeed.

Today's Forum goes to the heart of the origins of The Royal Society.

What has defined The Royal Society of New South Wales is its intellectual rigour in

examining the 'big issues' in accordance with the motto: *'Omnia quaerite'* or *'Question everything'*. This expresses the intent to challenge received opinion, the domination of authority and seek out truth and verification.

This is what we are asking everyone to do today at this Forum: examine *The Future of Work* to identify challenges and opportunities in an environment of rapidly increasing technological, social and economic change.

Our nation, like many economies around the world, is moving out of a traditional manufacturing-based economy to a digital and technology-driven economy.

For example, while we in Australia have seen a decline in our car manufacturing, Google has patented a driverless car. These vehicles combine artificial intelligence with the tools of *Google Street View* maps, video cameras and a range of sensors. And it isn't letting cows or cyclists stand in their way, patenting a system for driverless cars to avoid immoveable objects and recognise cyclists' hand signals.

This challenge of what the *Future of Work* looks like is a big issue and a pressing issue for our society. It is a topic that has been much discussed in the media, at conferences and by both sides of Government.

Employment – or, more to the point, unemployment, if we don't get this right – has a wider impact on our society in terms of our social cohesion.

It raises questions in my mind, and I am sure in the minds of everyone here:

Are we doing enough to prepare our young citizens and our future citizens for the future workplace?

Are our education and training – both school and post-school or tertiary – geared to the massive changes in technology of the next decade and beyond?

What more can we be doing?

I hope through confronting some of these big issues of our time, at this Forum and others like it, that we can provide input into policy debates, and create a long term platform for discussion of significant issues at Government House.

The themes to be explored today as part of our *Future of Work* Forum include:

- The digital divide,
- Emerging information technology and while-collar job replacement,
- The impact of technology on human creativity,
- The stratification of society and the emergence of new social classes,
- The rate of social and cultural change,
- The implications of big data,
- Teaching for the future.

When I was appointed Governor of New South Wales 11 months ago, I undertook to foster and promote the people of New South Wales, particularly in the areas of Youth Engagement, Regional and Rural Growth; Innovation, Industry, Trade and Investment; Indigenous Leadership and Inclusiveness and Diversity.

In the past year, I have met with many individuals, organisations and community groups around this State who are engaged in these issues surrounding unemployment and the future of employment for the people of New South Wales.

In the past few months, I have also engaged with many Universities on this issue of

educating our young people for the future workforce.

A PricewaterhouseCoopers report released in April this year, *Future-Proofing Australia's Workforce,* estimated that as many as 75% of jobs of the near future will require Science, Technology, Engineering and Mathematics (what they call the STEM subjects), yet it appears these are the areas of declining study of school and at university.

I am delighted to host this Forum at Government House – I hope the first of many.

I thank you for your enthusiastic consideration of these issues. This is a topic about which I know we are all passionate.

We can look forward to engaging and dynamic presentations, vigorous debate and challenging discussion; and, perhaps, unexpected, positive and productive outcomes.

In the spirit of the Royal Society:

'Omnia quaerite'.

I have touched upon just some starting points to think about in the course of this Forum.

I congratulate you all for starting the conversation.

Let's make sure that it is continued.

I declare this inaugural *Royal Society of New South Wales and Four Academies Forum: The Future of Work* at Government House open.

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The Royal Society of New South Wales and Four Academies Forum

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Abstract

The Royal Society of NSW and Four Academies Forum was held at Government House, Sydney on Tuesday, 15 September 2015. It was the first occasion on which the Society and the four national Academies of Australia have collaborated to consider an important issue that faces the people of NSW and the nation. This paper gives some background on why the Forum was held and the types of issues where the Society and the Academies believe that they can provide thought leadership on major challenges that face the country. The subject, "The future of work", is typical of the highly-complex socio-techno-economic challenges that face modern society. It has become clear in the last 80 years or so that the most productive approach to deal with these multidimensional "problematiques" is a dialogic one in which as many stakeholders as possible are engaged in consideration of the problem and contribution to an acceptable solution.

Introduction

On 15 September 2015, the Royal Society of NSW and the NSW-chapters of the four Australian learned Academies jointly held a forum at Government House, Sydney, to consider the future of work. Unprecedented change to the way in which we work is predicted to take place over the next 20-30 years. The inherent complexity of the challenge that faces NSW and the nation is typical of the "problematique" or the "wicked problem" that characterises many of the challenges for modern society. This paper gives some background to the forum and why the Society believes that it can add substantial value in the public discourse through engagement with the people of NSW on this and other major challenges that we face.

Structuring Complex Problems

In 1970, Hasan Özbekhan (1970) noted that many of the major challenges of the time[1] were interrelated and not capable of being solved in their own terms. For example, endemic health problems often were the consequences of poverty, environmental deterioration was linked to unbridled economic growth and crime and social deterioration in industrial cities was related to poverty and crime. He observed that these interrelationships were characteristics of "meta-problems" and "meta-systems" – they were systemic in nature and could not be solved by the accepted problem-solving paradigms that were mechanistic approaches.

[1] Other examples are environmental deterioration, poverty, endemic health problems, crime, the social issues from urbanisation and many others – he proposed a list of nearly 50 major issues in a project proposal for the Club of Rome.

Özbekhan referred to this problem type as the "problematique". Problematiques have also been referred to as "wicked problems" (Rittel and Webber, 1973) or simply as "messes". Often, they are not able to be formulated definitively and the full set of solutions has to be conceived first in order to anticipate questions and ultimate problem resolution – the standard strategic planning process does not work. Rarely, is there a clear test for the soundness of solutions and the outcomes of actions may have repercussions that flow through the system like waves. Solutions often are evaluated according to how good or bad they are and judgement of this differs among participants, according to their different views, ideologies and value-systems. Although these problems appear similar to one another, often they are unique and solutions that have worked for a similar problem may be inappropriate to the current one.

Over the last 50 years or so, a great deal of thought has been given to the nature these sorts of highly-complex socio-techno-economic problematiques that present governments world-wide with seemingly insoluble challenges. (Important contributions in this area were made by Nobel Prize winner Herbert Simon (1962), C. West Churchman (1970), Russell Ackoff (1979a,b), Mason and Mitroff (1981), Gerard de Zeeuw (1997) and Werner Ulrich (2003).)

Philosophers of science and cultural theorists have also given this matter considerable thought. It is beyond the scope of this brief, introductory paper to go into this in depth but a useful perspective was offered by Bausch and Flanagan (2013) on the way in which science has been practised and, more particularly, how it has changed in the last 70 years. They note that science has progressed through three phases: the first, being an objectivist paradigm, largely empiricist in its approach; the second that emerged in the mid-20th century that is more systemic and constructivist, recognising the influence of human behaviour; and a third, is from the late 20th century and is influenced by post-modernist thought that accepts subjective, individual interpretations of the system under examination.

The first phase dates from the very beginnings of Western philosophy, from the time of Plato and further developed by subsequent Arab and Scholastic philosophers. It is built on the notion of there being an objective world that can be observed and analysed through our senses and their consequent perceptions. This was further reinforced by Descartes and his separation of physical things from the mind. This approach is built on the notion of an "independent observer".

The second phase emerged in the mid-20th century as science itself was just coming to terms with the notion of uncertainty (for example, Heisenberg's uncertainty principle in the physical sciences[2] and the difficulty in finding any means to true objectivity as the social sciences developed). The nascent management science profession noticed that the very presence of observers changed human behaviour in social systems. Psychology and sociology attempt to imitate first-phase science in trying to transfer objective understanding from one situation to another but recognising that such a transfer will fail in many situations. Put differently, it aims to transfer context with the object. This is achieved through constructing a narrative that attempts to link the object and its connection to ideas. The central concept can

[2] In quantum mechanics, the concept of an independent observer does not exist because the very act of observation disturbs the system.

be thought of as attempting to define objects in some sort of qualitative standard deviation from a definable mean.

Third-phase science does not accept the Cartesian notion of an independent observer embedded in the concept of first-phase science neither does it accept the second-phase science notion of some probabilistic essence that is distilled from context. Rather, it is based on the concept that the object can only be represented as an aggregation of all individual subjective interpretations of the object and its context.

The solutions to the highly-complex problems identified by Özbekhan cannot simply lie in scientific investigation in the absence of the domain of interests involved in the problem nor can successful policy be developed in the absence of rational, objective analysis. These problems can only be solved by recognising their "systems" nature and the non-linear responses of the system to disturbances. There can be no independent observer nor can there be satisfactory policy responses without the active engagement of stakeholders and interest groups. There must be a dialogue around the subject and this must include representatives from all fields of knowledge: the sciences, the technological sciences and engineering, the social sciences and the humanities.

The Role of the Society

Over the last several years, the Society has been examining ways in which it could increase its relevance to the intellectual life of NSW in the 21st century, returning to the position of influence that it enjoyed in its first 150 years. The Society was formed to advance knowledge in the fields of science, art, literature and philosophy, yet for most of its history it has focused its activities predominantly on the physical sciences. When the Council considered the challenges posed by the highly-complex issues outlined above, it realised that should the Society return to the breadth of its original charter, it would be uniquely placed to make a major contribution to the solution of these types of problems. Furthermore, the Council of the Society formed the view that to collaborate with the NSW-based chapters of the four national Academies could provide an exciting opportunity for Fellows and Members of the five organisations to exchange ideas on issues that are important to the people of NSW and, more importantly, to extend the discussion into the broader community. With that in mind, we approached the Academies and found them very enthusiastic about the concept. A steering committee was formed and planning the first The Royal Society of NSW and Four Academies Forum got underway. The committee gave considerable thought to a topic and eventually agreed upon "The future of work".

The Future of Work

In 1930, at the start of the Great Depression, John Maynard Keynes (Keynes (1930)) projected that within a hundred years, we would be working 15-hour weeks on much increased incomes – the biggest problem we would face would be how to spend our leisure time. He cautioned however that this was a long-term view and there were a great many challenges to overcome before this utopic future would be achieved. Eighty years later, former US Treasury Secretary, Lawrence Summers, revisited the topic noting that he did not have the prescience of Keynes and could only look forward not two but one generation (Summers, 2013). Summers pointed out that Keynes got some things right but others were quite wrong. In particular, was that as the distribution of income and wealth increased, the need for skilled labour

would be diminished. A lot has to happen for Keynes' prediction to come true within his 100-year time-frame. Summers is but one of many commentators expressing concern about the potential impact of data-processing technologies on employment.

Technological advances of the 20th century impacted manufacturing processes either directly or indirectly through automation. The biggest effect of this has been felt in the last three decades, with the displacement of unskilled labour, either by developed countries "off-shoring" manufacturing to low-labour-cost countries or by automating manufacturing processes in high-cost, developed countries. In most developed countries, unemployment caused by the displacement of blue-collar workers was compensated for by growth in employment in service industries. But in many countries, although unemployment rates have stayed largely steady (with relatively brief periods of high unemployment during periods of recession), "non-employment" has been increasing, particularly among 25-54-year-old workers – the participation rate has been falling. Fortunately, this has not been the case in Australia where both unemployment and non-employment have been relatively steady and relatively low. But is this about to change?

Two years ago, a study published by Carl Frey and Michael Osborne, two researchers at Oxford, attempted to estimate the probability of about 700 occupations in the US being susceptible to substantial disruption by data-processing technology (Frey and Osborne, 2013). They forecast that up to 40% of white-collar jobs may disappear in the next 20-30 years. The difference between this wave of technological advance and the last will be its broad front. In the last 50 years, it was unskilled labour whose lives were most disrupted. But this will not be the case this time – the full spectrum of work will be affected.

The Forum

The Royal Society of NSW and Four Academies Forum, "The Future of Work" considered the work environment over the next 20-30 years and identified challenges and opportunities that might present themselves as this unprecedented wave of technological, social and economic change approaches. The themes explored were:

- The digital divide,
- Emerging information technology and white-collar job replacement,
- The impact of technology on human creativity,
- The stratification of society and the emergence of new social classes,
- The rate of social and cultural change,
- The implications of big data,
- Teaching for the future.

The Forum was the first occasion on which the Society and the four Australian learned Academies have collaborated. The aim of this event was to provide an opportunity for Fellows of the four Academies and the Society to meet together to discuss an issue of importance to the people of NSW and the nation.

When the Vice Regal Patron of the Society, the Governor of NSW, His Excellency General Hurley, was briefed on the project, he gave his most enthusiastic support and generously offered to host the event at Government House, Sydney. The Society and the Academies appreciate greatly his interest and commitment to the on-going programme expected to emerge from this event.

Participants were requested to complete a survey after the Forum and feedback was extremely positive. It is anticipated that a further programme will be developed to extend discussion into the broader NSW community and that the Society and the four Academies will embark upon analysis of other problematiques in the future.

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The Future of Work: a Chemistry Perspective

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Abstract

In this text of a lecture given by the President of the Australian Academy of Science, the history of scientific advancement is captured in the evolution of modern chemistry. The rapid increase in the ability to make discoveries in chemistry, since, say, the founding of the Australian Academy of Science in 1954, rests on the consequences of the other great discovery of that year, the silicon transistor. The throughput of a research chemist in 2015 is much greater than could have been envisaged in the middle of the 20th century, largely due to modern analytical and computational instrumentation. The pace of change challenges education, from the earliest schooling to postgraduate degrees. A researcher must now move out of a narrow specialisation and be prepared to apply her skills wherever needed. Additional training for postgraduate research students, beyond the traditional 'learning by doing, is needed and nine dot points of desiderata for a doctoral program are offered. The lecture ends with the uplifting words of Max Perutz, who in 1962 offered his principles for success of a research laboratory.

Introduction

In 1954, two events occurred that would have been of some general interest to the membership of the Royal Society of New South Wales, under whose auspices we meet today. One was the founding of the Australian Academy of Science, an organization of learned Fellows dedicated to the advancement of science in Australia, which I am proud to lead.[1] Although it might not have been clear at the time, perhaps the more important event was the invention of the silicon transistor (Riordan, 2004). This discovery, in combination with the efforts of others to develop techniques to mass produce and miniaturize them, has brought the information technology revolution into being by allowing the development of high-speed computers.

The technological developments enabled by this single device have completely changed the way that we live and work in every field. More importantly, it has vastly opened up the realms of possibility in science and research, making realities of concepts that could once have only been the domain of the most fantastic imagination. The concept of doing science by computer – such as computer modelling of molecular interactions, or the climate system, or using computers to investigate inaccessible domains in space or inside the human body – has arisen in its entirety in the last sixty years.

[1] See About Us, Australian Academy of Science, 2015, http://www.science.org.au/about-us, Accessed 13/10/2015.

The speed of this transformation is almost beyond comprehension. Sixty years is not even a single average lifetime, certainly well short of Keynes's century of change. In this period, the annual output of scientific knowledge will have grown over 100 times, yet the total population of the world has increased by about 2.7-fold.[2] Undoubtedly, the advent of the computer is responsible in no small measure for this remarkable increase in scientific productivity.

In my own field of chemistry, the laboratory of today would be seem a little odd to the founding fellows of the Academy. There would be some familiar elements certainly; students conducting reactions in scientific glassware, the business of preparing results for scientific journals or conferences and the alternate frustration and joy of research. Yet the speed at which chemical investigation can be conducted today would be unthinkable for these fellows. With the assistance of computerized instrumental techniques, a novel chemical compound can be identified and characterized in a morning; the same analysis would have required several weeks' or months' patient and careful experiments in the 1950s. The structure of DNA, which took eighty-four years to be determined after its isolation, can today be quickly analysed by computer-aided x-ray diffraction crystallography. Combinatorial drug discovery technology allows for new pharmaceutical leads to be revealed entirely automatically, allowing scientists to target their research efforts on refining and developing promising drug leads, rather than laboriously creating and testing individual molecules.

Clearly, the Keynesian dream of a fifteen hour working week has not yet arrived. However, because scientists (and society more generally) can now do much, much more with the time they do spend working, the amount that we can achieve in fifteen hours today would most likely dwarf a week's work from Keynes's day. The acceleration in scientific output, combined with an ever-increasing sophistication of scientific discovery, ensures that science will make significant progress towards solving some of the most challenging problems of our time. However, the pathway to capitalizing upon these discoveries is less clear – we know where we want to go, but how will we get there?

Of course, science is already responding to the problems facing the world currently, and there are some exciting developments that we *can* foresee. For example, although climate change is a significant challenge, the science community is discovering innovative ways to reduce greenhouse gas emissions, especially those from energy production. I am particularly encouraged by the advances being made in flexible plastic photovoltaic solar materials. These materials, which could even be sewn into clothing, might soon allow solar cells to be installed not just on roofs, but almost everywhere – allowing a truly ponderous amount of solar power to be generated for our use.

Similarly, we are discovering new ways of combating and treating a range of diseases, such as cancer. Increasingly, personalised medicine will be important in effectively treating cancer, where we tailor the treatment depending on an individual's genetic makeup, using advances in analytical chemistry, bioinformatics and biostatistics. We are also developing new ways of delivering treatments by using novel polymers to encapsulate the

[2] Over the period, the annual rate of scientific output is estimated to have increased by 8-9% per annum. See Bornmann and Mutz, 2015.

toxic chemotherapy agents, so that they are delivered directly to where they are needed.

These sorts of developments are relatively predictable if we extrapolate from current activities. They are, if you like, the 'known unknowns' – those advances that seem likely to arrive in the near term. Yet for a young person today, their lifetime will be filled to a much greater extent with the 'unknown unknowns' – discoveries that we cannot today foresee, nor have any hope of predicting how they might change society and work in the future.

I would not for a moment attempt the folly of predicting what the future will be like, or what the workers of the future will do. History has shown time and time again that scientific progress can have the most profoundly unforeseen impacts upon all facets of society. In fact, we tend to not be very good at predicting what might occur, even with discoveries already in hand. A panel of eminent experts assembled by US President Roosevelt in 1937, charged with advising him on the likely developments in science and technology, failed to divine the importance of antibiotics and fax machines. Both of these had been initially discovered in the preceding decade, and have both made profound changes to the world in the second half of the twentieth century (Thomas, 2014).

My background is Chemistry, and I have spent all my working life in academic teaching and research. Apart from a couple of vacation jobs I have had little experience working in the "real world" and therefore I feel ill qualified to comment on the topic in hand. I would rather talk about my own experiences as a research scientist and share some of the ideas that I have developed in adapting to jobs of the future.

Chemistry is one of the fundamental scientific disciplines and is broadly applicable to aspects of materials science and biology. Jobs in pure chemistry in Australia are rather limited. The greatest opportunities are in academia, publicly funded research institutes and a very few companies. Whereas in the post second world war years in Australia chemical research and chemical manufacturing were core business activities, in recent years these have largely moved offshore to locations where markets are larger or where labour costs are lower. It is the very fact that chemistry impinges on so many related disciplines that means chemists can gain employment in allied industries such as analytical and public health laboratories, biotechnology companies, medical research institutes and small manufacturing companies.

It is with dismay that I observe that a chemist is not rated sufficiently highly to be on the skilled occupations list for entry to Australia as a preferred permanent resident. There is one small crack letting in some light on all this - chemical engineers are listed as group having desirable skills. This list clearly looks only at the immediate skills shortages in the labour market, rather than giving consideration to preparing Australia to be an economy prospering through innovation in the future. For example, although taxation accountants are included on the skilled occupations list, there is a high probability that much of their work will be automated over the coming decades (Frey and Osborne, 2013). We should be using our skilled migration program not only to solve current skills shortages, but also strategically to boost our future innovation capacity.

Returning to chemistry I believe that it is still essential that any scientist is properly trained in the core discipline. History has shown that a well-trained chemist, whether it be at

Bachelor's, Master's or doctoral level, has sufficient analytical skills to be useful in a variety of professions, and is usually capable of acquiring new skills on the basis of the early training. By completion of the PhD degree the graduate should be able to demonstrate a capacity for independent and original thinking, and should exhibit problem-solving skills for a variety of tasks. In considering jobs of the future a crucial question to ask is "What is the best training to reach these outcomes?"

How will scientists be trained to be ready for jobs in the future? What should be the core aspect of training of scientists in general (and chemists in particular)? Ultimately our success as a nation will depend on education in preparation for jobs of the future. The Rt. Hon. Tony Blair said in launching the Labour party education manifesto on 23rd May 2001 at the University of Southampton "Our top priority was, is and always will be education, education, education". This statement is as relevant today in 21st century Australia as it was for Britain at the start of the century.

Alarmingly, the concept of having a "feeling for science" amongst younger people appears to be on the decline. A survey conducted on behalf of the Academy of Science in 2010 and again in 2013, which asked respondents a number of relatively basic science questions, found that the greatest decline in correct responses came from those aged between 18-24 years (Auspoll, 2013). A report completed by the Academy for the Office of the Chief Scientist found a worrying and significant decline in the number of senior secondary students studying science – showing a decline from more than 60 per cent of Australian year 12 students studying science in 2004 to only 51.4 per cent taking a science subject in 2010 (Goodrum et al., 2012). This report also makes it clear that a student's decision to take science subjects at a senior level is greatly influenced by their experiences of science at more junior levels.

Education starts with children and progresses through adulthood. To ensure that Australia has a continuing cohort of talented adult scientists, it is important that we attempt to engage students with science from the beginning.

The Australian Academy of Science has recognized school education as its core business for over a decade. *Primary Connections* is an inquiry-based program (generously supported by successive Federal governments) that empowers primary school teachers not formally trained in science teaching to inspire young children in the discipline. [3] Through its active teacher training and mentoring and extensive course modules aligned to the National Curriculum *Primary Connections* reaches about two-thirds of all Australian primary schools, and is mandatory in South Australia. It is truly inspirational. I saw it in action at an ACT primary school. There a teacher was introducing the concept of Venn diagrams to six year olds. There were two overlapping large hoops. In one hoop there were toys that could be pushed while in another hoop there were toys that could be pulled and in the overlapping sector there were toys that could both be pushed and pulled. I have to confess that for the first time I really understood a Venn diagram from that experience. Now the focus of the program is the development to reach remote rural and indigenous communities, and the hope is that the whole project will be financially sustainable.

[3] See Primary connections, Linking Science with Literacy, Australian Academy of Science, 2015 http://primaryconnections.org.au/, Accessed 13/10/2015.

In the area of secondary education the Academy (again with Federal government support) is developing *Science by Doing*, a comprehensive online science program for Years 7 to 10 available free to all Australian students and teachers and supported by award winning professional learning modules and a research based professional learning approach. [4] The Australian Academy of Technological Sciences and Engineering is actively engaged in a hands-on inquiry-based program of education in maths and science, called Science and Technology Education Leveraging Relevance (wisely abbreviated to STELR), that importantly 'provides career profiles which highlight the study pathways necessary for jobs in STEM – related industries'.[5]

The abovementioned educational programs have as their aims the development of a community of people who have "a feeling for science." Importantly they should demonstrate how we should be educated not only the jobs of the present, as mentioned for STELR, but also for jobs of the future. It is this latter task that we are addressing today, and it is virtually impossible to make detailed predictions, so I shall stick closely to the basic core training.

Much has been written about the most desirable aspects of tertiary education and training. For chemists we must not abandon training in the core elements of the discipline. I remember when the TV program *Crime Scene Investigation* appeared on television there was a huge demand for courses in forensic science. Graduates were produced in droves, far too many for employment in the field. However, most knew very little general science and many had difficulty finding employment in other areas.

In undergraduate courses there is a developing emphasis on active learning, essentially learning through problem-solving (Waldrop, 2015; Kober 2012). In undergraduate Chemistry courses we must teach the core skills of chemistry. Problem-solving can then be very effective. However, there still remains the problem of motivating chemistry lecturers to be innovative in their teaching practice. Rewarding teachers for application of such approaches in tertiary institutions is not well developed.

Similarly, science graduates in Australia are unlikely to gain experience of their discipline in the wider world. A broad educational experience makes better scientists; students with a range of educational experiences will better be able to make connections between disparate areas of knowledge, and hence be become better problem-solvers. Scientists who can forge connections can make important inventions – for example, one scientist's curiosity-driven research in electrochemistry, a branch of chemistry not then associated closely with medical research, led to the discovery of the blood glucose sensor that is now an essential tool used by millions of diabetics every day to manage their condition (Thomas, 2014). The Office of the Chief Scientist has recently highlighted the low levels of work-integrated learning opportunities available to undergraduate science students in Australian universities, and argued that lack of incentive, and a want of resources for academics to facilitate industry placements for the students were significant barriers to achieving meaningful educational experiences outside the lecture theatre

[4] See Science by Doing, Australian Academy of Science, 2015 http://www.science.org.au/science-by-doing, Accessed 13/10/2015.
[5] See STELR, Innovative Science Teaching, STELR-ATSE 2015 http://www.stelr.org.au/, Accessed 13/10/2015.

(Prinsley and Baranyai, 2015).

In doctoral training there is much room for improvement. While Masters courses in many institutions in Australia incorporate significant course work, this is far less common at the doctoral training level. Doctoral training requires the ability to frame a research problem, to think inductively and creatively, to design experiments and solve a problem and to write discursively about the evidence supporting the conclusions arising from observations. The topic is less important than the process. If I reflect on my own personal experiences and those acquired through different doctoral training programs in different countries, I would wish to include the following into a program.

- Share the concept of serendipity as captured by Horace Walpole – 'making discoveries by accident and sagacity of things they were not in quest of' (Oxford Dictionaries, 2015).
- Remind people of Pasteur's comment - 'In the fields of observation chance favours only the prepared mind' (Pasteur, 1854).
- Practise the art of asking incisive questions (Kinaret, 2015).
- Expose doctoral students to a series of inspirational speakers; provide Master Classes; begin early in thinking of careers outside academic life (Nurse, 2015).
- Provide engagement with industrial partners.
- Train researchers in general business skills, such as reading a balance sheet and principles of governance.
- Teach research leadership techniques (Leiserson and McVinney, 2015).
- Build a culture that strives for excellence.
- Develop entrepreneurial skills.

Above all in the doctoral process we must be exposed to ideas and thinking that are outside the normal range of experience. This can be managed in a variety of ways, most of them emerging from imaginative and creative research leadership by research mentors. From such a process will emerge the ideas and opportunities that will lead to the jobs of the future.

Most importantly, the challenges and opportunities of the future will require thinkers and workers that are eminently agile and adaptable. Increasingly, disciplines are converging to create new fields of knowledge. As a report prepared for the Australian College of Learned Academies points out, many of today's jobs in STEM fields did not exist a decade ago (Bell et al. 2014). There is no reason to believe that the exponential increase in scientific advances will run out of steam so it is likely new fields will continue to arise with increasing rapidity. Collaboration and interdisciplinary research will become ever more important, and the advances afforded by science will rely on scientists from different areas working together, and also in concert with non-scientists. A quote widely attributed to Niels Bohr, who pioneered the modern interpretation of the structure of the atom, says that an expert is 'someone who has made all the mistakes that can be made in a very narrow field'. However, the days of the very narrow field are probably numbered. I think the expert of tomorrow will be someone who sees the importance of not only their own mistakes, but also the mistakes in the fields of others. Of course, this is not to suggest that the chemists and scientists of tomorrow will not be specialists in their field – it will simply be increasingly important for scientists to be aware of developments beyond their immediate sphere, so as to adapt to developments as they arise.

Despite the rapid rate at which the science

and the world generally will evolve in the future, I think that the practical business of science and research will retain considerable continuity with the past. The ability for scientists to be inspired by curiosity and to be challenged and stimulated by their peers will remain crucial elements of scientific endeavour. The only proper currency in the conduct of science will continue to be good ideas that withstand rigorous investigation. Comfortingly to those founding fellows that I invoked earlier, I think the place of the student conducting good experimental work in science, and chemistry in particular, is assured.

And most importantly, in considering how we will approach the future, I think we can still learn from the successful ideas of the past. The philosophy of Sir David Rivett, founding fellow of the Academy of Science and Professor of Chemistry at the University of Melbourne, when setting up CSIRO was simple but effective: 'Determine the field that you want to study, find the best person to lead the group, get them money and give them their head.' (Moyal, 1994).

I might finish with Dr Max Perutz, who won the 1962 Chemistry Nobel Prize with John Kendrew for 'their studies of the structures of globular proteins' and founded the MRC Laboratory of Molecular Biology in Cambridge. He was asked about the secret of success that subsequently resulted in the award (so far) of ten Nobel prizes for work carried out at that institution. 'The principles he used were: choose outstanding people and give them intellectual freedom; show genuine interest in everyone's work, and give younger colleagues public credit; enlist skilled support staff who can design and build sophisticated and advanced new apparatus and instruments; facilitate the interchange of ideas, in the canteen as much as in seminars; have no secrecy; be in the laboratory most of the time and accessible to everybody where possible; and engender a happy environment where people's morale is kept high' (Thomas, 2002). This is not a bad recipe to start with.

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Reflecting on the Future of Work in Australia: Pessimism, Optimism and Opportunities

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Abstract

This essay has been adapted from a presentation made at the *Royal Society of New South Wales'* forum on *The Future of Work*. The impact of technology and innovation on the future of employment in Australia is examined from both pessimistic and optimistic perspectives. It concludes with a discussion of Australia's opportunities and suggests a number of measures that could be implemented to help Australia improve its technologically driven prosperity.

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1. Introduction

Thank you, Donald, for the invitation, and Governor, thank you for your inspiration and wonderful hospitality.

Today I will assume the role of the techno-optimist, and I will present a broad-ranging discussion of some of the technologies and innovations that will impact jobs and job opportunities.

To start, though, I will put on the pessimist's hat and share with you some of the many reasons to be gloomy about future employment prospects. Then I'll explain why I am optimistic, and finally I'll review a number of measures that if implemented would help Australia improve its technologically driven prosperity.

2. Pessimism

First of all, if you look at GDP growth, not over the last year, but over the last two millennia, you'll see that it's been flat until more or less the industrial revolution, when it started on an exponential rise (Roser, 2015). Which means that the pace of change that we're all dealing with is beyond that which we evolved to manage, and is almost enough to overwhelm people's ability to cope.

And then, of course, there are the many predictions of permanent losses of jobs. For example, in 2013 the Oxford Martin School at the University of Oxford predicted that in the United States almost half of all jobs in the United States will not exist within two decades, lost to computerization (Frey and Osborne, 2013).

Not to be outdone, PricewaterhouseCoopers (PwC) undertook a survey in Australia in 2015 and reported that 44% of jobs in Australia that we enjoy today will not exist in about 15 years from now. They also predicted that 75% of the replacement jobs will require science and technology skills (PwC, 2015).

Hugh Durrant-Whyte and his colleagues at CEDA recently published a report on the impact of computerisation and automation on employment in Australia. It predicts that

at least 40% of today's jobs have a 70% probability of being lost to automation in the next 10 to 15 years (CEDA, 2015).

And not so long ago, in 2011, two MIT economists, Erik Brynjolfsson and Andrew McAfee, analysed the trends in jobs and productivity and identified a displacement between productivity and job creation. They predicted that technology will continue to produce wealth, but not with accompanying new jobs, and therefore there will be a permanent loss of jobs (Brynjolfsson and McAfee, 2011).

If you look at what's been happening in Australia in the manufacturing sector in the last 30 years, the number of people employed in manufacturing has fallen from 16% to 8% (Conley, 2014). It's a staggering change that we've gone through in just three decades.

Another thing that adds to my pessimism about the future of jobs is the fact that in Australia our government invests very little to help researchers and other inventors translate their technologies into the market place. A couple of years ago the OECD published a report on competitiveness and innovation. In that report they presented the 2011 data for the direct government investment in business R&D and the indirect investment via tax incentives. On the direct investment data Australia was second last, just ahead of Mexico. The leaders such as Russia, the United States and South Korea had ten times or more direct government investment than in Australia (OECD, 2013).

A second surprising and telling indication from this data set is that the balance between direct and indirect government investment is completely inverted in Australia. The Americans give a lot more direct funding cash to inventors to help them undertake feasibility studies than we Australians do. We provide most of our funding for business R&D through the indirect means of the R&D tax concession. It is not clear to me based on personal experience and discussions with other business leaders that the indirect investment through the tax system is an effective utilisation of the money foregone.

Yet another reason to feel pessimistic is the stop-start nature of government policy. You might have noticed; very few policies last for more than a handful of years. For example, in the innovation sector we've had Commercial Ready grants, START grants, COMET grants, Commercialisation Australia grants, Accelerating Commercialization grants and more. They come, they go; the rate of change is such that none of them are given the opportunity to have long term positive effect. This is in stark contrast to the United States, where the well-funded Small Business Innovation Research (SBIR) grant scheme has been in continuous effect since 1982.

Sometimes there are unanticipated drivers that dissuade innovation. For example, in Australia there is an excellent system for measuring research excellence. This system, called Excellence in Research for Australia (ERA) is administered by the Australian Research Council (ARC). The ERA collates a large range of data to measure research excellence. But because it is heavily weighted towards publications and citations it inadvertently creates a bias within the universities against engaging with industry, because the time that a researcher spends working with industry is time not spent at the bench or at the computer doing the research and writing up papers for publication and consequent citations that will give her department a good score in the ERA. It's not the intention of the ERA to discourage

engagement, but in some university departments it has that effect.

Here's another reason to be pessimistic. If the government is not driving innovation, you would hope that private firms would step in and carry the mantle. In some areas they do, but in the so-called high-tech space they don't. There is no agreed way to measure "high-tech" activity, but one way is to look at firms that are backed by venture capital. In the United States and Israel, more than 10% of GDP derives from venture-capital backed companies (NVCA, 2011; Cohen and Scheer, 2015). In Australia, the contribution to GDP from such firms is a mere 0.2% (AVCAL, 2013); private industry is clearly not picking up early stage translation of technology from the lab to the market place at an acceptable rate.

Of course, another reason to be pessimistic is the excess of regulations. We have what I refer to as vertical columns and horizontal layers of regulations. The vertical columns are the duplications going from federal to state to local government. The horizontal layers are the duplications across departments. This is a well-known problem, afflicting many countries. The solutions are in some cases to eliminate the duplications. In others, to appoint a lead regulator to coordinate the filings. It is worth noting that the Australian government is in the process of reducing regulatory duplications.

Another driver of pessimism is the media. Nearly every day I read in the paper something about job losses, or a report on a failure in our tax system, or school education that's not working in Australia, as if we are the most dysfunctional country on the planet. It's negative thinking. It is rare to see a positive report such as "3,000 jobs created". This negative reporting impacts people, undermining their confidence to start companies or try new careers.

But the fact that pessimism is a state of mind doesn't mean that some of the concerns aren't real. Take the upcoming driverless cars. Many of the major car companies such as Mercedes, Volkswagen and Volvo are working on autonomous vehicles as too are new entries to the field such as Google. These new types of vehicles have the potential to deliver a lot of benefits. They'll reduce the rate of car accidents and deaths. As we grow older, unlike my 90 year old mother who still tries to drive herself despite the entreaties of her three children, we'll all have personalised 'chauffeur driven' driverless cars to take us around, which is fantastic. Further, since the cars will be able to talk to each other and central control computers there will be less congestion.

But the impact on jobs will be huge. You know about Uber. Uber is a novel model where private individuals arrive in their cars to take you to where you need to go. Now imagine that the cars drive themselves, and anticipate a complete change in car ownership patterns so that individuals don't own cars anymore. Thus instead of your personal car being parked on average 22 out of every 24 hours, we'll have far fewer cars each working a lot harder. But it will mean fewer jobs in manufacturing to make those cars. So the jobs for drivers will disappear and there will be fewer manufacturing jobs.

If anything can justify feeling pessimistic it is the onrush of super intelligence. For example, in 2011 an IBM computer named Watson (after the company founder) won the American quiz show named Jeopardy. This is a quiz show that requires not just knowledge but intuition and flashes of inspiration. Winning Jeopardy was a much tougher

challenge than winning chess or backgammon.

IBM won US$1 million prize money in that game show, but they spent an estimated US$900 million to $1.8 billion developing Watson (CNN, 2010). Are they silly? Of course not. It was just a means of motivating their engineers, it was a challenge. But now they're rolling Watson out into very high end jobs. It is hard to think of a higher end job than a medical specialist. Well, at the Memorial Sloan Kettering Cancer Centre in New York, IBM Watson, the computer, acts as an expert computer oncologist providing second opinions to the expert human oncologists.

In banking, the risk assessors and financial advisors are on the way out, because IBM Watson is stepping in at the ANZ Bank and other banks around Australia. These are high end intellectually demanding jobs.

I've given you many reasons to be pessimistic. Time to flip, and talk about some of the reasons to be optimistic.

3. Optimism

I'm optimistic because the reality is that pessimistic predictions are rarely correct. You hear about impending doomsday all the time, but fortunately we're still here. Doomsday predictions rarely eventuate. In 1970, Alvin Toffler wrote a book named Future Shock (Toffler, 1970). In it he talked about the stress that people were feeling from the rapid rate of technological change. By today's standard the rate of change was modest. Video tape was being introduced for recording movies and home videos, and the first mobile telephones were available in the form of in-vehicle installations. Well, 40 years later the rate of change is far, far greater, and you know, what? We're all coping well. We are dealing with the future shock, even today, despite it occurring at a much higher rate than concerned Alvin Toffler.

The classic doomsday prediction that did not come true is peak oil. After the Club of Rome published its treatise in 1972, I grew up worrying that I wouldn't be able to drive a car in my later years because there would be no oil. The concern started with Marion Hubbert, who predicted that oil production in the world would peak in the late 1990s, maybe as far out as 2000, and then go into terminal decline.

Well, the reality is, if you look at a graph of global oil production it is continuing to rise steeply, with no hint of reaching a peak or entering a decline. Oil production has grown steadily right past the year 2000 where Hubbert and others said we should have hit peak oil. Why does it keep going up and up and up? Because of innovation, because of technology. Technology can help us recover from the problems that technology causes. Innovation, or human ingenuity, is always there in abundance, wiping out the predictions of doom.

Let's talk about jobs. In 1779, the legendary Ned Ludd used a sledgehammer to smash the stocking machines that were taking away jobs from people in the garment industry in England. Hence the term Luddite. Ned and his co-workers didn't stop the machines. But neither did England enter an era of permanent unemployment.

John Maynard Keynes, the world famous economist, in 1930 wrote that the rate the United States was finding ways to replace the use of labour was outrunning the pace at which new jobs could be found (Keynes, 1933). He talked about a new disease – technological unemployment. He was

genuinely worried but he was smart enough to realize that the dislocations to employment were likely to be a temporary phase of maladjustment. Employment recovered. In 1961, Time magazine ran a story in which they concluded that the rise in unemployment in America at that time was due to automation (Time, 1961). Fear of automation got so bad that in 1964 President Johnson created a special commission to look into what could be done to save jobs in America from the threat of technology and automation. But by 1966 when the commission delivered its report, the United States was again approaching full employment.

Despite the fact that new jobs have replaced lost jobs again and again, it is always the case that the prognosticators say, "This time it will be different".

So let me go back to the MIT economists, Brynjolfsson and McAfee, who published the book Race Against the Machine (2011). They predicted that this time it would be different, that we are entering a period of permanently increasing unemployment.

Let's see how good they were at predicting the future, even in the near term. At the time that they published, unemployment in the United States was 9%. Today, August 2015, it is 5.1% (Bureau of Labor Statistics, 2015). It went down, not up. So in just four years they got it completely wrong. Prediction is difficult, especially about the future, and experts get it wrong all the time. They fail to take into account innovation, because as economists they only want to consider things they can quantify but in the case of innovation they don't know how to quantify it. Innovation leads to the creation and the invention of new opportunities. Time and time again, predictions that ignore innovation fail to anticipate major improvements to our health and wealth.

The biggest change in job sector employment that you'll ever see is in the farming industry. In America, 90% of people in the year 1800 were employed in the farm sector. I don't mean they were necessarily farmers, some were but the rest were rural merchants, or the manufacturers of the ploughs or the people storing the grain. Employment in the farm sector is now down to around 1.7% (Perry, 2011). At the same time, the output of the farm sector has grown enormously. Of course, as employment in that sector collapsed from 90% to less than 2%, unemployment did not increase by 88%. Instead, new jobs were created.

I'm also optimistic because here in Australia we have some fantastic examples of innovation. People think of innovation mostly as being in the high tech sector, in venture capital backed companies. But some of the big companies do a great job too. In high tech, we've got the cochlear ear implant, it's done wonderfully well for Australia. But our traditional big banks are innovative, too. Our banks have spent and continue to spend billions and billions of dollars on developing software for their internal systems, and also software for their customers. Our banking system is, if not the most advanced in the world, one of the most advanced in the world. Innovative technology serves our banks brilliantly and they are making huge profits.

One of our biggest mining companies, Rio Tinto, has a *Mines of the Future* program in which they deploy driverless trucks in the mines and remotely operate underground drilling machines. Everything is either autonomous or controlled by experts back in Perth. This increases the safety profile of the

mine, improves the economics and reduces the environmental damage. This innovative approach has allowed Rio Tinto to continue mining profitably despite the collapse in iron ore prices.

I'm also optimistic because I think we do a good job on workforce discipline training in Australia, and we are getting better. Further, at our universities we're now teaching entrepreneurship, we're setting up mentoring programs and we are teaching postgraduate students broader skills in communications and project management.

I'm optimistic because new companies create new jobs. This is well documented in the United Kingdom where it has been shown that companies created between 2007 and 2010 contributed 36% of the new jobs in that period (Anyadike-Danes et al., 2013). Similar results have been shown in Australia.

It is important that job destruction should not be considered to be synonymous with permanent loss of jobs. What the UK study found is that in a 12 year period, from 1998 to 2010, each year about 28% of the jobs in the private sector were destroyed and replaced. Often that's within the one company but either way, it is a lot of job churn. We tend to focus on the losses, but there's simultaneous creation.

I'm optimistic because we have improved the public discourse in this country about how science and technology and research can contribute. We've got a national science policy underway and some research priorities established. The government is talking the right talk, although there's very little action yet. There are a lot of reviews underway on research funding, research training and research infrastructure to support the research endeavour. I would hope that with the recent replacement of the Prime Minister there might be an even more welcoming acceptance of the need to do things differently.

So I've gone through why I'm pessimistic, and why I'm optimistic, but it's not enough. We have to think about where the opportunities lie and what we can do to drive growth and prosperity.

4. Opportunities

Universities generate research outcomes. Companies want to commercialize proven technologies. We've got both these ends of the innovation spectrum in Australia. What we don't have is a means of getting the research outcomes from the university to the point of being a proven technology. This is often referred to as bridging the Valley of Death. As a result, we don't have enough innovative small firms in Australia.

There are many things that can be done to try to address that. To start, we can learn from the United States. There the government helps to provide the funds to build the bridge over the Valley of Death, through programs such as SBIR, many programs run by the Defence Department and programs for medical technology development run by the National Institutes for Health. These highly effective programs are why the direct investment by government in business R&D is so high in the United States, as I mentioned earlier. We would do well in Australia if we mimicked these programs.

Now, of course, in the United States they've also got venture capital funding and even debt funding for startups. There's a bank called the Silicon Valley Bank that, unlike our banks, seeks to invest in high risk companies. We would also do well in Australia if we could mimic these funding sources.

We need to attribute value to the effort by university researchers to engage with their industry counterparts. Earlier I talked about ERA, which despite being a robust measure of research quality inadvertently has a negative influence on how researchers engage with industry. Cognisant of this, the Academy of Technology and Engineering (ATSE), of which I am President, has proposed a new metric to encourage collaboration between researchers and industries. It will be a pragmatic measure and it will be quantitative. It will not replace the ERA, instead it will sit alongside it.

What improvements do we need to consider to prepare the workforce for the future? One often hears that we need more science, technology, engineering and mathematics (STEM) graduates. However, in a recently published paper, Bob Birrell (2015) from Monash University analysed demand and concluded that with current government policies we are actually training too many STEM graduates for the number of jobs available. It's sad to hear that, because like many others I have personally been doing my best to encourage young people into the pipeline.

We have to train people to work in a fragmented workplace of the future where there will be many more people self-employed, some working in micro or mini entrepreneurial start-ups. But at the same time, we must not neglect the need to train people to work in large firms. Employees need to be flexible, they need to have deep discipline knowledge. There's a tendency to believe that with so much easily accessible information available it is not necessary to train people in deep discipline knowledge. That is not correct, because coming to grips with the intricate details of a subject is a necessary skill. Even if you're trained in arts, you can become a business person, or if you're trained in engineering you can become an HR manager, because the ability to deeply analyse is a skill that is required in the workforce and is learned by intensively studying any discipline. For all these reasons we need to support training and retraining for displaced workers.

Further, we will need new regulatory frameworks to manage the encroachment of artificial intelligence and robots. Artificial intelligence and robotics have the potential to do a lot of specific harm. For example, much concern is already being raised about AKMs, autonomous killing machines. These are drones that aren't controlled by somebody sitting in Los Angeles, but instead are given a mission, and given the authority to autonomously make attack decisions according to their mission profile.

We need to build confidence across our community in starting new businesses. Returning to the UK, it's stunning to learn that 200,000 firms are born every year creating about 1 million new jobs. Within 10 years four out of five have closed. However, the small fraction of firms that remain will still employ around half a million people (Anyadike-Danes et al., 2013). And all the time there are more and more startups that make a crucially important contribution to jobs and the economy.

So what if my optimism is misplaced? If I'm wrong then we need to be planning for a different society, and now is the time to be planning. We've got to be planning strategically. Unfortunately, for quite a few years now there's been a lack of long term strategic planning in our national government. We cannot afford to continue that way.

It's not necessarily all bad even if I am wrong and jobs disappear. Remember that loss of jobs does not necessarily equate to loss of wealth. What Brynjolfsson and McAfee from MIT were saying is that there will be massive productivity increases due to automation, huge amounts of wealth will be generated, but there won't be jobs. They've been wrong about employment in the last four years, but what if they're right in the long term? There will be tons of wealth. The challenge is to adapt our society to one in which the wealth can be distributed in an equitable fashion to the people who aren't working.

But wealth without jobs is not a comfortable solution because most people define their self-worth through their jobs. If our society goes this way at the very least we will create jobs for psychologists who will be needed to help people create their personalized definition of self-worth outside of employment.

Perhaps we can learn how to do this from the science fiction literature. One of my favourite books is called The City and the Stars, by Arthur C. Clarke (1956). I won't take you through the whole narrative, but wealth without jobs is exactly the theme that Arthur C. Clarke back in 1956 was tackling in this quite beautiful short novel, where no one, not a single person, had a conventional working job, because everything was taken care of by the central computer and the robots.

5. Conclusion

To summarize, we have to accept that the pace of change is rapid and will become even more rapid. Amazingly, young people, middle aged people, all of us, can cope. We have to invest in innovation to create the jobs that replace the jobs that innovation destroys. We can't just say "Innovation destroys jobs" and leave it at that. We've got to say "Okay, that's the nature of innovation, but it can also create jobs". We have to optimise that result.

We have to invest in workforce training and re-training because the job opportunities will be changing at a rapid rate. And as I said, if I am wrong in my optimistic view of employment, we have to start planning a different society.

6. Discussion/Q&A

"Many thanks for your very interesting and stimulating presentation. It strikes me that most of the data and analysis are taken from the USA, Europe and Australia. They focus on national labour market trends, especially with regard to cost-benefit considerations concerning automation of various types of work. Today, much industrial production is structured by an international division of labour and by global value-chains. Developed economies still focus on industrial products, even though the actual production work is often carried out in low-wage economies. In other words a product like a computer or mobile phone may include components made in several different countries – such as China, Vietnam and South Korea – while design and marketing remain mainly in the USA, Germany or another apparently post-industrial economy. This enables transnational corporations – still mainly based in developed economies – to capture most of the value of the product and to maintain high rates of profits, due to the low-levels of wages and social rights in the places where most of the work is actually done. Please comment on this observation, and on the prospects for automation in economies which today have very low wage rates."

- *Professor Stephen Castles, Research Chair in Sociology, The University of Sydney.*

"It is true that the supply chain is global. For many products that has been the case for a long time. For example, I made scientific instruments in California during the 1980s and a lot of our components came from Japan and various European companies. But accepting that globalization of the supply chain is increasing, it is an opportunity as well as a jobs threat. The opportunity is for our domestic suppliers to provide components to global companies. If we don't do that, and if we don't manufacture much here, the manufacturing job numbers will go down again, starting from what is already a single digit percentage. But jobs will likely increase in other sectors. For instance, through my company Cosmos Magazine we publish secondary school science lessons. In the old days, these would have been printed, and there would have been manufacturing jobs for printers, storemen and packers. Today, we distribute the lessons out of the digital cloud, but we employ a team of software engineers to develop and maintain the digital delivery platform. These are new jobs replacing the manufacturing jobs."

- *Dr Alan Finkel, President ATSE.*

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Crisis and Change: Learning from the Past to Prepare for the Future of Work

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Abstract

Until the point of crisis in the discussion about the future of work, it is still rather abstract – but it is clear that technology and economic change will rapidly reconfigure the way we work, and we need to prepare. Part of that preparation involves learning from past crises as a result of economic restructuring. It also involves identifying future opportunities not just in the STEM areas, but the crucial skills and expertise that come from the humanities and cultural sector. Technology will not only obliterate many well-established jobs, but it is possible that the role of work in social and political organisation will change and preparing for that will test many established institutions.

Framing the Narrative

The future of work will probably remain an abstract after dinner and conference discussion, until a crisis provokes us to think differently about what is at stake. Australia has been a rich and economically successful country for so long, our muscle for responding to disaster and crisis has not been well practiced in recent years.

Although there has been political talk about a declining economy and shrinking employment opportunities, the occasional mention of rising unemployment is more than offset by the repeated political declarations of new jobs created. I note that the outgoing Prime Minister's final tweet suggested he had created 300,000 jobs. I don't really know what these jobs are – is that a net figure, are they full time, where are they? No doubt this is all robust, but at the level of public discourse it is hard to know for sure, especially when the lived experience and anecdotal insights suggest that all is not quite as it seems. Hopefully the new Prime Minister's emphasis on innovation will mean that we are on the cusp of new industries being created that play to the embedded strengths of this country.

It is not sufficient to wave our hands around and talk about reform of the expenditure side, there is an increasingly urgent need to get the settings right to enable new jobs to be created as a consequence of new businesses and industries being formed. When you look at the top companies on the Australian stock exchange and compare them with the top companies on the exchanges of other comparable countries the problem is clear. While our top companies have adapted and used technology to improve their businesses, there are none in the top group that are themselves a product of technological innovation in the way that the new top group in the US for instance are a product of technology, innovation and hard headed

determination to engage with the what is being called the new Creator Economy.

For sometime now we have been hearing about the disappearance of jobs thanks to automation and changing industry structures. Yet even as the figures point to a slight increase in the proportion of people in full time work, huge numbers of people work part-time often with precarious contracts. Some say that they like this arrangement, that the flexibility is what suits them, but in a society that is still largely organised around work this has costs and consequences that play out in many ways – not all of them positive.

It is human nature not to want to deal with worst-case scenarios, to not address issues until they have become pressing and urgent. And we in Australia have been insulated from many of the worst global crises in recent decades. But if the predictions are right and the economy is contracting, traditional industries are closing, and almost half of all jobs can be automated out of existence it could be that we have a looming crisis.

There are advantages in a crisis – it can provide the cover needed to change and innovate, to look harder, to find realistic and sustainable solutions, to reconsider the values that define an organisation, a society or a nation.

We are not yet at the point of crisis in this discussion about the future of work, it is still rather abstract, like a storm building on the horizon – but it is clear that the storm is brewing and we need to prepare. Part of that preparation involves learning from past crises.

Lessons from Wollongong

It is exactly thirty years since my book, *Steel City Blues*, was published by Penguin. The book, in the words of the subtitle documented the 'human cost of industrial crisis', explored what happens in a region when the economic foundations that had underpinned its growth imploded, what it meant for people, for business, for local government, for the political system.

When I look back on it now, it seems as though it was describing a different world.

In the early 1980s Wollongong and the Illawarra was a region in crisis. The steel and coal mining industries that had been its raison d'être were caught in a pincer movement of collapsing global trade and rapid technological change on one side, and on the other the consequences of underinvestment, old fashioned and counter productive methods of industrial relations and community relations and a lack of economic or industry policy clarity from Canberra.

As I put this list together, it strikes me that maybe at some meta level that world isn't so different to the world we know now – but it is, and although the future is impossible to see the shadowy outlines can be made out and need to be taken seriously. The shadowy outlines before us now are more profoundly different than any that could have reasonably been imagined thirty years ago, it may be that we are on the cusp of a crisis that hasn't yet taken form.

At the time it was the latest, and worst. iteration of the recessions that the country had been unable to shake since the OPEC crisis and its consequences began to ricochet around the globe in the early 1970s. Although it seems odd now, during the decades between the early 1970s and early 90s recessions were normal, sustained periods of growth were more unusual.

As a result of this perfect storm that began in late 1981–early 1982, tens of thousands of people lost their jobs and the future not only seemed dire, it was. There were few alternatives, the unemployment rate shot up into double digits and stayed there, people lost their houses, others were forced to move, families fractured under the pressure. It was hard to be optimistic.

Wollongong at the time was one of the industrial cities – Newcastle, Geelong, Ipswich, Elizabeth, Kwinana – that had grown up adjacent to the capital cities during the middle years of the last century. Places where the dirty work that needed space could be done. Places with cheap land, access to ports and transport. Places that it was easy to overlook or ignore from the gleaming office towers of the CBD, even as they generated healthy profits. Places that became home to the hundreds of thousands of migrants who were brought to this country to provide the muscle needed for industrial operations. Low tech, relatively low skill, jobs that did not demand fluency in English or a capacity for innovation – classic working class jobs that were not fundamentally dissimilar to the jobs that had formed the basis of economic activity since the industrial revolution.

So when BHP, which at the time liked to be known as The Big Australian, stopped hiring, and then terminated the completing apprentices, and then started making people redundant, the reaction was one of shock and anger. Within a year more than 4,000 jobs had gone from BHP's operations in steel and coal alone. When another 430 redundancies were announced in its Kemira mine, the men at the mine decided it was time for direct action. Thirty-one of the fittest men opted to stay underground to draw attention to the situation, and they stayed there for 16 days.

This became a catalyst for action locally and attracted national and international attention when thousands of locals travelled to Canberra demanding action from the Fraser Government. Memorably the pressure of the crowds on the doors of the Old Parliament House broke the glass and the protestors pushed in and took over Kings Hall.

The raw display of anger and passion terrified members of parliament – the fear was palpable. But it also put the plight of the region on the political map, and crystallised a crisis that required a serious response.

A few months later in his last big campaign event the Leader of the Opposition Bob Hawke helicoptered into the Bulli Showground and addressed a huge rally, promising that if he were elected there would be a new industrial policy within a hundred days, improved support, and opportunities for retraining and education so that sacked industrial workers would be able to transition to the service economy.

The Importance of Remembering

I was reminded of this a couple of months ago when a reporter from a Wollongong radio station called and asked if I would be willing to do an interview. At the time BlueScope, which is what BHP's Australian Iron and Steel subsidiary became as part of the restructuring that followed this shock in the 1980s, was saying that unless it got rid of 500 jobs to save $200 million it would close down and take 5000 jobs with it. At the same time the remaining coalmines had begun to announce closures and massive jobs cuts. Technology, global trade, productivity were up for grabs and jobs would have to go. History seemed to be repeating itself.

Which was why the reporter called me, 'It has happened before. No one knows the history

though,' he said, 'they have forgotten what happened before and there is hardly any reporting of what is going on now.'

I declined, it was so long ago, and I felt I hadn't kept up with what has happened well enough to speak publicly about it.

But it did make me think about what has changed. At the time the process of deindustrialization was working its way through well-established towns and enterprises all over the world – driven by technology, competition, consequences of underinvestment. The same thing was happening in Britain, in the industrial and coal mining regions of Britain. Companies in Australia, US, Britain were learning from the then ascendant Japan about other forms of employment and supply, just in time, outsourced and so on.

Nonetheless while the notion that industrial jobs would give way to service jobs made sense in theory, for the people who would have to make the transition it seemed almost absurdly fanciful. The idea that Wollongong could be a tourist and lifestyle destination known for its spectacular environment was regarded as a joke – quite literally, remember Aunty Jack. The promise that the university could become not only the largest employer, but the generator of real economic wealth and innovation seemed unlikely. As were the ideas that the technology and labour relations of steel making could be restructured with higher producing blast furnaces and networks of distributed sub contracting firms and genuine global markets rather than international markets sopping up local overproduction; or that mining would be transformed with open cut mining becoming the norm; or the suggestion that the level of unionization would drop from 80 percent to 20 percent. Or that the local newspaper would make do with a dozen journalists, where once there were six times that many, who inevitably could not cover what was happening closely enough to make sense of it, or galvanise action by the power of story.

But all of these things have happened. The move to a service economy has left some behind, but it has also created new opportunities and new jobs for more people, especially for women. Now we are on the cusp of a much bigger change – the next forty percent of jobs that go will not be the relatively easy pickings of the past, the next round of automation, and globalization will shake established patterns of working and living to the core.

Service will not be a saviour in the way that it was as manufacturing contracted. The service economy will itself be transformed, much of it done by automation or by highly educated and cheaper employees off shore. Unless the service is something that must be done personally and by hand, it will evaporate.

I mention the huge cuts to the local Wollongong newspaper – business models have collapsed in the media, the jobs lost there have not been automated away, although many have been sent off shore. What has happened in the newspaper business is part of a pattern which has been the number of journalists in Australia reduced from 12,000 to about 6,000 over the past decade, but the next step is already taking shape, the automation of basic news reporting, by systems that use data and algorithms to produce an unlimited number of stories with little human intervention. Such a thought would have been unimaginable thirty years ago, when the target was to reduce the number of people manning the printing machines, now the journalism trade press is full of articles comparing the

merits of different systems and modes of automation.

The Emerging Precariat

Over the next thirty years the automation of work will I expect challenge the political and economic framework. As the Oxford Martin Commission for Future Generations noted: 'Economic models and political systems based on desire for full time work may have to be changed.'

I will come back to this profound observation later. Work has been a useful proxy for allocating income, but in future it may not be relevant. It has not been perfect, there are obvious disparities, like the way women are paid a fraction of what men are paid for doing the same job, or the way people working in the finance sector hang onto the money and don't make it available to those working in the social sector, or the way that the owners of football teams can make millions themselves, and spend billions on TV rights but pay the players $20k a year.

Work and money have not been precisely paired.

But in an increasingly automated future this nexus will be challenged even more, especially if once expensive information based services can be provided for marginal cost as many are predicting. This could be really profound, much more so than the changes we have seen to date – such as the deindustrialisation of Wollongong – even if the CEDA prediction of the abolition of 40 percent of jobs in Australia, or 48 percent of all global jobs is not fully realized.

In the meantime there are some pointers to what is happening and this is what I addressed in the *Griffith Review 45: The Way We Work,* which we published this time last year. It documented the on the ground way that work has changed from up close. Some of the profound changes are happening, almost in front of our noses and certainly universities are at the forefront of this. Our universities are great places of scholarship and innovation, and for those with secure jobs a great place to work. However increasingly, considerable amounts of the work done in universities is done by people who do not have security – members of what has been called the 'Precariat'.

Evolving the Way we Work

Australia was once known as the land of the long weekend. It was a snappy catchphrase that, like all the best clichés, embodied enough truth and ambiguity to endure and inspire a book, a film, countless newspaper headings and a few European websites imagining the land down under as a new utopia.

It was, however, not an affirmation, nor praise for a place where the work and life were balanced and certainly not an aspiration. It was not even an ironic dig, like Donald Horne's conjuring of a lucky country. It was critical of a people and place where things were taken too easily in their stride, where work was constrained by regulation and limited aspiration. A place where when people knocked off work they went home or to the beach or to football or the pub and got on with their lives. In 1978 when Ronald Conway's book was written, you couldn't even go shopping when you finished work, because with the exception of one night of late night shopping a week, the doors closed at five on weekdays and noon on Saturday.

What an odd notion, like the chimera of an old dream that can be dimly recalled, a trick of the imagination, was there really such a place…

Across a couple of generations, and in the living memory of anyone over forty-five, the nature, place, regulation and experience of work has profoundly changed.

Australians are now near the top of the list of working hours for those, in developed countries; a substantial and growing proportion of people work part-time – not all by choice; unpaid internships are the normal entry path for young people; women are no longer forced to resign when they marry or become pregnant, but the wage gap remains; manufacturing and agricultural jobs have given way to working in services, and now those jobs that don't actually demand hands on contact are also moving offshore.

When Conway wrote his book, well over half the workforce was in a union, now it is less than a fifth, increasingly low paid women; the expectation that you could start working with one organisation and after moving through a number of different occupations still be there forty or fifty years was not without foundation; the demarcation between white and blue collar jobs, between those who earned salaries and those on wages, was clear and embedded.

Now the proletariat is giving way to what has been called, the precariat, a new class who lack the stability and certainty of regular work or predictable social welfare. Guy Standing has done a Ronald Conway and used this for the title of his new book, and an accompanying volume *A Precariat Manifesto* (Bloomsbury, 2014).

Change, Recession & Predictability

Technology and globalisation are contributing factors to the profound changes to the way people are working here and elsewhere and now new forms of automation are threatening to disrupt well established principles of politics, economics and social relations. The opportunities in the always-on always-connected world are exciting, the ability to move ideas, goods and people around the globe with unprecedented ease transformative, but there are costs.

We are now living through a period of change as great as any in human history – like the move from agriculture to industry, from manufacturing to services and beyond, it will play out in ways we can only guess at.

The great transformation of the Australian economy that has unfolded since the 1980s, as a result of deregulation, the agreements between unions, employers and government, the targeted delivery of social benefits, has produced a rich and stable society.

The next stage of this development will be somewhat less predictable, the economic modeling has not reached a consensus, and the impact of automation will depend on decisions by countless companies and countries.

After an unprecedented period of growth, of rising incomes and standard of living, of unemployment at historic lows, it is easy for forget that this is the exception not the norm. Most transitions are lumpy, the future is rarely reached by travelling down a well lit path. Those over forty-five remember what it was like to live in a country which had periodic spikes of unemployment, even billionaire MP Clive Palmer recalled being unemployed for six months after university. There was a period of high unemployment in the mid to late 1970s, in the early 1980s it reached higher highs, then again in the late 1980s and during the recession we had to have in the early 1990s. There was a sense that unemployment, insecurity, closing and

collapsing businesses, were normal and the periods of growth and good times were the exception.

Inequality and the Role of Work

The new normal at least in the short term might be more like the old normal, but with a bigger dollop of inequality. Inequality is the new buzzword, between countries and between people. French economist Thomas Picketty galvanised international discussion about this, and how the way we work and are paid for that work can foster inequality. His book *Capital in the Twenty-first Century* broke all records for publication by Harvard University Press, topping the Amazon best selling chart for several weeks. The former academic and now Labor MP for Canberra, Andrew Leigh used a different frame but reached similar conclusions about the rising levels of inequality in his book *Battlers and Billionaires* (Black Inc, 2013), and George Packer's masterful book *The Unwinding* (Farrar Strauss Giroux 2013) documented with heartbreaking detail what it feels like to live without a reliable, reasonably paid job, and the consequences for families and cities.

Australia is not America, where millions struggle to make ends meet with inadequate jobs and social support, or one of those European countries where unemployment rates have reached well into double digits and remained there for years, or one of the many countries where work itself may be life threatening. But even here work is changing. It is less secure and less predictable, forcing us to adapt.

One thing has remained constant, work is essential to economic well-being and meaning, so getting it right is important.

But it may be that at core it will be this nexus that has to break. If automated systems can do the work of journalists and medical specialists and judges as well as the work of account clerks and storemen. What will the new jobs be, will we all need to work, or will we have to find new modes of organizing societies if half of us can't or don't need to work.

This is a big question and one that has not yet made the public agenda, but it is the logical end point of a profoundly different workplace and economy.

Humanities Skills and STEM

As the Oxford researchers who have analysed the jobs that are likely to go[1] found there are nine characteristics that mark whether a job is likely to be automated. The three that point to less automation, do you need to come up with clever solutions, are you required to personally help others and does your job require negotiation, are all characteristics of the humanities.

National Public Radio in the US developed a website where you can enter your job and find the chances of automation: I commend it as a scary game to play with your children. Jobs that are still highly paid and regarded are likely to disappear.

From where I sit in the humanities and social sciences I take some heart from this. It seems that the skills that will be needed in the future, as well as the technological skills to create and drive these automated systems, will be the skills of the humanities – of public sense making, of networking, of empathizing, of learning from history, of creating things and experiences of beauty and cultural meaning. These are the tasks that speak to our humanity and which will be needed.

I have written elsewhere about the possibilities that exist in the cultural sector,

and there is nothing I have read in terms of the future of work discussions, which contradicts this. Sure there are issues relating to protection of intellectual property and the sustainability of the cultural sector, but the evidence is that despite the changes in technology and platforms, that jobs continue to grow in these sectors. The cultural sector is another powerhouse of innovation, full of start ups and micro businesses with the potential to thrive in this environment.

A United Nations Conference of Trade and Development report in 2010 showed that even when global trade was declining by 12 percent a year, the cultural sector had had a global growth rate of 14 percent a year between 2002- 2008 and at that time accounted for $592 billion. Not only is it one of the most rapidly growing sectors, but it is as UN, EU, UNESCO and other reports have shown, a sector that now accounts for about a fifth of GDP in most developed countries and is rapidly growing in others.

It is also one in which Australia has distinctive advantages, a subset of the services sector which satisfies the requirements of enduring jobs. Regrettably it is a sector in which we are in danger of falling short. The cultural economy is one of the great new engines of influence and economic growth, one which plays to many of Australia's strengths as an educated, globally engaged, outward-looking, multi- lingual democratic state, in the same time zone as the world's most populous and increasingly middle class regions.

The cultural sector has the potential to create high value jobs and reward innovation and to enhance the qualities of citizenship. It accounted in 2008-09 for the employment of between 6 and 9 percent of the workforce, generated between $35 and $67 billion of Gross Value Add, according to a report by the 2013 UTS based Creative Industries Innovation Centre, *Valuing Australia's Creative Industries.*

I mention this because in the chase to boost the STEM skills base, which is important, the chances are that in a rapidly reformed world of work some of the best jobs, the most affirming jobs, the jobs that can't be reduced to data and algorithms will come from the cultural sector, which would be handy because the chances are that there will be a lot of people with a lot of time on their hands.

Conclusion

As Dr Fiona McKenzie is the Policy Director for the Australian Futures Project, wrote in the CEDA study, 'Australia is facing a range of megatrends that will change the way we live and work in coming years. We need to start thinking creatively about the opportunities and challenges on the horizon. This goes beyond debating minor reforms or making a few policy tweaks. The world is changing and with it our society, our economy, our democracy and the environment around us. How do we thrive in this brave new world? In a time of increasingly complex and interconnected systems, what skills do we need to navigate our way?

'For those that learn how to thrive in an unpredictable and uncertain world, rapid change and complexity need not be a liability. They can be an advantage. We need to be proactive in building our capacity to make decisions for the long-term while having the ability to successful react and adapt in real time to curve balls thrown our way. We need organisations that can cope with complexity by being able to learn and adapt to changing circumstances. We need leaders with humility, willing to draw upon the emergent and self-organising nature of complex

adaptive systems through empowering others and continuous re-calibration. This requires taking risks, experimentation, and accepting failures. We need governments that are willing to do all these things. And we need citizens that will encourage them doing so. We might be getting older, we can also get wiser. The 21st century is still young.'

As President Obama's former adviser Rahm Emmanuel famously said, 'Never let a crisis go to waste.' A crisis is building, but it is hard to predict when it will hit these shores. We now have the time to prepare for it, the exercise the muscle of innovation and imagination to create a new future. The question is whether we have the willingness to do so.

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Shifting Global Production Systems, Labour Market Flexibility and the new Precariat in Southeast Asia

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Abstract

Researchers writing on the subject of technological automation, job substitution and the rights of low-waged migrant workers in Southeast Asia have linked the continuing exploitation of these workers to labour market flexibility and workers' declining share of national income. Moreover, the establishment of the Association of Southeast Asian Nations (ASEAN) and the ASEAN Economic Community (AEC) has also resulted in reduced labour protections, vanishing labour contracts, inadequate social security provisions and workers' recruitment via outsourcing arrangements. In contrast, the migration governance schemes for foreign skilled workers have facilitated these workers' freer movement through the establishment of Mutual Recognition Arrangements (MRAs) of professional services. This paper examines ASEAN's shifting economic policies as a reaction to the opening up of China and diminishing investment by multinational corporations in the region. It then reviews ASEAN's strategy to develop industrial clusters through growth triangles, ASEAN and the AEC. This strategy has led to an expansion of skilled and low-skilled labour migration in the region, consistent with the reform program developed following the Asian Economic Crisis of 1997-8. Generally, the future of work for low-skilled, low-waged workers has not changed, reflecting the workers' economic polarisation in society.

Introduction

Prior to the outbreak of the Second World War, trans-Asian labour migration was an essential feature of Asian globalisation. During the colonial period, foreign low-skilled labour migration (particularly from India and China) was central to the transformation of Malaya/Malaysia, Singapore and Thailand (Kaur, 2004). After Malaya and Singapore became independent, they (and Thailand) grappled with three major immigration policies that centred on the establishment of legal migration channels and migrant workers' employment conditions. The first policy in Malaya and Singapore (introduced after 1957) discontinued the recruitment of low-skilled foreign workers and shaped new legislation for recruiting skilled migrants. The second policy incorporated the recruitment of both skilled and low-skilled migrants and amendment of immigration regulations to meet short-term labour shortages. This policy also corresponded with the design of circular temporary migration programs for low-skilled workers for the construction, manufacturing and services sectors. These programs were created on the basis of binational labour agreements with labour-sending states (and emphasising the connection between remittances and development). The third policy incorporated the harmonisation of legal channels for recruiting foreign labour, crackdowns on irregular migrants, and new strategies to reduce the brain drain and lure skilled diasporas to return home.

Concurrently, the globalization of production associated with multinational corporations (MNCs) and foreign direct investment flows (FDI), together with fragmentation and locational separability of production processes, facilitated Southeast Asia's industrialization and greater integration into the world economy. Alongside this, the Cold War united the market economies of Indonesia, Malaysia, Philippines, Singapore and Thailand against communism and they established the Association of Southeast Asian Nations (ASEAN) in 1967. The founding members also held the door open for other Southeast Asian states, providing they subscribed to ASEAN's policies. In 1984 Brunei Darussalam joined ASEAN soon after receiving independence from Britain. Then, against the background of the changing global production system and diversion of FDI flows to China and other developing countries, ASEAN leaders endorsed the formation of regional growth triangles or industrial clusters to take advantage of co-locational synergies and undertake industrial upgrading.

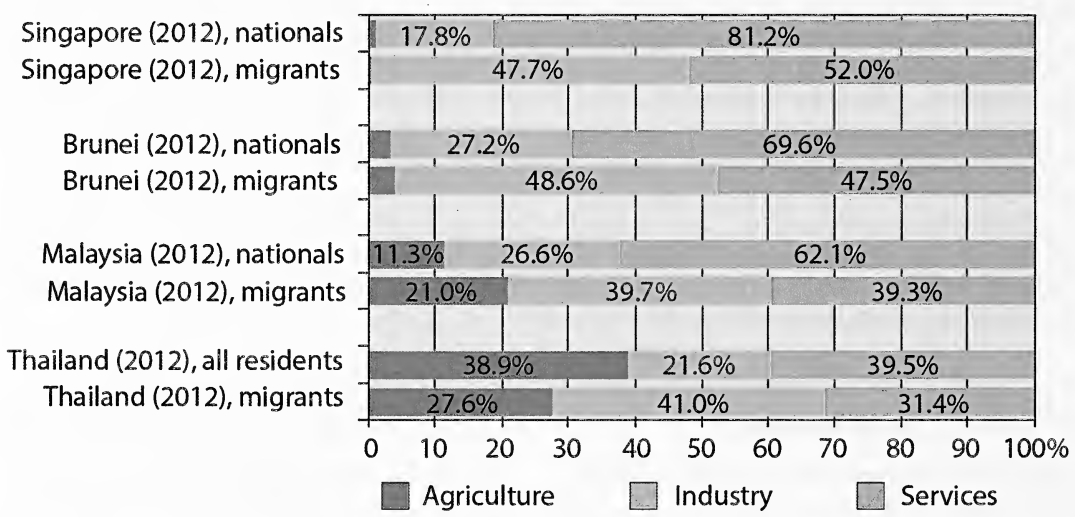

Figure 1: Employment of nationals (citizens)/migrant workers by sector in the main labour-importing countries

Between 1989 and March 1994 ASEAN leaders established three growth triangles, namely, the Indonesia-Malaysia-Singapore Growth Triangle (IMS-GT), linking Singapore with the Indonesian provinces of Riau and West Sumatra and Johor in Malaysia; the Brunei-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA), linking Brunei Darussalam with East and West Kalimantan and North Sulawesi in Indonesia, Sabah, Sarawak and Labuan in Malaysia and Mindanao and Pahlwan in the Philippines; and the Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT) connecting the southern provinces of Thailand, the northern Malayan States, and the North Sumatra Province and Aceh. The Growth Triangles (GT) were envisioned to stimulate the development of outlying or peripheral regions via foreign and regional capital investment and promote low-skilled labour mobility within the ASEAN framework. Similar to the European Union scheme of using quotas for legal migration via

bilateral labour agreements or Memoranda of Understanding (MOU), ASEAN states also implemented new temporary labour migration programmes to facilitate low-skilled labour mobility. The region's commitment to temporary labour migration programs corresponded with simplification of employment regulations and easing of controls on labour mobility within the growth triangles in particular, and ASEAN in general (see Figure 1).

Both Singapore and Malaysia amended their regulatory employment structures for both categories of foreign workers, i.e. high-value/skilled migrants and low-skilled migrants. High-value migrants included those who had exceptional talent, or skilled net-worth investors and entrepreneurs. Skilled workers included those whose jobs might not be filled by citizens.

Professionals and skilled workers subsequently encountered relatively fewer challenges in the three major destination countries in ASEAN. The new geography of "managed" migration, especially in Malaysia and Singapore, made it mandatory for migrant workers to be in possession of job offers and work permits with recognized employers. Of the two, only Malaysia signed Memoranda of Understanding (MOU) with labour-sending states to recruit workers and secure the co-operation of sending states. Quotas for recruiting low-skilled migrants thus became negotiable, depending on the demand for these workers.

The labour recruitment programs included fixed-term employment contracts and a range of restrictions, including workers' repatriation upon completion of contracts. Crucially, private recruitment agencies and intermediaries were therefore entrusted with recruitment and placement processes. Subsequently, as labour outsourcing became widespread in Malaysia, well-connected recruitment agencies too became involved in the trade in labour. These policies not only reduced migrant workers' freedoms but also led to the entrenched exploitation of low-skilled workers in particular.

In 1991, ASEAN members made a commitment to move towards an ASEAN Free Trade Area in 1992. This policy shift corresponded with the reorganization of the General Agreement on Tariffs and Trade (GATT) into the World Trade Organization and the establishment of the European Union in 1991. Following the creation of the North American Free Trade Agreement (NAFTA) in 1994, the world's largest free trade area, the other Southeast Asian states subsequently also joined ASEAN. Vietnam joined in 1995, followed by Lao PDR and Burma (Myanmar) in the same year. Cambodia joined in April 1999, thus making up the present ten member states.

The subsequent Asian Economic Crisis of 1997-8 (alleged to have been caused by deregulation and privatisation and the rise of entrenched patronage networks) made it unlikely that ASEAN leaders could sustain the region's competitiveness for foreign direct investment (Felker 2003; Robinson *et al.* 1987). Clearly, a revised approach was needed to facilitate further mobility in the value-added regional chains in ASEAN.

In 2003, ASEAN states established the ASEAN Economic Community (AEC) and decided to accelerate regional integration to 2015, following the endorsement of an ASEAN Economic Community Blueprint at the 13th ASEAN Summit in Singapore in November 2007. (See Figure 2 for a map of ASEAN countries).

The AEC, Labour Mobility and the New Precariat

In 2007, ASEAN member states agreed to fast track the establishment a single market and production base in the region to promote greater skilled labour mobility. Thus selective admission policies for professionals and highly skilled foreign workers, alongside migrants' educational qualifications, skills and networks, have become important factors in their projected movement within ASEAN. Freedom of movement will be limited initially to accountants, architects, dentists, doctors, engineers, nurses, surveyors and tourism industry workers. Importantly, no provision has been made for greater mobility of low-skilled workers under the proposed arrangements, despite the fact that currently intra-ASEAN migration flows comprise mostly unskilled migrants, about 87 per cent of whom are low-skilled workers.

According to an Indonesian commentator, migration flows between ASEAN countries also mirror the growing inequality among the member countries. Malaysia and Singapore recruited 1.8 and 1.2 million workers respectively from the other ASEAN countries in March 2015 while Indonesia had 1.5 million Indonesians employed in other ASEAN countries. Nevertheless, although the lead economist at the Asian Development Bank has advised that "more attention is needed on a low-skilled migration policy", such a policy is not considered a priority of the AEC.

Crucially, the AEC's new employment model has led to greater precarity for low-skilled migrant workers in the region. Loopholes, including enlarged roles for middlemen, lack of oversight by government bodies, non-unionization and the increasing role of labour-hire companies (through outsourcing arrangements) have increased the vulnerability of these workers. The ILO states that there is little provision for investment in better education and vocational training systems for low-skilled migrants. Thus, low-skilled migrants may not benefit from the "shared prosperity" goal, or achieve true gender equality, or experience equitable development. Furthermore, despite the existence of regional declarations and bilateral agreements, there is no regional regulatory framework for low-skilled migration, nor any agreement to halt irregular migration in the region.

Singapore's immigration policy has concentrated on achieving longer-term goals of industrial-upgrading and technological change, while maintaining competitiveness in the shorter-term. These guidelines are aligned with its national population policy, and a human capital investment strategy, to develop the skills sector by increasing the professional and skilled migrant category intake. The state's strategy includes incentives to encourage them to take up permanent residency. Foreign migrant workers are admitted under Employment Pass P1, P2 and Q1 programs which ensure permanent residency, eligibility for dependents' subsidized healthcare, dependents' education, and housing incentives.

Figure 2: ASEAN states.

In Singapore, foreign workers recruited for low-skilled occupations are classified as temporary workers and are employed in designated sectors for specific periods. They are hired under the Work Permit (R Pass) program, which is restrictive and designed to prevent settlement of the workers. There is also an S Pass category meant for mid-level skilled workers who have a trade qualification and relevant work experience. Employers in Singapore are required to pay a monthly levy on foreign workers employed in their firms/companies under both the Work Permit or S pass categories. Additionally, employers are expected to abide by official employment regulations if they want to continue employing foreign workers. They are also liable to be penalised if they allow surplus to requirement/sacked workers to remain in the country. To forestall this, Singapore has endorsed the establishment of private repatriation firms that act on behalf of employers in Singapore to "forcibly" repatriate sacked workers or those who have completed their contracts and are no longer required by a company (Kaur, 2010a).

The Singapore government has signed labour accords with Bangladesh, India, the

Philippines and Sri Lanka for the recruitment of low-skilled foreign workers in the state's manufacturing, construction and domestic service sectors. Unlike Malaysia, the Singapore government does not utilize the MOU instrument to manage low-skilled labour migration or deal with migrant workers' affairs. The government has also introduced dependency ceilings or upper limits for hiring of low-skilled workers in the various low-skilled occupations. These ceilings stipulate the maximum number of migrant workers approved for employment by the state.

In 1980, Singapore citizens comprised 91 per cent of the total population but this figure dropped to 74 per cent in 2000. In mid-2013, more than 38 per cent of the population comprised foreign-born permanent residents or temporary residents. Statistics on the number of foreign workers employed in the different employment categories in Singapore from 2007 to 2015 are presented in Table 1.

The number of domestic workers employed in the country also rose from 201,400 in 2010 to 227,100 in June 2015. Nonetheless, they have limited rights and few enjoy a weekly day off.

Table 1. Singapore: Documented Foreign Workers by Employment Pass Classification, 2007-15

Pass Type	Dec. 2007	Dec. 2009	Dec. 2011	Dec. 2013	Jun. 2015
Employment Pass[1]	99 200	114 300	175 400	175 100	180 800
S Pass[2]	44 500	82 800	113, 900	160 900	173 800
Work Permit[3] (Total)	757 100	856 300	901, 000	974 400	993,900
Total Foreign Workforce	900 800	1 053 500	1 197 900	1 321 600	1 368 200

1 Foreigners employed on the Employment Pass are classified as professionals and are not subject to quotas; they receive a fixed monthly salary of at least S$3,300 and have acceptable qualifications.

2 The S-Pass is for mid-level skilled workers possessing a trade qualification and relevant work experience; they receive a fixed monthly wage of S$2,200.

3 The Work Permit is for foreign semi-skilled workers employed in the construction, manufacturing, marine, or services sectors (excluding domestic workers who are employed under the Work Permit for Foreign Domestic Workers).

Sources: Singapore, Ministry of Manpower, http://www.mom.gov.sg/documents-and-publications/foreign-workforce-numbers; http://www.mom.gov.sg/passes-and-permits; Lim, H; Aw, Bernard, Loke H., "AEC Scorecard Phase IV… The Singapore Country Report, June 2015 (ERIA Discussion Paper Series) http://www.eria.org/ERIA-DP-2015-47.pdf

Malaysia's recruitment programs for foreign professionals/skilled workers and low-skilled migrant workers have some similarities with the current migrant worker schemes in Singapore. Nevertheless, Malaysia continues to have problems reconciling its demand for human talent with its race-based affirmative action policies, Malay nationalism and foreign worker quota system. The state originally utilized labour accords in the 1980s to recruit foreign low-skilled workers, and subsequently developed MOUs with most labour-sending countries to negotiate employment conditions. MOUs are considered less formal and nonbinding, and can respond flexibly to changing economic conditions. The government's preoccupation with ethnicity, nationality and gender also underline its governance arrangements for highly skilled and low-skilled migrant workers. The former (covering the professional, technical and kindred category), are conceptualized as *pegawai dagang,* or expatriates, while the latter are categorized as *pekerja asing* or foreign contract workers. There are correspondingly two types of employment agreement/work visas: an employment pass (*Pas Penggajian*) for expatriates; and a work permit or visit pass (*Pas Lawatan Kerja Sementara*) for low-skilled workers, including domestic workers.

The country's continuing dependence on mainly low-skilled migrants during the period 1985-2010 is shown in Table 2.

Table 2. Malaysia: Percentage of Migrant Workers in the Main Economic Sectors, 1985-2010

Sector	**1985**	**1990**	**2000**	**2005**	**2009**	**2010**
Agriculture*	50.1	37.7	24.8	26.0	26.1	20
Manufacturing	6.9	8.8	38.1	32.1	34.6	39
Construction	15.0	34.4	8.5	15.5	15.6	19
Services (non-domestic)	20.3**	19.1	6.7	8.8	10.6	10
Domestic service	–	–	22	17.6	13.1	12
Total (per cent)	95.3	99.5	100	100	100	100
Total '000	212	441	807	1815	1918	1900

Notes: * Includes forestry, fishing, mining and plantations
** Includes Domestic service

Sources: [1985-2009] Devadason E.S. and Chan Wai Meng, "A Critical Appraisal of Policies and Laws Regulating Migrant Workers in Malaysia", www.wbiconpro.com/210-DEVADASON.pdf - C; [2010] *Malaysian Insider* " Foreign worker levy hike in 2011", 20 May 2010 http://www.themalaysianinsider.com/malaysia/article/foreign-worker-levy-hike-in-2011/

Against the backdrop of greater regional labour mobility, Malaysia also introduced tougher measures to oversee an increase in low-skilled migrant labour. In 1995, the government established a Special Task Force on Foreign Labour, which then became the sole agency responsible for the recruitment of foreign labour (excepting domestic workers and shop assistants). Additionally, the government aimed at halting unauthorized migration and the task force took over the processing of foreign labour applications from the Immigration Department. Nevertheless, the Immigration Department has continued to oversee regulation of foreign labour recruitment, the identification of "appropriate" labour-source countries, and monitoring of the eligibility of sectors/firms wanting foreign workers. The government also depends on a non-state actor – the Ikatan Relawan Rakyat Malaysia (RELA) or Peoples' Voluntary Corps – to control irregular migrants arrivals (including refugees and asylum seekers).

In 2005 the government introduced a new "model" of labour brokerage/outsourcing arrangements for firms employing fewer than 50 workers. Contractor-based labour arrangements have created vulnerabilities for workers, including non-existence of appropriate documentation for the workers or employment in non-designated sectors. Then, in 2013 the Malaysian government implemented a new policy that placed the burden of paying immigration and employment authorization fees on foreign workers rather than their employers. The employers were also allowed to retain the workers' passports.

Several United States multinationals involved in the Malaysian electronics sector have been accused of involvement in the 'sale of jobs' to Bangladeshi workers through labour brokers. According to Verite (a US-based NGO), 73 per cent of the workers also "displayed 'some characteristics' of forced labour" http://www.verite.org/sites/default/files/images/VeriteForcedLaborMalaysianElectronics_2014_0.pdf

Employers in the plantation and construction sectors also operate as both speculative labour contractors and *de facto* employers and this pervasiveness has also exacerbated human trafficking and exploitation of workers. But the government's migrant labour policy has fundamentally vacillated between ensuring an uninterrupted supply of cheap labour and instigating crackdowns on undocumented migrants. Consequently, this policy has led to a huge increase in the inflow of regular and irregular low-skilled foreign migrants.

It is also well known that workers' irregularity occurs in tandem with flexible labour markets, and companies who are not able to remain in business without the low-cost flexibility, resort to sacking workers *en masse.* In 2014, the Malaysian Human Resources Minister reported that there were an "estimated 6.7 million foreign workers in the country, despite the fact that only 2.1 million had valid work permits". Moreover, about 93 per cent of foreign workers in Malaysia are low-skilled (Figure 3).

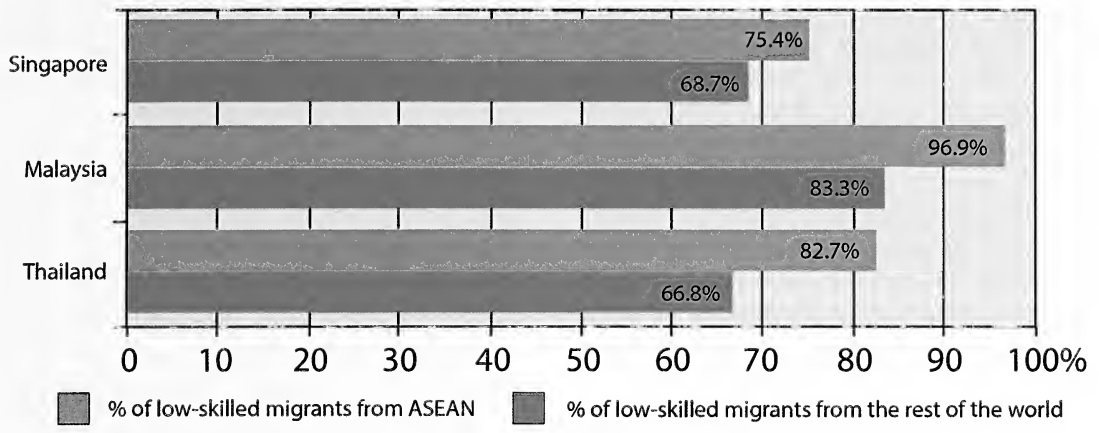

Figure 3: Low-skilled Migrant Workers in ASEAN.

Thailand warrants a cautious scrutiny owing to its large number of low-skilled workers, estimated at between 2 to 3 million in 2014 (most being undocumented), the existence of bonded labour practices, and inherent disparities in labour recruitment systems. Since the 1970s, Thailand's industrial parks and factories have not been restricted to Bangkok and its environs but have spread inwards and upwards to its borders with Burma, Cambodia and Laos, in search of 'cheaper' labour for manufacturing and agriculture. Initially, the government decided against establishing a legal employment channel for low-skilled temporary workers. But the state continues to utilize an employment strategy based on worker regularization and annual registration schemes to manage the employment of low-skilled migrant workers.

Effectively, the system of registering low-skilled migrant workers through annual cabinet resolutions was "primarily concerned with controlling migrants, knowing their whereabouts and allowing for the deportation of any migrant who was not registered". The annual registrations were a financial burden on migrant workers, and the brokerage systems that provided jobs, documentation and remittance facilities were exploitative, dangerous and paralleled human trafficking. The situation improved only after the launch of the United Nations' Inter-Agency Project on Human Trafficking in 2000, which delivered a stronger and more coordinated response to human trafficking in the Greater Mekong sub-region (GMS).

Subsequently, the Thai government accepted the MOU strategy and between 2002-4 signed individual MOUs with Cambodia, Laos and Burma to promote cross border "cooperation for the employment of workers". This policy approved employment of low-skilled undocumented foreign workers on two-year contracts, following the registration and the provision of documentation (proof of identity) by employers. Employers were permitted to deduct registration costs from the workers' pay. Migrant workers were forced to leave Thailand upon completion of two-year contracts, when the entire process began again.

In 2009, the Thai government made it mandatory for low-skilled migrant workers to submit to a nationality verification process

organized by representatives from their country of origin and acquire passports into which the work visas could be inserted. Despite these measures for enabling regular migration, the abuse and trafficking of migrant workers has continued (Kaur, 2010b; A 2010 study of migrant workers in Thailand, *From the Tiger to the Crocodile. Abuse of Migrant Workers in Thailand*, drew attention to migrant workers' tribulations in the country. Then, in 2014 the Thai government established One Stop Service Centres in the country to provide options for legal migration (under MOU arrangements) and regularization of foreign workers. Essentially, this policy was introduced primarily to "inform importers of Thai products overseas" that Thailand was serious about rectifying foreign "labour problems" in the country.

Irregular migration and human trafficking have been a persistent challenge in the region. In Singapore, undocumented workers are typically "over-stayers", who enter on tourist visas and subsequently remain in the country. The government's mechanisms for monitoring the movement of low-skilled workers; the provision of "mega-dormitories" for construction and marine sector workers in designated zones; and stringent immigration regulations have ensured that irregular migration does not become a major issue.

This is not the case in Malaysia and Thailand, where, in addition to the illicit activities of unscrupulous intermediaries, the evolving border control systems of both countries, has become diffused within and outside the countries, and has contributed to this state of affairs. A 2010 study of migrant workers' human rights violations in Peninsular Malaysia, *Trapped: The Exploitation of Migrant Workers in Malaysia*, concluded that individual recruitment agents perpetrated labour trafficking but the government of Malaysia facilitated the abuse with its 'loose regulation of agents, abusive labour laws and policies and the practice of allowing employers to confiscate their workers' passports'.

Labour exploitation continues to thrive and the United States' Department of State Annual Trafficking in Persons (TIP) Reports for the period 2000 – 2014, placed Malaysia in Tier 3 for 2000, 2001, 2007, 2009 and 2014, while Thailand was placed in Tier 3 in 2014. Singapore was placed in Tier 2. Interestingly, in 2015, while Singapore and Thailand's ranking remained unchanged, Malaysia was upgraded to the Tier 2 Watch List (despite the discovery of mass graves of potential trafficking victims at the Thai-Malaysian border).

It is alleged that Malaysia was upgraded to allow the country to participate in the Trans-Pacific Partnership, following passage of the Trade Promotion Authority which tie a country's eligibility to participate in trade agreements to its TIP ranking (*The Guardian*, 27 July 2015). Thus although the protection of low-skilled migrant workers has been included as an objective in the ASEAN Socio-Cultural Community (ASSC) Blueprint, and the 2007 *Declaration on the Protection and Promotion of the Rights of Migrants*, implementation of their recommendations has been slow.

Shifting Global Production Systems and Migrant Workers: Everything Changes and Nothing Changes

During the colonial period, when Southeast Asian states were divided into labour-surplus and labour-shortage states, colonial authorities resolved the problem of labour shortages in their colonies by expediting the recruitment of migrant workers from India, China and Indonesia. These workers typified

the first major cohort of proletarian workers (the original precariat) in colonial production systems associated with Industrialization in Europe. A significant number of Chinese, Indians and Javanese also settled in the country on expiry of their contracts. This pattern of labour migration from essentially the same source (now independent) countries to wealthier Southeast Asian states (e.g. Malaysia and Singapore) has been replicated in the contemporary global production system (agriculture and manufacturing), with one caveat. Since a large number of women in Singapore, Malaysia and Thailand have been absorbed into administration, the professions or government jobs, a whole army of foreign women domestic workers from the traditional (now independent) source countries have been hired for housework and child-minding jobs. Essentially, both male and female migrant workers have become the new precariat, with few benefits, pensions and security. The foreign workers are also allowing wealthier Southeast Asian states to cope with stagnant or declining populations. These workers do not currently make up a permanent precariat since they are employed on a contract basis and are dismissed and repatriated when their services are no longer required.

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The Future of Work: Pivotal Decisions for Society

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Abstract

Technological and social change is inevitable, and a smart society should shape its future, ideally through broadly-based and well-informed discussion. Technology is likely to unravel the 'work trilogy' (of task, pay, esteem) and we have the option to construct new socially-relevant alternatives, to take a laissez-faire approach, or to resist and attempt to maintain the status quo. Technology may reduce traditional employment opportunities, and its impact depends on the social response to maintain an egalitarian society. How do we as a society, agree on and progress towards the future society we desire, particularly as our politics tends towards shorter time-frames and personalities, rather than substance and long-term goals?

Introduction

It's virtually impossible to predict the future, but it is possible to influence the future, and it's desirable for us as a society, both as the Royal Society and as Australian society, to formulate some plausible future scenarios of work in society to help identify what we should strive for. One of the key objectives of creating future scenarios is to focus attention on causal processes and decision points (Kahn & Weiner 1967; Durance & Godet 2010) – but it remains surprisingly difficult to construct useful scenarios and to focus discussion on the opportunities that arise and the consequential decisions that are needed. Too often participants restrict themselves to technical predictions, rather than offering insightful scenarios, and in turn, inadequate scenarios fail to stimulate productive discussion or to motivate pivotal actions. Worse, many predictions remain too narrow, too technical, and too limited. Thus for instance, Ken Olsen, founder of the computer giant Digital Equipment Company (1957-98), told the 1977 meeting of the World Future Society in Boston that he saw "no reason for any individual to have a computer in his home" (Anon 2004), clearly failing to foresee how computer hardware would change, how new applications and networks would be created, and how people and society would adapt to new opportunities. So the challenge for the Royal Society and the four Academies is to elaborate a series of insightful scenarios, and to provoke discussion about those scenarios that help to gauge possible consequences and societal preferences, in order to inform public policy and to motivate key players towards appropriate action (Vanclay et al. 2006).

Scenarios

One of the important steps in formulating scenarios is a broad environmental scan (Lowry & Baughman 2011) in an attempt to detect any emerging disruptive technologies (Carvalho et al. 2013). The challenge is to make such scans sufficiently bold and broad. Too often, such scans are too narrowly confined within disciplinary fields. Two examples from my own field of forestry are instructive. Poplar plantations abruptly

ceased to be viable in Australia when BIC disposable lighters disrupted the market share of wooden matches in 1973, coupled with the introduction of a disease in 1974 (*Melampsora laricis-populina* poplar rust), neither of which was anticipated by the plantation industry. Again in the early 1980s, the advent of the laser printer led to a dramatic shift in demand from conifer-based pulp (for tear-resistant paper used in high-speed line printers), to eucalypt pulp for its smooth finish better suited to laser printers. The forest industry did not anticipate either of these extra-sectoral disruptive technologies, a major shortcoming since a typical plantation crop at that time took 25 years to mature. Other sectors have also been blindsided, notably Kodak, the 133-year-old photography giant that filed for bankruptcy in 2012, after failing to respond adequately to the advent of digital photography (Lucas & Goh 2009). Clearly, to facilitate insightful scenarios, environmental scans need to be broad and multi-sectoral.

A challenge for environmental scans is that it is notoriously difficult to predict the pace of change. One might predict that the clumsy industrial-looking domestic power sockets used in Britain (BS1363 adopted in 1947) and South Africa (BS54, originating as BS317 in 1928) might be ripe for replacement with a more compact and common standard, but such progress appears glacial. In contrast, the dramatic transition from Sputnik (the first artificial satellite) to Apollo's men on the moon took about a decade, as did the transition from 'brick' phone (the brick-sized 'mobile' phones of the early 1990s) to the smart phone. Admittedly, the space race was propelled by the cold war and a presidential commitment (Kennedy's "man on the moon" speech of 1961), but the smart phone revolution was consumer-driven. And the smart phone was not just an improvement in telephony, but also revolutionized other channels of communication (e.g., Facebook), photography (cf. Kodak's bankruptcy), position-finding (e.g., Google maps) and many other applications. It is likely that few, if any, futurists during the heyday of the brick-phone could have predicted the utility or ubiquity of smartphones just one decade later. The clear implication is that it is near-futile to predict technological progress, and more fertile to compile a series of plausible scenarios that stimulate discussion regarding options and consequences.

In formulating scenarios, breadth and utility is all-important. Intra-sectoral predictions are often blindsided, and inter-sectoral predictions tend to misjudge the pace of change. Whilst technological change is relatively straight-forward, the societal and political responses to changes are more complex and may have a substantial impact on the uptake and consequences of change. Thus it is important that the scenarios offered inform and provoke responses concerning social and political implications of change, especially in the present context surrounding the future of work.

Challenges

In recent times, work has served society in three ways: it completes tasks, it supports families, and it gives the worker a sense of purpose and self-esteem. For many workers of our generation, it may seem that these three aspects are inextricably intertwined, but this has not, is not, and will not always be so. One need not look far in our society to find families who are supported by social security rather than by a worker within the family. It is not hard to find individuals who find satisfaction in life through their volunteering or hobbies, rather than through their work. And an increasing number of tasks are now completed by automaton rather than by

workers, a trend that will surely accelerate. It is easy to assume that work is the linchpin of modern society (Jones 1993), but closer examination suggests that this will not continue, and has probably been the exception rather than the rule. It is not hard to find examples where tasks are completed in ways other than through paid manual work – communal 'barn-raising' is an example from recent history that still persists in Amish society, and the modern equivalent, open-source software, is still alive and well (cf. Linux). So one scenario that we should consider is that the future of work will mean that most tasks can be done autonomously, and that our social and political challenge is to find other ways to provide family support and individual satisfaction. Perhaps the real challenge facing our society is to acknowledge that the "work trilogy" of task, pay, and esteem, can be disaggregated, and to ask whether it is a good social investment to require people to undertake tasks that can be done more safely and efficiently through automation.

Some pundits predict that some 40% of current jobs may become redundant in the foreseeable future (Jones 1991; Rifkin 1995, CEDA 2015). Whilst this may be perceived as a threat to our existing society, it can also be viewed as an opportunity: it is the boring, repetitive and dangerous jobs that most under threat, and freeing people from that drudgery should be liberating, individually and collectively. Throughout the history of humanity, societies have often responded to new opportunities with a blossoming of art and culture, so if managed skilfully, the new opportunities of automation could foster a new renaissance. Automation will not mean fewer tasks or less output; instead it will mean that tasks are completed more quickly, efficiently and safely, autonomously, so it should stimulate rather than depress the economy, provided that we find an appropriate way to share the benefits. Loss of 40% of existing work could lead to a society in which a 20-hour working week is the norm, where workers enjoy 20 weeks annual leave, where we commence retirement at age 40, or in which 40% of the population live in poverty – and the social consequences of these various options are enormous. Our present government seems blind to this possibility, and is still promoting an increase in retirement age, so public discussion of some insightful scenarios should be a priority.

The Luddite reaction could be canvassed amongst other scenarios: such a scenario might advocate legislative and financial instruments to restrict new technology and imports, and subsidies to maintain existing labour-intensive activities. Recent experience in the automotive industry could inform this scenario. An alternative scenario might take a liberal market-based approach, and suggest a levelling of the playing field by refining taxation, shifting the tax emphasis from workers (e.g., payroll and income taxes) towards services (e.g., GST) and finite resources (e.g., fossil fuel tax). At this point it is worth observing how alarming it is that our status quo, like comfortable old slippers, detracts from the crux of how to create the society we desire, and leads us towards the minutiae of fine-tuning an existing tax system – rather like re-arranging deck chairs on the Titanic. It is tempting to assume that our current social security system and taxation system are central to our society, and it is easy to forget how much, and how rapidly, taxation and social security can and has changed (Steinmo 1996; Ey 2012). But we should not be diverted by taxation, and should remember that taxation should serve the needs of our society. The key question is to imagine the kind of society we wish to create in a post-work era, and it is salutary to

remind ourselves that democracies have substantially re-shaped themselves in recent times, for instance through the abolition of slavery and apartheid, through equality for women (both voting and wages), and other far-reaching reforms. We should be confident that our society can accommodate the technological and social changes we canvass, so should be bold in considering how we wish to reshape our society for our children. And we should be mindful that the failure to anticipate future challenges is implicated in the collapse of societies (Diamond 2005), so we should be bold and provocative in promoting our discussion.

Luddite and market-based scenarios have been mentioned, and it is appropriate also to suggest some aspects of an optimistic and progressive scenario. Such a scenario might address emerging problems with drug abuse and have a strong emphasis on building self-esteem through education and community engagement. Most Australians value our secure and egalitarian society, and don't want Sydney to become Johannesburg-by-the-Sea, so we must devise innovative ways to manage income distribution and essential services as our society evolves. It's likely that technology will further reduce physical activity associated with work and increase leisure time, so our society should encourage physical activity (perhaps through public transport, cycle paths, walking tracks) and cultural pursuits (museums, theatre, libraries, adult education). Conservatives may dismiss such suggestions, but the evidence suggests that social investments offer strong economic payoffs (Temple & Johnson 1998).

Conclusion

The Royal Society and the four Academies have opened an important and timely debate, but have left several key issues unattended:

- Technology is likely to unravel the 'work trilogy' (task, pay, esteem): do we facilitate this unravelling and construct new socially-relevant alternatives, do we take a *laissez-faire* approach and wait to see what happens, or do we resist and try to maintain the status quo?

- If (as has been predicted) technology extinguishes 40% of current jobs, how should our society respond: is it more socially sustainable to propose 20-hour working weeks, 20-weeks annual leave, retirement at age 40, or 40% unemployment?

- Can innovation and entrepreneurial activity create sufficient new jobs, and if so, how do we bring innovators, entrepreneurs and investors together in a productive and durable way?

- How do we as a society, agree on and progress towards the future society we desire, particularly as our politics tends towards shorter time-frames and personalities, rather than substance and long-term goals?

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The Future of Engineering

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Abstract

Technology is an increasingly important component of our existence and a determining factor in the evolution of society. Engineers are main drivers of both the development and application of technology, but is the engineering profession reflecting the rate at which both the nature of the work and the requirements on the education required to support it are changing? This article examines a limited aspect of this question in the form of a scenario, and points to some likely consequences for the work identified as engineering in the next couple of decades.

Introduction

It does not require a profound analysis to recognise that technology is a major driver of change in our society – changes to how we live, to how we work, to how we communicate with one another, and generally to how we experience the world around us. It is also easy to see that the rate of change is accelerating, and this has raised the question in many quarters as to the extent to which we, as a society, are currently controlling and responding to this change and, in a more extreme formulation of this question, as to the extent to which we are even *able* to do so (e.g. Ellul 1980). The Forum focused on one particular aspect of this issue, that of the future of work, both because of its obvious importance to society through its impact on the economy and the structure of society, but also because it is an area where the process of change has been very visible and well documented for quite some time.

The main features of this process – the changing demand for particular skills, the need for retraining and occupational flexibility, the shorter working hours, and generally the decreasing importance of paid work as the focus of life – are recognised, but are we also responding proactively to them, or are we simply trying to minimise the damage after the fact? In the following brief article we consider this question as it relates to one profession – engineering – which is at the centre of the change process, as it is largely engineers that develop the applications of technology that society experiences.

Technology, Engineers, and Industry

Central to an understanding of the work engineers perform and of how it is changing is a clear understanding of the concept of "technology". Reflecting the ubiquitousness of technological artefacts in a modern society, "technology" is a word that is used very frequently, but mostly in a general and imprecise manner. This was discussed in some detail in a recent discourse in this Journal (Aslaksen 2015), so here we simply recall that by "technology" we shall understand the resources engineers employ in creating applications that meet real or perceived needs of society; i.e. in performing

engineering. Those resources can be conveniently divided into two groups: knowledge-based contained in textbooks, articles, standards, and also in the minds of experienced engineers, and the resource-base consisting of all the standard construction elements, from a standard bolt to a microprocessor, without which creating any application would be practically impossible.

In the process of creating new applications, engineers continually look for better ways of achieving the desired results and thus create new technology - it is this dynamic that drives the exponential increase in technology. A result of the continuous transformation of technology, as well as the current exponential increase in volume, is that, in the sense of understanding, maintaining, and being competent in using, various actors relate to different parts of technology, as illustrated in Fig. 1.

The *technical workforce* includes technologists, technicians, drafters, and trades persons; all persons that require access to the combined knowledge and resource bases, that is, technology. This structuring is defined formally, and to a large extent also in practice, by education and training, but experience and individual interest and aptitude can result in a significant blurring of the boundaries. For the present, we shall define an engineer as someone with a degree from an accredited four-year university course and meeting certain requirements for Continuing Professional Education (CPE). Engineers are the practitioners of the professional process of engineering, and the engineering disciplines, such as civil, chemical, electrical, and mechanical engineering, are distinguished by the subdivision of the resource and knowledge bases reflected in their education.

From one engineering project to the other, the ratio of creating new technology to applying existing technology varies greatly, but on the average the application of existing technology dominates by far, and it is useful to distinguish two groups of engineering projects:

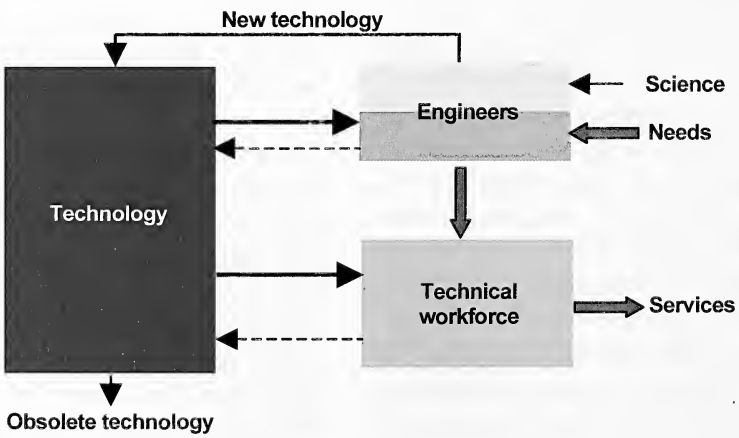

Figure 1: The interaction with technology by engineers and the technical workforce. The dotted arrows indicate that all engineering projects provide some input to technology in the form of experience, and the subdivision of the engineers illustrates the two types of engineering projects (see below).

- those that utilize the existing technology to meet a need expressed by all or a part of society; and
- those that are aimed at developing new technology.

Or, in other words, projects in the first group *apply* technology in order to meet requirements imposed by entities or people who are generally not engineers, and it is these stakeholders that are the judges of project success; whereas projects in the second group *develop* technology, often using that part of the knowledge base that is provided by science, but sometimes also based on heuristics or arising from trial-and-error, and their success is judged generally by other engineers. Let us agree to call these two groups of engineering projects *application projects* and *development projects*, respectively.

There is not a sharp boundary between these two groups, and there will be many projects that contain sub-projects of both types. In any case, every application project also leads to an increase in technology, if by nothing else than simply by acting as an example for later projects, as was indicated in Fig. 1. The usefulness of this grouping and the distinctiveness of the two groups was discussed in (Aslaksen 2012); in particular, as the group of application projects is very much greater in number and direct importance to society than the development group, it allows us, by focusing in the following exclusively on the former group, to make some general statements.

The Problematique

The suite of problems facing the engineering profession with regard to the future of work – the *problematique*, to use an expression introduced by Warfield (Warfield 2006) – is dominated by two issues, and the first of these is evident in Fig. 1. In that figure, the content of technology is in constant flux, with new technology entering at the top, and obsolete technology being discarded at the bottom. A corollary to this downward movement is the increasing degree of standardisation; what is leading edge technology today is embedded in a standard ten years from now.

The right-hand side of the Figure shows the stratification of the workforce, and it remains unchanged. The implication of this is that engineers should not be associated with the actual content of the technology but with a level of technology. The content of the technology engineers work on today should be handled by technologists in five or ten years.

The second issue is the influence of IT and the role of software. Software applications are relieving engineers of more and more of the time-consuming drudgery of detailed calculations and are allowing more sophisticated and cost-effective designs. And work at the lower end of the technical workforce, such as drafting, is being increasingly automated, in analogy to how machine code is automatically generated from source code. However, while computers and software will have a very significant effect on the future of engineering work, there is an aspect of this that is often overlooked, and to highlight this, we need to make a brief digression.

A Brief Historical Digression

The fundamental issue is that engineering, as a profession, has not been able to develop at the same rate as technology and its applications; in responding to the demands of industry, engineering has become a victim of its own success. This was discussed in a previous publication (Aslaksen 2013) by considering the environment in which

engineering takes place. This environment, which was called *the engineering paradigm* on account of its similarity, as far as its influence on the profession is concerned, with the scientific paradigm introduced by Thomas Kuhn (Kuhn 1996), consists of a number of components:

- The technology, consisting of the knowledge and resource bases and the associated internal structure of the profession;
- the relationships to the other participants in the technical workforce, such as technicians and technologists, drafters, machine operators and trades personnel;
- the relationships to non-technical participants in engineering projects, such as business, finance, and marketing personnel; and
- the relationships to society.

All of these components underwent rapid change in the eighteenth and nineteenth centuries, and while this change had a different character and extent in different parts of the world, it resulted in creating, particularly in continental Europe, a profession on a par with science, medicine, and law. This *vertical structuring* of the technical workforce is illustrated in Fig. 2, where the vertical axis is intended to be a qualitative indication of the intellectual content of the activities involved, or what we might call engineering's *value-creating potential.*

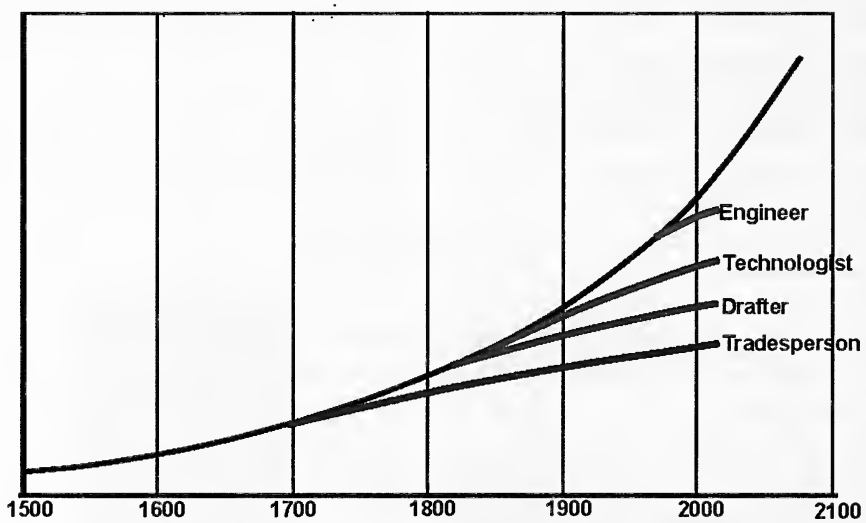

Figure 2: The development over the last six hundred years of one aspect of the engineering paradigm: the structuring of the technical activities within engineering projects by intellectual content (the vertical axis is intended as a qualitative indication only) (from Aslaksen 2013).

If we, for a moment, consider the field of technical activity to be described by two coordinates, type (civil, electrical, mechanical, etc.) and intellectual level (tradesman, technologist, engineer), then the enormous expansion of that field has been handled by increasing the number of types, i.e. increasing specialisation, but there has not been an

increase in the number of levels. This *horizontal structuring*, as indicated in Fig. 3, brought with it its own problems, in the form of inter-disciplinary communications barriers and a narrow, stove-piped approach to projects. But, more significantly, it has not been complemented by a further vertical structuring; the *role* of engineers within the technical workforce is essentially the same as it was a century ago.

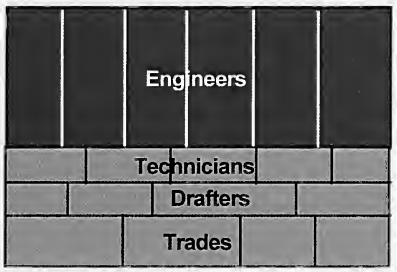

Figure 3: The horizontal structuring of engineering into disciplines.

This leads us now to the aspect of computing and software mentioned above, and it is best illustrated by a comparison with what happened as machine tools were introduced. For example, when engineers invented the lathe, it did not take long before a specialised class of operators, the turners and fitters, arose, and when sophisticated numerically-controlled tools were developed by engineers, specialised programmers and operators emerged; engineers did not have to operate the tools they invented. But in the case of engineering software applications we have not yet been able to make this transition, and a considerable amount of engineering time is spent on learning how to operate software applications (which can be similar to learning a new language) and then applying them. This process, while resulting in an increase in productivity, invariably leads to increased standardisation and to a consequent lack of creativity, but also involves a significant investment in maintenance due to the frequent upgrades and, above all, does not really require an academic education.

A Possible Scenario

As has been pointed out in another contribution to this volume of the Journal (Vanclay 2016), predicting the future development and consequences of technology is very difficult, if not futile, and a much better approach is to construct a number of possible future scenarios, estimate their probabilities, analyse their consequences, and then selecting the most desirable one as the basis for planning. Here we present one such scenario for the future of engineering.

Due to the exponential increase in the technology and the similar increase in the interface between technology and society, the requirements on the education, training, and social integration of engineers reach a point where the current paradigm breaks down. Not a breakdown in the Kuhnian sense, but in the sense of a glaring deficiency in cost-effectiveness. If engineers are to be able to meet these requirements, they need to rise above the largely routine part of the activity to be able to focus more on creativity and the concerns of society, and one or more new levels should be created within the technical workforce to meet the needs of industry for the application of the standardised part of technology, as illustrated in Fig. 4. The driving force behind the proposed restructuring would have to be the engineering education sector and the professional skills of academia, as only a formal, vertical structuring will yield the desired results. The present approach of adding a few non-technical subjects to the engineering curriculum is not effective. First of all, because one cannot just add material to a degree program with fixed duration, the technical part of the curriculum is necessarily

reduced in scope, often without explicitly acknowledging the effect this will have. But more importantly, because what is needed is a fundamental differentiation in the approach to knowledge. Reduced to a minimum, one could express the difference as being between understanding and competence, or perhaps between a professional and a worker. Like the transformation of craftsmen to workers in the industrial revolution, the role of engineers has changed from the shining knights spearheading society's way into a glorious future to invisible intellectual labourers, anonymously providing the fuel for industry's relentless drive to transform society into a consumer society, with Growth as the Holy Grail and with marketing and advertising as its handmaidens. This was already discussed in Veblen (1921), and again in Noble (1977).

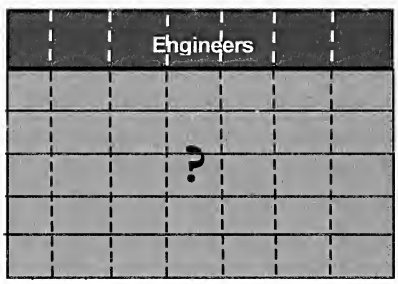

Figure 4: Vertical restructuring of the technical workforce, relieving engineers of the largely standardised parts of their current workload.

At present, engineering education and the various certifying and accrediting bodies are focused very much on competence, on being skilled in applying engineering knowledge to meeting the needs of industry. What is needed is to separate the engineering program from the practical applications program, so that the program provides the students with an appreciation of the structure and functioning of society as it relates to possible interfaces with engineering, and prepares and motivates them to take a critical and proactive role in increasing society's appreciation of the options and consequences the application of technology offers. It is a role somewhat analogous to that of journalists: working as employees within an organisational environment, while maintaining both close relationships with society and their professional independence and ability to pursue the truth.

The engineering program might have a total duration of five-and-a-half years, with the last half year dedicated to completing a small research project, and would not be strictly discipline-based. While much of the basic technical knowledge, at least in the first two years, would be the same as in the current BEng program, it would emphasize the place of the knowledge within a broader, somewhat more abstract framework, and introduce the system concept as an essential aspect of engineering. Following the first two years, about half of the engineering subjects would be common (mandatory) and half discipline-based (selected); they would be complemented by a common set of subjects in sociology, law, economics, and philosophy, presented with a rigour appropriate to engineering students, and always from the perspective of their relationships to engineering. The importance and complexity of the relationship between engineering and society warrants the same rigour of study and research applied otherwise in engineering; what is required is the application of the engineering methodology to social issues rather than for engineers to dabble in sociology.

The proposed restructuring would, of course, have a significant impact on the education and training of the technical work force. The number of engineering graduates per year required by industry would be only a fraction of the current number of combined MEng

and BEng graduates, and the number of institutions offering this degree would be correspondingly reduced. The qualification for the level below engineer would formalise what is already the case for something like three-quarters of BEng graduates who go into fairly routine positions in industry, and in doing so, would allow a sharper focus on the needs of industry and make both education and employment more effective.

Our economic system is based on growth; initially driven by the desire for a secure lifestyle, but once this and the capital associated with the security has been achieved, growth is driven by the pressure to provide opportunities for investing this capital and receiving a return on it, as the earning value of capital (in addition to the earning value of labour) is the basic tenet of capitalism. And that is what industry provides; each project can be viewed as basically an investment opportunity. This exponential increase in the size of the economy can, of course, not continue indefinitely. However, in the medium term, say, the next few decades, we should expect continued and increasing economic growth and an increasing technical content of the new services, so that engineering will account for a rapidly increasing fraction of the GDP. But under the restructuring of both the work and the technical workforce proposed in this scenario, together with the more effective use of computers, the demand for engineers will decline significantly.

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The Future of Jobs: Reflections on the Royal Society of New South Wales and Four Academies Forum

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Abstract

The future of jobs and work in Australia is reviewed against the background of economic and other policies and events in Australia over recent decades. The impact of technology is only one of the issues which must be considered. Some of the assumptions as to the factors that contribute to prosperity and community wellbeing are explored. The role of government and behaviour of business is considered. Attention is drawn to some recent reports on jobs and futures in Australia and the world and some suggestions offered as to actions that should be taken in Australia to achieve outcomes that benefit all.

The views expressed here are personal and do not reflect the policies of the Australian Museum Trust.

Jobs count, especially (but by no means exclusively) to men, they contribute to identity and bring in money. Usually. Employment and unemployment are issues of huge importance. But the nature of work and the workplace are less thoroughly discussed in the popular media, though they are extensively in the academic literature and government reports. The reasons why jobs are not available are not well understood in the community except that they have something to do with how well people are trained, how diligent they are in seeking work, and how hard and smarter they work.

The impact of technology is important, as are currency exchange rates, wage levels, productivity, market responsiveness and general prosperity. The much bigger issue is the relative responsibility of various sectors of the economy to generate jobs: that includes both business and government. How to improve the nature of work: to provide safe conditions, to give appropriate recognition for achievement, to pay appropriate wages and salaries and to ensure adequate training, gets far less attention than is due. Arguably the same is true in respect of relative rates of remuneration and demands for hours of work to ensure people are not exploited and are clear as to what their responsibilities are and are not so great as to not invade every other part of life.

The future of jobs is a bigger issue than how many of the present jobs will be replaced by technology, i.e. what jobs won't be, which grab attention. It includes what education and training need to be engaged in now in preparation for change, what tasks are likely to be critical. Simply focusing on literacy and numeracy does not seem adequate, especially when the imposition of standardised tests for them at school are doing nothing to improve achievement levels.

Employers often say they want prospective employees to be able to analyse and reason and work in teams but complain because they don't seem to be very good at math and spelling. Possibly the work environment is no more engaging than a lot of schooling.

In this note I try to address some of the issues.

Australia in the 21st Century

In Australia the last 20 years especially have seen only a few attempts at reform despite much rhetoric. Instead there has been an overwhelming obsession with what passes for economics, reductions of government debt and deficit together with reductions in taxes (promised if not always delivered) and the daily fluctuations in prices on the stock exchange for equities and commodities. Privatisations, advocated as a means of ensuring government is involved only in what it should be, have almost never generated real economic gains and usually lost money. The imbroglio over Telstra is an example (Gittins 2009).

Government debt is Australia is amongst the lowest of any developed country. There is no correlation between tax rates and economic growth and, despite assertions in some quarters; Australian corporate and personal tax rates are also not high by international standards. That governments should institute austerity budgets, which anyway have proved disastrous, is both unnecessary and irresponsible, which is not the same as saying prudent budgeting is unnecessary (Hacker & Pierson 2012).

Education is improved by educational leadership, quality teaching and high expectations. Health is effected by diet, the stresses of life and access to basic medical services addresses significant issues of non-communicable diseases. Both are affected by people's socioeconomic levels (Marmot 2010). Mostly, government policies have failed to adequately address these facts.

Economic growth continues to be almost everywhere promoted as the driver of gains in prosperity for all when it is not – it is cross border transfer of ideas (UNDP 2010). Income isn't unimportant, it just isn't the most important, a very relevant point in a country which seems to take little from overseas events. At the same time business urges ever more ways to reduce wage costs, increase profits and lower taxes.

Investment in public transport and infrastructure has fallen behind, despite the contribution it would make to job creation and productivity, and often it is offered up, like many other activities of government, to the private sector which means it costs more because of higher borrowing costs; risk is not reduced as intended.

Housing affordability has declined to alarming levels, driven by several decades of favourable tax arrangements. All of which affects jobs because the housing is further and further away from where the jobs are and the time to travel increases as a result and advantage is not taken of new technology which would allow working from remote locations. Wealth, and private debt, have grown with rising house prices which in turn has simply funded consumption. The increased wealth is illusory.

These issues affect jobs. And so do the following.

In daily discourse within Australia, certainly politically and in some other quarters:

- the prevailing view of the role of government is too narrow and poorly understood,
- the dominance accorded business within the argument about economic futures is too prominent, and
- the view of economics presented by business, and very often by the governments of developed countries over the last 40 years, is too narrow.

Government and Neoclassical Economics

The influence of government is substantial and exercised through regulation, funding and tax arrangements. The proposition that small government is good is contradicted by the evidence. The ongoing downsizing of government has stripped out experience and knowledge with the result that many tasks consequently assigned to the private sector are inadequately oversighted and some important tasks, such as 'Measures of Australia's Progress', which looks beyond GDP to assess the other things such as the quality of the environment, the wellbeing of the population and the way people live together in society, have been abandoned. Substantial capital expenditure on schools in Australia as part of the response to the Global Financial Enterprise was less efficient in those states where project management skills had been lost from government (Stone 2013).

In *Governomics: can we afford small government.* Ian McAuley and Miriam Lyons (2015) write, "In the din of political slogans about the supposed need to cut public expenditure it is easy to lose sight of the sound economic reasons for investing in public education, for resisting the sell-off of public assets, for taking strong action on climate change, for public funding of health care, for regulating to protect safety standards, for providing decent support for aged pensioners and the unemployed, for allowing modest levels of public debt, and for collecting enough tax to fund these services."

Governomics is impeccable and extensively referenced economics and not some radical socialist tract. McAuley and Lyons note, "In our work together we have seen two strong trends in Australian public life: one is the dominant idea that the best possible government is an emaciated one; the other is that many who seek change struggle to make their case in economic terms."

Downsizing of employment in governments (and in universities and some other domains), has led to an increase in "corporate" staff involved in accountability, liaison, communication, human relations, public relations and financial management and a decrease in staff engaged in the central purpose for which the enterprise was established. The new staff may not necessarily increase the competence of the organisation to achieve its goals but instead create more layers of authorisation and scrutiny. There are cartoons and TV series depicting some of the unfortunate and even ludicrous outcomes.

In universities, restrictions on tenure combined with increased linking by students of course subjects with perceived employment prospects have amplified the corporatisation and led to abandonment of some courses; increased emphasis on assessment of the value of research has increased competition amongst researchers and led to fewer academic staff teaching, their role being taken over by graduate students. All of this has led to frustration

and a decline in quality of graduates (Corden 2005).

Should we really place so much Trust in Business?

The advocates of business are persistent: much of their influence depends on armies of lobbyists. But it is not reasonable to assume that the advocacies actually are likely beneficial to society as a whole; to do so would be naïve. Some examples:

Emphasis on the need to ensure that the best talent is recruited to the most important jobs has contributed to huge rises in corporate remuneration and the proposition that having an interest in the outcomes, or "skin in the game", as well as push back against escalating salaries, has meant part of the remuneration is stock in the company. Average salary levels for executives are now many multiples of wage levels of the average employee.

Ongoing belief in the right of management to determine outcomes has, with cooperation of government, led to decline of unionisation which was a brake on excessive executive remuneration. Though workplace bargaining was successful in the later decades of last century in Australia, government changes later varied that to give more power and influence to management; later changes did not recover the previous situation.

Then there is the matter of unpaid overtime. The amount of money companies save by refusing to pay for the overtime they demand their employees work has been estimated at more than $100 billion in Australia (Kimmorley 2014). Can claims for changes such as reduced penalty rates, which are identified as inhibiting profitability of business trading on weekends, really be taken seriously? And how many extra persons could be employed if corporate salaries were reduced (and performance bonuses and merit pay recognised as not contributing to better performance) and demands for unpaid overtime eliminated? The maths is very simple.

Casualisation, part-time work and short-term contracts, as well as use of labour hire companies and, in certain areas, engagement of migrants on temporary work visas, has increased. In some areas such as seasonal agricultural work, students and others on tourist visas, which limit the number of hours which can be worked, are employed but forced to work longer hours on pain of being reported for failing to abide by the provisions of their visas.

These arrangements are particularly common in businesses used by food retailers Woolworths and Coles and cleaning companies, as reported by various ABC programs.

Argument continues over the obligation of employers to seek local employees for work before importing overseas labour. In these arguments business groups such as the Chamber of Commerce and Industry and the Australian Industry Group consistently claim employer freedom to make employment decisions.

There are other issues affecting the availability of jobs and who gets to be employed.

Over the last few decades, large companies have devoted significant proportions of retained earnings to share buy-backs and consequently payment of substantially larger dividends to shareholders (Lazonick 2015).

Executives have benefitted as already explained. Growth and diversification of the company has been diminished. The notion that the main purpose of the corporation is to increase the wealth of shareholders has been a justification; employment opportunities are diminished.

In Australia and other countries many transnational companies have pursued cost reductions through offshoring and transfer pricing so reducing taxes paid in countries where they operate and make the profits. The actions of Google, Apple and Amazon are particularly egregious. In the decade to 2013 Apple shifted nearly $9 billion in untaxed profits from Australia to Ireland, where it pays no taxes and is not required to file any financial reports because its operations are managed and controlled in California (Chenowith 2014).

Activities of financial institutions in developing complex financial instruments such as collateralized debt obligation (supposedly asset-backed and reliably rated), excessive lending on real estate and poor quality advice on investment, sales persons rewarded for size of loans without regard to likelihood of repayment, are well-known. As well those institutions have limited much of their trading to interacting with each other rather than investing in the expansion of various enterprises. In concert with much company activity being in mergers and acquisitions with substantial benefit to lawyers, this has meant fewer jobs being created than would otherwise be the case.

What should be the Future for Jobs and what can we do about it?

It would be wrong to suggest that there have been no serious considerations in Australia of future job opportunities. It is just that the issue of employment is overrun by rhetoric, not least the rhetoric of governments being in the business of creating jobs when in fact mostly they have been shedding jobs, as noted above.

In Australia, in 2015 especially, there has been mounting frustration with the seeming inability of government to take the leadership role they should, despite calls by business that government reduce taxes on business and objections to removing tax advantages favouring businesses and the already rich in areas such as superannuation, real estate and capital gains. John Howard as Prime Minister introduced a GST despite saying in the election campaign which brought him to government that he would not. But the present government keeps resisting changing disproportionally beneficial tax arrangements until approval is given by the electorate at the next election!

The Committee for Economic Development (CEDA) reported on 'Australia's future workforce' in June 2015 (CEDA 2015): the Report represents an approach to economic futures common in Australia. The underlying proposition of the Report is that government's role is to pursue an environment which enables industry to flourish, maximising application of human capital and incentivising innovation. The Report recommended investment in education from early childhood focusing on competency and improvement of learning systems and incentivising innovation. Issues concerning corporate behaviour and leadership and governance were not mentioned.

A National Reform Summit of business, community and employee groups met late August 2015 (Anon 2015a): it saw a prosperous country with an even more prosperous future that improved the quality

of life for all through sustainable growth and high quality jobs generated by a comprehensive program of economic and social reform to boost competitiveness through investment in skills, research and development and infrastructure.

Governments promote new international trading arrangements in the name of giving access by Australian business to the markets of overseas countries and thereby creating jobs. But in fact their actual value is overstated, even according to government's own modelling. Assertions that the so-called free trade agreements such as the Trans Pacific Partnership Agreement (TPP) and Australia-China Agreement will significantly increase jobs is wrong: instead of the 178,000 additional jobs trumpeted by Trade Minister Andrew Robb in respect of the China Agreement, it is estimated that only a little less than 5,500 will result according (Martin 2015) to the government's own modelling! *The Age* economics editor Peter Martin observes that by 2035 the gain will be less than one-half of one-tenth of one per cent of Australia's workforce.

Large governments can frustrate individual creativity, small governments can leave people floundering. As Ian McAuley (2015) said, responding to former Treasurer Hockey's advocacy of income tax cuts, "We found countries with high taxes and low growth (e.g. France and Belgium), countries with high taxes and high growth (particularly the Nordic countries), countries with low taxes and high growth (e.g. Switzerland), and countries with low taxes and low growth."

Whilst the impact of new technology will have a profound impact by computerisation through replacement of jobs – especially in office administration, services and sales and anything involving simple assessment, addressing the future need for more jobs is required now. The failure of the economic policies of the last 30 or so years and the negative impact they have had on health, education, infrastructure and much more to contribute to a cohesive and productive society must be acknowledged.

That means creating and preparing for the kinds of jobs needed in the near term as well preparing now for the new jobs in the more technology dominated world of the more distant future. It means acknowledging the huge cost to the community of high levels of unemployment and ceasing the rhetoric that justifies penalties on many of those not working but fails to address the cause of the problems, especially high levels of stress which flow over to significant drug and alcohol abuse: those are symptoms. That means both a greater role for government and a more responsible business sector. And it means leadership committed to understanding and acting on evidence rather than populist demands.

The cry we hear is for workplace reform and more flexible working conditions which is shorthand for reducing employee conditions. That is not to say that there are not structural issues to be addressed. But what is not talked about very much are the real factors which contribute to improved outcomes, especially in the much talked about but less well-understood areas of productivity and in creativity. Australia does not score high in competitiveness, engagement of industry with academe in research and development and leadership is given cursory consideration (Hall, Agarwal & Green 2012).

The continued assertions that people on welfare should get a job and receive minimal support so as to encourage them to do so does not contribute anything, especially in the case of younger persons. The stories of ordinary people, unemployed or homeless or both, which can be found in the pages of *The Big Issue* sold on street corners by poor people tells a quite different story from that broadcast by politicians and some business advocates.

Work under the Community Employment Programs in more remote Indigenous Communities made a difference (Altman 2015). Its removal in the belief that it was not real work has contributed to stress, substance and alcohol abuse, violence, incarceration and suicide: the level of youth suicide per person amongst Indigenous youth in the Northern Territory is higher than any national rate for any other country (Anon 2015b).

Instead of facing up to the evidence, the response has been cashless debit cards. Health and education services and housing continue to be grossly inadequate and financially supported to a significantly lower level than for non-Indigenous people. Why is this not recognised as a reason for the poor educational achievement and health levels in Indigenous communities, in suburbs where the majority of Indigenous people live as well as in remote areas? Consider the Northern Territory. Millions of dollars in wages stolen from Indigenous people over the period to 1973 have still not been repaid! The fundamentally important issue of self-determination already demonstrated as a significant contributor to better outcomes is simply not talked about.

And Now for the Long Term

A consequence of Australia's relative isolation and devotion to market economics is that major studies which would likely contribute to significant advances in public policy seldom get to where it counts. With few exceptions the only media outlet that attends to these matters is the ABC. Major studies of world futures is an example. The Oxford Martin Commission is worth mention.

The Oxford Martin Commission is chaired by former World Trade Organisation Director-General Pascal Lamy and includes a huge range of people from various countries and backgrounds including Nobel laureates and leading politicians. The Commission published its report, *Now for the Long Term* in October 2013 (Lamy et al 2013). Lamy toured Australia in 2014 to communicate the findings of the Report: his visited attracted almost no media attention!

The Commission observed that the hyper-connected world requires unprecedented collaboration: reaching consensus requires deep understanding of "how the one-world affects the many and how the many worlds affect the one". The Report sought to contribute to the ability of governments, institutions and communities to understand and navigate competing tensions "to grapple with the major long-term issues of today". Its five areas of focus addressed youth unemployment, women and inequality; climate change, green growth and resource security; health for richer or poorer; managing change and uncertainty cooperatively; and governance.

The Commission's major recommendations urged business to revisit accounting for the future to reduce the bias against future generations, invest in people and attack

poverty at its source. Most especially efforts must be made to build shared global values.

The future of jobs in Australia requires reforming education and workplaces, it means genuinely engaging young people in learning in their formal education years and valuing older employees with experience. It also means vigorously addressing the ongoing gender discrimination, recognizing that merit-based appointments as a way of overcoming the gender gap will achieve little since most assessments are inherently biased to criteria chosen by dominant males.

Paying big money to private schools, in the mistaken belief that it provides choice which improves outcomes should be revisited: from 1973 through 2012 the additional cost to government per student at non-government schools was $3,000 more than it would have been had the students been enrolled in a public school (Connors & McMorrow, 2015).

Since 1996 when the Howard Government increased its spending on independent schools test scores have declined, according to the OECD's PISA studies. Moreover, nearly 30 academic studies show no greater gain by students attending non-government schools after adjusting for socioeconomic differences in enrolment (Cobbold 2015). Students from public schools do better at university and there is actually little relationship between end of school test scores and the salary level of later employment (Cawley, Heckman & Vytlacil 1999).

A major driver of increasing wage inequality in the US has been rising educational wage differentials: rising costs of college education reduced the number of college graduates who then were in greater relative demand and accordingly could demand higher wages (Anon 2007).

More importantly, it means recognising and acting on what is known of the vital contribution early life makes to the rest of life and to the community, as a feature of most traditional societies before they were overrun.

It means acknowledging a genuine and unique role for government as well as the importance of a mixed economy in which commercial business is able to achieve its proper aims and benefits employees and all stakeholders including the community. Of special importance will be providing training and retraining so people can transition through jobs by development of a portfolio of skills over time which will be important throughout working life so enhancing the value experience can bring to the enterprise. Some of these issues have been addressed recently by the International Monetary Fund (Colebatch 2015); inequality has been especially highlighted, including by the CEO of the IMF and the Governor of the Bank of England. Angus Deaton who studies consumption, poverty and welfare has been awarded the 2015 Nobel Prize in economics: will governments sit up and take note?

For Australia in particular it means learning from the real lessons of the experiences of other countries and not cherry-picking just those instances which accord with preconceived ideologies and the views of those in authority. It means addressing the inequalities in every aspect of life which hamstring the real everyday experience of more and more people as the super rich

become more and more isolated from everyday experiences.

In particular it means valuing genuine education and learning which engages those who participate in it, which ultimately is everyone throughout life, the experiences of which ought to provide the opportunity for all to reach their maximum potential, social justice in the Rawlsian and not the Benthamite sense.

It can't be that radical: Nobel economics laureate Edmund Phelps has said as much recently in talking of the "good life" and the need for "prospering", i.e. "gaining for oneself better terms—or means to rewards, whether material, like wealth, or nonmaterial" and "flourishing", i.e., "exercising one's creativity, taking fascinating journeys into the unknown, and acting on the world" (Phelps 2015).

A common humanity means community and cooperation. As we understand more and more about the lives of non-human animals we must surely struggle to hold on to those features which distinguish us as humans.

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The Crisis of Care and the Future of Work in the Asia-Pacific Region

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Abstract

In our lifetimes we have seen old jobs disappear and new jobs come into being. We have seen dramatic changes due to computerisation and robotisation as well as the mechanisation of manufacturing, agriculture, mining and other industries. Some forms of work, however, are more resistant to change. The basic work involved in feeding and taking care of human bodies cannot easily be mechanised. It is possible to imagine various ways of ensuring that these basic physical needs are met – complete socialisation, complete marketisation or various combinations of paid, unpaid and volunteer labour. Even if we experiment with different forms of compensation for such work and different ways of allocating such work, though, it is ultimately human beings rather than machines that need to do the work of feeding, cleaning and caring. In this article I survey some of the ways in which societies have dealt with or are dealing with the need for housework, childcare and care work and consider what this means for the future of work in our region.

Keywords: aging, care work, housework, childcare, Asia-Pacific

Introduction

In our lifetimes we have seen old jobs disappear (such as telegraph operator) and new jobs come into being (such as web designer). Computerisation, robotisation and mechanisation have brought dramatic changes. In advanced economies, there has been a shift from agriculture to manufacturing to a post-industrial economy focused on knowledge, information and services. Work in the post-industrial economy has been described as "immaterial labour" (Hardt and Negri 2004: xvi). Some forms of work, however, are more resistant to change. The very material labour involved in feeding and taking care of human bodies can not so easily be mechanised.

For much of modern history, the work of cooking, cleaning, and caring for children, the ill, the aged and persons with disabilities has been carried out in a household or family unit. Such work has disproportionately been carried out by women, and this has been the basis of the modern gendered division between paid work and unpaid housework and care work.

There are various ways of ensuring that these basic physical needs are met – complete socialisation, complete marketisation or various combinations of paid, unpaid and volunteer labour. Even if we experiment with different ways of allocating such work and compensating workers, though, it is ultimately human beings rather than machines who need to do the work of feeding, cleaning and

caring.[1]

Depending on the demographics of a particular society, there will be a need for particular forms of care work. In Japan, for example, with the highest life expectancy in the world and the greatest proportion of the elderly, the overwhelming need is now for elder care. This contrasts with neighbouring countries like the Philippines, which has a relatively young population and a high birthrate (Mackie 2014: 278–296). In parts of Africa, high rates of HIV or other infections mean that care for the unwell is an overwhelming burden (Urdang 2006: 165–177).

Below, I provide some snapshots of how these issues have been dealt with in different parts of the world, using the names of relevant cities as a shorthand label for each model. I conclude with some thoughts on what this means for the future of work in our region.

The Tokyo model

For much of the twentieth century, the need for housework, childcare and other forms of care work in Japan was dealt with through a gendered division of labour whereby men engaged in full-time paid work and women tended to withdraw from the full-time paid workforce when they married or bore children. There was only a brief period in the mid-twentieth century, though, when the majority of married women actually engaged in home duties full-time. From the 1980s, the number of married women in the paid work force has risen, but the increase has largely been in part-time or irregular positions, meaning that women have been the ones to juggle the demands of paid work, housework and care work.[2] During the post-Second World War baby boom and the secondary baby boom of the 1970s the main need was for housework and childcare (Osawa 2005: 111–130).

From the 1980s people have been marrying later or not marrying at all, having fewer children and having them later. The low birthrate, combined with high life expectancy, means that the most pressing need now is for the care of the aged, an issue we will return to below.

In Japan and other countries from the 1970s, feminists discussed how to change this gendered division of labour. In feminist-influenced households, individual family members discussed how to renegotiate the gendered division of labour and seek a balance between the demands of paid work, housework, childcare and care work. In some countries, such as Sweden, social policies were implemented in order to encourage a more equitable gendered division of labour.

The Stockholm model

Sweden has had a generous paid parental leave scheme since 1974. Under the current system, Swedish parents receive a total of 480 days of leave per child, 390

[1] While there have been advances in the use of robots for some tasks in hospitals and in elder care, such as lifting bodies or monitoring physical indicators (Hay 2015), most of the messy business of feeding, cleaning and caring for human bodies still needs to be done by similarly embodied human beings.

[2] Needless to say, this division of paid work and household work was not unique to Japan, and could also be seen in the USA, UK and Australia, for example. Nevertheless, Japan and South Korea have particularly high rates of women's withdrawal from the paid workforce on marriage and childbearing, resulting in an "M-shaped" labour participation graph, with peak labour participation rates in the twenties before childbearing and childrearing and again in the forties when childcare responsibilities have eased (Macnaughtan 2015 unpaginated).

days of which is paid at 80 per cent of salary (up to a maximum of $162 a day). Two months of the leave is reserved for the man (in heterosexual couples), and the rest can be shared between the parents. As of 2012, Swedish men took 24 per cent of the leave, meaning that each on average stays home and looks after each baby or toddler for a little over three months (Orange 2014). A system like this allows for more equitable sharing of paid work, childcare and housework.

In addition, as reported by Brennan *et al.*, municipalities must provide a full-time childcare place for all children whose parents are working or studying, while children of unemployed parents and those whose parents are on leave are eligible for 15 hours of childcare per week (2012: 382).

In Sweden, a large proportion of elder care is funded by the government and provided by the government. In recent years, some taxpayer funds are being used to purchase care from non-profit or profit providers, but this marketisation has not progressed as far as it has, for example, in Britain or Australia (Brennan et al. 2012: 381).

In other places, such as the socialist societies of East Asia, complete socialisation of housework, childcare and other care work has been proposed as the solution.

The Pyongyang model

In the early days of the Democratic People's Republic of Korea (North Korea), as in other socialist regimes, the government proclaimed gender equality and promoted the state provision of communal kitchens and the socialisation of childcare and housework. Propaganda magazines proclaimed that the problem of the gendered division of labour had been solved by socialisation.

In practice, however, it is likely that even under socialised conditions, it was women who provided the actual labour of cooking, cleaning and childcare (Kim 2010: 765). It also seems likely that the provision of socialised cooking, housework and childcare was never as extensive as claimed. Rather, as in China and other socialist states, women who worked outside the home were likely to suffer from the double burden of housework and paid work. This is even more so with recent reforms in China and Vietnam where a greater welfare burden has been relegated to the family (Truong 2006: 169–188). In North Korea, the economic collapse of the country and several decades of famine mean that the state provision of welfare, goods and services has broken down (Kim 2015). The complete socialisation of childcare, housework and care work is an ideal which probably was never achieved.

In other societies, as we shall see below, the market is seen to provide solutions, through informal "grey" economy solutions, through capitalist enterprises which mediate between care workers and their employers, or by a combination of different forms of provision.

The Singapore model

The problem of how to take care of the need for housework, childcare and other caring labour in some societies is dealt with by employing domestic workers, on a casual, daily or live-in basis. Where there is a relatively flat income distribution in a country, however, it is rarely feasible to employ domestic help. To employ a domestic worker, the family would need to have a combined income high enough to cover one other person's wages.

In Singapore, however, it is possible for middle-class working families to employ domestic workers due to economic disparities between Singapore and neighbouring countries. State policies regulate the employment of overseas contract workers, while agencies mediate between domestic workers and their employers, and make profit from these transactions.

When commentators compare Singapore with other parts of Asia, it is often in terms of "working women" employing domestic labour. It is more accurate, however, to state that *both men and women* are relieved of domestic labour if the family employs domestic workers.

The employment of immigrant workers to carry out housework, childcare and other forms of care work means that the provision of care work is now something which crosses national borders. This is closely regulated in Singapore, but happens in rather more informal and irregular ways elsewhere.

As is well-known, the economy of the Philippines is highly dependent on remittances from workers who travel overseas to work in various forms of care work (as well as construction and service industries). These movements are determined not only by economic disparities but by demographic disparities (Parreñas 2001). Workers move from poorer to richer countries – from "South" to "North" – while countries with an aging population will recruit workers from countries with a younger demographic.

The San Diego model

In much of the USA, many middle-class families informally employ irregular immigrants as domestic workers. This is strikingly apparent, for example, in San Diego at the border with Tijuana in Mexico. Every morning, people cross the border from Tijuana to San Diego where they work as domestic workers for relatively wealthy middle-class families. In the evenings they return to their own homes in Tijuana (Ley 2013). As in Singapore, the need for housework and care work is met by immigrant workers, but on a more informal and undocumented basis.

In various parts of Southeast Asia, too, there is regular informal border crossing for work, for example between border regions of Indonesia and Malaysia (Ford and Lyons 2007: 236–263).

The Kuala Lumpur model

Above we have briefly surveyed countries which try to solve the problem of care work by redistributing the labour within national boundaries or, at times, by importing workers. Increasingly, however, the aged themselves are moving offshore in search of cheaper housing and more affordable care. Malaysia, for example, has recently drawn attention as a retirement destination (Malaysia a top retirement destination 2015).

The phenomenon of overseas retirement is a combination of individual decisions, the policies of governments in receiving countries which seek to attract retirees, and the policies of sending governments which may facilitate their retirees' travel overseas.

Retirees will make choices about destinations according to their retirement income: Queensland or Western Australia for the relatively wealthy, Thailand or Malaysia for those with smaller retirement funds. It is possible for retirees to immigrate to Australia, for example, as long as they can demonstrate

that they have enough assets and retirement funds to ensure a livelihood.

No matter what the location or destination, however, the need for embodied human workers to take care of the bodily needs of other human beings does not go away.

A Glimpse of the Future?

The models presented above may be thought of as ideal types, for in most societies these various forms of care work are provided by a "patchwork" of different methods (Leland 2015). Truong et al. remind us that care work is

> both paid and unpaid, straddles the public and private realms, is subject to cash payments and service provision, and could be contractual or non-contractual. The care economy in a sense is a 'mixed economy' involving the state, market, household and voluntary sector (2006: xix–xx).

The involvement of the four sectors of the family, the community, the market and the state in providing care is sometimes referred to as the "care diamond" (Razavi 2007), although this schema fails to capture the transnational dimensions of care work in the contemporary world (Parreñas 2012: 273).

With reference to the aging populations in several countries in East Asia and Western Europe, and neoliberal policies which have led to cutbacks in state provision of welfare benefits and services, Truong et al. describe a "crisis in care systems worldwide" (2006: xxi), epitomised in the situation in contemporary Japan.

Until the mid- to late twentieth century, it seemed that Japanese governments had been successful in population management, with good nutrition, a healthy population, low infant mortality, high educational levels, high life expectancy, low unemployment and high economic growth. This very "success", however, is what has led to the current demographic crisis.

Japan now has over 60,000 centenarians; around 10 million people over 80 years old (7.9 per cent of the population); and just short of 34 million people over 65 (26.7 per cent of the population) (Japan's centenarian population tops 60,000 for first time 2015; Japan increasingly gray as people 80 or over top 10 million, 2015). Of the aged population, 14.62 million are men (23.7 per cent of the total male population) and 19.2 million are women (29.5 per cent of the total female population). In other words, the aged population of Japan outnumbers the total population of Australia.

Japan's total fertility rate – the average number of children born per woman aged between 15 and 49 – dropped continuously until the early 2000s: 2.16 in 1971, 1.29 in 2004, down to 1.26 in 2005, then inching up to 1.42 in recent years.

If we add up the population under 15 and the population over 65 and divide this by the productive population (those from 15 to 64) this produces a dependent population ratio of around 2:1. That is, the two-thirds of the population of productive age have to work to support the other third who are too old or too young to work. This ratio is expected to decline to 3:2 by 2025. This is a matter of economics (of paying for pensions, welfare and medical care from the taxes of a shrinking labour force), but also a matter of finding the labour power to deal with the physical care of the aged.

As noted above, for much of the twentieth century in Japan, the need for housework, childcare and other forms of care work was largely dealt with by married women withdrawing from the paid work force during the years when the demands for care work were the greatest and then returning to the paid work force on a casual, part-time or temporary basis. In the context of the current demographic crisis, however, the family can no longer meet the need for various forms of care work.

Government statistics show that bedridden elderly relatives are cared for by: husband (13.3 per cent), wife (28.4 per cent), son (13.3 per cent), daughter (16.6 per cent), daughter-in-law (23.8 per cent) and others (4.7 per cent). In around 70 per cent of cases, then, it will be a female who provides care (Sugimoto 2010: 170).

In the 1980s, conservative governments promoted a so-called "Japanese style welfare state", where family-based care would be supplemented by volunteers. When it became apparent that the need for care work could not be met with family and volunteer labour alone, a Carers' Insurance scheme was implemented.

Consider a married couple of the "baby boomer" generation where, according to the gender ideologies of mid-twentieth century Japan, the husband has been the primary breadwinner. They will have adult children, and possibly one or more grandchildren. It is likely that both partners' parents will be alive and in their eighties. One or more of their grandparents might still be alive, too. Paid work will be juggled with caring for the needs of aging parents and parents-in-law who may or may not live close by. Carers' insurance allows for casual or part-time paid help, but the burden of managing the activities and timetabling of relatives, paid carers and volunteers falls disproportionately on women.

Care work in Japan has shifted from largely invisible unpaid work carried out by family members to a combination of family-based care, volunteer work, paid care and institutional care. Marketisation has been facilitated by the Carers' Insurance scheme.

The market in care labour is now a transnational one, involving both documented and undocumented immigrant labour. The Japanese government has entered into Economic Partnership Agreements with Indonesia, the Philippines and Vietnam which allow for small numbers of workers to enter Japan to be trained as care workers. More recently, the government has promoted the entry of immigrant domestic workers as a way of encouraging women's labour force participation. The idea that domestic work is *women's* responsibility remains unchallenged. The numbers in these official programs are still small, however, while large numbers of care workers enter the country through informal channels (Piquero-Ballescas 2009: 127–38).

Conclusions

While the aging of the population has not yet advanced to the extent it has in Japan, Australian society also faces issues related to the need for housework, childcare and other forms of care work.[3] Recent policy responses have included childcare subsidies, a paid maternity leave system and a disability insurance scheme.

[3] 15.1 per cent of the Australian population is over 65, compared to 26.7 per cent in Japan.

In practice, the needs for housework, childcare and care work are met in Australia through the kind of patchwork of paid and unpaid, formal and informal, home-based and institutional, public and private forms of provision described elsewhere (Leland 2015; Truong et al. 2006: xix–xx). It has recently been reported, for example, that grandparents – largely grandmothers – provide most childcare in Australia, and that this sometimes conflicts with policies aimed at maximising the workforce participation of older Australians (Hamilton 2015). Similarly, it is women who provide most unpaid care work in Australia, and this is reflected in the different workforce participation rates for men and women, and in a greater proportion of women than men engaged in part-time work (Australian Human Rights Commission 2013), perhaps not so different from the "Tokyo model" described above.

In future years, Australians will need to decide what models to follow for the provision of care work. We can learn from the experiences of other countries, as outlined above. No matter what model is chosen as the "Canberra model", the need for workers to look after the embodied needs of human beings will not go away. Attempts to address these issues will need to confront the persistent gendered division of housework, childcare and care work. It is also likely that the solutions to such problems will involve looking for lessons beyond the boundaries of the Australian nation-state.

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Thesis Abstract

Effects of Organic Amendments and Plants on the Chemistry of Acid Sulfate Soils under Aerobic and Anaerobic Conditions

Dr. Patrick S. Michael

Abstract of a thesis for a Doctorate of Philosophy awarded by
The University of Adelaide, Adelaide, Australia

Acid sulfate soils with sulfuric horizons (sulfuric soils) can exert a range of negative impacts on the ecology and productivity of soils. The primary treatment for these soils is to raise the pH using lime. Although often effective, this treatment can be expensive and not well suited to large areas. In this research, the possible use of plant organic matter to ameliorate sulfuric soils or to prevent acid sulfate soils with sulfidic materials (sulfidic soils) from acidifying was investigated. The advantage of this approach is that organic matter is readily available, inexpensive and environmentally friendly, especially in Ramsar listed wetlands where lime cannot be used. The experimental treatments used ground leaves of *Phragmites*, lucerne hay, pea straw and wheat straw as sources of organic matter with varying nitrogen, which were either incorporated into or overlaid on the surface of the soils. After six months of incubation under either aerobic or anaerobic soil conditions, pH, Eh and sulfate content were measured. Incorporation of complex organic matter significantly increased the pH of both sulfuric and sulfidic soils. These changes were correlated with reductions in soil redox and sulfate content. The magnitude of the changes depended on the nitrogen content of the complex organic matter.

The relative importance of carbon and nitrogen in ameliorating acid sulfate soils was further investigated respectively using glucose, sodium acetate and molasses as simple carbon sources, and urea, nitrate and ammonium as simple nitrogen compounds. It was found that compounds containing inorganic nitrogen alone, without carbon, were ineffective, while urea significantly increased pH and reduced Eh, but did not affect the sulfate content of the soil. Glucose had no significant effect on sulfuric soils, either at low (catalytic) or high concentrations, while acetate significantly increased pH. Molasses (which may contain small amounts of nitrogen) caused moderate changes in pH, Eh and sulfate content. On sulfidic soils, acetate prevented oxidation but glucose strongly acidified the soil, most probably by fermentation to butyric acid.

The effects of live roots on sulfidic and sulfuric soil chemistry under either aerobic or anaerobic soil conditions were investigated using *Typha*, *Phragmites* and *Melaleuca*. *Typha* and *Melaleuca* are respectively common wetland and inland plants, whereas *Phragmites* grows under both wetland and inland soil conditions. The

study was extended to investigate the combined effects of incorporated ground *Phragmites* leaves as organic matter and *Phragmites* plants together. Generally, a great deal of variability was found in the changes in pH, redox and sulfate content, the overall effects being dependent on plant type, whether there was incorporated organic matter, the type of soil and the moisture conditions. However, in all cases the growth of the live plants resulted in greater acidity than in the unplanted control soils. In the case of *Typha* and *Phragmites,* which have aerenchymatous tissues, the acidification under anaerobic conditions was attributed to the transport of oxygen in these tissues into the soil. Under non-flooded conditions, the acidification was most likely due to increased oxygen penetration as a result of loosening of the soil by the plant roots.

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Thesis Abstract

Methodologies for Using Satellite-Based Positioning Systems in Determining Vibration Parameters of Aircraft Structure

Dr. Zoran Vulovic

Abstract of a thesis for a Doctorate of Philosophy awarded by
The University of New South Wales, Sydney, Australia

This thesis looks into applications of GPS other than navigation that would improve the performance, reduce the cost and enhance the safety of aircraft. General Aviation (GA) category of aircraft is the one that benefited least from technological improvements, despite the fact that GA pilots are, in general, in greatest need of maximum technological support. The emphasis of this work is on GPS applications for light aircraft, however, most of the conclusions, are equally applicable to other categories of flying vehicles as well.

Most GPS receivers perform very accurate position and velocity measurements and an appropriate placement of antennas at the extreme points of an aircraft's structure enables the attitude of the aircraft to be easily determined and consequently controlled without using any other sensors. However, the fact that the aircraft is not a rigid structure results in a reduced accuracy of this approach.

A proposed solution to this problem is the addition of a centrally located antenna used as a reference point, which makes the peripheral antennas capable of measuring both the periodic and non-periodic wing flexure. The accuracy of the wingtip displacement is thus significantly improved using the relative GPS positioning. Oscillatory wing motion can be measured only to an extent determined by the positioning frequency of the given GPS receiver. A method developed here takes into account low-frequency natural modes of the wing and monitors whether the frequency of the actual wing motion approaches a natural frequency established earlier. This will not only improve the safety by providing a warning against flutter, but also provide a long-term fatigue indication.

The varying amount of fuel in the wing tanks throughout the flight is also considered in this thesis. The relationship of the fuel status and frequency domain parameters of the wing is established both analytically and experimentally.

Based on this work, two practical applications are examined. One is the use of the experimental modal analysis for detecting structural deterioration; the other one is a GPS-based Flight Management System for light aircraft named AWIMI. The former proposes two novel methods of ground vibrations tests used for determining modal frequencies to be monitored in flight. The latter uses the GPS data and fuel data, compares the distance to the destination with the rate of fuel flow and warns the pilot when the remaining fuel is insufficient to complete the flight.

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Proceedings of the Royal Society of New South Wales

The 2015 programme of events – Sydney

Held at the Union, Universities and Schools Club, 25 Bent St, Sydney unless otherwise stated.

Wed 4 Feb	1229th Ordinary Meeting RSNSW Scholarship winners	Melanie Laird Ruth Wells Stephen Parker	University of Sydney, School of Biological Sciences University of Sydney, School of Psychology University of New South Wales, School of Chemistry
Mon 16 Feb	The Four Societies Lecture	Dr Adi Paterson Chief Executive Officer, ANSTO	Latest developments in Small Modular Reactors
	Held in conjunction with the Nuclear Engineering Panel of the Sydney Branch of Engineers Australia, the Australian Nuclear Association and the Australian Institute of Energy. Held at Clayton Utz, Level 15, 1 Bligh Street, Sydney		
Wed 4 Mar	1230th Ordinary Meeting	Scientia Professor Katharina Gaus ARC Centre of Excellence in Advanced Molecular Imaging NHMRC Program in Membrane Interface Biology, University of New South Wales	Super-resolution microscopy: Understanding how T cells make decisions
Wed 18 Mar		Associate Professor Igor Aharonovich - University of Technology, Sydney	Quantum Emitters in wide band gap Semiconductors
	Joint Meeting with the Australian Institute of Physics, held at Trinity Grammar School Professional Development Centre, 5 Thomas Street, Lewisham		
Wed 1 April	1231st Ordinary Meeting	Scientia Professor George Paxinos University of New South Wales	Is the Brain the Right Size?

Tue 5 May	Annual Dinner. RSNSW 2015 Distinguished Fellows Lecture	Past Patron, The Hon Marie Bashir AD CVO Dist FRSN	Lachlan Macquarie, 5th Governor of New South Wales: his Life and Legacy to Australia
Wed 3 June	1232nd Ordinary Meeting	Dr Kathleen Riley	The Science of Spontaneity: Fred Astaire as Consummate Craftsman
Wed 1 July	1233rd Ordinary Meeting	Dr James Ley Editor, Sydney Review of Books	Science in Literature
Wed 5 Aug	1234th Ordinary Meeting	Professor Roland Fletcher Professor of Theoretical and World Archaeology, University of Sydney	Complexity and Cultural Transitions 100,000BP to the Present
Thu 6 Aug	2015 Clarke Memorial Lecture	Distinguished Professor Bill Griffin Professor of Geology, Macquarie University	From the Solar Nebula to the Deep Earth – a Geological Journey
Tue 1 Sep	2015 Dirac Lecture	Professor Subir Sachdev Professor of Physics, Harvard University	Quantum entanglement and superconductivity"
Wed 2 Sep	1235th Ordinary Meeting	Professor Mark Westoby Macquarie University NSW Scientist of the Year, 2014	Trait-based Ecology
Tue 15 Se	RSNSW and Four Academies Forum	Government House, Sydney.	The Future of Work
	Held in cooperation with the Australian Academy of Science, the Australian Academy of Technological Sciences and Engineering, the Australian Academy of the Humanities and the Academy of Social Sciences in Australia.		
Wed 7 Oct	1236th Ordinary Meeting	Professor Elaine Sadler Professor of Astrophysics, University of Sydney	The Revolution in Radio Astronomy
Wed 4 Nov	1237th Ordinary Meeting	Professor David Christian Macquarie University	Big History
Tue 17 Nov	Joint Lecture of the Australian Institute of Physics and the RSNSW	Professor Michael Burton School of Physics, University of New South Wales	Interstellar Explorers – mapping the molecular clouds of the southern Milky Way
	Joint Meeting with the Australian Institute of Physics, held at Trinity Grammar School Professional Development Centre, 5 Thomas Street, Lewisham		

Wed 2 Dec	1238th Ordinary Meeting	RSNSW Jak Kelly Award James Colless School of Physics, University of Sydney Society Christmas Party	From Quantum Devices to Quantum Machines

The 2015 programme of events – Southern Highlands

Held at the Performing Arts Centre, Chevalier College, Bowral.

Thu 19 Feb	Dr Charley Lineweaver School of Astronomy & Astrophysics and Earth Sciences, Australian National University	Science, Humility and the Fallacy of the Planet of the Apes
Thu 19 Mar	Professor Andrew Holmes, University of Sydney	You Poo and You: gut microbes, diet and modern lifestyle changes
Thu 16 Apr	Professor Richard Banati, ANSTO	Plastics in our Environment
Thu 21 May	Robert Pritchard, Executive Director, Energy Policy Institute	The Energy Gods must be Crazy
Thu 18 June	Michael Parker, Headmaster, Oxley College, Burradoo	Ethics and Thinking Program for Schools
Thu 16 July	Dr Brian Keating, CSIRO	Food Security in a Changing World
Thu 27 Aug	Professor Richard Roberts, University of Wollongong	Discovery of "The Hobbit" Homo floresiensis
Thu 24 Sep	Dr Lydia Guja, Seed Bank Canberra	Importance of having a Seed Bank to Conserve the World's Plant Resources
Thu 19 Nov	Det. Sgt. Charles Agius, Forensic Service Group, NSW Police	Forensic Science applied to Police Investigations

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Awards for 2016

The Council of the Royal Society of New South Wales have determined to make the following awards for 2015.

1. Edgeworth David Medal:

Associate Professor Simon Ho

ARC Queen Elizabeth II Fellow, School of Biological Sciences, University of Sydney.

The Edgeworth David Medal, established in memory of Professor Sir Tannatt William Edgeworth David FRS, a past President of the Society, is awarded for distinguished contributions by a young scientist under the age of 35 years.

Associate Professor Simon Ho has made hugely important contributions and developed new methods in the field of 'molecular clocks' in biology – a way of estimating evolutionary rates and timescales from DNA sequences using statistical models. These estimates underpin a broad range of studies in conservation genetics, speciation and diversification, domestication of animals and plants, events in human prehistory, and the population dynamics of pathogens. His research focuses on understanding how evolutionary rates vary at the genomic level and estimating the timescale of the Tree of Life. These are fundamental goals of biological inquiry because they deal with the details of the evolutionary process.

Simon Ho's work has set a range of standards in the field, as well as producing methods and practises that are now widely used by researchers. His research has led to important improvements in the way that researchers estimate evolutionary timescales using genetic and genomic data, with significant consequences for our understanding of the evolutionary past.

2. History and Philosophy of Science Medal:

Professor Warwick Anderson

ARC Laureate Fellow and Professor in the Department of History and the Centre for Values, Ethics and the Law in Medicine, University of Sydney. Additionally, he has an affiliation with the Unit for History and Philosophy of Science at Sydney University.

The Royal Society of NSW History and Philosophy of Science Medal was established in 2015 to recognise outstanding achievement in the History and Philosophy of Science. The medallist will have made a significant contribution to the understanding of the history and philosophy of science, with preference being given to the study of ideas, institutions and individuals of significance to the practice of the natural sciences in Australia.

Professor Anderson is a medical doctor turned historian, who has made important contributions to the history of science, medicine, and public health; the history of racial thought and postcolonial science studies. He is a Fellow of the Academy of the Social Sciences, and won the 2014 History of Science Society's Price/Webster Prize for article - "Hybridity, Race and Science: The Voyage of the Zaca, 1934-1935."

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In 2014 Professor Anderson, with immunologist Ian Mackay, wrote a brilliant and original book "Intolerant Bodies: A Short History of Autoimmunity", published by Johns Hopkins University Press. The authors follow the puzzle of autoimmunity from theory to laboratory practice to individual patients' case histories. The result is a compelling study of concepts in action. This sophisticated but highly readable history helps close the gap between medical science and the general public's understanding.

3. Clarke Medal for Zoology.

Professor Christopher Dickman
University of Sydney School of Biological Sciences.

The Clarke Medal was established to acknowledge the contribution by Rev William Branwhite Clarke MA FRS FGS, Vice-President of the Royal Society of New South Wales from 1866 to 1878. The Medal is awarded annually for distinguished work in the natural sciences of geology, botany and zoology done in Australia and its Territories.

Professor Dickman's major contributions lie in terrestrial zoology and ecology. He has long been curious about the factors that promote and maintain biodiversity, especially among land mammals and other terrestrial vertebrates. For the last 35 years he has focused in particular on understanding the forces that shape the distribution and abundance of Australia's endemic mammals and identifying the factors that are causing so many species to decline. His ground breaking works on Australia's desert mammals and on the continent's introduced predators have gained him a formidable reputation as a leading national and international authority on mammalian ecology.

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4. Royal Society of New South Wales Scholarships.

Adrian Dudek (Australian National University, School of Mathematics)
Yevgeny Stadnik (University of New South Wales, School of Physics)
Charles Foster (University of Sydney, School of Botany)

The Council of the Society funds the Royal Society of New South Wales Scholarship in order to acknowledge outstanding achievements by early-career individuals working, in a science-related field within New South Wales or the Australian Capital Territory, towards a research degree in a science related field.

Adrian Dudek is working in number theory under Dr Trudgian at the ANU. During his PhD he has published (or had accepted) eight papers in the peer reviewed literature. His application explained his research thus: "In particular, I'm interested in the elusive tale of the prime numbers. When I let this slip to most people, somewhat tepid memories of their primary school days are horrifically conjured. However, the prime numbers have been studied for thousands of years, or at least since 300BC, when the great Greek geometer Euclid proved that there are infinitely many of them. Since such ancient times, the primes have attracted the attention of curious mathematicians (and other characters) for one reason: it's extraordinarily difficult to understand the behaviour of the prime numbers. For instance, if you were to write down a list of the first 100 prime numbers (a rousing exercise for a Friday night, I'm sure!), you would not be able to find an intelligible pattern. That being said, some recent spectacular advances in number theory mean that the prime numbers are becoming less elusive and more understandable …"

Yevgeny Stadnik works with Professor Flambaum FRSN on "Manifestations of Dark Matter and Variation of Fundamental Constants in Atoms and Astrophysical Phenomena". He writes: "My project is on the investigation of new effects produced by dark matter and proposing novel ways of detecting dark matter. We have published a number of important works in this direction, including results that already improve on existing sensitivities in the detection of certain types of dark matter by up to 15 orders of magnitude. Our results have been published in leading physics journals, including three publications in Physical Review Letters (which is the most highly cited physics journal), and have contributed to the initiation of a number of new laboratory searches worldwide."

Charles Forster is a botanist working with our Edgeworth David medallist Simon Ho on a project "Using genome-scale data to untangle the evolutionary history of flowering plants". A University of Sydney medallist, Charles has been able to estimate the timescale of evolution of a range of plants using genomic data. His analyses have been careful and comprehensive, and he is on the verge of publishing his outstanding work on this topic. This is in addition to three papers from his honours research and three published or under review. This work has also led to the development of some important research collaborations with colleagues at the Royal Botanic Gardens (Sydney) and Université Paris-Sud (France). He writes: "I have provided the most comprehensive combination of analyses of the angiosperm evolutionary timescale so far. The results I have obtained reflect the increasingly common finding that molecular dating estimates predate the oldest fossils by a non-trivial amount of time, up to 70 million years when considering mean estimates."

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5. The Royal Society of New South Wales and Australian Institute of Physics Jak Kelly Award

James Colless
University of Sydney, School of Physics

The Jak Kelly Award is awarded jointly with the Australian Institute of Physics (AIP) to the best PhD student talk, this year presented to a joint meeting with the AIP held on November 17 at Trinity Grammar School.

James Colless is a postgraduate student at the University of Sydney currently undertaking his PhD under the supervision of Professor David Reilly. His research focus is readout and control techniques for GaAs spin qubits. James hopes his research will influence the design and fabrication of reliable multiqubit gates. His talk was entitled "From Quantum Devices to Quantum Machines". It explored the complexity of scaling quantum processors and discussed new techniques and hardware developed to meet these challenges. In particular, James had developed new methods of readout that allow the dispersive sensing of single-electrons using integrated sensors and the capability to read out multiple qubits simultaneously. A scalable control scheme is also demonstrated allowing large numbers of qubits to be manipulated with a small number of input signals.

The award consists of an engraved plaque, a $500 prize and a year of membership of the Society. As the winner of the Jak Kelly award, James then presented his talk to Royal Society on the 1st of November at the Union, Universities and Schools Club.

Archibald Liversidge:
Imperial Science under the Southern Cross

Roy MacLeod
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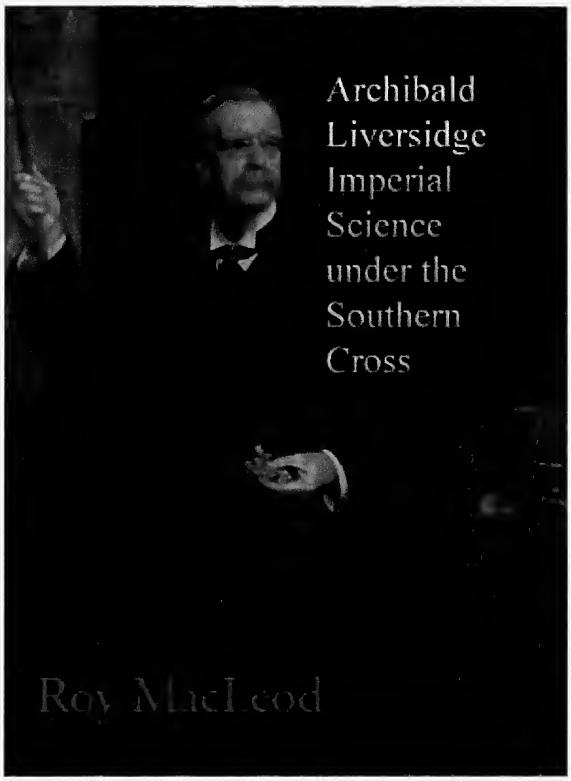

When Archibald Liversidge first arrived at the University of Sydney in 1872 as Reader in Geology and Assistant in the Laboratory, he had about ten students and two rooms in the main building. In 1874, he became Professor of Geology and Mineralogy and by 1879 he had persuaded the University Senate to open a Faculty of Science. He became its first Dean in 1882.

In 1880, he visited Europe as a trustee of the Australian Museum and his report helped to establish the Industrial, Technological and Sanitary Museum which formed the basis of the present Powerhouse Museum's collection. Liversidge also played a major role in establishing the *Australasian Association for the Advancement of Science* which held its first congress in 1888.

This book is essential reading for those interested in the development of science in colonial Australia, particularly the fields of crystallography, mineral chemistry, chemical geology and strategic minerals policy.

To order your copy, please complete the Liversidge Book Order Form available at: http://royalsoc.org.au/publications/books/McLeod_Liversidge_Order_Form.pdf and return it together with your payment to:

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