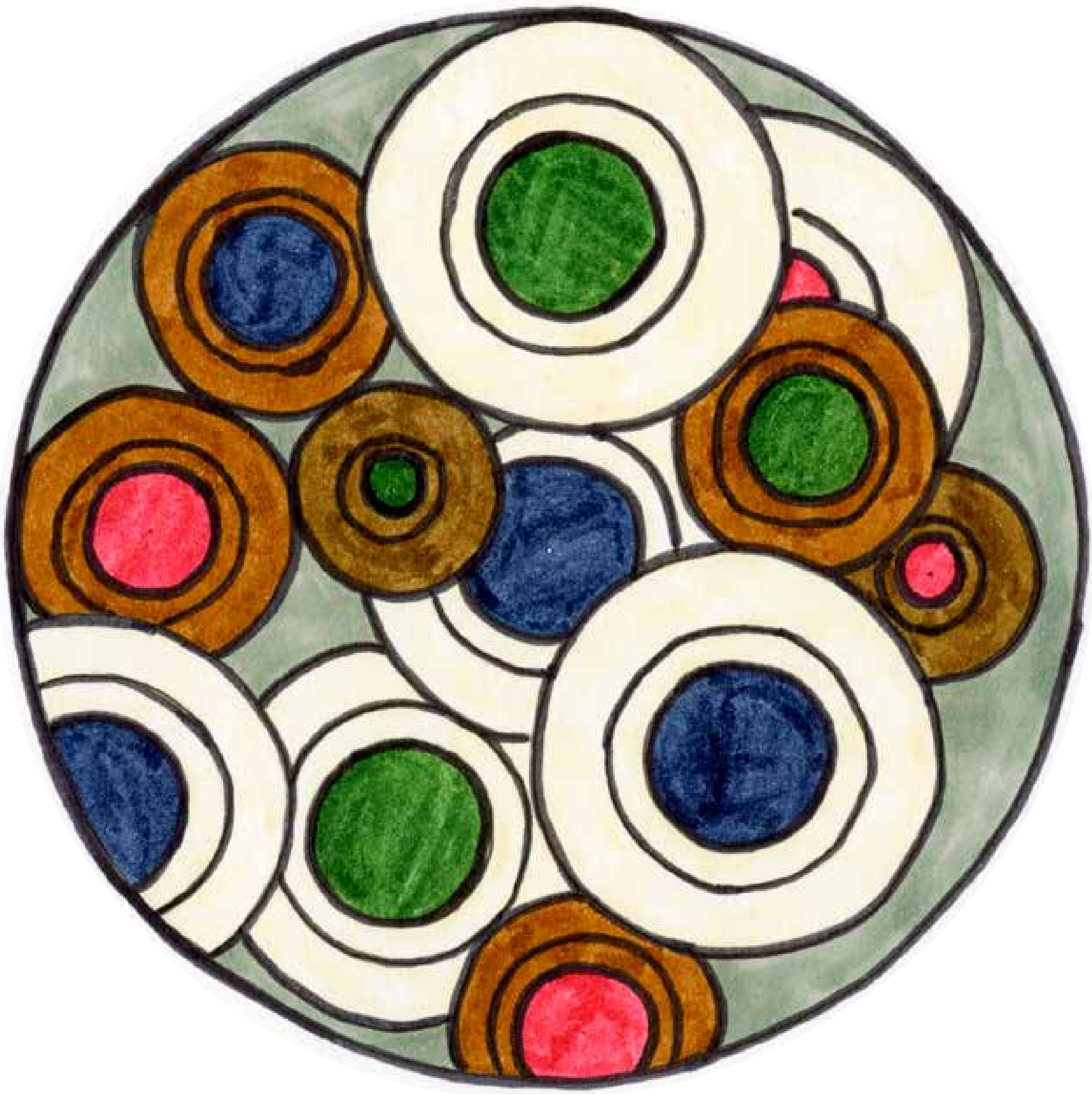
2020 A CENTURY OF CHEMICAL ENGINEERING AT UCT



CHEMICAL ENGINEERING AT UCT

Editors:
Jim Petrie and Jenni Case

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

CONTENTS

1556
The publication of *De Re Metallica* which heralded the modern-day minerals and metals industries

1888
The first course in chemical engineering was offered at MIT and George Davis promoted the "unit operations" model of chemical engineering

1920 – 1960

1920
Chemical Engineering programme established at UCT

1956
The BSc Chemical Engineering degree is reinstated

1960 – 1980

1960
The Department takes up residence in its distinctive new building on North Lane

1965
The Department of Chemical Engineering is formally constituted

1968
The first women and first Coloured students graduate from the Department

1980 – 2000

1985
The first black African student graduates from the Department

1993
The Caltex Education Development Programme established

2000 – 2020

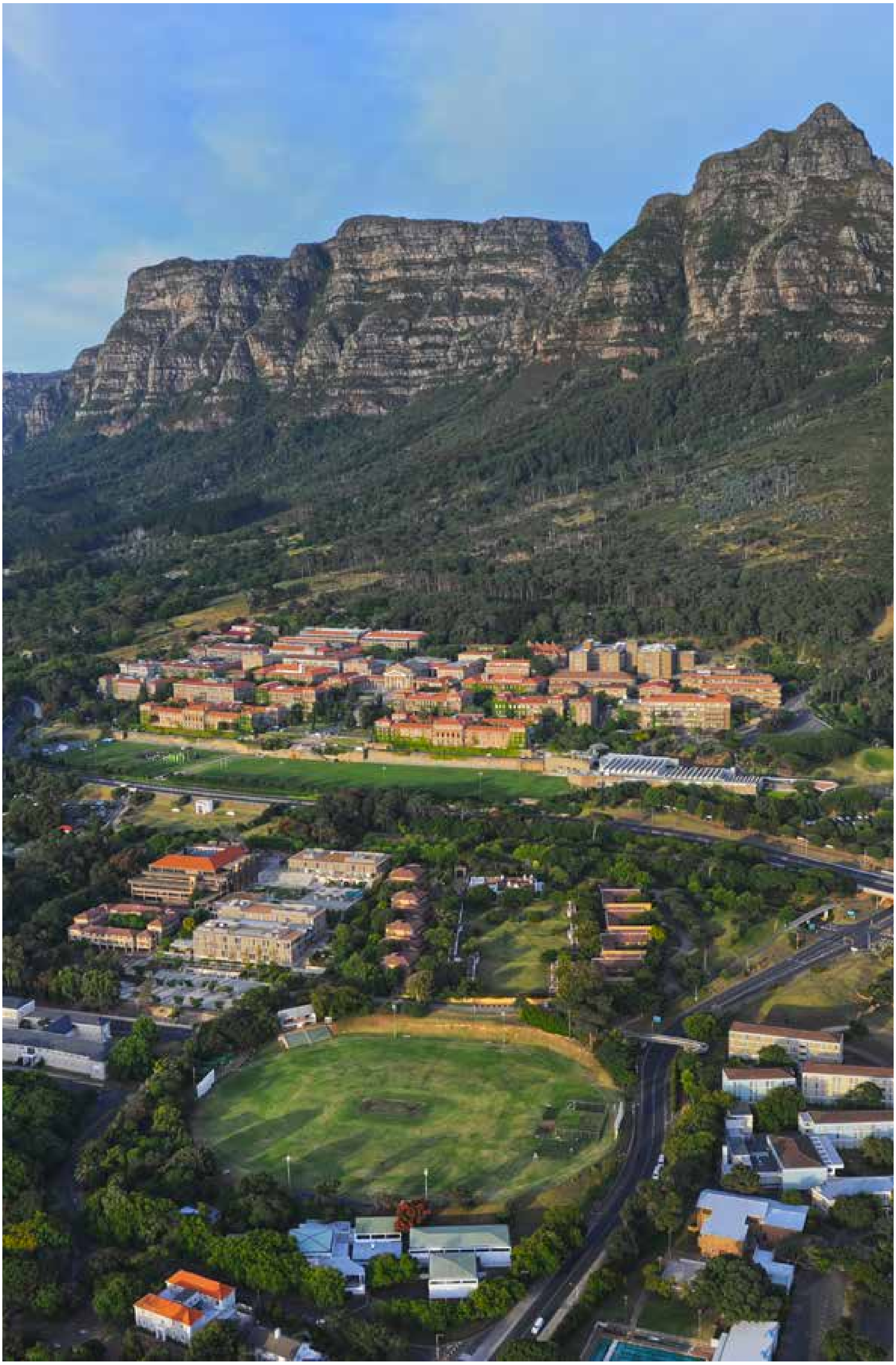
2003
The Department moves into a custom-made building that integrates it more closely with other engineering departments

2008
First SARChI research chairs established in the Department

2013
New Engineering Building opens

Cover:
"Of molecules and cells; bubbles, drops and particles; fluids, fluxes and equilibria; systems, networks and partnerships. These are the colours of chemical engineering at UCT."

Original artwork by Ann Donald, Cape Town.



FOREWORDS

A WORD FROM THE DVC

A strong department built on talented people

Sue Harrison

Deputy Vice-Chancellor for Research and Internationalisation

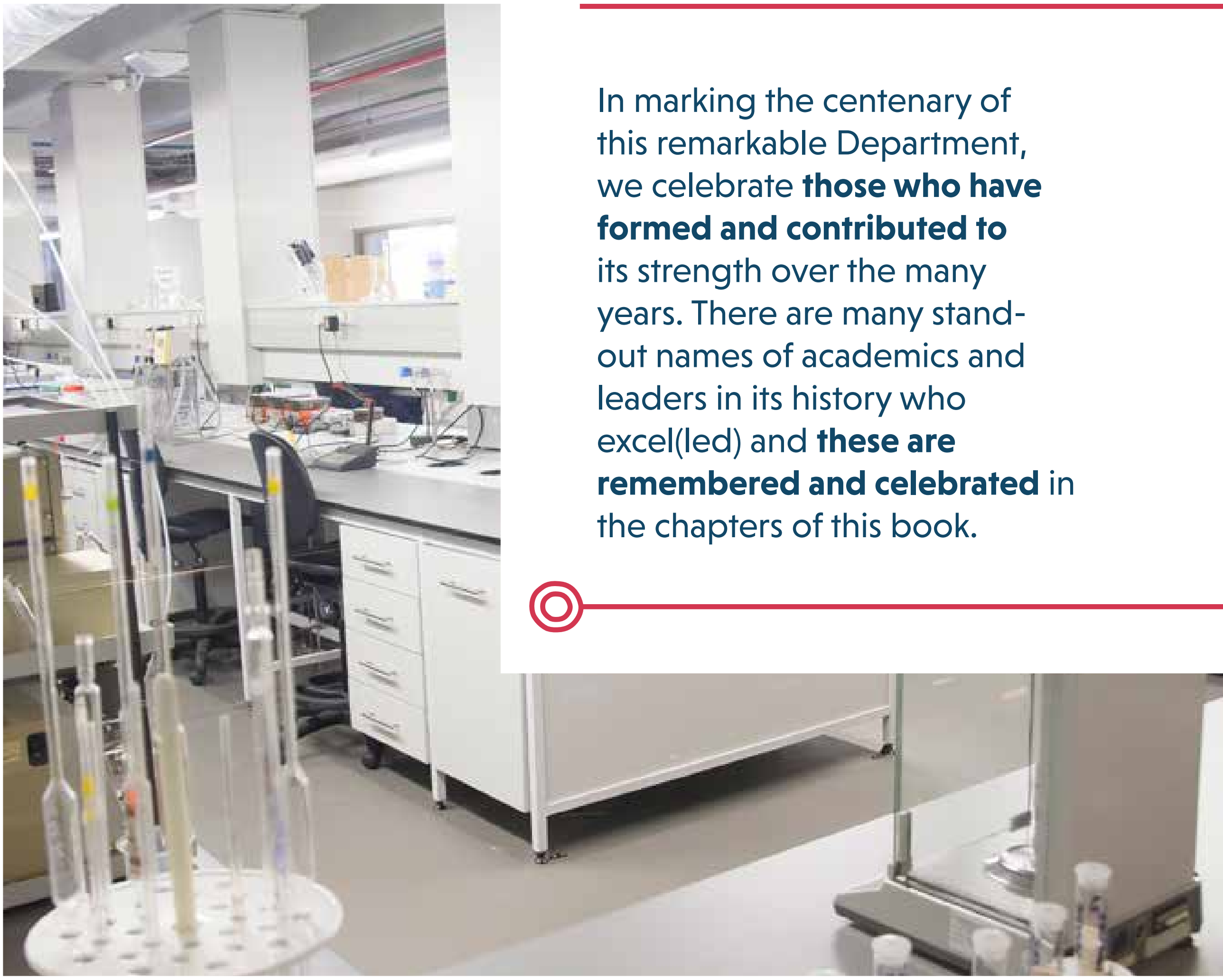
Chemical Engineering has been a part of UCT for 100 years. A Department built on strong and talented people who value both knowledge generation and knowledge translation, many of the senior staff have been associated with the Department for over 20 years – some for 40! Academic positions in the Department are sought after and many staff and students retain an ongoing interaction with it long after moving on in their careers. Our undergraduate classes are usually full, and our postgraduate numbers have swelled.

The Chemical Engineering students are central to the focus of Chemical Engineering at UCT. A hallmark of the Department is that, guided by excellent researchers in engineering education, the team was among the first to mainstream academic development, new pedagogies of teaching and learning, and new teaching tools into the curriculum. Faculty are happy to be research subjects in the classroom and to continually learn together to deliver an integrated and accessible programme.

Of course, academic departments are about both generating and translating knowledge – research and teaching and learning. Often these live in tension with each other. In Chemical Engineering, these are embedded and, wherever possible, an easy flow exists between them. The strong, soft-funded research enterprise that has grown within the Department means that no longer is everyone a researcher and a teacher, but the spirit and principle remain and most contribute in some way to both.

The Department has demonstrated down the years both its willingness and capacity to support national tertiary education research initiatives. Its early successes in collaborative research projects, with industry support, provided a template for other UCT departments to follow. Its commitment to the National Research Foundation's research rating scheme from its inception has resulted in one of the highest relative numbers of rated researchers outside of the Faculty of Health Sciences at UCT and across South African chemical engineering departments. And its research and teaching outreach across Africa continues to reward the Department and UCT more generally in terms of networks and partnerships.

Research drivers have been shaped by differing influencers over time. Some 40 to 50 years back, we focused strongly on the needs of the economy and our key resource industries: the mining, energy, liquid fuels and chemicals sectors in particular. Twenty-five to 30 years ago, the focus refined towards the delivery of products and processes that caused less impact on the environment and places where people lived. With this, our bioprocess engineering, environmental engineering and process systems research grew. These areas all continue to thrive, but the Department has superimposed on them the deep need to contribute to sustainable development in which societal, environmental and economic components experience equal attention.



In marking the centenary of this remarkable Department, we celebrate **those who have formed and contributed to** its strength over the many years. There are many stand-out names of academics and leaders in its history who excel(led) and **these are remembered and celebrated** in the chapters of this book.

To meet these pressing needs, chemical engineering is returning to its roots of celebrating interdisciplinarity. After all, chemical engineering is an early product of exactly that – being formed through the linking of industrial chemistry and mechanical engineering sufficiently long ago for this to be a centennial celebratory work.

We understand the space of letting work across disciplines, and with other disciplines, inform our findings and our ways of doing. This has been a core focus of the Department, for example, through the growth of bioprocess engineering and has increased in focus over the past 10 to 15 years. It informs the interdisciplinary research groupings that we are currently nurturing – Minerals to Metals and Future Water – where we work in concert with researchers across UCT to tackle the complex and wicked problems of our country, continent and globe.

In marking the centenary of this remarkable Department, we celebrate those who have formed and contributed to its strength over the many years. There are many stand-out names of academics and leaders in its history who excel(led) and these are remembered and celebrated in the chapters of this book. Here the feature to note is "chemical engineering as a team", always with clear goals and a joint endeavour to attain them – be it a new curriculum, a new building or a re-energised set of research thrusts. We have not got it right over all 100 years, but those periods – and they have been many – when we have, have spurred us on to build on our complementary skills and expertise, and to place our work into the context of our University and of South Africa.

Through this reflection on our past, we also hope to inspire the next generation to expand our groundwork and work together to deliver new ways of thinking, doing and being in all sectors of interest and influence.

A WORD FROM THE DEAN

A Department that has grown and changed with the times

Alison Lewis

Dean of the Faculty of Engineering & the Built Environment

I have been fortunate to be part of the Department of Chemical Engineering since 1981, when I started as a first-year undergraduate student. I completed my Master's degree in 1987, worked in industry as a process engineer and came back to complete my PhD in Civil Engineering in 1993. After a postdoctoral fellowship, I joined the Department in 1995 as a senior lecturer.

From being a student to a lecturer, Head of the Department between 2013 and 2015, and from 2015 as Dean of the Faculty of Engineering & the Built Environment (EBE), it has been wonderful to see the Department grow and change with the times – eternally entrepreneurial and always ahead of the next wave. It has always been a vibrant and exciting space to work in. I feel very honoured to have worked and collaborated with its diverse academic staff who are respected leaders in their fields.

Along the way, I have had many mentors who have helped me develop and grow. As an undergraduate student, I was one of five women in my class (of fifty) and looked up to the sprinkling of senior female students ahead of me (Nicky Illing, Kim Anziska, Dee Bradshaw), as well as the single female academic on the staff at the time (Dr Masami Kojima). Professor Cyril O'Connor was an extremely progressive Head of Department, an innovative thinker and a committed mentor. I know that he has mentored many young academics and I count myself very lucky to be one of them.

From the programme's origin in 1920, its generation-long alignment with the BSc Applied and Industrial Chemistry course, and, in 1957, its first graduating class of seven (white, male South Africans) from the new Department, the Department has evolved beyond measure. In 2020 it has 649 registered undergraduate and postgraduate students, of which nearly 50% are female, and 65% black. There are 60 PhD students and 20 postdoctoral fellows. To accommodate the growing student numbers and research, the Department has physically moved three times since 1960. While we celebrate this centenary and everything the Department has achieved, we also need to acknowledge and reflect on the injustices of the past that excluded talented black South Africans from studying at UCT. It is heartening to see the transformation that has taken place, not only in the student body, but also in the staff, thanks to a firm commitment to change. We have also had substantial support from our research partners and sponsors, who, over the years, have assisted in helping to shape the Department's strategic vision, through, among other initiatives, the direct funding of academic posts.

Chemical Engineering is made up of many exceptional people. I am continuously impressed by the ground-breaking, innovative and dynamic staff in the Department. Their willingness to embrace change, whether in the form of a radical new curriculum or the new challenges of interdisciplinary research, are testament to its vibrant culture and entrepreneurial style.

The Department's **willingness to embrace change**, whether in the form of a radical new curriculum or the new challenges of interdisciplinary research, are testament to its vibrant culture and entrepreneurial style.

As we look to the future, Chemical Engineering's roles in the African Climate and Development Initiative, the African Centre for Cities, the Future Water Institute and our Future Energy project, attest to its ongoing and critical role in helping the faculty not just respond to, but lead and shape the field.

I would like to thank all the staff members – current and past – for their dedication and hard work that has helped to make the Department the exceptional, vibrant, challenging and internationally recognised place that it is. I also want to recognise all the industrial partners, sponsors and other organisations without whose efforts and investments very little of this work could have taken place. Lastly, I would like to acknowledge the students and alumni, many of whom have gone on to be leaders in their fields and make profound contributions to industry and to the Department. You serve as excellent ambassadors for the institution as a whole. You could not make us any prouder!

CONTRIBUTING EDITORS' INTRODUCTION

Shaping an inclusive narrative against the backdrop of South Africa's evolving social history

It has been a conscious decision to structure this narrative in ways that foreground the voices of the people who have shaped the evolution of UCT Chemical Engineering and, also, to provide a platform for alumni **to reflect on the value of their UCT experience** in their lives since those formative years.

This monograph is a celebration of the centenary of Chemical Engineering at the University of Cape Town. It outlines the evolution of the programme; highlights key personalities who contributed their vision, energy and commitment to ensure that the programme succeeded and thrived; and showcases a range of personal vignettes from alumni, research colleagues and industry associates about their relationship with the Department, its programmes and its people.

At the same time, the volume attempts to develop an inclusive narrative that positions this story against the backdrop of South Africa's evolving social history.

In compiling this celebratory book, we have solicited input from around the globe, scoured UCT's own archives, local media and national resources; all in an effort to make the story as representative and factual as possible. Any bias or omissions are entirely our fault as contributing editors.

It has been a conscious decision to structure this narrative in ways that foreground the voices of the people who have shaped the evolution of UCT Chemical Engineering and, also, to provide a platform for alumni to reflect on the value of their UCT experience in their lives since those formative years. It has been our good fortune to have been able to tap the enthusiastic memories of alumni from the 1950s onwards. For the preceding years, we are reliant on documented resources.

This narrative is unashamedly a colloquial "social history". It does not pretend to be a definitive research document or attempt to resolve the inevitable inconsistencies of memory and of differing accounts of similar events. At the same time, it is our hope that the picture we have captured will be useful to the Department as it navigates its future, continuing to ensure its relevance and contributing its expertise to help address the critical challenges of 21st century living.

Almost inevitably, we have been forced to compile this book as a chronology. At the same time, we have been liberal in our use of timelines, and many of our stories and the personalities involved cross multiple chapters.

The story is told over six chapters:

Chapter 1 considers the establishment of chemical engineering as a distinct academic discipline, and its positioning at the intersection of chemical sciences and engineering technology. It provides a brief account of how global initiatives from the 1880s intersected with the explosive growth of South Africa's minerals sector at that time, which in turn provided the bedrock for the formation of chemical engineering in South Africa.

Chapter 2 chronicles a brief account of how Chemical Engineering as an academic programme found a home at the University of Cape Town in 1920, and how it evolved into a fully-fledged Department over the subsequent 40 years. This story cannot be told independently of UCT's own evolution over that same period.

Chapter 3 outlines the foundation of a research culture at UCT Chemical Engineering, led initially by the (already then) critical imperatives of energy and water security. It showcases the growth and significance of industry collaborations. It marks an era in which the academic profile of the Department expanded and changed significantly; and the start of the Department's transformation journey to move away from being the exclusive domain of white male students.

Chapter 4 addresses the almost exponential growth in staff recruitment, student numbers and research productivity, which also aligns with the arrival of democratic governance in South Africa. It documents the Department's committed endeavours in the field of academic development to address the inequities of the apartheid legacy and reflects on the extent to which the physical space of Chemical Engineering started to limit further expansion.

Chapter 5 records the success of the Department in securing an expanded spatial footprint over two custom-designed, inter-connected buildings, which should solve its physical resource constraints for some time going forward. It details radical curriculum renewal, focusing on research-led, practice-based teaching and learning, underpinning the Department's commitment to academic development. This is echoed, too, in the changing academic and research staff profiles. This chapter also details the consolidation of much of the research activity around university-recognised centres, the capitalisation of institutional opportunities and structures and the continued building of global networks and partnerships.

Chapter 6 turns its attention to the future and reflects on the considerations that the Department is grappling with as it prepares for its next century. Key elements here include the consideration of trans-disciplinary research, the seamless embedding of all transformation initiatives into the mainstream, the alignment with professional institutions, the catalytic promotion of innovation and entrepreneurship, and so much more.

There are many individuals who have contributed directly to this story. We hope that their voices come through in the narrative. Beyond that, this project would not have been possible without the financial support of our alumni who contributed enthusiastically via a crowd-funding campaign, notably: John Marriott; The Green House; William Cahill; Candida Cahill; Patrick Largier; Harshad; Jennifer Margaret Case; Sargon Lovkis; Peter Dold; Anthony Williams; KTS Luk; Ed le Roux Horn; Sally Berge; James Mohlaba; David Watson; Zwai; and Arisaig Albion (note that some donors wished to remain anonymous). Many others have worked behind the scenes to help us tell this story, including UCT archivists, EBE Faculty and Chemical Engineering academic and administrative staff. Though unsung, their contributions have been pivotal, especially in this 2020 year of Covid-19.

As contributing editors, we would like also to acknowledge the keen professional work of our Rothko production team, who have kept us in check when needed, and brought their wise counsel and creative flair to bear where it mattered.

But our most sincere thanks must go to all the UCT Chemical Engineering staff and alumni down the years. Without your participation in the programme, there would be no story to tell.

UCT Chemical Engineering is its people. Long may that continue.

Contributing editors

Jim Petrie
Jim is an emeritus professor at the University of Sydney and an honorary professor at the University of Cape Town. A transplanted Scot, via Australia and Rhodesia, he has been associated with UCT Chemical Engineering for close to 50 years. He says that this centenary publication is an excellent opportunity to give something back to the Department that has helped shape his professional career in so many ways. And has provided many close personal friendships through the years.

Jenni Case
Jenni was a member of the academic staff in the Department of Chemical Engineering for just over 20 years, and remains as an honorary professor following her move to head up Engineering Education at Virginia Tech in the USA. She was delighted to receive the invitation from Jim Petrie to join the editorial team for this book. She played a key role in the Department's academic development work from the late 1990s and is excited to see the fruits of that work profiled here, as well as the tributes to so many people whose exceptional efforts and talents made this Department such a brilliant community in which careers have grown and lives have been changed.

1 WHAT'S IN A NAME?

A BRIEF HISTORY OF CHEMICAL ENGINEERING

There has always been a chemical industry. The early alchemists of ancient Egypt and China looked at material transformations to produce medicines, soaps, and attractive metals, among other products. However, chemical engineering as a unique academic and professional discipline, and not merely some hybrid of chemistry, civil and mechanical engineering, only came into being in the 19th century.

1556

The publication of *De Re Metallica* which heralded the modern-day minerals and metals industries.

An early attempt to define and organise the physical and chemical processes associated with mining and metals refining came about in the mid-16th century with the posthumous publication of Agricola's seminal work *De Re Metallica* in 1556.[1] This could justifiably be heralded as the rigorous foundation of all minerals and metals industries, which are closely tied to the development of chemical engineering in South Africa.

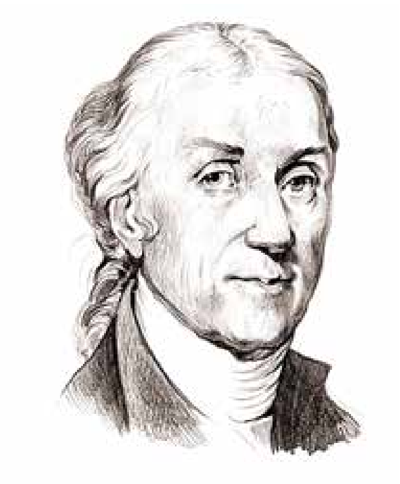
But it was only in the late 18th and early 19th centuries that the science of chemistry evolved markedly. Against a backdrop of significant colonial expansion, these advances were driven by people like Antoine Lavoisier in France and Henry Cavendish in England who (separately) confirmed the law of conservation of mass. Atomic theory was developed in the first half of the 19th century by John Dalton, Jöns Jacob Berzelius and others. This gave chemical scientists "workable assumptions regarding the structure of matter, and laws to describe observed chemical phenomena".[2] The late 19th century saw this knowledge applied in the United Kingdom to focus on the energy- and water-intensive burgeoning textiles sector (alkalis for soap, bleach, and textile dyes). In France and Germany, the focus was on batch processing of fine chemicals (synthetic dyes, fragrances and proto-pharmaceuticals). In the USA, the emphasis came to be on the development of continuous processes to support a rapidly expanding manufacturing industry.

In this climate of expanded scope and sophistication, the need for a new professional discipline emerged to successfully oversee the chemical industry and place it on a more rigorous and quantitative basis. And hence, chemical engineering came into being as a distinct discipline that would focus on the fundamental understanding of the science which informed chemical transformations at industrial scale.

1 Published in 1556 and translated into Latin from its original German text.
2 Perkins, J.D. (2003) "Chemical Engineering – the first 100 years", in *Chemical Engineering; Visions of the World*, R.C. Darton, R.G.H. Prince, and D.G. Wood (eds), Elsevier Science, Amsterdam.

As a discipline, chemical engineering is located at the junction of science and technology and rooted in chemistry – as early labels such as "practical chemistry", "applied chemistry" and "industrial chemistry" demonstrate.[3] It is also a discipline that is constantly evolving, thanks in part to the fact that its practitioners are people who are willing always to push boundaries, reframe problems and develop solutions to difficult problems which might otherwise be missed by adopting a more singular focus.

Antoine Lavoisier (1743 – 1794), considered to be the father of modern chemistry.



Henry Cavendish (1731 – 1810), English natural philosopher and scientist noted for his discovery of hydrogen, which he termed "inflammable air".

Lancashire cotton mill circa late 19th century. The emerging chemicals sector played a key role in the development of the textile sector in the UK.

3 See e.g. Musson, A.E. (2009) "Science, technology and economic growth in the eighteenth century", Routledge, Oxford, UK.

The development of chemical engineering education

George E. Davis, author of the seminal *A Handbook of Chemical Engineering*, published in 1901, and the spiritual father of the IChemE. The Institution to this day has its headquarters in the building that bears his name.

Arthur D. Little, who was the originator of chemical engineering at MIT, along with William Walker and Warren K. Lewis.

The challenges for this nascent discipline were immediate and direct. In the 1880s in Manchester, England, George E. Davis gave a lecture series using the label "chemical engineering" to deconstruct chemicals manufacture to a series of basic operations. He could thus be credited with developing Chemical Engineering's unit operations model. Much of Davis's work was motivated by wanting to find a solution to the increasing water pollution problems associated with textile manufacture. Water treatment, of course, remains a mainstay of chemical engineering to this day.

In 1888, in the USA, the first course in Chemical Engineering was offered at MIT, thanks to the energy and vision of Arthur D. Little, supported by William Walker and Warren K. Lewis. This promoted the unit operations model of chemicals manufacture from both a design and analysis perspective. This utilitarian model became the backbone of the evolving education approach for chemical engineers globally. It was only in the late 1950s and into the early 1960s that it began to be challenged by those seeking to better understand physical and chemical transformations at the primary scale of molecular interactions.

In the early part of the 20th century, other academic courses followed, initially in the USA and the UK, but then also in Canada, Australia and South Africa, where there was a profound recognition of the seminal role that this new discipline offered. Academic programmes elsewhere in Europe, South America and Asia developed more slowly. Some of that had to do only with labels (in France and Germany, the term "chemical engineering" was not used before the 1930s). To ensure a level of consistency and professional standardisation, the American Institution of Chemical Engineers (AIChE) was founded in 1908, and the Institution of Chemical Engineers (IChemE) was established in the UK in 1922. Both professional bodies play a major role in the academic accreditation of chemical engineering degree programmes around the world and their joint membership in 2020 exceeded 100 000 members from more than 100 countries.

The birth of the South African chemical industry

Chemical engineering received a major boost after the First World War (WW I) when the UK and the USA saw rapid growth in their chemical sectors as they sought to replace chemicals previously purchased from Germany. This helped shape the evolving discipline of chemical engineering: urgent engagement was required to solve issues of production scale, utilities provision, supply chain considerations and their security.

In South Africa, too, there was considerable growth in commodity chemicals manufacture from the turn of the century and through the inter-war years. Much of this was underpinned by explosives manufacture to support growth in the gold and coal mining sectors. It was this appetite for local control of explosives production that provided the primary stimulus for the establishment of local chemical engineering programmes at UCT and the University of the Witwatersrand.

By 1909, three different companies were manufacturing nitroglycerin and dynamite in Modderfontein, Somerset West and Umbogintwini. In 1923, all three companies merged to form African Explosives and Industries (AE&I). By this stage, the Cape and Natal operations had also diversified into synthetic fertilisers and allied products. The Great Depression era further incentivised local companies to develop substitutes for imported chemicals. Coal-based ammonia plants were built, leading to the production of nitric acid and ammonium nitrate to replace nitroglycerin in explosives. Up to that point, glycerol had been imported.

By the mid-1950s and early 1960s, the South African chemical sector had **evolved in sophistication and diversity as well as scale**, requiring an expanded pool of technical skills to draw from.

The original AECI dynamite factory at Modderfontein.

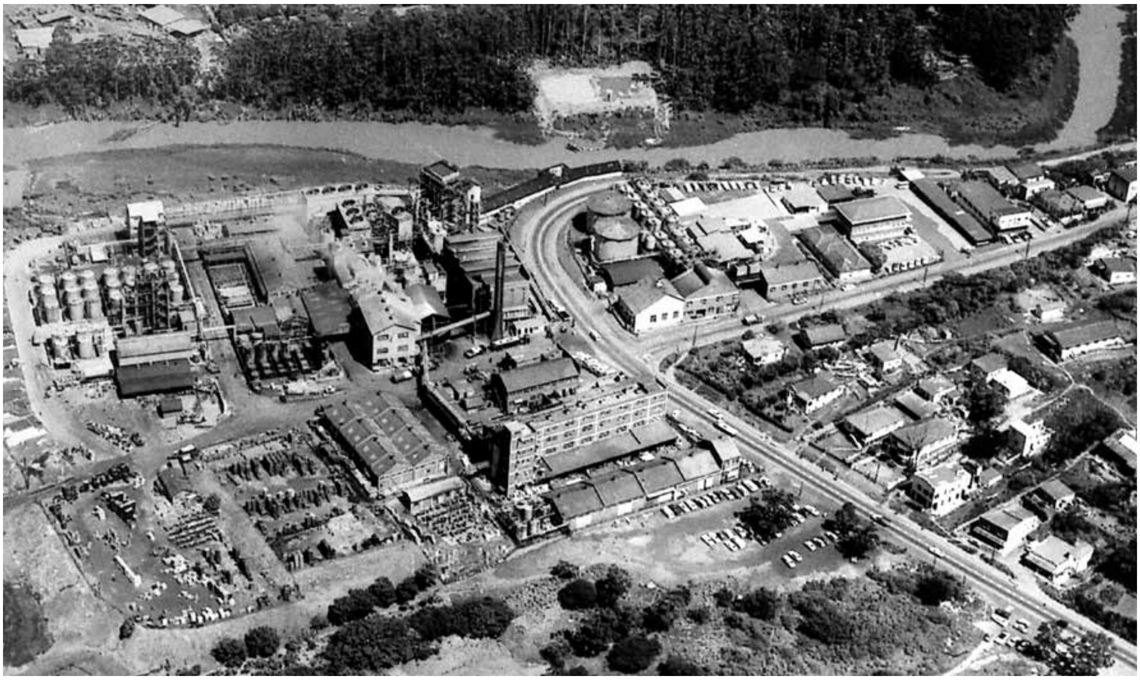
There were other synergies, too, notably with the gold mining industry in the early 1930s. A pyrites roaster was built for sulphuric acid production, for example. By the end of the Second World War (WW II), AE&CI, as it was called by then, had diversified to produce calcium cyanide (for gold extraction), fertilisers, insecticides and paints. In the following 20 years, the company added chlor-alkali production, polyethylene, PVC, urea, formaldehyde resins, titanium pigments, and – through its acquisition of SA Nylon Spinners – both nylon and polyester fibres. In parallel, local growth in organic chemicals production was driven by National Chemical Products, established in 1935. Initially focused on alcohol production (first from maize, then molasses), its product range diversified rapidly to encompass (by 1960) alcohols, ketones, acid esters, mining flotation agents, resins and plasticisers and animal feed supplements.[4]

4 South African Chemical and Allied Industries Association (CAIA) (1999) "Historical view of the South African Chemical Industry 1896 – 1998", *Chemistry International*, **21**(3), 71–77.

The other important leg of South Africa's evolving chemical industry was the liquid fuels sector. The first oil refinery was built in Durban in 1954, with three others to follow throughout the country over the next 20 years, all of which continue to operate to this day. The 1950s also saw the creation of Sasol,[5] to produce synthetic fuels via coal gasification and Fischer-Tropsch (F-T) synthesis, commercialised in collaboration with the German Engler-Bunte-Institute. By the 1960s, the Sasol 1 plant in Sasolburg had evolved to produce tailored feedstocks for the production of synthetic rubber, fertilisers and secondary chemicals and went on to become the largest chemicals production complex in the southern hemisphere.

Sasol 1 under construction. Photograph from the estate of E.J. Adelbert, one of the original design and construction engineers from Germany, circa 1954.

By the mid-1950s and early 1960s, the South African chemical sector had evolved in sophistication and diversity as well as scale, requiring an expanded pool of technical skills to draw from "if the requisite degree of industrial development and self-sufficiency was to be attained".[6] This provided a major stimulus for the further development of academic chemical engineering programmes in South Africa, including that at UCT.



NCP Umgeni Works, circa 1960, where the factory was producing ethanol, resins and plasticisers, mining chemicals and liquid CO2. Picture supplied by Peter Starling, Managing Director of NCP Alcohols.

5 Prior to the creation of Sasol, South Africa had ventured into mining and refining of torbanite oil shales in the 1930s, a joint venture between the Anglovaal mining company and the UK's Burmah Oil Company. That company was called SATMAR. It was SATMAR which initially flagged the potential of the Fischer-Tropsch process and held the original licence for the F-T process in South Africa, which was transferred to the South African government when Sasol was created.

6 Volckman, O.B. and F. Hawke (1982) "Chemical Engineering and the Chemical Industry in South Africa", in *A Century of Chemical Engineering, W.F. Furter (ed), Plenum Press, New York.*

The maturing of chemical engineering science

Chemical engineering academic programmes were evolving globally throughout this period. The unit operations model, which had underpinned chemical engineering education to this point, had relied largely on empirical consideration of their macro features, as well as heuristics, to inform their design and operation. What was missing was a deeper understanding of the underlying scientific principles of heat, mass and momentum transfer to complement thermodynamics and reaction kinetics in analysis of chemical engineering problems. Such an analysis was provided by the seminal book *Transport Phenomena* by Bird, Stewart and Lightfoot in 1960.[7] Supported by the development of more widely applicable mathematical and computational tools, for example, texts by Lapidus[8] and Amundson,[9] these texts, among others, spearheaded the arrival of chemical engineering science as a distinct analytical approach to solving chemical engineering problems. Levenspiel complemented much of this evolution in a reflective paper from 1980 focused on reaction engineering.[10] Collectively, their approaches rapidly became key elements of chemical engineering education programmes globally, including at UCT.[11]

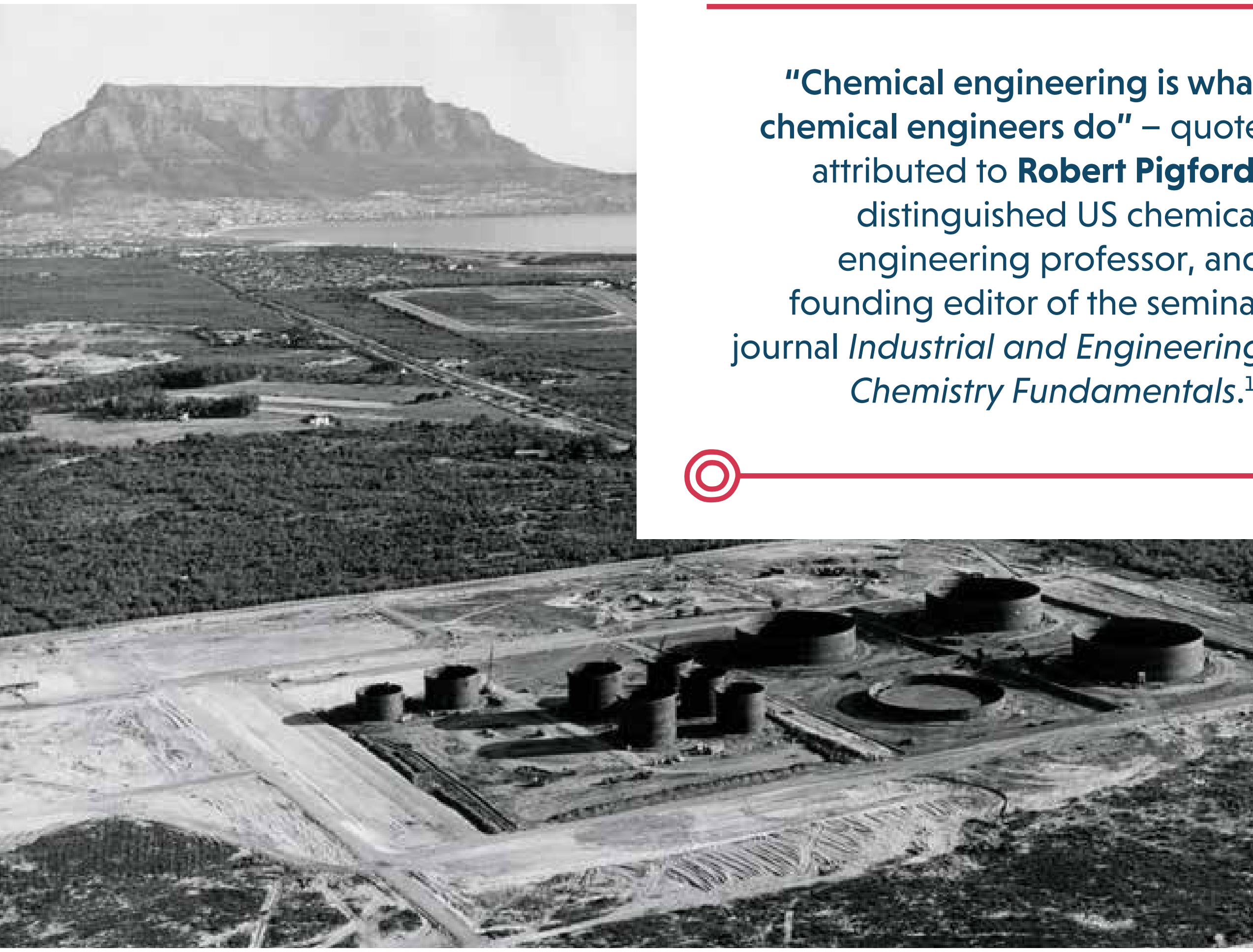
By the end of the 1960s, the **increasing availability of digital computing** within chemical engineering enabled numerical solutions of hitherto intractable engineering problems.

By the end of the 1960s, the increasing availability of digital computing within chemical engineering enabled numerical solutions of hitherto intractable engineering problems. It is fair to say, too, that computers led to the development of improved design and synthesis capabilities, the ability to consider more complex process interactions over different time scales, as well as improved process control, all of which informed education curricula. This process systems engineering approach complemented chemical engineering science, bringing a revived balance to curricula development between synthesis and analysis.

By the 1960s, too, the field of bioprocess engineering had matured sufficiently to warrant its inclusion in many chemical engineering education programmes around the globe. While its advent stemmed from straightforward consideration of fermentation processes for the production of commodity chemicals and their intermediates, it rapidly expanded to other areas of interest to chemical engineers, including food processing, bio-catalysis, protein synthesis, minerals processing and more. In South Africa at that time, bio-engineering courses in the undergraduate curriculum were more of a novelty and took some time to develop. At UCT, it was only in the mid-1970s that such a course was offered.

7 Bird, R.B., W.E. Stewart and E.N. Lightfoot (1960) "Transport Phenomena", John Wiley and Sons, New York.
8 Lapidus, L. (1962) "Digital Computation for Chemical Engineers", McGraw-Hill, New York.
9 Amundson, N.R. (1966), "Mathematical Methods in Chemical Engineering: Matrices and their Application", Prentice Hall, New Jersey.
10 Levenspiel, O. (1980) "The coming of age of chemical reaction engineering", *Chem Eng Science*, **35**(9), 1921–1839.
11 Donald Carr introduced *Transport Phenomena* into the UCT course as early as 1962, albeit in a reduced form.

"Chemical engineering is what chemical engineers do" – quote attributed to **Robert Pigford**, distinguished US chemical engineering professor, and founding editor of the seminal journal *Industrial and Engineering Chemistry Fundamentals*.[12]



The formation of the tank farm for the Caltex Milnerton refinery, which came on stream in the mid-1960s.

Particle technology became another building block of chemical engineering education in this period. It had its origin in understanding particulate behaviour in areas as diverse as mining and minerals, food processing, energy and the environment. As with biochemical engineering, this filtered downwards to core undergraduate level teaching via research and postgraduate courses. In South Africa, the impetus for skills development in this area came from the dominant role of the metallic and energy minerals sectors in the local economy, as well as the critical importance of water resource management and pollution control.

A key realisation for South Africa's chemical engineering programmes was that, in addition to the grounding in scientific fundamentals, graduates needed to be trained as generalists, versatile in the application of their skills, and as ready to tackle management challenges as technical problems. Ingenuity and initiative were deemed essential graduate attributes.

12 Personal communication, A.M. Lenhoff (UCT class of 1976 and colleague of Pigford at University of Delaware).

The role of chemical engineers in the modern era

The 1970s saw growing global awareness of the potential environmental impacts of large-scale chemical manufacturing, with issues such as air and water pollution, resource management and product impacts,[13] energy security[14] and safety[15] commanding increased attention. All of these had consequences for South Africa and the training of its chemical engineers. In addition, the 1980s saw the South African industry becoming increasingly isolated because of international reaction to steadily worsening apartheid crimes. This emphasised the need for home grown solutions, skills and materials and spurred local innovation. The South African government invested in Sasol's coal-to-liquids capabilities, with new plants built in Secunda in the early 1980s. Other examples included the growing sophistication of flotation chemistry reagents for minerals processing, and the increasing reach of the South African chemicals sector to service agro-chemical and food processing markets across the subcontinent.

The **global chemical engineering profession has evolved considerably,** shaped by massive technical innovation delivered at lightning speed, **compelling social imperatives including sustainability and climate change, changing geopolitics** and their development impacts.

As the country transitioned to democracy, international investment became possible again in the 1990s, and there was a rapid increase in international technological and research cooperation. The opening also meant that South African universities' chemical engineering departments were able to expand their international networks and add to and benefit from international cooperation, which influenced both the curriculum as well as teaching and research practices.

In the years since, the shape and scale of the SA chemical sector has changed considerably. Mergers and acquisitions have seen the loss of some big corporate names and a progressive realignment of the remainder to provide a highly diversified product range (Figure 1). These shifts have also encouraged the introduction of SMEs into the chemicals supply chain.

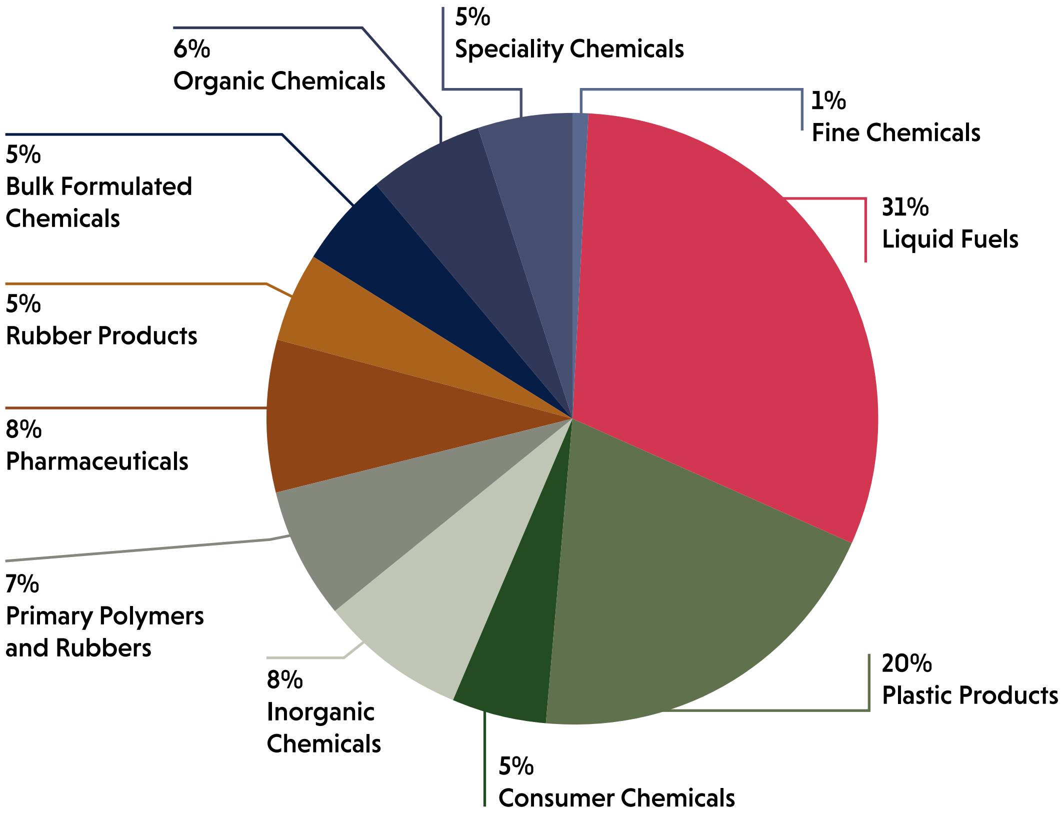
This has presented exciting prospects for chemical engineers, but also posed some challenges to ensure effective alignment of local chemical engineering education programmes with these opportunities.

At the same time, the global chemical engineering profession has evolved considerably, shaped by massive technical innovation delivered at lightning speed, compelling social imperatives including sustainability and climate change, changing geopolitics and their development impacts. This has required both a broadening and a deepening of

13 E.g. Carson, R. (1962), "Silent Spring", Penguin Books, England.
14 Driven by the OPEC oil embargo of 1973 – 74.
15 The industrial accidents of Flixborough in the UK (1974) and Seveso in Italy (1976) led to significant re-shaping of accreditation criteria by both AIChE and IChemE to emphasise process safety as an integral aspect of both design and operation of chemical processes.

academic course content, embracing macro-, micro-, and nano-scales, which is research led.[16] Going forward, the role of chemical engineers as both "molecule suppliers" and "problem solvers" is warranted, supported by new business models for R&D and innovation hubs.[17] Both the AIChE[18] and IChemE[19] are committed to ensuring the highest standards of professional practice as part of their accreditation of chemical engineering programmes, to ensure that chemical engineering education is increasingly focused on producing graduates who fulfil a role beyond that of technical experts, one in which they are able to apply their knowledge within an active citizenry.[20]

Figure 1: South Africa's chemicals industry is highly diversified. This chart shows the key segments of the chemicals manufacturing sector and their share of the country's total production in 2011.[21]



16 Amundson, N.R. (1998) "Frontiers of Chemical Engineering: Research Needs and Opportunities", National Academy Press, Washington DC.; National Academies of Science, Engineering and Medicine (1992) "Critical Technologies: the Role of Chemistry and Chemical Engineering", National Academies Press, Washington, DC.; National Research Council (2003) "Committee on Challenges for the Chemical Sciences in the 21st Century", National Academies Press, Washington, DC.

17 Felcht, U.H. (2003) "The Future Shape of the Process Industries", in *Chemical Engineering: Visions of the World,* R.C. Darton, R.G.H. Prince, and D.G. Wood (eds), Elsevier, Amsterdam.

18 Westmoreland, P.R. andC. McCabe (2018) "Revisiting the Future of Chemical Engineering", *CEP,* **14**(10), 26–38.

19 IChemE (2016) "Chemical Engineering Matters", 3rd ed, Institution of Chemical Engineers, Rugby, U.K.

20 Mitchell, C.A., A. Carew, and R. Clift (2004) "The Role of the Professional Engineer and Scientist in Sustainable Development", in *Sustainable Development in Practice*, *Case Studies for Engineers and Scientists* A. Azapagic, S. Perdan and R. Clift (eds), Wiley & Sons, U.K.

21 Majozi, T. and P. Veldhuizen (2015) "The Chemicals Industry in South Africa", *CEP* **111**(7), 46–51.

2 FOUNDATION

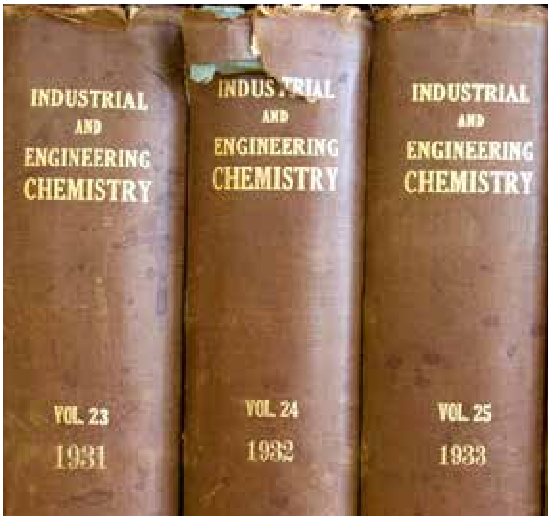
1920 – 1960

AN "OBVIOUS" HOME FOR A DEGREE IN CHEMICAL ENGINEERING

The discipline of chemical engineering has been taught at UCT for 100 years, but it turns out the story is a little more complicated than this simple fact conveys. To follow the establishment of the chemical engineering programme at UCT, you have to go back to the history of UCT and its predecessor, the South African College (SAC). The SAC was established in 1829 as a private, bilingual boys' high school.[22] Seventy years later, a growing demand for post-matriculation qualifications by its students and patrons led to the creation of The South African College School (SACS) as a separate high school institution, leaving the SAC to focus solely on university courses. The SAC essentially prepared students for examination by the first university on the subcontinent, the University of the Cape of Good Hope (UCGH), which had been created in 1873 as a degree-conferring entity only.

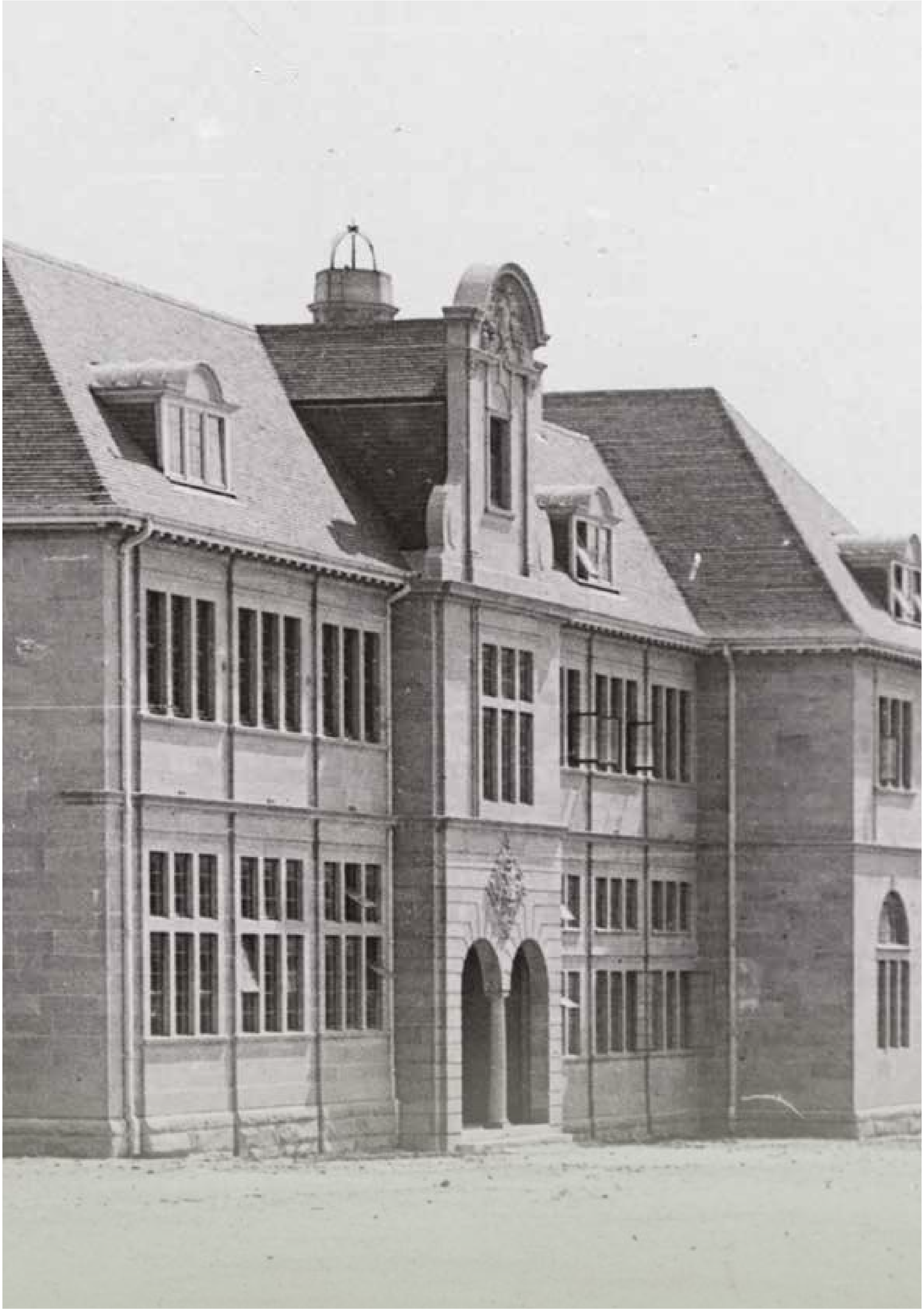
The situation changed again in 1918, when the SAC was formally established as South Africa's first national teaching university and renamed as the University of Cape Town. The idea for the creation of a national university to promote, among other outcomes, better collaboration and cooperation between white English and Afrikaans speakers had originally come from Cecil Rhodes in 1891. Rhodes offered the Groote Schuur estate on the Rondebosch slopes of Table Mountain for this purpose. But this initiative gained real impetus only in 1906, with the bequest of £200 000 from Alfred Beit to create a university in Johannesburg. By 1910, the Beit bequest was directed to the campaign for the establishment of a national university at a yet to be determined location, and the funding augmented by a further £300 000, courtesy of fellow mining magnates Otto Beit and Sir Julius Wernher.

As early as 1915, the SAC lobbied for the full Beit-Wernher bequest to be used to establish the first national university on the Rhodes estate, and in 1916 a bill was put before parliament to this effect. Not surprisingly, this was met with significant opposition from Witwatersrand parliamentarians who claimed that, as Johannesburg was rapidly becoming the economic hub for South Africa on the back of the mining industry, the national university should be situated there, which would also honour the original Beit bequest. The Cape Town faction won out, however, and the University of Cape Town came into being in April 2018.



UCT was an early adopter of comprehensive periodical collections, of which Chemical Engineering has taken full advantage down the years.

22 Phillips, H. (1993) "The University of Cape Town 1918 – 1948", Cape Town, UCT Press.



The Old Commerce Building on Hiddingh Campus, which was the original home of UCT Engineering where Chemical Engineering students would also have been taught. Other classes would have been taken in the Chemistry Building (now named the Little Theatre) pictured on the opening page of this chapter.

The Scottish connection

Engineering students at work in the drawing room on Hiddingh Campus.

A key characteristic of the SAC, which influenced its evolution to a fully-fledged university as UCT, was the profile of its teaching staff. Almost half came from the four traditional universities in Scotland – St Andrews, Edinburgh, Glasgow and Aberdeen – and followed the secular tradition of the Scottish universities.[23] This was an attractive prospect for many of the families in the Cape Colony wishing a university education for their children. The Scottish university background also embedded in the SAC curriculum a firm basis in physical and applied sciences and strongly supported the growth of engineering, medicine and law. The second building to be erected on the SAC Hiddingh campus was the chemistry laboratory (now the Little Theatre) in 1881. A new physics laboratory was built in 1890, and chairs in mathematics, mineralogy and geology were established at the same time. By 1906, the SAC boasted two professorial engineering chairs which provided a strong academic foundation to support a programme in chemical engineering.

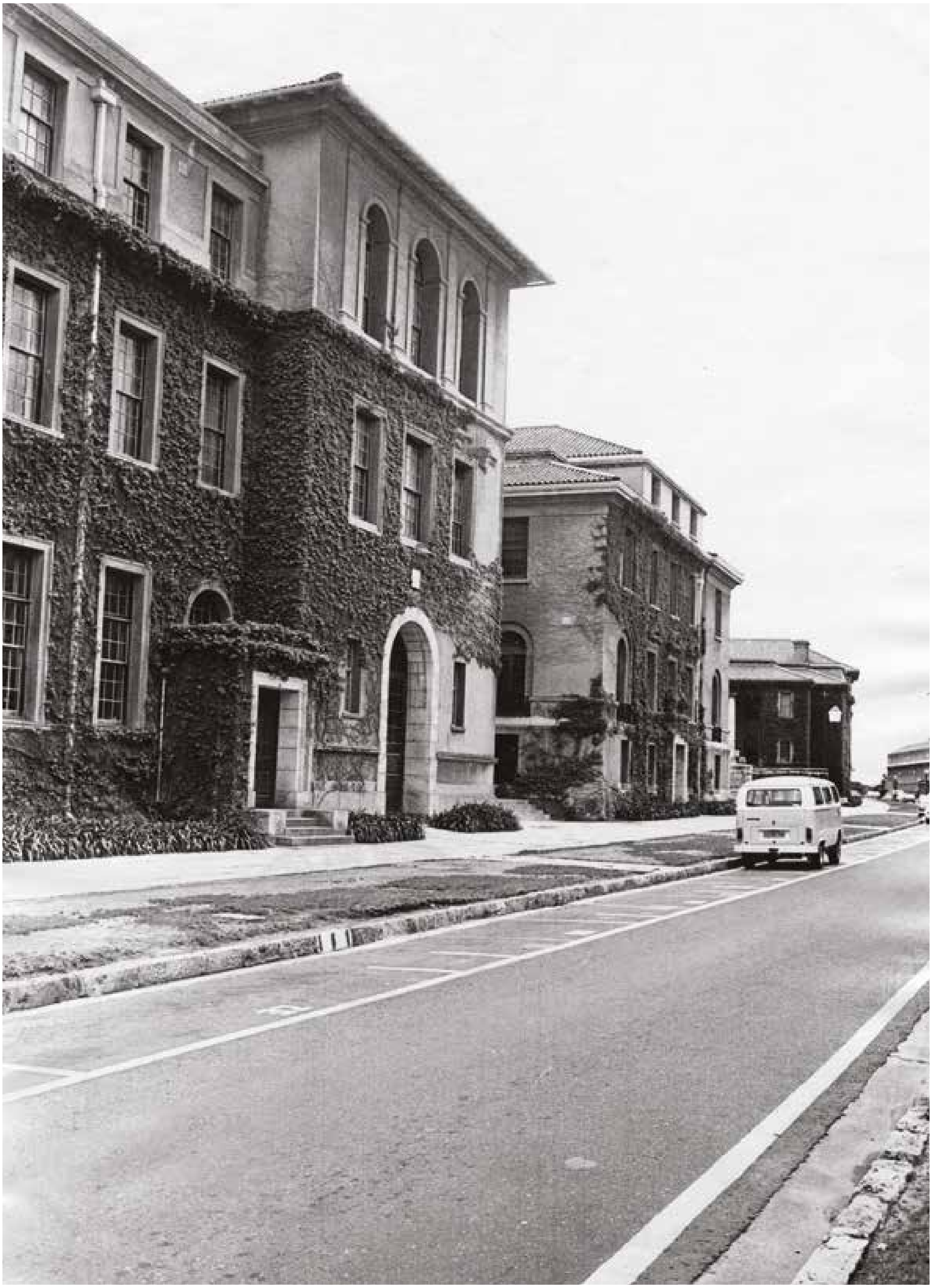
2 professorial chairs in engineering at the SAC by 1906.

Another, more speculative benefit which flowed from the "Scottish connection" was linked to the evolving technology base of the burgeoning South African gold-mining industry, whose bounty had been recently unlocked with the Scottish-patented McArthur-Forrest cyanidation process for gold recovery in 1888.[24]

The SAC contribution to the mining industry goes back to that same period. The South African School of Mines was formed in Kimberley in 1896, offering a four-year training programme for mining candidate professionals in the diamond industry. The first two years of theoretical coursework for this diploma course were offered by SAC, while the practical training took place in Kimberley. By 1903, this training had been relocated to Johannesburg, and, in 1910, the South African School of Mines and Technology began to offer courses leading to a Diploma in Chemical Engineering, making it the first post-matriculation qualification in chemical engineering in South Africa. It was, however, not until 1924, after the School of Mines had been renamed the University of Witwatersrand, that the first BSc Chemical Technology degrees were awarded by that institution. The degree's name was changed to BSc Chemical Engineering in 1928.

23 Phillips, H. (2003) "A Caledonian college in Cape Town and beyond: an investigation into the foundations of the South African university system", *SA J Higher Education*, **17**(3), 122–128.

24 Fivaz, C.E. (1988) "Presidential Address: How the MacArthur–Forrest cyanidation process unlocked South Africa's golden future", *J. South African Inst Mining and Metallurgy,* **88**(9), 309–318.



On the newly built Upper Campus, the Chemistry and Engineering buildings were given pole position on either side of Jameson Hall (now Sarah Baartman Hall) with the Engineering Building (pictured above) on the south side and the Chemistry Building (pictured on page 27) on the north. The Chemical Engineering programme was symbolically situated at the nexus of these two disciplines and was physically housed in the Chemistry Building until 1960.

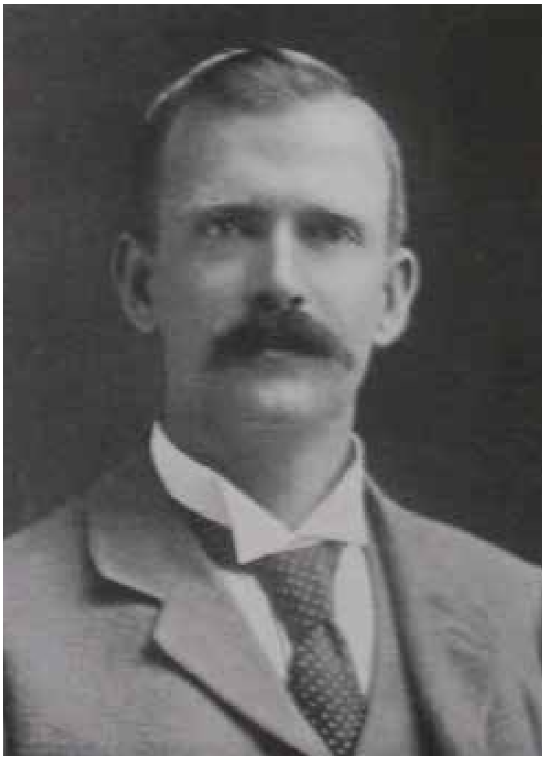
A new degree programme **in chemical engineering at UCT**

UCT's chemical engineering degree programme came into being a few years before Wits' chemical engineering programme. In the same year that UCT was founded, a proposal was put to the then Dean of Engineering, Professor Hermann Bohle, who was also joint head of both Electrical and Mechanical Engineering, for the establishment of a degree programme in chemical engineering at the university. The architect of that proposal was the chemist and metallurgist, Dr William Arthur Caldecott, who then occupied the position of Consulting Metallurgist for the Consolidated Gold Fields company of South Africa.

Caldecott's promotion of UCT as the "obvious" home for a degree programme in chemical engineering can be linked to his connections with the SAC/UCGH, where he received his BA (Hons) and DSc, as well as his leading role in the Royal Society of South Africa, where he was an early Fellow and served on the council for several years.[25] His proposal was likely motivated by the need of the South African minerals industry for engineers with a good practical bent as well as a strong theoretical foundation.

For a new programme in chemical engineering to thrive, it needed not only the blessing but the active support and resources of both the Faculty of Engineering and the Department of Chemistry. Known at that point as the Department of Chemistry, Metallurgy and Assaying, this entity also had its origins in the SAC, dating back to the 1850s, and its staffing profile was dominated by Professor P.D. Hahn for more than 40 years, until his death on the eve of the birth of UCT in 1918.

As it transpired, Caldecott's proposal was well received by the UCT Executive, under the vice-chancellorship of its first Principal, the Scot Carruthers Beattie (HOD of Physics). A UCT committee made up of representatives from engineering, chemistry, mathematics and physics formally adopted Caldecott's proposal in 1919, and the Engineering Faculty prospectus for 1920 heralded the start of the BSc (Chemical Engineering) at UCT.



Dr William Arthur Caldecott was the architect of the proposal to establish a programme for chemical engineering at UCT.

25 Southern Africa Association for the Advancement of Science (S2A3) Biographical Database of Southern African Science, W.A. Caldecott. Accessed April 2020.

1st Year
Pure Mathematics
Applied Mathematics
Chemistry
Physics
Graphics (non examination)

2nd Year
Pure Mathematics
Chemistry
Geology
Engineering
Engineering Design and Graphics

3rd Year
Chemical Technology
Electrical Engineering
Mechanical Engineering
Engineering Design
Modern Language

4th Year
Electro-Chemistry
Chemical Technology
Metallurgy
Design and Management of Chemical Engineering Plant

Proposed Chemical Engineering syllabus 1918. Contrast this with today's curriculum in Appendix C.

The Department of Mechanical Engineering was identified as the preferred home from which to teach the new discipline of chemical engineering with just three academic staff on its books: W.G. (George) Weaver, a senior lecturer, Professor Duncan McMillan (trained at the Royal Technical College in Glasgow, Scotland), an expert in motorised transport, and J.J. Brooks, whose interests were in power systems. Two year later, in 1922, the university celebrated its first graduate of the BSc (Chemical Engineering) degree: Mr C.S. van der Poel.

In parallel, in 1922, the Department of Chemistry introduced its own BSc programme in industrial chemistry, which raised questions about the best location for the chemical engineering programme at UCT. On the suggestion of Professor H.G. Denham, a New Zealander who held the Inorganic Chemistry Chair at the time, this was resolved by consolidating both degrees under the new banner of BSc Applied and Industrial Chemistry (BSc AIC), which would be administered by the Department of Chemistry, but still draw on teaching expertise from the Engineering Faculty. Students in this programme were always labelled "chemical engineers", even though the programme was located within the Chemistry Department. This remained the status quo until 1957, whereafter the BSc Chemical Engineering degree was reinstated within its own department. The evolution of the programme is aptly mirrored in the progression of buildings it has inhabited. Starting out in the Little Theatre and Old Commerce buildings on Hiddingh Campus, then the old Chemistry Building on University Avenue on Upper Campus, Chemical Engineering acquired its own building around about the time that the BSc Chemical Engineering was reinstated.

The old Chemistry Building on Upper Campus.

For a new programme in chemical engineering to thrive, **it needed not only the blessing but the active support and resources** of both the Faculty of Engineering and the Department of Chemistry.

A giant among chemical engineers in South Africa

Professor Andrew Donald Carr

BSc AIC, 1949; PhD, 1953;
Academic staff member, 1956 – 1987

Professor Donald Carr is as much a part of the Department's 100-year history as the mountain is a backdrop to Upper Campus. He is widely credited and remembered for establishing the Department in its current academic form in the 1950s – and for leading its growth until 1979, when he was appointed Assistant Principal of the University.

He was **a solid teacher and an early driver of research** – a man whose lasting legacy for students wasn't merely just do it – as, perhaps, the modern maxim states – but that of **do it right.**

Born in Cape Town but educated in Grahamstown, Carr's celebrated journey began when he returned from active service in WW II. He graduated with a BSc in 1949 before earning a PhD for his thesis on liquid-liquid extraction in 1953. After a few years working in the UK, he rejoined the Department as a senior lecturer in 1956.

Although he was firmly entrenched at UCT, Professor Carr enjoyed two academic stints in the USA. The first as Visiting Associate Professor at the University of Michigan during the mid-1960s and then as Visiting Professor in Environmental Engineering at Clemson University in South Carolina in 1972–73.

It was during these decades that he led the growth of Chemical Engineering into a large and active department with an international reputation for excellence, spearheading the development of various specialties funded by industry, such as biochemical engineering and industrial ceramics. He is also credited with leading the charge to establish a dedicated new building for the newly formed Department in 1960 and semesterising the curriculum into its current form.

Carr is well-known to every student during this era, having taught virtually all the Chemical Engineering courses on the curriculum between 1956 and 1978. Jack Fletcher remembers him as "a believer in chemical engineering and a believer in the fundamental underpinning thereof. He was a solid teacher and an early driver of research – a man whose lasting legacy for students wasn't merely just do it – as, perhaps, the modern maxim states – but that of do it right. A meticulous man with smartly polished shoes – a man who paid attention to detail. Indeed, a gentleman and a visionary, wholly dedicated to the University and rightly remembered as the founder of the Department in its modern form."

His research – focused initially on the field of liquid metal heat transfer – was pragmatic, too. He oversaw research into the use of long chain organic solvents for uranium extraction, which formed the basis of all subsequent uranium extraction operations in South Africa up to about 1975. He is rightly also credited with spearheading the Department's ongoing commitment to water research.

Carr's leadership of the Department laid the foundations for its global stature today and his talents were employed elsewhere in the University, too: first as Assistant Principal of the institution and, in 1981 as a Deputy Vice-Chancellor when Dr Stuart Saunders became Vice-Chancellor.

He retired in 1987 and settled in Villiersdorp in the Western Cape. He passed away in 2009, but his legacy lives on through the countless students and faculty he impacted across nearly five decades of dedicated service. Long-time friend and colleague Cyril O'Connor sums up his impact saying: "Professor A.D. (Donald) Carr will long be remembered as a giant among chemical engineers in South Africa and beyond, and his memory will long be cherished by all who knew him and for many years by those who benefit from his legacy."

A life-long champion of chemical engineering

Christopher M.W. Orpen
BSc AIC, 1953

When Chris Orpen left South Africa in 1954 with a letter of introduction for a job at the Esso Refinery in the UK, little did he know that life had other plans for him. He would go on to enjoy a fascinating international career that ended back in his home country, eventually retiring as as a Senior Executive Director and General Manager of Sentrachem in 1990. That career started when he enrolled at UCT in 1949.

Despite having been among a minority of students to get through its rigorous curriculum successfully, Orpen seldom referred to himself as a chemical engineer in the decades to follow. "For many years, I felt my qualification to be inferior to that of others who called themselves chemical engineers! But in terms of what I had learned, I later found the degree to be in no way inferior in practice, and in some respects, superior to that of others."

It would prove to be so, judging by the doors that opened for him after graduating. Fate would also play its hand. After being offered the job at Esso, a chance encounter on the train back to London would take him in a completely different direction: directly to Trinidad in the West Indies.

"I met a fellow engineer who had also been interviewed. He had worked in an oil refinery in Trinidad as a Refinery Supervisory Trainee. The contract included a house and travel on a tanker to and from the UK at the start and end of the contract. I was impressed, as I knew nothing of the real world and was anxious to learn about continuous processing and the oil industry. He gave me the name of the offices in London and after a couple of interviews I was offered the job."

Newly married, Orpen spent nearly six years in Trinidad with his wife Shirley, cutting his teeth at the refinery and moving up through the ranks until another well-timed meeting took his career in a different direction once again.

"The company was acquired by the US company, Texaco Inc and as luck would have it, the VP of Petrochemicals was on the lookout for someone to promote the development of petrochemicals for Texaco in Europe. I was offered the job in 1960, which included a six-month training stint in the US at various plants and the company's head office in the Chrysler Building in New York. I then spent the next two years travelling round Europe getting to know people in the chemical industry. It was a fascinating experience from which the company built two plants on my recommendation – one for cyclohexane and one for n-paraffins to make biodegradable detergents."

Orpen would take on a number of other challenging roles in the UK over 10 years including the general managership of Laporte TiO_2 factory in Grimsby Lincs, before eventually returning to South Africa as Production Manager of the NCP Group, part of Sentrachem. In 1976, he was made Managing Director.

"It turned out to be the best job I had ever had. It involved production, marketing and research from two distilleries, two yeast plants and subsidiaries in animal feeds in Australia and the UK. From early 1980, I became a Senior General Manager of the holding company Sentrachem and after being elected to the main board I became the Chairman of NCP and two other divisions namely Safripol and Megaplastics."

After retiring in 1990, Orpen continued to serve on the Board until the company was sold to Dow Chemical Company. It was the end of a fulfilling career to which he dedicated many years and much energy.

What advice does Orpen have for new graduates embarking on their own career in chemical engineering?

"I was fortunate in starting at a very low operating level and having to learn from others and work my way up the ladder. A little humility is not out of place when starting one's working life."

For those entering managerial positions, Orpen has this to say: "The ability to listen, to issue instructions clearly, to consult and keep employees informed at all levels are all essentials."

Celebrating the congenial ChemEng spirit

Dr John de Kock

BSc AIC, 1956; Academic staff member, 1963 – 1965 and 1971 – 1976

A familiar face around campus for many years, Professor John 'Old King Coal' de Kock would first come to the Department as a student in 1953 to study Applied and Industrial Chemistry. He'd return as an academic staff member for two stints, as a senior lecturer in 1963, by which time the department had "come into its own as a member of the Engineering Faculty and moved into its own building", and as an associate professor in 1971.

De Kock managed to pack in a great deal of professional and academic experience in his decade away, bringing a wealth of knowledge back to the Department. "I rejoined after spells in the uranium industry, lecturing physical chemistry at Wits, doing research at Cambridge University in the UK and, later, in the Central Research Laboratory of Canadian Industries Limited in Montreal."

Some of this high-achieving spirit may be attributable to his undergraduate degree that, he says, "prepared me and others well for our later careers. This opinion is supported by the stellar performance of many of our graduates and of whom Peter Rein is a prime example. He graduated with straight firsts in all subjects and went on to achieve great things in sugar research."

Even now, de Kock remembers in some detail the content and "heavy workload" of his undergraduate courses: "The lectures were of a high standard, often illuminated with demonstrations and supported by practical sessions in the physical sciences and supervised tutorial sessions in maths. We had to wait until our final two years to encounter engineering subjects, which included chemical engineering and industrial chemistry, plus a variety of mechanical and electrical engineering topics.

"I found some of the last useful later on, such as drawing, stress analysis, strength of materials, steam properties and engines, electric motors, etc., but never a knowledge of four bar chain mechanisms, Walschaert's valve gear animation, involute gear teeth design, illumination, etc."

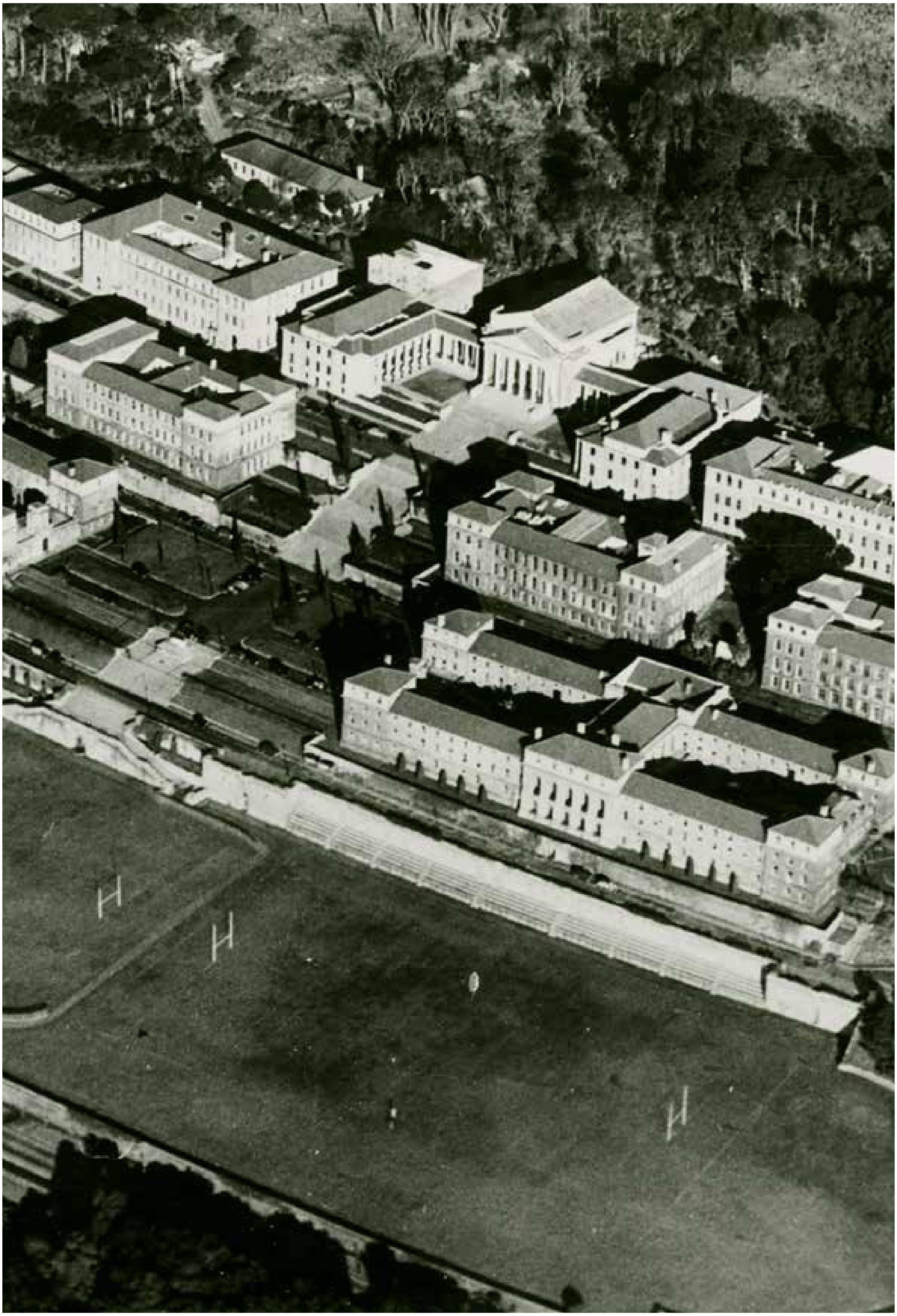
Returning to the department as a young faculty member, de Kock found that the pace had not let up in the ever-growing Department and had to run to keep up: "The programme was steadily improving under Donald Carr and Heinrich Buhr, student numbers kept growing, and it was a challenge for me as a newcomer to keep abreast of all the new material and to stay a few steps ahead of my students.

"We could not have managed without our temporary lecturing staff, who were often caught in the difficult position of doing research for their postgraduate degrees while performing their departmental duties. Some spent long years in this limbo before graduating."

Like them, de Kock had to negotiate the pressures of lecturing while supervising PhD research and MSc students: "I reverted to my Cambridge research work on fluidisation by way of supervising Robin Judd as a PhD candidate and worked with a colleague completing research into liquid phase heterogeneous catalysis, which earned him a PhD. I also started a small school of minerals processing, which produced nine MSc graduates.

"The Department was a congenial and stimulating place to work and I made many firm friends during this time with teaching staff and our dedicated technician, Paddy O'Neill.

"An easy informality existed between staff and students and I remember the 'smokers' with particular pleasure. It was where I could let my hair down with my students without the fear of losing their respect. I probably did raise the eyebrows of some more conservative members of staff with my shenanigans, but even Donald Carr would join in the fun and could be counted on to deliver some really good jokes, supposedly done 'under protest'. It is good to know that this spirit still continues in the department today."



UCT Upper Campus aerial view, 1948.

The application of science to support local chemical and mineral industries

1946

The CSIR's National Chemical Research Laboratory (NCRL) established.

The NCRL looked to the BSc AIC at UCT **to provide young graduates** and even **launched a vacation-training employment opportunity** for these students.

Professor Denham's tenure at UCT was to be a short one, but despite this, he made a notable contribution. In addition to his role in initiating the BSc AIC, he also established an enduring connection with his birth country, New Zealand. This led to the appointments to UCT Chemistry of Bill Rapson and Phillip Carman in the mid-late 1930s. On his appointment, Rapson assumed overall management of the BSc AIC course for roughly 10 years. An organic chemist, his research interests were largely aligned with fruit chemistry and marine oil extraction in those years.[26] The marine oil work helped contribute to the subsequent growth of commercial activity in this field in Cape Town. Carman had read for his doctorate in Chemical Engineering at University College in London in the mid-1930s and worked for ICI UK on various industrial chemistry projects before coming to Cape Town in 1936. His research and teaching interests were very much centred on applied chemistry. He is best remembered by chemical engineering students around the world for his contribution to the analysis of flow through porous media.[27] Rapson's tenure at UCT overlapped with the national call for more engineers to support the growing local chemical and mineral industries, including during the years of WW II.

The launch of South Africa's Council for Scientific and Industrial Research (CSIR) in late 1945 was an outcome of this growing awareness of the need for graduates with more applied science skills. A serious conversation was underway at national government level about the role of national laboratories in promoting long-term research and the CSIR's ability to complement the work of universities through collaboration, courtesy of the state-of-the-art equipment which the national entity was able to provide. The CSIR's National Chemical Research Laboratory (NCRL) was established in mid-1946, and Rapson assumed the post of its director in early 1947.[28] In the intervening months, he cemented the relationship with UCT's Chemistry Department by fostering joint appointments between the two entities. Carman joined him at the CSIR in a full-time capacity later in 1947 and took over Rapson's role as NCRL Director in 1958. Several recent UCT Chemistry and AIC graduates joined the NCRL in that period too. Notable here is Dr Ruth Blumberg, who had completed her chemical engineering PhD at Columbia Univerity, New York, in solvent extraction.[29]

26 Stephen, A.M. (2005) "A History of the Chemistry Department, University of Cape Town", *Trans.Roy.Soc.South Africa*, **60**(1), 19–48.
27 E.g. Carman, P.C. (1997) "Fluid Flow through Granular Beds", *Chem.Eng.Research and Design*, **75** (Supplement), S32–S48.
Carman, P.C. (1947) "Chemical Constitution and Properties of Engineering Materials", Edward Arnold & Co, England.
28 Kingwill, D.G. (1990) *The CSIR – the first 40 years*, CSIR, Pretoria.
29 Her work on tartaric acid synthesis was developed further by another UCT alumnus, John Bewsey, flagged in Chapter 3.

Under the direction of first Rapson and then Carman, the NCRL focused on "the application of chemistry and chemical technology to the exploitation of national resources such as those of mining, agriculture, fishing, forestry and animal husbandry, and to the conservation and efficient use of the most basic of all material resources, namely water".[30] Rapson deemed that "support and initiation of activities of these types clearly offered to the CSIR an excellent means of involving in research and development a variety of industries in South Africa which were still operating along traditional lines, without serious consideration of the potential benefits which might accrue to them as a result of the developments in the application of science to technological processes".[31]

In terms of academic skills development, the NCRL looked to the BSc AIC at UCT to provide young graduates, and even launched a vacation-training employment opportunity for these students. Both the academic research by staff in UCT's Chemistry Department, and its relationship with the CSIR's NCRL, informed the context in which the teaching in the BSc AIC was conducted. This included the focus on mining and minerals, as well as water supply and pollution control, both areas which have been mainstays of UCT chemical engineering research in the years since. While there had been only one PhD graduate from the AIC programme prior to 1950 (Dr Douglas Lloyd in 1942), the following decade produced five PhD graduates, which was a significant achievement and reflected the growing emphasis being placed on research.

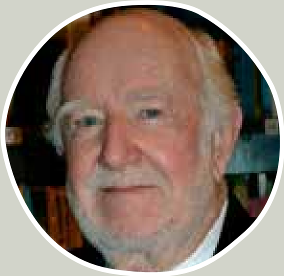
The National Chemical Research Laboratory building on the CSIR site Scientia, completed in 1959. The NCRL played a formative role in promoting UCT Chemical Engineering research over several decades.

30 Kingwill, D.G. (1990) *The CSIR – the first 40 years*, CSIR, Pretoria.
31 Ibid.

A disciple of chemical engineering

Dr Philip Lloyd

BSc(Eng) Chem, 1958; PhD, 1961



"Chemical engineering opens up so many different and fantastic opportunities because chemistry, itself, is part of everyone's everyday life."

During my PhD I developed a far more **cost-effective method** using solvent extraction for uranium refining. Within five years, this new process had completely replaced ion exchange within the industry.

So said Dr Philip Lloyd, whose own life was immersed in the discipline after he left the Department with a groundbreaking PhD in 1961.

"After graduating in 1958, there was a scholarship going begging, funded by the Chamber of Mines and later the Atomic Energy Board. Uranium extraction at that time relied on the ion exchange process. During my PhD I developed a far more cost-effective method using solvent extraction for uranium refining. Within five years, this new process had completely replaced ion exchange within the industry."

The Atomic Energy Board sponsored Lloyd to attend MIT in the USA for three years of research into nuclear physics and "other exciting stuff" – and when he returned to South Africa, he joined the Government Metallurgical Laboratory's extractive metallurgy division. When the Board later decided to move into nuclear weapons-related work, Lloyd decided to go his separate way.

"I did not want to be involved with that and I joined the Chamber of Mines Research Laboratory in Melville, Johannesburg. In those days, it was funded to the tune of R100 million per year, so it was a very exciting place to work, including a lot of work on reprocessing gold dump tailings."

Lloyd would later have a hand in designing the Mossgas gas-to-liquids plant in Mossel Bay, before returning to the world of teaching and researching in the latter years of his career. Among his various tenures at South African universities was a post back at his alma mater in UCT's Energy Research Centre.

Without doubt, among his notable career achievements, he noted, is his work with the Intergovernmental Panel on Climate Change in the noughties. "I helped to write the special report on carbon capture and storage, and they were kind enough to recognise me as part of the team which shared the Nobel Peace Prize with Al Gore in 2007.

"So my advice to students is, don't be frightened and carry on learning for the whole of your life. A chemical engineering degree will provide the tools to understand a huge range of technologies and technological advances, without which the whole world would be a lot poorer."

Fertile ground for growing industry ties

Clive Thorpe
BSc(Eng) Chem, 1961

The Department of Chemical Engineering at UCT has for decades enjoyed its status and reputation as a valued partner to South African industry, and for Clive Thorpe, a move into the fertiliser sector in the 1960s would mark the beginning of an enduring relationship with the department he first encountered as an undergraduate in 1958.

"I was one of 40 new chemical engineering students – like the rest of the UCT engineering faculty, all male, all white and all wearing yellow neckties to indicate our fresher status," he remembers.

> I was one of 40 new chemical engineering students ... all male, **all white and all wearing yellow neckties** to indicate our **fresher status.**

More than a decade later, Thorpe joined Fisons, a UK-based fertiliser company, as a shift supervisor around about the same time as it won a long-term contract to procure methane-rich tailgas from the newly built Caltex refinery near Milnerton to produce ammonia, nitric acid, and ammonium nitrate.

The South African fertiliser industry would experience huge volatility in the decades to come, with the plant changing ownership a number of times. Thorpe, too, would change roles and grow in professional stature, but from the mid-1960s, the Milnerton complex would maintain steady links with UCT.

"While the permanent staff were fully occupied trying to maximise the reliability, capacity and efficiency of the three plants at the Milnerton complex, a list of smaller projects and problems was growing longer and longer. When UCT's Professor Carr asked us to take on vacation students from the Department of Chemical Engineering, we were happy to – and we handed out items from this list to the students. The arrangement proved popular with both parties and we started taking on up to 12 students per year during the winter and summer holidays."

It was to become a long and fruitful relationship that would grow to include students from mechanical and electrical engineering, as well as from Stellenbosch University and the Cape Technikon.

"I had long admired a mobility that I had seen in the US between academia, government and industry, and my colleagues and I were happy to provide industry lectures and external examining, to sit on advisory panels and to maintain contact with UCT and other local tertiary institutes in whatever ways we could."

Research collaborations with UCT's Electrical Engineering, Mechanical Engineering and Chemical Engineering departments would help solve real-world technical challenges at the plant, in some cases lending the business a competitive edge. Thorpe recalls a life cycle assessment (LCA) project involving Professor Jim Petrie and colleagues in the Department. "They used our nitric acid plant to carry out LCA studies to quantify and compare various design alternatives aimed at waste reduction. It concluded that one design alternative was clearly superior to the others – and also that operational changes could result in significant environmental improvement at minimal economic cost."

The Milnerton nitrogen complex would close down in the early 2000s and Thorpe took slightly early retirement after spending most of his professional life with the plant among his responsibilities. He remains an active affiliate to the Department, supporting its senior undergraduate teaching in design practice, and has many ideas for how the department can continue to deliver value in areas as diverse as food and water, clothing, energy, transport and feedstocks to remain relevant to industry through the next 100 years.

The BSc AIC evolves with new staff appointments

There was **considerable impetus** from the South African chemical and **minerals industry to support** the growth of the AIC programme.

The BSc AIC programme evolved rapidly in the early 1950s. Chris Orpen, an early graduate of the programme recalls: "At the time, it was said by many to be the toughest of any of the engineering courses, and I found it so; 24 of us started the course and I was one of six who completed it ... The degree at that time consisted of four years of chemistry (up to MSc Physical Chemistry standard), two each of pure and applied maths, physics, chemical, mechanical and electrical engineering, with one each of civil engineering, engineering drawing and applied chemistry. Each had a single exam at the course's end, followed separately by a design project."

There was considerable impetus from the South African chemical and minerals industry to support this growth. Notable were the Sasol 1 project, the expansion of the explosives and fertiliser industry at, for example, AECI, and the expansion of the minerals sector to consider uranium ore separation from gold-bearing ore. This last was linked directly to the birth of the Cold War, as well as increasing interest in nuclear power generation.

The growth of the AIC programme was enabled by several new staff appointments to the Department of Chemistry to cover the teaching load and to drive a nascent chemical engineering research agenda. Several of the appointees were themselves BSc AIC graduates and included Victor Tarica (1946), Andrew Donald Carr (1949) and Hendrickus Kropholler (1950). It was this trio, supported by Dr F.H.H. Valentin, who laid the groundwork for the re-establishment of the BSc Chemical Engineering degree, with a curriculum that reflected the needs of the South African industry of the day. Fred Valentin could be justifiably credited with creating a teaching and research interest in the relatively new field of particle technology. He moved from UCT to the University of Natal, and ultimately to the UK's Warren Spring Laboratories, where he headed up its Bulk Solids and Particle Processing Division.[32]

The Caltex refinery in Cape Town in the early days.

32 Valentin, F.H.H. (1967) "Mixing of powders and pastes – basic concepts", *The Chemical Engineer*, **45,** 99–106.

Take two: The "new" chemical engineering degree is approved

The relationship between UCT and the CSIR, and the overlapping roles of Rapson and Carman at its NCRL, would provide much of the motivation to return to a specifically named chemical engineering degree. In the mid-1950s, the NCRL created its own Process Development Division.[33] This, together with the recognition that UCT Chemistry was increasingly being strained by swelling student numbers,[34] paved the way for the re-establishment of a specific chemical engineering programme at UCT in 1956. The intention was clear from the outset that this "new" BSc Chemical Engineering degree programme needed to be recognised internationally. Approval of the new curriculum, which had been shaped since the early 1950s, was sought and received from the Institution of Chemical Engineers in the UK.[35] Once UCT approved the new degree programme, the first graduates were awarded their degrees as BSc(Eng) Chem in 1957. Of that graduating class of seven, two – Heinrich Buhr and Robin Judd – subsequently came back as lecturers in the new Department in the early 1960s and completed their PhDs in parallel.

At this point, the newly minted Chemical Engineering programme was still housed within the Old Chemistry Building on University Avenue, and would continue to be administered by the Department of Chemistry until 1965, when the Department of Chemical Engineering was formally constituted within the Faculty of Engineering. But well before then, ongoing growth in student numbers meant that Chemical Engineering was rapidly outgrowing this space. The need for a unique and distinct building was becoming urgent, and the project to attain one would be taken on by Carr, who was instrumental in raising support for the venture from several companies.

1956

The "new" chemical engineering programme is established.

From left to right, Dr PR Enslin (1972 – 1983) with Dr WS (Bill) Rapson (1946 – 1958) and Dr PC (Phillip) Carman (1958 – 1972), the first three directors of the CSIR's National Chemical Research Laboratory. Carman and Rapson, both from New Zealand, came to UCT in the mid-to-late 1930s and their overlapping roles with UCT and the CSIR helped establish a very strong and enduring relationship between the two entities.

33 The Process Development Division was ultimately renamed as the Chemical Engineering Group under Wim Mandersloot.
34 Between 1950 and 1960, enrolments in the Chemistry Department, including the chemical engineers in its midst, rose by 50%. The Chemistry Department was responsible for considerable service teaching in the early years of UCT's undergraduate programmes in Engineering and Medicine.
35 IChemE thereafter became the formal accreditation body for the UCT Chemical Engineering programme until the mid-1990s, when the Engineering Council of South Africa assumed that role, linked to UCT being an adopter of the Washington Accord. In recent years, a conversation around joint-accreditation between ICHemE and ECSA has been reinvigorated.

An influential presence in a time of change

Dr Heinrich Buhr
BSc(Eng) Chem, 1957; PhD, 1967;
Academic staff member, 1958 – 1980

Talk to anyone about the Department of Chemical Engineering in the 1950s, 60s and 70s, and Heinrich Buhr's name is bound to come up. Another student-turned-faculty, Buhr was instrumental in the Department's coming of age after it moved from chemistry into the North Lane building, and later, in the design of that building's extension.

"I was in the first group of Applied and Industrial Chemistry students to graduate with the designation 'chemical engineering' in 1957," says Buhr, adding that he was not privy to the politics behind the transition from chemistry to engineering. "It would have been Donald Carr and Hein Kropholler who engineered the change, but I know that a major effort lay in getting the Institution of Chemical Engineers in London to approve the curriculum and for the Department of Chemistry to go along with it."

The physical environment would undergo radical changes too. "I remember that up until 1957 we did all of our lab work and had lectures in the Old Chemistry Building. When I joined the staff in 1961, a new building had sprung up on North Lane. Another new building was constructed again, I think in the late 1960s. I remember being very surprised that the concept went through the powers-that-be with very little trouble. I took a personal interest in the design of the new building. It was my idea to have some offices equipped with a small lab opposite!"

"The new building essentially cocooned the old one and since there was no telling what future research might require, the accent was on flexibility. The research lab was four storeys, with beams and grating on each floor, effectively creating a flexible space in which anything could be constructed. We knew we wanted a tall height to house our vertical heat-and-momentum-transfer columns, but other, unknown projects had to be accommodated, too. The old lecture theatre was converted into a very nice analytical lab, and three new lecture theatres were added. The upper, more intimate lecture theatre was laid out in an amphitheatre style. There was even a darkroom, and an industrial-scale boiler! Steam, compressed-air and vacuum lines throughout. In my eyes, a totally grand building!"

Buhr recalls a significant change in research direction during those years too: "In my early days, my research interest lay in the mathematically-intense momentum transfer area. We had some support from the Atomic Energy Board, but in the late '60s they decided that they weren't going to design a nuclear-reactor power station, but rather buy one.

"When research funds dried up, Donald (Carr) and I sat down and decided we needed to go in a different direction. That is how the emphasis on wastewater treatment originated. At this time, Gerrit Marais joined the Civil Engineering Department, and drawing on his boundless energy and enthusiasm in the field of municipal wastewater treatment, our interests turned in that direction. This was reinforced by the arrival of Geoff Hansford, who had a great background in microbiology, acquired at the University of Pennsylvania.

"Other people of note from this era included John de Kock and Cyril O'Connor, who had a great knack for raising research funds from the Chamber of Mines. Cyril eventually presided over a virtual empire in minerals processing. Bill Randall, of course, our electronics genius, and I should also mention Paddy O'Neill, our tireless workshop supervisor, who came forward with many wondrous inventions to support the undergraduate and postgraduate lab work."

After 20 years on the staff, Buhr and his family moved to America, where he continued as a consulting engineer in wastewater treatment for another 30 years. "However, my time with colleagues and the multitudes of enthusiastic students at UCT will always be among my most treasured memories."

Remembering the birth of chemical engineering

Professor David Glasser
BSc(Eng) Chem, 1958

When David Glasser and his older brother Leslie started doing chemistry experiments at home during their school years, the field of chemical engineering was still in its infancy, but he'd go on to enjoy a career spanning five decades, witnessing the evolution of the discipline as we know it today.

"During the war, there was an urgent need to design radical new equipment such as ultrahigh-pressure reactors to make polythene. Physicists, chemists and engineers were brought together in teams to design this equipment more scientifically and out of this grew chemical engineering science and the more modern way of teaching chemical engineering."

When Glasser enrolled in 1955, chemical engineering was still in its formative stages in South Africa and the courses were very much chemistry and unit operations oriented. In fact, when his brother enrolled two years earlier, there was no formal chemical engineering degree on offer at UCT, and aspirant chemical engineers registered for a BSc in applied and industrial chemistry.

Glasser stayed in residence throughout his studies, becoming secretary of the house committee in his final year. His memories paint a very different picture to the UCT residences of today. "We were in a post-war residence meant to house demobilised soldiers after the war and it consisted of a series of military-styled huts spread over an area about a 15-minute walk from campus."

But like today, there were still plenty of diversions for Glasser and his fellow students, albeit of a less digital kind. "My laboratory partner was Bruce Ilsley and his father taught us both to play Bridge – an activity that could distract from chemical engineering!

"For our fourth-year project, we prevailed on Donald Carr to let us build and test a rocket engine. This was the era of Sputnik and we felt this was something appropriate for chemical engineers to do. To avoid ignition problems, we chose what were called hypergolic fuels, namely those that self-ignited. To cut a long story short, the rocket engine blew up when we tested it remotely in a blockhouse. From the remains we saw that one of the welds that separated the two fuel inlets from each other had sprung a small leak. Once the fuels mixed prior to entering the engine, it was all over. Anyway, we were given good marks for our initiative and effort."

Glasser went on to complete a PhD in Physical Chemistry at Imperial College London, before returning to South Africa and joining the newly constituted Department of Chemical Engineering at Wits University, where he stayed for nearly 50 years.

That was the time that chemical engineering changed **from unit operations to chemical engineering science,** and I was glad to be a part of the transition.

"That was the time that chemical engineering changed from unit operations to chemical engineering science, and I was glad to be a part of the transition."

His brother Leslie (BSc AIC 1956) also enjoyed a distinguished academic career at both Rhodes and Wits universities, in the Department of Physical Chemistry.

David Glasser is currently retired Professor Extraordinarius at UNISA. He was Professor and Director of MaPS (Material and Process Synthesis) at UNISA, Florida, Johannesburg.

The long shadow of the apartheid policies

South Africa's education scene was also changing in this period. The National Party was voted into government in 1948, ushering in the apartheid era. This impacted not only formative education but also the tertiary education sector. Over and above the creation of "Bantu education", which relegated black[36] children to inferior schools, Prime Minister D.F. Malan made it explicit from the start that apartheid practice would be deployed in universities too. The universities of Cape Town and Witwatersrand were firmly in his sights, as both had exercised a liberal and merit-based policy on student recruitment, although this policy was not without its problems, and did not have the ambition to provide open access to education for the black majority of the population at that time.[37] When TB Davie assumed the role of UCT's Vice-Chancellor in 1948, his stated commitment to "the maintenance of absolute academic freedom" drew a line in the sand, which was the start of the institution's strained relations with the apartheid government over the next 30 to 40 years.[38]

Just as the new chemical engineering programme was coming into its own in the mid-1950s, the apartheid government, under Hendrik Verwoerd, passed legislation which impacted universities profoundly. The *Extension of University Education Act of 1959* segregated universities by statute. Black students were denied access to so-called "white" universities, and students classified as Coloured and Indian could only attend with a special permit issued by national government to study degree programmes not available to them at the universities designated for their race group, most of which were established post the adoption of these regulations.[39] Much has been written about this cruel and cynical manipulation of fundamental human rights which had immediate consequences for many.[40]

None of these newly created universities offered engineering courses, let alone in chemical engineering. Equally frustrating was the fact that public high schools accessible to black students were not necessarily geared to offer matriculation courses needed to gain entry to those universities that did offer chemical engineering. Overcoming these inequities would come to define a large part of the mission of UCT's Department of Chemical Engineering in the decades ahead.

Jameson Hall (now Sarah Baartman Hall), the centrepiece of UCT's Upper Campus.

36 The term "black" is used here as a collective descriptor for black African, Indian and Coloured people.
37 An unlabelled, but structured segregation in the university sector existed prior to 1948. While UCT and Wits student populations were dominated by English and Afrikaans speakers, the University of Fort Hare was the only institution at the time that admitted "black African" students generally.
38 Phillips, H. (2019) "UCT under Apartheid: Part 1: From onset to sit-in 1948 – 1968", Fanele Press, South Africa.
39 University of the Western Cape (1959); University of Zululand (1960); University of the North (1959); University College for Indians (1961).
40 Davies, J. (1996) "The State and the South African University System under Apartheid, *Comparative Education*, **32**(3), 319–332.

3 CONSOLIDATION

1960 – 1980

A DEPARTMENT IS BORN

The repercussions of Sharpeville played out across the country in profound ways, including at universities, where **segregationist policies were increasingly being interrogated** with regards to education.

In 1968, 600 UCT students started a nine-day peaceful sit-in at Bremner Building to protest the Council's decision to overturn the appointment of Archie Mafeje.

Ask anyone about the 1960s, and you will likely get the answer that it was a decade of social and political upheaval globally. There was a rebellious spirit in the air, and the conservative old-world social order was being challenged on many levels, focused largely around equity and human rights. At the same time, the global political order was being reshaped by a more aggressive Cold War, the slow demise of colonialism, and the rise of new nation states in the East and in Africa.

The 1960s in South Africa started with widespread protest against apartheid's segregation policies, to which the ruling National Party responded violently, killing 69 peaceful protestors at the Sharpeville massacre in March 1960. The repercussions of Sharpeville played out across the country in profound ways, including at universities, where segregationist policies were increasingly being interrogated with regards to education. In 1968, against a global backdrop of protest – including the student revolt in Paris – 600 UCT students started a nine-day peaceful sit-in at Bremner Building to protest the Council's decision to overturn the appointment of black scholar and anthropologist, Archie Mafeje. While the protest was only attended by a tenth of the student body, it was one of the first mass protests at UCT against apartheid injustices which reverberated across the University.[41]

This was the climate within which the newly established Department of Chemical Engineering set about defining its place in the Engineering Faculty at UCT, but also more widely on the national and international stage.

41 Hughes, K.R. (2008) https://uct1968sitin.wordpress.com/2018/07/01/lessons-of-the-great-uct-sit-in-ken-hughes/. Accessed April 2020.

The **newly established Department of Chemical Engineering** set about **defining its place in the world** against a backdrop of social and political upheaval **at home and overseas.**

FINAL YEAR 1960

Back Row: H.H. Jawurek, G.S. Hansford, S.P. Scott, G. Homolka, D.B. McQueen, G.O. Rutter, E.P. Slabbert

Middle Row: I.L. Duff, T.M. de Vos, R.K. Brooke-Sumner, S.B. Miller, A.R.P. Hammond

Front Row: L.C. Samols, W.G.D. McIlleron, H.W. Kropholler, G.R.V. Damp, W.Teper, A.D. Montlake

A journey into biochemical engineering

Professor Georges Belfort

BSc(Eng) Chem, 1963

There are few (if any) UCT alumni who can boast of building something for NASA. Georges Belfort is one of them. That was way back in the 1960s, and since then his research and academic interests have taken an interesting turn into the world of biochemical engineering – an area he believes should form part of the education of all young chemical engineers today.

For 42 years, Belfort has been teaching at the Rensselaer Polytechnic Institute in New York – the oldest technical non-military university in the English-speaking world. There, he's taught membrane technology, downstream processing, separations, thermodynamics and, for the last seven years, advanced transport phenomena for graduate students.

"My research has depended on transport phenomena, thermodynamics, mathematics, chemistry – all from Chemical Engineering at UCT – and biology, and has focused on separations engineering, biotechnology, and surface science and engineering."

For an undergraduate who enrolled in the department with a very cursory understanding of the field, it's an impressive list of interests.

"I entered the chemical engineering programme at UCT in 1958. My mother asked me what is chemical engineering and why do it? I told her I really did not know but I think it is related to soap dissolving in water (prescient!) and that the smartest students were planning to take chemical engineering for their BSc degrees. I also told her that I liked chemistry and mathematics, and both were strong components of chemical engineering. She relented."

Belfort would not regret his decision: "I was completely smitten. That one could describe quantitatively the movement of mass, heat and momentum by diffusion and convection was amazing to me and that these processes were mathematically and physically related was even more astounding. In fact, these ideas formed the foundation and basis of my 57-year industrial and academic career."

"The stringent academic programme was a shock, and it took time for me to realise that hard, focused work was required. Playing cards in the Union or sitting in the sun on the steps of Jameson (now Sarah Baartman) Hall were out (except for brief moments with my girlfriend and future wife, Marlene Stern)".

Belfort would leave Cape Town for the US and join the Astropower Laboratory, a division of McDonald Douglas Aircraft Company. "I designed and built one of the first wick evaporators for water recycling for the NASA space programme. Then I built and tested zirconium phosphate-based inorganic fuel cells for space flights. Finally, I developed and studied transport phenomena for desalination of brackish and seawater using electrodialysis and reverse osmosis processes."

He'd go on to receive his PhD from the University of California in 1972 before joining the Hebrew University of Jerusalem as a senior lecturer. He found his academic home at Rensselaer in 1978 and from there, he extended his influence internationally. He was elected a member of the prestigious US National Academy of Engineering. He has also been awarded all the major separation awards in the USA.

"Two teachers at UCT were most influential in my later career: professors Donald Carr and Heinrich Buhr taught me classical thermodynamics and reaction kinetics, and transport phenomena, respectively. Dr Buhr and I are still in touch via email."

"I have travelled extensively, presented lectures in Asia, Europe and Australia, been an advisor to the US National Academies of Engineering, Science and Medicine, the Chinese Academy of Sciences, the Max Planck Institutes, Germany, the Japanese Advancement of Sciences, the Hebrew University of Jerusalem, and consulted with more than 30 industrial companies in the USA, Japan and Europe."

Both Belfort and his wife were awarded honorary doctorates by UCT in 2018.

A captain of invention and industry

John Bewsey
BSc(Eng) Chem, 1963

John Bewsey has that special combination of inventive spirit and entrepreneurial flair. He's also not one to shy away from a challenge and his career has seen him pioneering the manufacture of several chemicals for the South African and international markets.

"Chemical engineering started for me in one class in the chemistry building, where Mr Kropholler laboured on about dimensionless numbers and Bernoulli's theorem and Fanning friction factors. Quite soon, we moved into the curiously shaped saw-tooth building that really set chemical engineers apart from other engineers and gave us the unfounded opinion of being somewhat special in the engineering world."

Founder and owner of Trailblazer Technologies (TBT), established in 2006, Bewsey's current focus is producing potassium nitrate and ammonium sulfate from mining effluent through his patented KNeW process – recognised in the water innovation category at the 2013 IChemE awards.

"The South African Innovation Fund has backed this process and we have built a world-scale pilot plant in our Krugersdorp factory that is now processing road tanker loads of acid mine water (AMW) to prove the concept. The plant is running smoothly, converting some very impure effluents to demineralised quality water, high-quality fertiliser with very little residual waste and at an overall profit – a unique attribute for a waste recovery process."

Bewsey's journey as a plant and process innovator started not long after he graduated from UCT in 1963. While working for Petersen Ltd (now Fine Chemicals Ltd), Bewsey spotted an opportunity to produce fire extinguisher powder (FEP), which was only imported at the time. When the Board sniffed at his idea, he and a colleague decided to go it alone. His first venture, Glenjohn Chemicals, was born.

"We found a warehouse on the main road of Sebenza Industrial Township of Edenvale and became the third industry in an area that now houses hundreds of factories. We got some contracts with office suppliers to blend and pack their alcohol-based solvents to offset our overheads while we setup an FEP manufacturing plant."

We have proved that even the most difficult technology **can be invented or improved upon here in South Africa** – small teams can be world beaters.

Ever on the lookout for new opportunities, the business would expand into other areas, including polyurethanes and non-explosive elements for the South African arms industry.

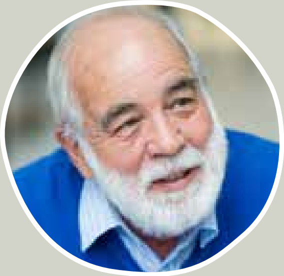
Bewsey believes South Africa has all the ingredients needed to be a world-class chemical industry, but for a lack of investment support.

"I have learnt a lot about the ethics of international business over many projects. We have proved that even the most difficult technology can be invented or improved upon here in South Africa – small teams can be world beaters.

"The investment and financial sector can only think of moving minerals out of SA as quickly and as profitably as possible and will almost never back the chemical sector. I know how much energy I have had to put into this one area, and I know how many opportunities we have missed because the capital flow has no courage."

A solid foundation in systems thinking

Professor Theodor J. Stewart
BSc(Eng) Chem, 1963



"Like many undergraduates, I came to UCT to study chemical engineering with very little idea of what the profession entailed. The attractions were a broad introduction to the basic hard sciences, together with a clear career prospect – at that age, more the concern of parents and family friends."

That was in the early 1960s and Theodor Stewart would later find himself excelling in a very different field – albeit one where his chemical engineering background paid dividends.

... my chemical engineering training **developed a deep appreciation of systems thinking** and the integration of quantitative models into systems and decision analysis.

"It was third year before I discovered the concepts of research, and the role mathematical modelling played in research. But there would be no immediate opportunity for me to undertake graduate studies as I had bursary obligations to work off in the mining industry. For the next seven to eight years I was in hard hat and boots much of the time."

On site, Stewart discovered his greater interest and professional challenge lay in trouble-shooting and problem-solving at the plant level: "I recall vividly coming to a realisation that decreasing product quality was primarily caused by increasingly rapid staff turnover in a poorly instrumented plant!"

"An early interest was sparked by the concept of 'evolutionary operation' (EVOP), developed initially in the chemical industry by the statistician, George Box. I became exposed to concepts of operational research as an approach to complex systems optimisation and discovered that a number of the earlier workers originated from a chemical engineering background. I was to join that line. Clearly, my chemical engineering training developed a deep appreciation of systems thinking and the integration of quantitative models into systems and decision analysis."

Stewart enrolled to study statistics and operations research through UNISA – achieving an MSc and later a PhD. During these years, he joined the then National Research Institute for Mathematical Sciences of the CSIR, in an emerging division for Operations Research.

"At the time, there was pressure to address problems of national interest, which came to include defence planning, agricultural logistics, planning of new town developments, water, fisheries and energy planning. At first sight, such activities took me far from my chemical engineering roots, but in many ways, the chemical engineering background provided a solid foundation. There were two important features of that early training that stood me in good stead: model-based thinking as a first step to analysing any problem, and an ability to think in a systems framework while alternating between the broad systems perspectives and attention to critical details – a dichotomy many co-workers seemed to find difficult to manage."

His skill for this kind of work saw him appointed Divisional Head for Operations Research at CSIR, which soon amalgamated with the Statistics Division to form a group foreshadowing the modern concept of Analytics. This led in 1984 to his accepting a chair in Mathematical Statistics (later re-named Statistical Sciences) at UCT, with a brief to develop the operations research component. One of the core MSc programmes in the department is now called Advanced Analytics and Decision Sciences.

Now retired, Stewart continues to pursue his passion for analytics, acting as Editor-in-Chief of the *Journal of Multi-Criteria Decision Analysis*.

An unwelcome start

Denis Cornelius
BSc(Eng) Chem, 1969

First year is a daunting time for any student on campus and under apartheid, this journey was made even more difficult for some.

Denis Cornelius enrolled in the Department in 1965, with his government-issued permit to study at a "white" university. It would be an uncomfortable start for him and a number of fellow students, excluded from activities on the grounds of their skin colour.

"My first unpleasant experience came during my first term. During registration week, we joined the Chemical Engineering Student Society. The annual dinner of the society was to be held at a hotel in the Tokai area. My classmates, Rosalind Cairncross and Gregory Steenveld and I approached the chairman of the society to clarify our situation.

"He undertook to investigate and report back to us. He came back and said that the then acting head of the Department wanted to see us (Professor Carr was on sabbatical at the time). We expected to be told that we would be denied attendance of the dinner. We received a very unpleasant surprise when he did not talk about the dinner but suggested instead that we transfer to the University College of the Western Cape (as it was then known) and study science. We felt very welcome."

From an academic point of view, Denis recalls receiving a solid education and, for the most part, being treated much the same as the white students. But his memories of his time at the University are sullied by the prevailing political and social conditions in the country at the time. "These conditions affected black students in a profound way. This also applies to my subsequent professional career. We had very little contact with white students and did not form any lasting friendships. We had more contact with black students in other disciplines, such as other engineers, medical and music students than our white classmates.

"We were disadvantaged as we could not live in the student residences on campus. As I was from out of town, I boarded with a family on the Cape Flats. This meant travelling by bus and train to Rondebosch and running up Stanley Road to be in time for the first lecture."

We had very little contact with white students and did not form any lasting friendships. **We had more contact with black students in other disciplines,** such as other engineers, medical and music students **than our white classmates.**

Vacation training presented further problems, with placements difficult to find – and this was to be the pattern after graduation. "I started working for Cape Portland Cement (CPC, later PPC) at De Hoek. Finding work was difficult. When I first applied to CPC during September of my final year I was not called for an interview. They advertised again the following January after which I was offered a position. While there I looked for other job opportunities. I was called for an interview by SFW but did not get past the receptionist. She disappeared for a while and returned to say that there would not be an interview."

Thankfully, not all doors were shut in his face and Cornelius was able to establish a career at Unilever in Durban. "After CPC, I worked at AECI in Somerset West for a short time. I spent the greater part of my professional career with Unilever, mainly in soapmaking. I had the opportunity to supervise the in-service training of students from the Mangosuthu Technikon and provide training for many newly qualified graduates and diplomates."

A new building
for a new era

"**Quite soon, we moved** into the curiously shaped **saw-tooth building** that really set chemical engineers apart from other engineers and gave us the unfounded opinion of being **somewhat special in the engineering world**."

– John Bewsey, BSc(Eng) Chem, 1963

In 1960, the Department moved out of its cramped and under-resourced quarters within the Old Chemistry Building on University Avenue and into a new building on North Lane, a location that would serve as its home for the next four decades. The new building, which Dr Heinrich Buhr called "a totally grand building", was distinctive and easily identified from as far afield as Rondebosch Common and the Groote Schuur campus. Its saw-tooth pitched roof profile with its big light wells and outwardly compact presentation separated from all other structures created the impression of a modern engineering complex. Its location on the campus was important, too. Separated by some distance from the engineering precinct, but adjacent to chemistry (and what was to become its own new P.D. Hahn Building), that spatial planning exercise helped define (and add to) the idea that chemical engineering and its people were distinct and different, as closely aligned to the physical sciences as to engineering.

Over the years, the North Lane building went through many changes in response to a growing staff and student base and changes in research emphasis. For occupants at the time, it must often have seemed that they were working in a perpetual building site. The most significant change, which talks to the shifting emphasis of research in the Department, was the "flooring in" of the open plan atrium, which had enabled the definitive ion-exchange research work in previous years.

J.P. Franzidis recalls "[it] was closed over to accommodate postgraduate student carrels on one level, and a general common room (which had been moved twice) on another level. Closing the atrium meant that a computer laboratory could be created, and a large open-plan flat-floor teaching space was purpose-designed to facilitate group teaching. The HOD and Admin suite also moved twice. A new instrumentation workshop and design studio were created, and both the chemical laboratory and the mechanical workshop were reconfigured substantially. Somehow, office spaces were created for the significantly expanded academic and research staff, and a library was established. The entire utility services to the Department were redesigned and relocated". And even an internal bicycle storage area was created to encourage bicycle usage, which contributed much to fitness, as anyone who has cycled from Main Road in Rondebosch to Madiba Circle on Upper Campus can attest!

Perhaps the most significant factor behind all these changes was that they put people "front and centre" in the operation of the building and its resources. This built on the strong "community spirit" at UCT Chemical Engineering – which continues to be one of the hallmarks of the Department to this day.

1960

The Department takes up residence in its distinctive new building on North Lane.

The North Lane building.

A venture capital career seeded in chemical engineering

Annette Campbell-White
BSc(Eng) Chem, 1968

Girls did not study engineering in the 1960s. Although **women had broken through** in many professional fields, **women didn't really think about engineering as a profession.**

Inspired by a childhood living in mining towns around the world while her father worked as a mining and metallurgical engineer, Annette Campbell-White was determined to study engineering, despite prevailing norms.

"Girls did not study engineering in the 1960s. Although women had broken through in many professional fields, women didn't really think about engineering as a profession. Females were certainly not discouraged from engineering study, but nobody actively recruited us."

She enrolled in UCT Chemical Engineering in the mid-1960s and was one of the first women to graduate from the programme, but after graduation, she ran into a roadblock. "Companies, it appeared, were nervous about hiring a woman graduate. What about all of those ladders to climb on a distillation column? Or perhaps one's hair might get caught in a pump valve. The few jobs open to a woman graduate were barely above office assistant level, so I decided that perhaps I should pursue life as a university lecturer instead."

Campbell-White completed her Master's thesis in 1970 and spent some time in the nuclear medicine department at Groote Schuur Hospital as a technologist and researcher. Her decision to leave South Africa in 1972 – and with it her dreams of working as a chemical engineer – proved to be the springboard into a successful career in business and finance.

"After leaving South Africa, my first real job was as a strategist in the medical division of British Oxygen in London, which led to an invitation to work in California at the Stanford Research institute (SRI) as a healthcare economic strategist. I left SRI in 1976 to found ECCO Consulting Group, undertaking economic research on medical imaging technology and equipment.

This led to my breakthrough into the world of finance: in 1979, I was recruited by the investment banking firm Hambrecht & Quist in San Francisco to start a research focus for the firm in the healthcare field."

She went on to become the first biotechnology analyst on Wall Street and later founded her first seed capital healthcare investment fund in 1985.

"Women at that stage were not accepted as peers in the all-boys' club atmosphere of the developing venture capital industry, so in order to participate, I had to 'go it alone'. I called the firm MedVenture Associates, and we did well. We invested in the first rounds of external financing for important products such as the first artificial cervical disc, the first off-fingertip blood glucose home testing meter, the first programmable implantable defibrillator, and numerous other medical devices and biopharma products. The work of early stage investing was fast paced and competitive. You had to learn to live with the fact that many of the investments failed, so one never took success for granted."

Annette Campbell-White speaking at UCT's 2018 graduation ceremony where she encouraged graduands to use the gift of education to make a difference.

Now retired, Campbell-White credits her time at UCT for her success: "Chemical Engineering was a tough, tough field of study. The act of persevering to obtain the degree, and to overcome the stress of the workload, prepared me for my later career in a way that nothing else could have done. I learned discipline, focus, and not to be afraid of hard work. I learned to be collegial, and of most importance – not to be afraid to lose.

"In hindsight, I realise that much of my later professional confidence came from those years of study in the company of a group of talented, unassuming and collaborative friends, as they became. Nobody made a big deal of the fact that I was a girl. They treated me as an equal, as a pal, as a fellow sufferer from the pressure of too much work, and significantly, they taught me how to down beer so that I could qualify as a contestant in the engineering 'smokers'.

"I am certain that without those years, I could never have had the confidence to create the career I've been lucky to enjoy. I'm thankful to UCT and especially to its brilliant Department of Chemical Engineering."

In hindsight, I realise that much of **my later professional confidence came from those years of study** in the company of a group of talented, unassuming and collaborative friends, as they became. Nobody made a big deal of the fact that I was a girl.

The changing face of the student body

As the Department of Chemical Engineering was changing its physical location to the North Lane site, so too was its student body transforming. Undergraduate student numbers grew steadily throughout the 1960s, went through a dip in the early 1970s and then boomed in the late 70s. The latter was sparked by the construction of Sasol 2 and 3, big developments at AECI and a sustained increase in the gold price. Within this, the demographic mix was slowly starting to shift too. Though the permit system had been in place since 1959, it was not until the mid-1960s that the first black students gained entry to Chemical Engineering. The slow pace in change is attributable, in the main, to the fact that very few permit applications were approved by the National Government. Reasons given for refusal were mostly arbitrary. Thus, by 1968, only 5.5% of the total student enrolment at UCT were black students, and then only those classified as Coloured and Indian.[42]

Alumni testimonials from that time attest to the fact that it was not easy to be a black student in an historically white facility. And the difficulties these students faced in those early years did not stop at graduation. Most struggled to secure vacation-training placements or permanent employment, which led many to staying on at UCT for postgraduate study.

Greg Steenveld was the first male student on permit to graduate from the Department in 1968, followed by Michael Ellman and Denis Cornelius in 1969, and Eugene Cairncross in 1970. Each went on to carve out distinguished careers in business, research and education.

The gender profile of the department also started to shift at this time, albeit slowly. The first women graduates from the programme were Annette Campbell-White and Eleanor Samson, also in 1968, and Rosalind Cairncross followed as the first black female graduate in 1972. Their challenges were significant, ranging from having to counter the stereotype that engineering, in general, was a man's profession, to the practicalities of finding industry placements, as well as dealing with employer reticence and misogyny.

In the following decade, only five other women graduated from the programme. And it took a full generation and a half before the number of women graduates achieved anything close to parity with their male counterparts.

The apartheid government had decided to permit a handful of "coloured" students to access some of the faculties at "white" universities. The engineering faculty at the UCT was one of these. And I was one of those students permitted to attend. **I was the rare, maybe the first** "coloured" female student in the mostly "white" male engineering faculty. I was, and we were, in for a rude shock. Academically and culturally."

– Rosalind Cairncross, BSc(Eng) Chem, 1972

42 Phillips, H. (2019) "UCT under Apartheid: Part 1: From onset to sit-in 1948 – 1968", Fanele Press, South Africa.

5.5%

percentage of black students at UCT by 1968.

Greg Steenveld was the **first male student on permit to graduate** from the Department in 1968, followed by Michael Ellman, Denis Cornelius in 1969 and Eugene Cairncross in 1970.

FINAL YEAR 1968:

Back Row: P.J.S. Gibb, P.J. Buley, R. Douglas, P.T. Hadingham, A.J. Dryburgh

Standing: S.W. Pienaar, B.W. Fraser, A. Baigel, G.N. Steenveld, M.A. Williams, J.D. Lancaster, M.J. Ellman

Seated: P.J. Broli, E. Samson, S.B. Miller, J. Anstey, A.D. Carr, A. Campbell-White, W.A Jackson

Absent: E.T. Amm, J.O. Read, R.P.A Siaens

Driving nails into apartheid's coffin

Dr Michael John Ellman
BSc(Eng) Chem, 1969

Dr Michael Ellman does not have fond memories of his time at UCT. In fact, it took him some 50 years to make peace with what he calls "one of the most traumatic periods of my life" as the first black student to enrol in the Department of Chemical Engineering.

I am proud of what I have achieved against huge odds. I am very happy with my chemical engineering career, and grateful to all those who have, over the many years, made it possible. I have also forgiven those who threw rocks, sometimes boulders, in my path, for their own nefarious reasons, both at UCT and subsequently. **I was able to find inner peace at UCT's golden graduation ceremony in December 2019.**

What started off on shaky ground grew into a highly rewarding academic and professional career. It took an exceptional amount of hard work and a few champions who were happy to open doors where most kept them firmly shut.

Ellman recalls being challenged as to why he'd enrolled at UCT and wasn't "where he belonged" at the University College of the Western Cape. "On each occasion, I didn't reply.

I was at UCT on a permit from the Minister of Coloured Affairs and any resistance on my part might have meant the withdrawal of the permit."

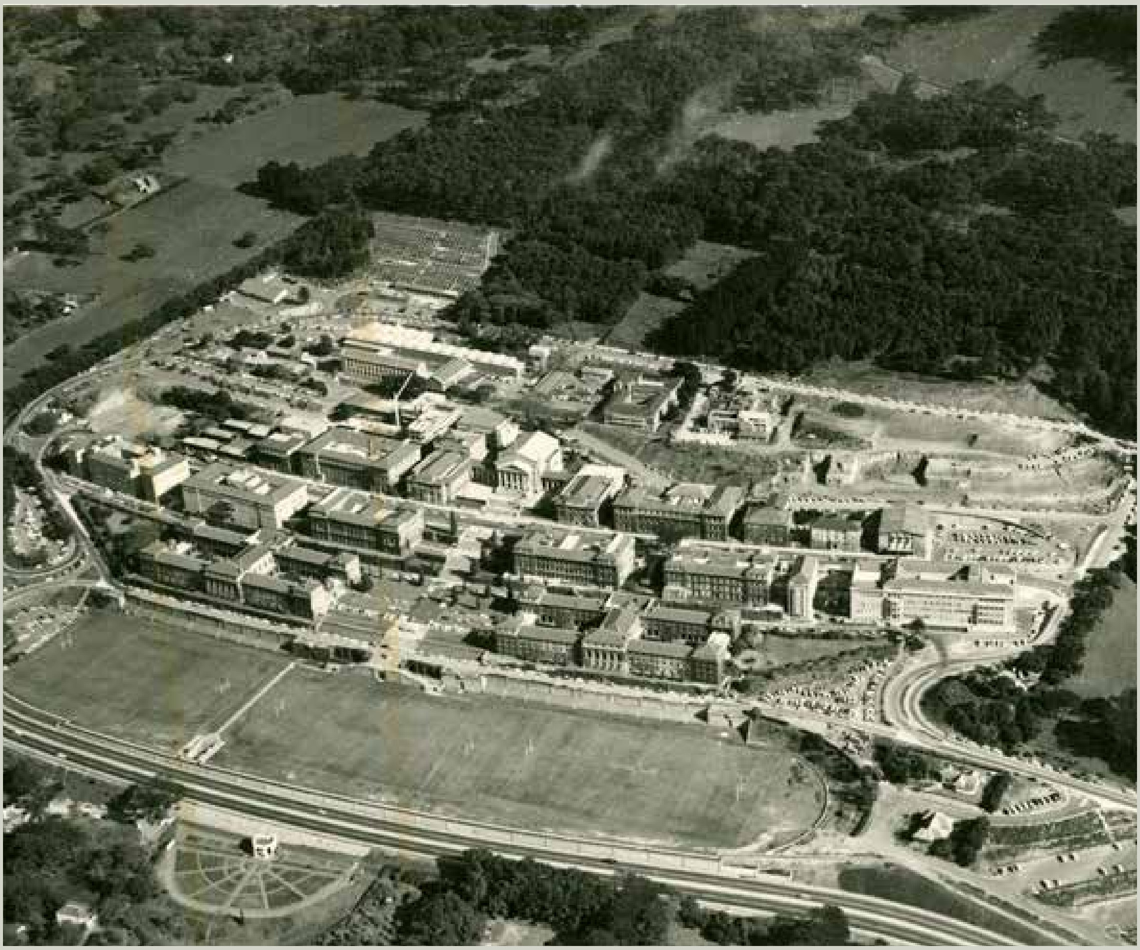
When he entered the Department at just 16 years old, Ellman was out of his depth in a number of ways. "I was terribly young and immature. I landed up in a class of about 20 students, all white except for me. One was the first woman to do chemical engineering at UCT, Ms Annette Campbell-White.

"It was a very new and bewildering situation. Most of the students came from top schools and had completed their military training and were already about 20 years or older. In class they asked very 'intelligent' questions; I was intimidated and too afraid of making a fool of myself and being humiliated. I performed poorly and it took me six years to complete a four-year degree."

Like other black students from the late 1960s and later, Ellman would find it near-impossible to find industry placements at the end of each academic year. Sheer determination to gain practical experience changed his fortunes. "During 1965, I ran into Mr Bettisworth, the head of the UCT Mechanical Engineering Workshop. I related my story and he said if I was willing to give up my June vacation, I could come and do my workshop practice with him. I am eternally grateful to this gentleman for his kindness."

Whatever some people thought, Ellman had designs on a successful chemical engineering career and he joined the Chemical Engineering Students Society at UCT, as well as the Institution of Chemical Engineers in London (IChemE) and South African Institute of Chemical Engineers (SAIChE). He would however leave UCT "with a tremendous lack of self-confidence and self-esteem and a thorough dislike of the place".

Fortunately for Ellman, his experiences after graduation would be more welcoming, for the most part. He got his first job at Gold Fields in Johannesburg, becoming the first of the black chemical engineering graduates of 1967 to 1969 to take up a position in industry.



Aerial view of Upper Campus, 1967.

He also became the first black professional to join the CSIR in 1978. "All the while, in my own small way, I felt that I was driving nails into apartheid's coffin without ever having to sell my soul or give up my personal values."

Soon thereafter, Ellman was granted a scholarship from the Dutch government to complete his Master's at the University of Twente in the Netherlands. "I was very happy to find that with my chemical engineering degree from UCT, I could hold my own against Dutch students and academic staff. I was regarded as an equal in all respects. It was very refreshing to live in an environment with absolutely no racial discrimination."

After a stint doing research at the CSIR, Ellman received another scholarship and completed his doctorate – in French – at the University of Technology in Nancy, in the field of multi-phase gas-liquid catalytic chemical reactions. He published two groundbreaking papers and his work has been referenced hundreds of times by others in the field.

Upon returning to South Africa, Ellman worked on the Mossgas Project. He earned an MBA part-time and has been a non-executive director of several state-owned enterprises. In 2003, he left full-time employment to work as a consultant with the SA Department of Energy's iGas until 2017.

"I am proud of what I have achieved against huge odds. I am very happy with my chemical engineering career, and grateful to all those who have, over the many years, made it possible. I have also forgiven those who threw rocks, sometimes boulders, in my path, for their own nefarious reasons, both at UCT and subsequently. I was able to find inner peace at UCT's golden graduation ceremony in December 2019."

From unit operations to chemical engineering science

1960

Transport Phenomena, the seminal textbook by Bird, Stewart, and Lightfoot, is published.

The teaching of Chemical Engineering at UCT underwent some significant changes in the early 1960s – in line with international shifts. If the period prior to that could be defined by a unit operations approach to teaching, this next era introduced a chemical engineering science model to students. This focused on analysis as well as design, multi-scale processes, transport phenomena, advanced thermodynamics, applied mathematics and the introduction of computation.

Professor Donald Carr and his colleagues took this to heart, beginning to lecture transport phenomena from Bird, Stewart and Lightfoot's first edition already in 1961. But the students were also expected to look beyond their own discipline. Clive Thorpe remembers: "Our third and fourth years focused quite intensely on chemical engineering topics – unit operations, transport phenomena, process control and others, but they also included Chemistry III and the honours course in Physical Chemistry, given by the white-haired Dr Herbert Spong. He typically covered the blackboard in triple integrals which I blindly copied, hoping to unravel them one day. I still have the notes and I'm still hoping. Each of us also had to write a 2,000-word essay on a Humanities topic given to us by Prof Carr – mine was J.J. Rosseau's Philosophy."

In 1964, the undergraduate programme was briefly restructured formally into two streams, one called Chemical Engineering Science, the other called Chemical Engineering Management, which introduced business management, economics and related topics to cater for those students who would move on to careers in management after graduation. As Carr commented at the time, "every graduate has three offers of work … and they tend to move into management".[43] This delineation within the teaching programme served two purposes: the creation of a parallel and vibrant research programme underpinned by the Chemical Engineering Science approach to teaching, and an outreach to industry to better understand the challenges being faced by companies operating in South Africa. This was the heyday of commodity chemicals when AECI and National Chemical Products and Sasol 1 had rapidly diversified their product range, and the liquid fuels sector expanded.

The Chemical Engineering Science stream also required students to take Physical Chemistry up to fourth year, which significantly increased the number of students taking Chemistry to higher level. While this requirement was dropped in the 1970s, at that time it was possible for students to study all courses required of a BSc Chemistry major.

By the end of the 1960s, the staffing profile of the Department had changed also and was now anchored by the core team of Donald Carr, Heinrich Buhr, Sydney Miller, Brian Paddon and Geoff Hansford (these last two had arrived in 1969 to replace a number of junior academics who were also senior research students). It is interesting to note that all five were UCT alumni.

43 Phillips, H. (2019) "UCT under Apartheid: Part 1: From onset to sit-in 1948 – 1968", Fanele Press, South Africa.

Donald Carr at his desk.

By the end of the 1960s, **the staffing profile of the Department** had changed and was now anchored by the core team of Donald Carr, Heinrich Buhr, Sydney Miller, Brian Paddon and Geoff Hansford … **all five were UCT alumni.**

The relationship between UCT and the City of Cape Town was for some years captured in the City's awards of Corporation Medals to the top Engineering students at UCT. Four (out of five) students in this image from 1977 are Chemical Engineers. Pictured from left are: Professor Victor Grainger, Dean of Engineering; unknown; David Walwyn; Peter Dold; Cape Town Mayor Edward Mauerberger; Rodney Dry; and Jimmy Jacka.

In defiance of the norms of the times

Dr Eugene Cairncross
BSc(Eng) Chem, 1970; PhD, 1974

"Early 1966, my father dropped me below Jammie steps, proud that I would be entering what we thought would be a non-racial educational environment. My father and mother opposed apartheid all their lives. His favourite injunction was 'reach for the stars', beyond the straitjacket of apartheid education. My mother focused on finding enough money to get me (and my sister Rosalind) through university.

First year was exhilarating. I recall an enthusiastic chemistry lecturer, a dour physics lecturer and **a possibly brilliant maths lecturer** who seemed to spend lectures scribbling on the board and muttering to himself.

The expectations of family, school and society weighed on me. After two turbulent matric years, with teachers arrested for political activities, interspersed with student boycotts, I had matriculated from Trafalgar High School as a top student. We had the brightest and most inspirational teachers, an intellectually vibrant school atmosphere. I started university, determined to jump in boots and all, to work hard and to play hard.

I was not among the pioneers of black students at UCT. Earlier, small groups, including luminaries, Neville Alexander and Archie Mafeje, studied at UCT, before the Orwellian *Extension of Universities Act of 1959* required students not classified 'white' to apply for a permit, only granted to 'non-white' students for courses not offered at the new, race-based 'Bush Colleges'. The post-1959 cohort of 'non-white' students, including myself and my sister Rosalind, had to choose engineering, medicine, architecture or music. I chose chemical engineering.

First year was exhilarating. I recall an enthusiastic chemistry lecturer, a dour physics lecturer and a possibly brilliant maths lecturer who seemed to spend lectures scribbling on the board and muttering to himself. I hardly noticed my fellow white students, except for a group of white Rhodesian students who would crowd around when our maths tests were returned. They appeared concerned that I regularly got near top marks in the Maths 1A class, occasionally scoring more than 100%. But I was competing with myself, not them. I ended my first year with four As.

On the extra-curricular front, we (the 'non-white' students) found that the students' Chemical Engineering Society was holding social events from which we were excluded. We were told that it was 'the law', that the Department was not responsible. Another exclusion related to compulsory vacation work. The Department was responsible for the placements but could not place me. I was exempted.

In my third year, in May 1968, the student rebellions in Paris had an impact on student life at UCT, leading to the occupation of Bremner Building. The political ambivalence of the university then, as during the more recent "fallist" movement, came under scrutiny. My focus on academic work wobbled a bit, although my results were still good.

I enjoyed my fourth year, particularly the Design and Experimental Projects, and Fluid Flow, close to my childhood passion of aerodynamics. Dr Nico Louw taught Mass Transfer with quiet grace and an incredibly neat and regular handwriting. In my postgraduate years, Nico invited me to teach a part of his course, a gesture of support that I appreciated and accepted enthusiastically.

I chose PhysChem IV, part of Chemistry Honours, as my final year elective, an unfortunate choice. Towards the end of the year, I inadvertently missed an assignment due on a Friday, the PhysChem department took offense, refusing to accept a late hand-in, resulting in year-mark below 50% and a supplementary exam early 1970. Consequently, although I had enough points (A passes) for First Class Honours, and received

UCT Chemical Engineering prides itself on its long tradition of family connections, including many siblings (and some twins), and across multiple generations; too many to mention, but going back to the 1940s. Pictured here are members of the Cairncross family at the graduation ceremony for Lenore Cairncross, who attained her Master's in Chemical Engineering in 1998. From left to right: Sophia Kisting-Cairncross (mother), Lenore Cairncross, Mary Cairncross (grandmother), Eugene Cairncross (father). Eugene was a 1970s Chemical Engineering graduate. His sister, Rosalind, also graduated from the Department in 1972.

the final year Class Medal, I graduated in June 1970 with Second Class Honours because I had not completed the degree in four years.

In 1970, I registered for an MSc. An enthusiastic Dr Geoff Hansford, recently returned from the US, suggested a topic in non-Newtonian flow. Together, we worked through the graduate texts on viscoelastic fluids. Our research meetings included other graduate students, with whom I generally had collegial relationships. The inscription, '*Oh Lord, when tired and weary, let my last results fit the bloody theory*', was our mantra.

In December 1974, I graduated with a PhD. My parents and two younger siblings had emigrated to Toronto, Canada in 1969, but my proud mother managed to come from Toronto to be there! I believe I was the only person of colour in a red robe that day on the venerated Jammie steps, overlooking the vista of Cape Town, a sight only the colonial masters were meant to enjoy.

UCT provided an excellent technical basis for a long and varied professional career, but many factors and people contributed to my success. The main drivers were the strengths and values learnt in my family, my father's intellectual curiosity, the self-belief I, and my siblings, learnt from both our parents, and our rejection of apartheid-imposed limitations.

The solidarity of fellow students enabled us to survive and do well in a hostile environment. I also remember, with appreciation and gratitude, those individual interventions at university and beyond, often in defiance of the norms of the time, for the support and guidance they provided to a young student and professional."

Then and now: perspectives on a changing world

Rob Louw
BSc(Eng) Chem, 1969;
MSc(Eng) Chem, 1971

"The world in the mid-60s and early 70s was in many ways a different place to what it is now. The Cold War was in full swing, men were landing on the moon, and in South Africa, there was apartheid rule and no television. We were still using Imperial units of measurement. China was an insignificant power. The Beatles were top of the pops. There were no calculators or computers, no internet and no ability to do literature searches online. Slide rules were the only computing power we had. Environmental awareness was low. At that time, it was definitely a man's world with little gender or racial equality."

Like his contemporaries from that time, Rob Louw has seen a tremendous change in the decades since. He's also tried to help that change along, perhaps influenced by the inequality that was so plainly obvious on campus in those days.

"We enjoyed academic freedom, but at the height of apartheid, very few people of colour were permitted by the government to attend UCT. Engineering and Medicine were two of the exceptions. Hippy culture was alive and well in the US and students at UCT were also free spirited and we had our fair share of student protests and sit ins."

"Academically, UCT Chemical Engineering was an excellent course. All our lecturers were good. I would have liked more tuition in applied maths, less in pure maths, some statistics and more modern physics. This would have made an already demanding course even tougher!

"Chemical engineers had to work hard but, like all engineers, we played hard as well. I remember well the engineering 'smokers', building floats for RAG, marching down Adderley Street in nappies, toboggan races down Jammie steps, intervarsity rugby (especially the sing songs) and many other fun events (such as romping in the fountain on the foreshore). Most of us learnt to play Bridge and just do the things that students normally do. And then there was the local pub, The Pig and Whistle, where a few raucous parties were held. I also managed to get in a few rounds of golf with various classmates."

Louw had been on track to do his Master's at McMaster University in Canada but a bursary offer was withdrawn at the 11th hour due to South Africa's apartheid policies. "I did an MSc at UCT instead and this stood me in good stead in my later career, particularly in understanding and applying evidence-based scientific techniques."

He landed his first job at South African Nylon Spinners (SANS) and as a plant manager, he employed the first female shift operators to work on the spinning machines – a job that was traditionally seen as men's work. "The works manager was a bit surprised at how well the 'experiment' worked."

In 1985 he transferred to KwaZulu Natal and here his eyes were opened to the conditions in black rural areas: "I came to realise some of the more serious challenges facing the rural Zulu communities. Local schools were very run down and there were no functioning science labs. We arranged to upgrade some school classrooms with pupil and parent labour. Our standout project was the conversion of a disused warehouse on our factory site into a school laboratory."

Louw would also experience an awakening to environmental issues later that decade: "In 1988, I gained a senior technical position representing AECI in ICI's London headquarters. It was here that I really became acutely aware of just how big the environmental challenge was that the chemical industry as a whole was facing. Environmental awareness was much less elevated in SA at that time."

He was appointed Commercial Director of Huntsman Pigments in 2000, responsible for $1.5 billion worth of global business. His experience has shown him that South Africa's chemical engineers are up there with the best.

"I have met many chemical engineers from around the world and found that our training was as good as you could get anywhere. At least we all know what a mass balance or an energy balance is! I also believe we have a better understanding of economics than most economists do!"

Blazing a trail for coloured women

Rosalind Cairncross
BSc(Eng) Chem, 1972

"Many of the memories of my time in the Chemical Engineering Department have faded. But a few remain: the tense atmosphere in the country, the frosty reception from the faculty and, on a better note, taking some flying lessons with the UCT Flying Club.

The late 1960s was a fraught time. I was the rare, maybe the first "coloured" female student in the mostly white male engineering faculty. I was in for a rude shock. Academically and culturally.

The transition from high school to university is a leap for most students. At our high school, the dedicated teachers did their best to prepare us, but they and the few people in our community who had degrees could not provide all the support we needed. My school classmate, Greg Steenveldt and I took our places in the lecture theatres at UCT. I found myself in a sea of mostly white men and a few white women. Neither group was inclined to so much as greet me. The men in our small group had a little more luck. Things eased a little when my brother, Eugene joined the next year.

As for coursework, needless to say, first-year didn't go well. I went from being at or near the top of my class to being a struggling student. I best remember the month spent in the workshop at the end of first year. The instructor was one of the few who I felt treated me simply as a student. Added to my struggles was the constant need to earn some money. I spent most of my second year working in the R&D laboratory at a chemical coatings plant in Kuilsriver, a long commute from home and from campus. This later turned out to be a blessing.

In the chemical plant, I observed some of the unit operations of chemical engineering. The handling of various fluids and mixtures gave me a real feeling for fluid mechanics. Engineering is essentially a practical endeavour, but our studies were largely theoretical.

I landed a job in the chemical coatings industry, helped by my earlier experience. I recall no help from anyone in the Department in my job search. I later emigrated to Canada joining the rest of my family there.

My engineering background and a later Master's degree in Environmental Studies in Canada led to a rewarding global career. Close to retirement, I found myself back in an engineering faculty teaching at the University of Toronto. Being a woman in the engineering field, especially a woman of colour, has never been easy. I encouraged young people, especially girls, to study science, serving on the Board of the Ontario Science Centre, advocating for women and girls as president of Women in Science and Engineering and on other bodies. As Contributing Editor with a magazine for consulting engineers, I've been writing about engineering and engineers for decades.

Being a woman in the engineering field, especially a **woman of colour, has never been easy.**

My best memory of UCT came after graduation. I heard that the University Flying Club offered flying lessons and as a graduate I could apply. In the cockpit of the little Cessna the instructor and I were suspended between the sea and the sky. The cost of the lessons soon proved more than my budget could stand. I didn't get my pilot's license, but the experience was both frightening and exhilarating. Thank you Uniform Charlie Tango."

An expanding research agenda

The **early research profile** of the Department was largely driven by questions related to the **national fossil energy and power generation research agenda** at the time.

This early lab photo from 1961 features Heinrich Buhr (bent over the desk) and Hein Krophoeller (at the columns).

South Africa, in the early 1960s, was intrigued by the prospect of nuclear power, and the Atomic Energy Corporation (AEC) began to fund university research into various aspects of nuclear reactor technology. Some of this funding found its way to Donald Carr, who spearheaded much of the early research carried out in the Department. Building on his own PhD in the field of liquid-liquid extraction, he started to explore prospects for solvent extraction for uranium recovery from aqueous leach liquors.[44]

Carr, along with Heinrich Buhr, also began to research various aspects of momentum and heat transfer to liquid metals used for nuclear reactor cooling, supported by collaboration with the University of Michigan, leading to the awarding of a PhD for Buhr in 1967.[45] This work, and other dimensions of nuclear reactor design for air loop cooling systems, continued for some years,[46] until South Africa in the mid-1970s took the decision to purchase the Koeberg nuclear power plant in Cape Town from France, rather than design its own.[47]

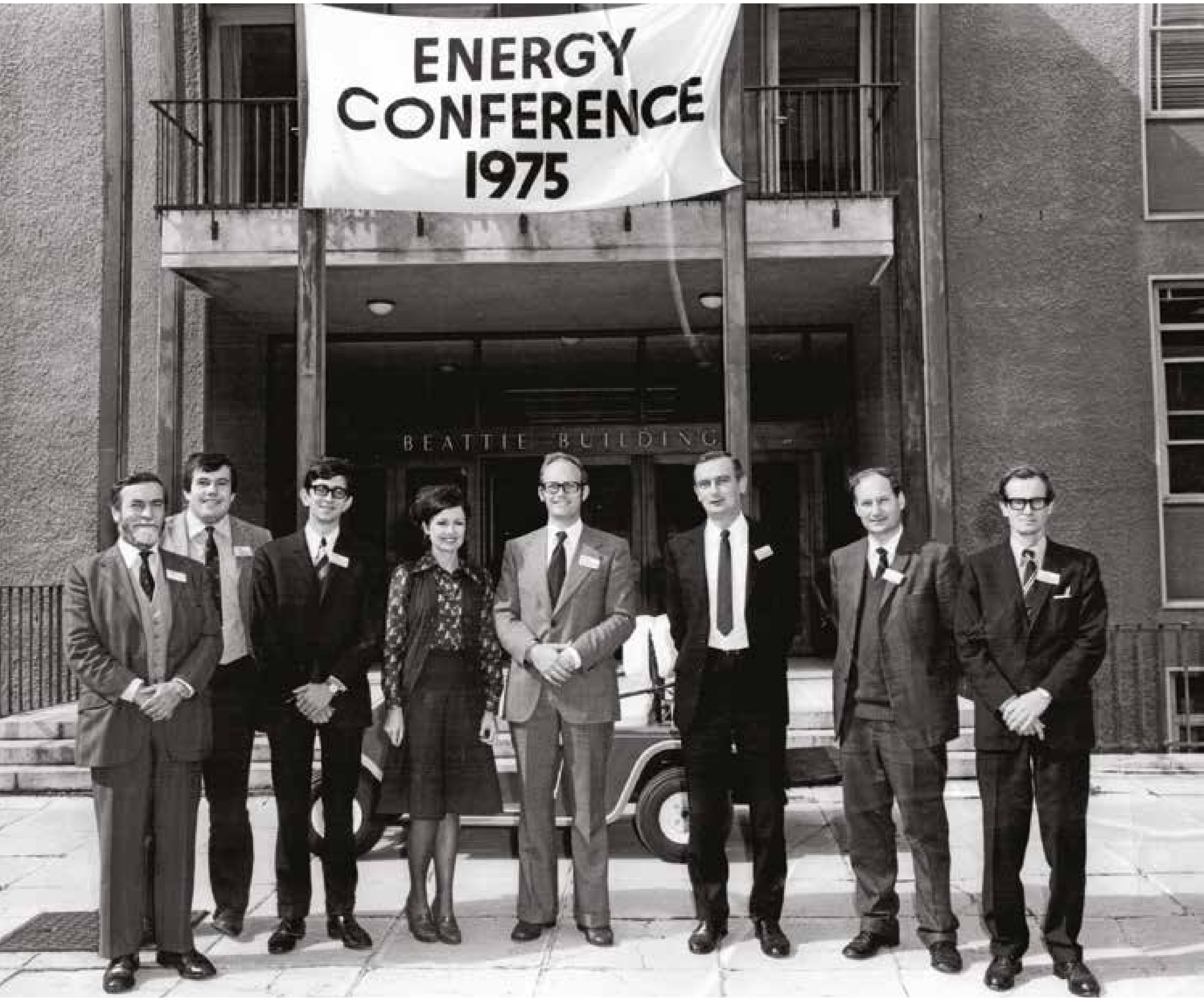
John de Kock's contribution to Chemical Engineering at UCT is also notable on a number of levels. His understanding of particulate processes did much to enhance the learning experience of students. He also promoted an understanding of coal processing, which, for a country like South Africa where coal accounts for upwards of 70% of primary energy needs, provided important exposure for undergraduates.[48]

The early research profile of the Department was largely driven by questions related to the national fossil energy and power generation research agenda at the time and early research funding came from statutory agencies such as the AEC and the recently established South African Water Research Commission (WRC). Much of this energy-related work moved to UCT's Energy Research Institute (ERI) in the late 70s, under the curatorship of Mechanical Engineering's Professor Dick Dutkiewicz (ex-Director of Research at Eskom). The ERI

44 Lloyd, P.J. (1962) "Solvent Extraction in the South African Uranium Industry", *SAIMM.J*, **62**(March), 465–480.
45 Buhr, H.O., Carr, A.D. and Balzhiser, R.E. (1968) "Temperature profiles in liquid metals, and the effect of superimposed free convection in turbulent flow", *Int'l J. Heat & Mass Transfer*, **11,** 641–654.
46 PhDs of Michael Connor (1971) and Duncan Fraser (1977).
47 Personal communication, H.O. Buhr (2019).
48 IEA (n.d.) "South Africa", www.iea.org/countries/south-africa. Accessed April 2020.

became a magnet for UCT Chemical Engineering graduates like Anton Eberhard, Jim Petrie, Susan Baldwin, Anthony Williams, Gareth Shaw and Stephen Law, and the relationship between Chemical Engineering and the ERI, latterly the Energy Research Centre, has become an important example of interdisciplinary research collaboration within UCT since.

Within Chemical Engineering, the synfuels research agenda developed rapidly under Cyril O'Connor and his colleagues from the mid-1980s. The incorporation of comminution into the minerals research focus (built on 1980s research in the ERI on comminution and tribology) led to several PhDs in the 1990s and 2000s, including that of the current HOD, Aubrey Mainza.



In the mid-1970s, South Africa's energy future was linked to coal and the 1975 Energy Conference provided good opportunities to strengthen research collaborations across UCT Engineering and with industry. Pictured from left to right are Doug Jones (Transvaal Coal Owners Association); Andy Sass, Tony Miles and Christine Burnie (UCT Mech Eng); John de Kock; Dick Dutkiewicz (Director of Energy Research Institute); Brian Paddon; and Peter Stevens-Guille (McGill University).

The light of UCT still burns bright

Professor Eldred Chimowitz
BSc(Eng) Chem, 1974

Ripples of the **youth cultural 'revolution'** in the USA, in particular, had arrived on campus and a lot of that energy manifested in **opposition to the apartheid government.**

These days, Professor Eldred Chimowitz teaches at the HAJIM School of Engineering and Applied Sciences at the University of Rochester in the USA. Though it's been decades since he joined UCT as an undergraduate in the late 1960s – part of the group of "outsider" students from then Rhodesia – he still finds similarities between the curriculum and what he teaches today.

"The topics in third and fourth year covered material that still constitutes the core of current chemical engineering programmes throughout the world. What is demonstrably different today, though, is the existence of elective courses in new areas like biotechnology, materials science and data analytics. These were either non-existent, or in their infancy back then. Slide rules were still the mainstay of numerical calculations until Hewlett Packard first came out with their famous handheld calculator in the 1970s."

The world is in many ways unrecognisable from this era, which Chimowitz recalls as "an eventful time to be at UCT".

"Ripples of the youth cultural 'revolution' in the USA, in particular, had arrived on campus and a lot of that energy manifested in opposition to the apartheid government, mixed in with Woodstock-generation acting out. There were periodic fevered outbreaks of political activism on campus."

The Rhodesian students banded together, united by their outsider status and their different schooling background, based on the British A-level system. "My A-level material covered much of the entire first-year engineering curriculum, which led to a year of relative scholarly indolence, rudely upended in subsequent years." Many idle hours were spent in the local (and legendary) watering holes of the Forrester's Arms and Pig and Whistle.

That was soon to change and Chimowitz would have to apply himself in later years. "The academic material was uncompromising in its standards and would easily pass muster with that taught in the best overseas universities to the present day," he says.

"I recall Professor Carr introducing the book titled *Transport Phenomena* by Bird, Stewart and Lightfoot into the curriculum. Its mathematical rigour was intimidating, the material dressed up with so much theoretical garb that to many it seemed the text would quickly find itself archived in the backroom collections of academic libraries. Ironically, it has turned out to be the most successful textbook used in teaching the discipline."

Chimowitz would go on to complete his PhD at the University of Connecticut in 1982 and develop a successful career as a chemical engineering academic, working in the area of supercritical fluids and energy systems, and finding time to publish a memoir, *Between the Menorah and the Fever Tree*.

"I am forever grateful for the academic foundation I developed and I'm sure that for many others the same sentiment holds, and the light of those years spent at UCT still burns brightly in our lives."

Towards a research group culture

Around 1970, the Department's research took a significant step towards water treatment, which has remained one of its signature research themes. This move was enabled by two appointments in the preceding years: Geoff Hansford (BSc(Eng) Chem, 1960) and Gerrit Marais, Professor of Water Resources Engineering within the Civil Engineering Department.

On completion of his PhD at the University of Pennsylvania, awarded for a study to model mass transfer in non-Newtonian fluids to mimic biological systems, Hansford returned to UCT Chemical Engineering as a senior lecturer. Thus began a lifelong research career in various aspects of bioprocess engineering, spanning fields as diverse as fermentation technologies, water treatment and biological minerals processing. Hansford served as Head of Department for 10 years, from the time of Donald Carr's ascendency to the role of Assistant Principal, then Deputy Vice-Chancellor, in 1979. Marais's research field was municipal wastewater treatment, and he would go on to become a world authority on the subject, supervising the PhDs of several UCT Chemical Engineering alumni.[49]

With Hansford and Marais to guide them, Carr and Buhr redirected their research to municipal wastewater treatment. They were joined by de Kock in this endeavour, who had developed a research focus on industrial wastewater treatment in parallel to his particle technology work, and by Brian Paddon, who had joined the Department after more than a decade in the South African petroleum industry. These two focuses merged with a large multi-year effluent reclamation and desalination research project using ion exchange. Apart from removing pollutants, research focused on producing a chemical usable as a synthetic fertiliser, so that much of the initial chemical regeneration cost could be recovered. The project was funded from 1972–1978 by the WRC [50] and continued with other funding sources thereafter.

This WRC project is important for two reasons. First, it heralded the start of a "research group" approach within UCT Chemical Engineering, directed at tackling critical problems across the South African landscape, which was to underpin much the Department's research for the coming decades. Secondly, the WRC project relied heavily on a multi-column experimental set-up that straddled several floors of the open-well laboratory. Alumni from that era recall how this rig dominated the internal space of the building. It served as a very good example of the flexibility enabled by the new building's design and indeed, the flexibility and adaptability of the people within the Department.

The ion-exchange columns which dominated the interior of the Chemical Engineering building for some years in the early 1970s. The multi-year effluent reclamation and desalination research project, funded by the WRC from 1972 – 1928, relied heavily on this experimental set-up.

49 Peter Dold and Alison Lewis.
50 At this time, the WRC's Chief Director was Dr G.G. Cillie, himself a UCT AIC PhD graduate from 1957. Another notable alumnus of the WRC was Mr Greg Steenveld who returned to SA in the late 1980s and assumed a position as Research Manager.

Leading the charge to power South Africa

Professor Anton Eberhard
BSc(Eng) Chem, 1975

Like so many graduates who end up in adjacent fields, Anton Eberhard's career has followed a different trajectory to that of a traditional chemical engineer. Widely published with more than 100 peer-reviewed papers and six books under his belt, he's become an influential thought leader on South Africa's challenging energy sector.

I wanted to experience and **contribute towards a more direct connection** between technology, engineering, and **economic and social development**.

After graduating in 1975, his career started off conventionally enough with stints at AECI and then DB Thermal. But already in these early years he was thinking more broadly and took the very unconventional route of studying a BA before registering for a PhD at the University of Edinburgh.

"I wanted to experience and contribute towards a more direct connection between technology, engineering, and economic and social development. My research was on solar energy and rural development and I spent a year in a village in the middle of the mountains in Lesotho examining the efficacy of appropriate technology.

"Chemical engineering education teaches us to think in a certain way, initially around mass and energy balances and flows. It instils a discipline around thinking clearly and logically. And, although my subsequent career has involved economic, policy and political-economy disciplines, applied to the energy sector, I have a sound understanding of the underlying technology and engineering of power systems. The reverse is much harder for social science graduates."

Eberhard returned to South Africa in 1983 and was hired by the Energy Research Institute at UCT, later spearheading the creation of the Energy and Development Research Centre and a Master's Programme in Energy and Development.

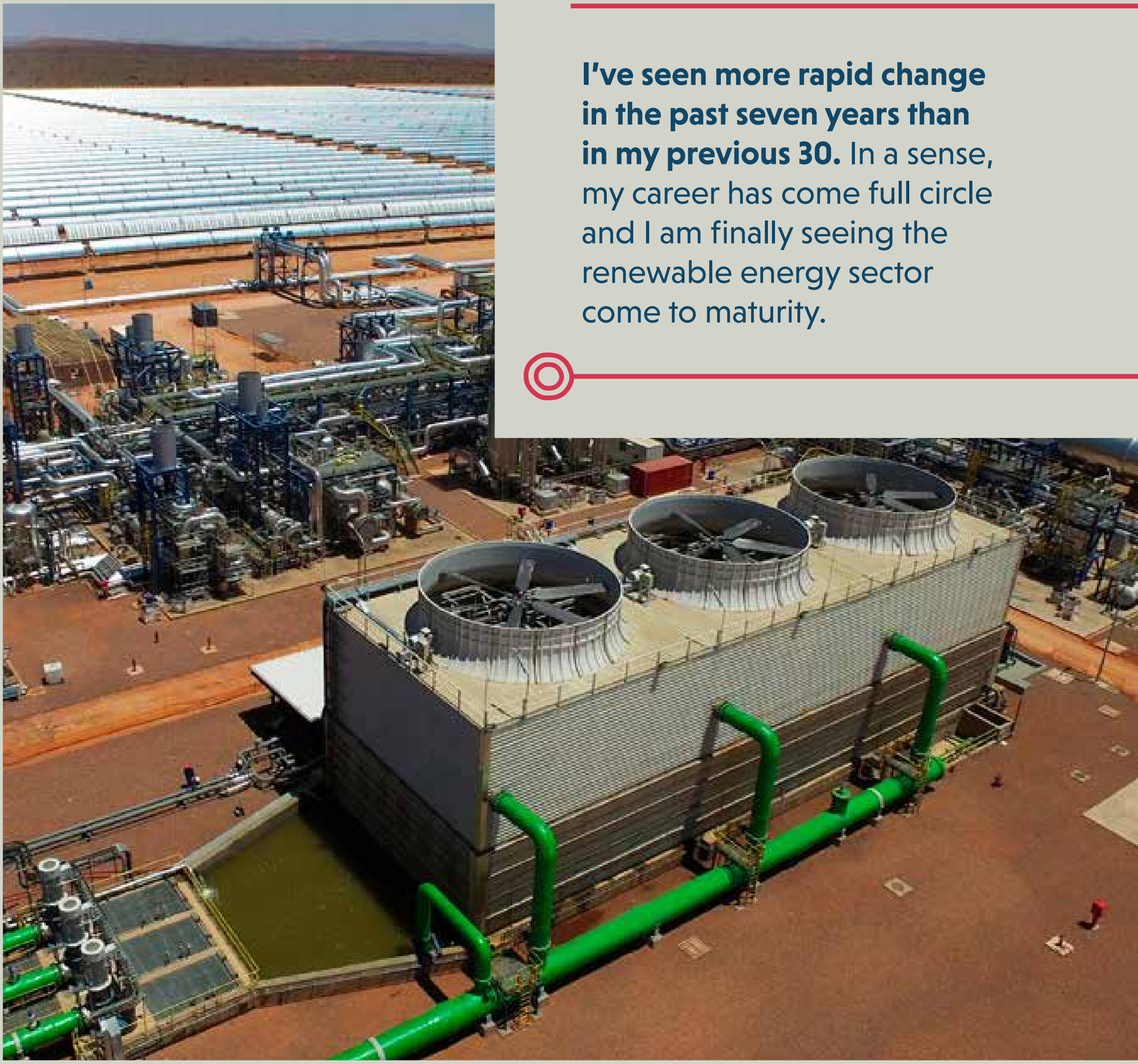
"Those were still the dark days of apartheid. I had been imprisoned, briefly, for refusing a military call-up. We had little prospect of influencing government policies and hence tried to make a difference at the local level by setting up a field station in Transkei, where staff and students undertook research projects."

All that was to change in the 1990s as the ANC rose to power. Eberhard saw the opportunity to work with the party to develop energy policies and programmes that would widen access to affordable energy. "We helped design a national electrification programme, which ended up being the most successful element of the Reconstruction and Development Programme (RDP). Access rates went up from around a third of households to 90% today. We also helped with regulatory reform and the development of government's Energy Policy White Paper."

This period of his career is remembered as an "incredibly exciting and fulfilling time". "We were able to attract a large number of talented, bright and committed young people into our Master's and research programme: most have stayed connected and many are now in leadership positions in the energy sector."

Eberhard joined the UCT Graduate School of Business in 2001 to focus on his own research and teaching. He has been a prolific writer and is frequently quoted as an expert opinion leader in the media. His influence has also extended into advisory work across the continent for governments, utilities, regulators, financial institutions and the private sector.

I've seen more rapid change in the past seven years than in my previous 30. In a sense, my career has come full circle and I am finally seeing the renewable energy sector come to maturity.



The 50 MWe Bokpoort CSP plant in the Northern Cape; image courtesy of Acwa Power, South Africa.

"I became a Foundation Member of the Academy of Science of South Africa and have also been honoured to serve on the Board of the National Electricity Regulator, the National Planning Commission, the Ministerial Advisory Council on Energy, the President's Eskom Sustainability Task Team and, more recently, the Global Commission to End Energy Poverty."

Currently Professor Emeritus with a Senior Scholar appointment, Eberhard is approaching retirement at a time of extraordinary innovation in the energy sector.

"I've seen more rapid change in the past seven years than in my previous 30. In a sense, my career has come full circle and I am finally seeing the renewable energy sector come to maturity. Renewable energy technologies are finally breaking through economically and are now the cheapest source of power generation. This trend has created new challenges in designing and managing power systems, as increasing shares of variable solar and wind energy technologies need to be complemented by flexible and ancillary resources including gas, pumped storage, utility-scale batteries and demand-side interventions."

Resilience in the face of prejudice

Hamied Mazema
BSc(Eng) Chem, 1975

We were resilient and single-mindedly focused on achieving our common objective of graduating, **despite the system that was designed to destroy our aspirations.**

When Hamied Mazema decided to study at UCT at the end of the 1960s, his application involved a lot more than the usual registration papers. As a "non-white" student he had to apply for a special permit to study at a "white" university. His racial designation would continue to shape much of his university experience – as it did every area of life under apartheid.

"The application had to have a sound motivation and the unwritten law of the permit was to be careful of one's associations, activities and of expounding one's political beliefs, because there were spies around and the Minister could revoke the permit without giving any reason."

These were dark days and demonstrations were often held on campus – sometimes with brutal consequences for those involved: "I witnessed demonstrations in which the notorious 'riot squad' entered and brutally assaulted students, even the women. Cliffy, one of the employees of the Department, was beaten unconscious and was helped by the late Greg Steenveld."

Unsurprisingly, Mazema and the other black students gravitated together to form a small, tight group, united in their shared sense of isolation: "It took long for us to integrate and feel a degree of acceptance."

The Group Areas Act also meant that Mazema was excluded from the privilege of staying in residence. He and others in the group had to lodge with local families instead. With so many obstacles to overcome, many took longer than the standard four years to graduate. "What was remarkable was that none of us dropped out: we were resilient and single-mindedly focused on achieving our common objective of graduating, despite the system that was designed to destroy our aspirations."

There were some tailwinds, too, and Mazema recalls a number of supportive faculty who made his journey that little bit easier, including Dr Geoff Hansford, who once during project time, when students often worked late in the Department, gave Mazema a lift home in his VW Kombi, and Dr John de Kock. "Dr de Kock had the biggest impact on my life because he was very sympathetic to us and often gave encouragement. He was the one who went the extra mile to find me a place for my third-year vacation training.

"When I qualified, it was again Dr de Kock who called AECI for employment for me. I was promptly summoned to an interview, for which I was not prepared. I went dressed in jeans, t-shirt and sandals. There were smiles around the enormous table as they interviewed me and no sooner did I reach home than I received a telephone call offering me a job, which opened the door to a most exciting and rewarding life experience.

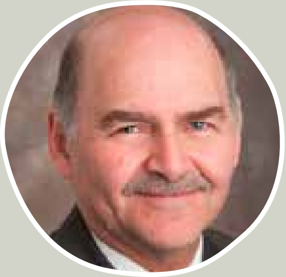
"Another interesting instructor was Mr Bettisworth who kindly took us for workshop practice during the first-year vacation because companies refused to accept us because of the 'job reservation' legislation."

Mazema is now the Western Cape Chairman of the South African Institution of Chemical Engineers (SAIChE) and has been involved with the organisation since 1984. The value of that professional membership stems from his UK work experience. He is keen to re-energise the value proposition of the membership of professional societies among young graduates. As well as consulting in sustainable development, covering energy efficiency, water, wastewater, solid waste and hazardous waste, he dedicates much of his time to mentoring young applicants, students and graduates at the University.

More than just a technical education

Professor Abraham M. Lenhoff

BSc(Eng) Chem, 1976



The beginning of Professor Abraham M. Lenhoff's impressive career can be traced back to a meeting with the influential Heinrich Buhr.

"My original academic plan was to do a BSc in applied maths, statistics or that general area. Cousins of mine told me I'd be bored taking just two courses, so I added more – one of those was Chemistry I. The lead instructor was Luigi Nassimbeni, who made chemistry not just interesting but also entertaining. Early in my first year this lit a fire that started me thinking about chemical engineering. A friend from Upington was doing his MSc in chemical engineering and I went to find out more from him. He took me to speak to Heinrich Buhr, and the deal was done."

Lenhoff admits he got more than just a technical education at UCT. He was to grow up in ways small town life had not prepared him for: "I arrived at UCT in 1973 eager to leave the limited academic, intellectual and social confines of Upington, but not particularly well-prepared for the journey.

"The undergraduate chemical engineering experience had both technical and sociological elements. On the technical side, the core topics were much the same as in other programmes anywhere in the world, but a few aspects stand out now with the perspective of a few decades of teaching. One is that we learned something about particle technology, which has disappeared from most curricula despite particulates representing about half of all products of the chemical industry."

What Lenhoff calls his "complementary education" came from living in residence: "It was over meals, in the common room and otherwise, that I began to see the much larger world in which I lived, whether it be in culture, literature, religion, sexual orientation, academic discipline and many others."

This social awakening cultivated a longstanding sensitivity in how Lenhoff, now based at the University of Delaware in the USA, has approached his own teaching career: "I consider it a privilege to interact with the 18- to 22-age range. This is the period during which self-conscious, peer-pressure-sensitive kids make most of their transition to being adults who have figured out who they are and who and what they want to be."

The subject matter Lenhoff explored as a UCT undergraduate also seeded his later research interests: "I first gleaned some sense of the research taking place in the department in a summer job with the water resources group. Ironically, I spent my time measuring ion-exchange equilibria, which in a different context have occupied a fair fraction of my independent research career. Water treatment was of great local importance, as everyone in the Western Cape was to discover dramatically nearly half a century later!

It was over meals, in the common room and otherwise, that **I began to see the much larger world in which I lived**, whether it be in culture, literature, religion, sexual orientation, academic discipline and many others.

"An internship at AECI at the end of my third year and then my final-year project took things much deeper. I also arranged a part-time project on water treatment with Heinrich Buhr while I was doing my military service.

"These collective experiences, with a recurring theme of water treatment, left me with two take-home messages: societal benefit as a principal driver of research in South Africa, and biological processing as a scientifically-interesting topic – and one on which I've spent much of my career."

A hard-working daredevil

Dr Francois du Plessis
BSc(Eng) Chem, 1979

Health and safety regulations and campus rules would never allow it these days, but, back in the 1970s, tobogganing head-first down the 75 granite steps of Jameson Hall – now Sarah Baartman Hall – was an annual tradition. Francois du Plessis was one of the daredevils who completed the feat all four years he was a UCT student.

The Department instilled in me the confidence that **any problem, no matter how complex or insurmountable, is able to be broken down into its component parts and solved**. And that applies to problems with managing people, project management issues, financial problems and organisational problems.

Thankfully, he graduated in 1979 with his body intact and a Chemical Engineering degree in hand. Like many of his era, he'd only spend a short time working in the field in South Africa, with SA Nylon Spinners and Tongaat Hullett, before returning to UCT to complete an MBA. He went on to do a PhD in Finance at the University of Georgia in the USA, working in the financial services industry, eventually starting a renewable energy company and becoming the first CEO of Green Cape, a not-for-profit entity established to promote investment in South Africa's green economy.

"At the time that I graduated, I, like many of my contemporaries, wondered at the value of our four-year degree as it appeared to us that we were only qualified to design oil refineries, and not much of that was taking place in South Africa at the time. But in my career since then I have on many occasions had the opportunity to not only appreciate the skills that I acquired from Chemical Engineering, but also to appreciate those that I had not and needed to work on.

"The Department instilled in me the confidence that any problem, no matter how complex or insurmountable, is able to be broken down into its component parts and solved. And that applies to problems with managing people, project management issues, financial problems and organisational problems."

The memories and antics of campus life have endured, too, and du Plessis still remembers starting an exciting chapter of his young life – and friendships formed during first year.

"I arrived by train in Cape Town in February 1976 to begin my university life at Driekoppen residence. There were four of us at Driekoppen who started Chemical Engineering that year: Michael Bergh, David Walwyn, Phil Morkel and I. Phil was the quiet, gentle giant and is still working in the field, in Canada. David, who is brighter than the rest of us put together, went on to do a PhD in Organic Chemistry at Cambridge and is a Professor at the University of Pretoria. Mike – the joker among us – went on to do a PhD in Applied Maths at UCT, taught at UCT, and now has his own business doing data analysis. We were a varied group."

Despite the four having a lot of fun, there was a definite sense among the Chemical Engineering students that they were being worked harder than those from other disciplines.

"My abiding memory of third year was that I was being cheated. All the Chemistry majors we were doing chemistry with had one or two courses and we still had practicals four days a week and a full lecture load of four full-time courses. When the weather was good, the science students used to disappear to the beach, and we would be stuck listening to Heinrich Buhr, Geoff Hansford, Cyril O'Connor, Duncan Fraser and Brian Paddon drilling reactor design and more energy and mass balances into us."

During the annual UCT Rag, toboggan races were held down the 75 granite steps of the Jameson Hall. This daredevil was captured in 1977. (photo Cape Argus)

Making the choice for global sustainability

Professor David Walwyn
BSc(Eng) Chem, 1979

What I learnt at UCT was foundational in how my life subsequently unfolded. Out of **many capabilities acquired through chemical engineering**, the three most useful to me have been the **paradigm of the heuristic,** the **power of deterministic modelling** and the **challenges of sustainability transitions**.

How does a chemical engineer, turned life scientist, turned academic contribute to the debate on sustainability transitions? These are the kinds of questions Professor David Walwyn finds himself interrogating nowadays at the Graduate School of Technology Management at the University of Pretoria.

"What I learnt at UCT was foundational in how my life subsequently unfolded. Out of many capabilities acquired through chemical engineering, the three most useful to me have been the paradigm of the heuristic, the power of deterministic modelling and the challenges of sustainability transitions."

What Walwyn has learned since those undergraduate years – as many chemical engineers tend to learn at some point – is the limitation of theory and tools like algebra and calculus when it comes to the social sciences and humanities.

"Human behaviour is mostly context-specific, unpredictable, irrational, inconsistent and chaotic – attributes which don't do well in deterministic models and require alternative analytical approaches, such as the methodologies which derive from doctrines of relativism and critical realism.

"The study of sustainability transitions, which is the third legacy of my UCT chemical engineering experience, cannot be undertaken with a positivist framework since it mostly relates to power, politics and behaviour."

"In 1979, when I worked for Geoff Hansford on bioethanol, the field didn't really exist in a formal sense although there was already some discussion about the need to find an alternative to fossil fuels. The experience of the bioethanol project persuaded me that it was not possible for me to live a values-based existence in the oil and gas industry, although I would be the last to judge the decisions of other people in this regard. Recent events, however, have upheld the choices that a few people made 40 years ago. Scarcely a day goes past without not just one, but tens of news stories about decarbonisation or renewable energy or global warming."

What does Walwyn think this means in a country like South Africa, with the second highest emissions of carbon dioxide per unit of GDP in the world, and for chemical engineers of the future?

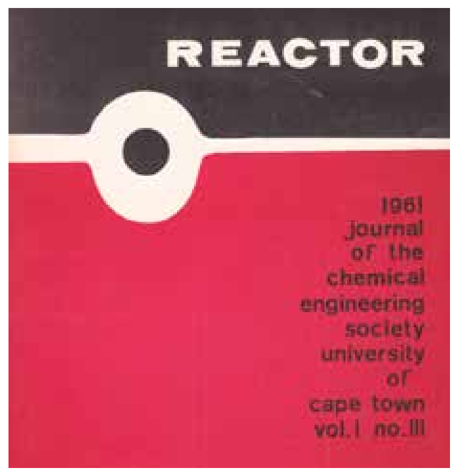
"We are a country most in need of change but least able to make this change," he says. "We have a huge decarbonisation burden and limited resources with which to achieve this imperative. I challenge all present graduates to take this up. You will be required to make decisions that have long-term implications for global sustainability; use your knowledge and privilege to make the right ones!"

A Department with a sense of humour

The 1970s brought additional academic staff into the Department who would play a significant role in its ongoing evolution. New additions to the lecturing staff included Gerhard Hoppe and Trevor Giddey (both of whom were completing postgraduate degrees in parallel) and Duncan Fraser and Cyril O'Connor (both of whom joined in 1979).

The Department's growing "team spirit" was also building steam thanks to several student-led initiatives. The Chemical Engineering Student Society was at the forefront of these in the 1960s. As a group, it organised plant visits, industry talks and social events, provided feedback on sector growth and employment opportunities, and published a quarterly review, *Reactor*, featuring many humorous anecdotes about staff and students alike.

While the Chemical Engineering Student Society was discontinued in the mid-1970s,[51] some of its social practices exist to this day. Notable among these are informal occasions for staff and students to mingle outside the classroom (often on a Friday afternoon) over drinks and snacks. These events were called "smokers" back in the 1960s and 70s – a term that endured right up to the 1990s.[52] These occasions helped reinforce the idea of the Department being a fun place to work, its academics not without a good sense of humour.



The Chemical Engineering quarterly review featured many humorous anecdotes of staff and students alike.

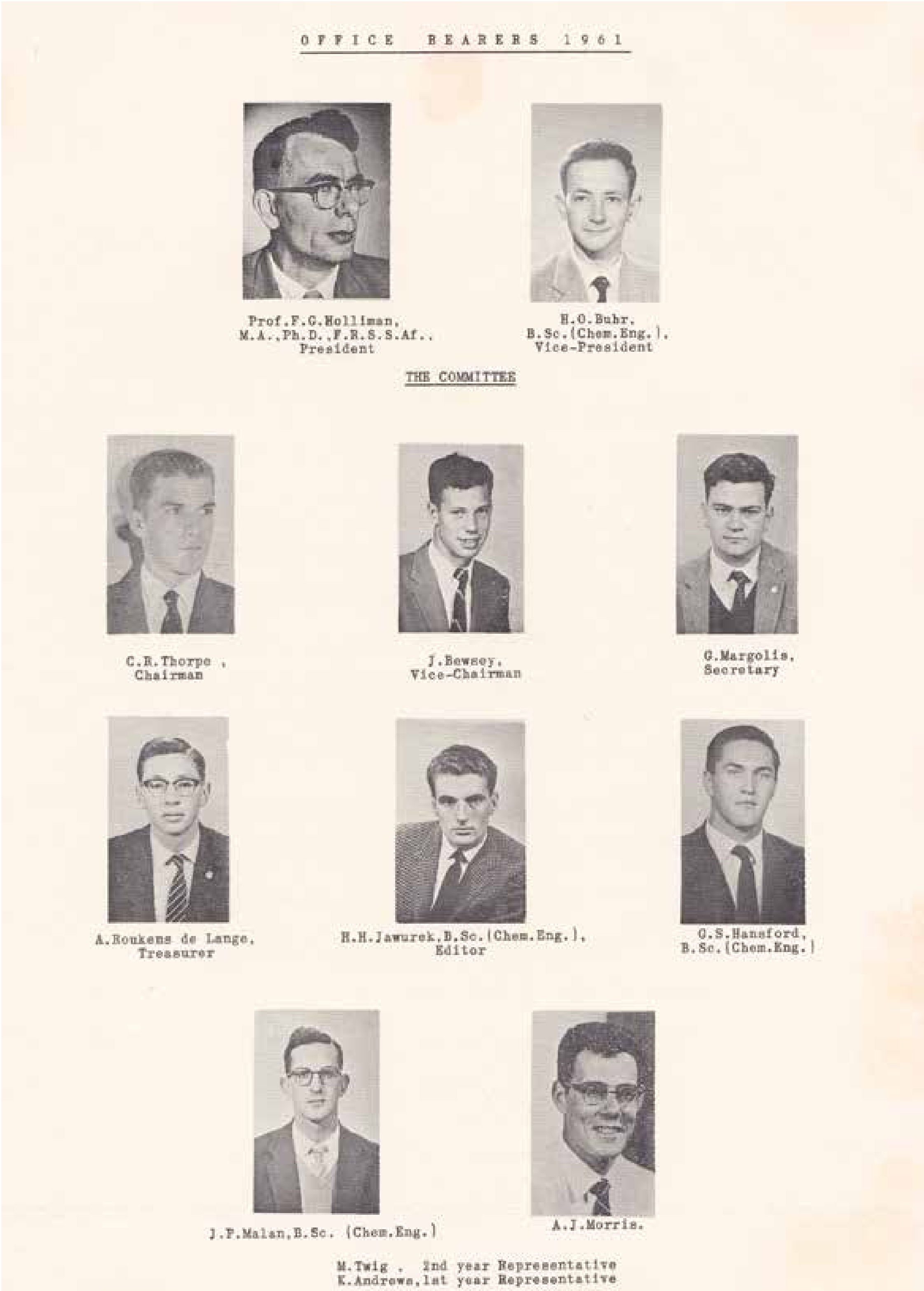
Christopher Swartz, who was a student in the late 1970s and later a member of faculty recalls, "The Chemical Engineering Department was a very social one, helped, I believe, by the relatively small cohort of students. There was a level of camaraderie that seemed to be etched into the Department's DNA. I regularly attended the chemical engineering smokers, which were an excellent opportunity to engage with classmates, lecturers and students in upper and lower years". These social occasions provided many markers in sustaining departmental culture over the years.

There was a level of **camaraderie** which seemed to be etched into the Department's DNA.

As UCT Chemical Engineering prepared for the 1980s – with new academic staff, growing student numbers and an invigorated sense of purpose – its emergence over the preceding two decades had been shaped by strong personalities, a keen commitment to the value of scholarship and a new building from which could emerge a vibrant graduate population, while the political climate outside the university became increasingly constrictive. The coming two decades would see it use all of these factors to its advantage, while riding the wave of political transformation that was about to break in the country.

51 Many of the formal activities of the Chemical Engineering Society focused on industry were absorbed within the teaching programme of the Department in later years.

52 The etymology of which means "a social gathering of men" and reinforces the gross gender imbalance which persisted across all engineering disciplines for way too long.



OFFICE BEARERS 1961

Prof.F.G.Holliman,
M.A.,Ph.D.,F.R.S.S.Af.,
President

H.O.Buhr,
B.Sc.(Chem.Eng.),
Vice-President

THE COMMITTEE

C.R.Thorpe ,
Chairman

J.Bewsey,
Vice-Chairman

G.Margolis,
Secretary

A.Roukens de Lange,
Treasurer

H.H.Jawurek,B.Sc.(Chem.Eng.),
Editor

G.S.Hansford,
B.Sc.(Chem.Eng.)

J.P.Malan,B.Sc. (Chem.Eng.)

A.J.Morris.

M.Twig , 2nd year Representative
K.Andrews,1st year Representative

The Chemical Engineering Society in the 1960s and 1970s enjoyed a broad mandate to connect students to the profession, but also to promote social interaction amongst staff and students. This photo of the Committee from 1961 includes many familiar faces whose contributions are documented in this book. Fred Holliman, as President of the Society, was the Chair of Organic Chemistry at UCT, which retained administrative oversight of Chemical Engineering until 1965.

POSTGRADUATES AND STAFF – 1974
Back row: E. Mills, W.W. Thomas, G.N. Steenveld, S.B. Miller, D.M. Fraser, G.S. Hansford, B.D.A. Paddon, R.N.D. Price
Standing: J.M.T. Greensmith, N.P. Harris, T.R Curr, J.P. Franzidis, R.C. O'Donnell, V. Rudolph
Seated: E. Roberts, Dr J.W. de Kock, S. van den Linden, A.D. Carr, E. Barton, P.F. Basic, M.P. Coetzee
In front: V.E. Jacobson, C.D. Levy

Student antics in the 60s and 70s were often led by activities sponsored by student residences. This photo, from 1976, captures a tradition of Driekoppen/"Belsen" residence, which encouraged students to run repeatedly up and down to Rhodes Memorial, imbibing much beer along the way. Two of these five are chemical engineers who went on to attain PhDs and who, in 2020, continue to make meaningful contributions in response to South Africa's development challenges – their names are embargoed to protect the innocent!

Hitting the high notes in engineering and beyond

Gavin Fraser
BSc(Eng) Chem 1980

Gavin Fraser says that the best thing about studying chemical engineering was the incredibly bright and interesting people in the class and the tough but humour-filled faculty. "We built very close relationships and a space to share many other interests from politics to sport, music, film, theatre and even opera." Nurturing these interests would see him go on to be not only a successful engineer – but also an opera singer, music conductor and the author of books on the history of art and a work of non-fiction called *The Moral Stress of Nations*, which reached single digits on the hot new seller lists in many categories on Amazon in September 2020.

Not surprisingly, he has many stories to tell from an interesting career spanning several decades. One such anecdote comes from his time as a young engineer, working at the Caltex Head Office while also studying a Bachelor of Musicology through UNISA part-time. He was part of a *Turandot* opera production at the Artscape and had to crawl across the stage as a Chinese peasant. At one point he faced the audience, "I was surprised to see many of the Caltex executives and their wives in the third row, looking up at me – in full colourful make-up and a fake beard – singing at the top of my lungs in the opening scene!"

> We built **very close relationships** and a space to share many other interests from politics to sport, music, film, theatre and even opera.

Highlights of his professional career include being head-hunted to Deloitte's newly formed strategy practice in Johannesburg in 1988, following his completion of an MBA, and being appointed the team leader for Gemini's analysis of Sasol's Secunda operations to develop their transformation plans. He performed similar work for major oil companies' upstream and downstream operations in the North Sea. He later joined Accenture as a partner.

Some of his best-known work was done with world-renowned professors W. Chan Kim and Renée Mauborgne – rated the world's most influential business thinkers in 2019. They convinced Fraser to become co-lead developer of the practical innovation process that was to become Blue Ocean Strategy (then Value Innovation) in 2001. For 20 years, Fraser has worked with clients globally to create innovative new products and services using the Blue Ocean Strategy tools – such as the Kimberly Clark Brazil's 'Compacto' high quality/low cost toilet paper, which has won many international green product awards.

The seeds of this innovative thinking were sown many years earlier, while studying at UCT, he claims. "The combination of working with what you can see and what you know is there, but cannot see, but measure somehow, and then modelling this, has been an incredible asset. Chemical Engineering gifted me this structured and multi-dimensional thinking where no problem seems as difficult as a heat and mass balance on one of Professor Hansford's tricky distillation column puzzles!

"Chemical engineering is a unique discipline because it combines abstract concepts, such as dimensionless numbers, with empirical reasoning and exact science in a way that requires detailed knowledge of both the proverbial forest and some very exotic trees. Intellectually, there is nothing else that even comes close to it."

Reimagining the role of chemical engineers to serve all sectors of society

Professor Susan A. Baldwin
BSc(Eng) Chem, 1980

Susan Baldwin had "never heard of engineering" when she arrived at UCT in 1977, but when she discovered it was "about using science and mathematics to make things", she determinedly transferred into Chemical Engineering. Three decades on, she is now a professor in Chemical and Biological Engineering at the University of British Columbia in Vancouver. Her early interest in "making things" has evolved into a passion for fixing things – specifically, the negative impact of industry on the environment.

"I enjoyed Chemical Engineering at UCT since it was broad and enabled me to take quite a few courses on diverse topics outside of the core curriculum, such as oceanography and ecology. These happen to be part of my current research today. I very much felt that I belonged to a community and was a trailblazer by being one of the few female engineering students at that time."

After graduating, Baldwin was disappointed by her time in South African industry, when she first started experiencing "the career impediments related to the then novel and not fully accepted notion of female engineers".

"I also missed the intellectual challenge and fellowship of academics. Serendipitously, I joined the Energy Research Institute (ERI) at UCT in 1984 and again joined a group of intelligent and interesting researchers. Being at the ERI opened the door to interdisciplinary collaborations and diversified the types of applications that chemical engineers can be involved in, which was important for me since I was motivated by helping people and the environment rather than corporate profits."

Baldwin would leave the ERI with a Master's in Engineering and the confidence to embark on an academic career in Canada, first pursuing a PhD at McGill University. She sees a new role for chemical engineers in meeting the sustainability challenges of our times – and an appetite in today's students for doing so.

I learned to **trust my own intuition** and **follow my own goals**. Perhaps this was fostered early on in the freedom that I experienced at UCT.

"In my career, I embraced the incorporation of biology and mathematics into chemical engineering. And if there was some resistance from the community to ideas outside the convention of chemical engineering, it wasn't long before the sceptics were proven short-sighted. I learned to trust my own intuition and follow my own goals. Perhaps this was fostered early on in the freedom that I experienced at UCT."

Baldwin thinks that chemical engineers are well positioned to create the new economy in which environmental sustainability and social responsibility outweigh corporate gain. "Resource depletion and waste are being addressed using fundamental chemical engineering principles. It is very clear from today's student body that the new generation of chemical engineers wants to be involved in an economy that benefits society without the many deleterious impacts of past practices such as polluted water, climate change and ecosystem destruction," she says.

"Curricula are being changed to incorporate concepts of systems thinking, sustainability, ecology and life cycle assessment. Diversity, equity and inclusion are also now key principles to guide present and future education to ensure that chemical engineers serve all sectors of society."

Making chemical engineering societally and industrially relevant

Professor Christopher Swartz
BSc(Eng) Chem, 1981 ; Academic staff member, 1989 – 2000

Professor Chris Swartz has been a mainstay of McMaster University's Chemical Engineering Department in Canada for the past 20 years and he has enjoyed a long international academic career.

"I began my undergraduate studies in 1978 after matriculating from Athlone High School. At that time Chemical Engineering was reputed to be the most difficult programme at UCT. I saw this as a challenge, rather than a deterrent. I worked like a demon in high school and was prepared to do the same at university."

A move to the University of Wisconsin after graduation to complete his PhD with Warren Stewart would offer an interesting comparison point to the quality of education he received at UCT. Even now, he sees key differences in his present-day students to those of his era.

> The **camaraderie** and **student focus** that I experienced as an undergraduate student were again apparent as a faculty member.

One of the biggest differences Swartz noticed upon leaving UCT for the USA was not academic in nature. "Student politics thrived at UCT, with lecture rooms packed for SRC election speeches. This was perhaps one of the starkest contrasts I encountered when I arrived at University of Wisconsin – the almost total absence of student political activity."

When Swartz returned to the Department as a senior lecturer in 1989, the differences would be apparent once again. He recalls this as "an exciting time of transition and growth" in the University and in the Department.

"The years during my absence saw a significant change in the student demographic, from a small minority of persons of colour when I graduated, to around 50% when I returned. There were well-established research groups in the areas of catalysis, minerals processing and bioprocessing. And there was also a strong focus on pedagogy and the development of structures, programmes and strategies to enhance academic success.

"The camaraderie and student focus that I experienced as an undergraduate student were again apparent as a faculty member. The department had an annual 'bosberaad' (much more descriptive than 'departmental retreat' used in my present institution!), always followed by a social get-together. The culture of cooperation, collegiality and common purpose played a large part, in my view, in the Department's success."

The Department's ties with industry would also have a big influence on Swartz's later academic outlook: "One of the Department's hallmarks has been its strong connection with industry. This resulted in industrially-relevant research and graduates well prepared for industrial employment. Academic-industrial collaboration is something I continue to value and underpins my involvement in the McMaster Advanced Control Consortium and the McMaster Steel Research Centre – the former which I have led for the past 12 years."

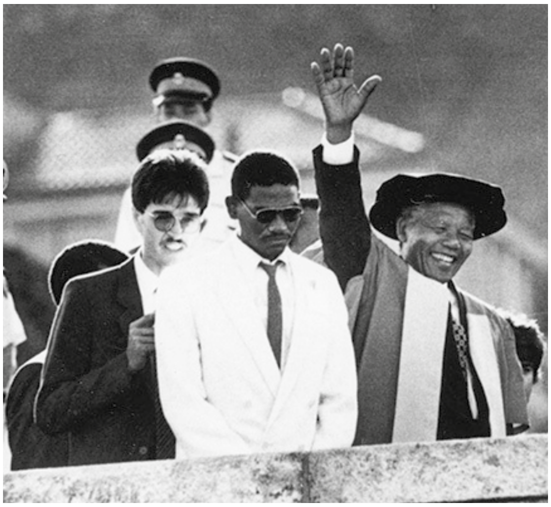
A keen interest in making chemical engineering societally and industrially relevant runs through Swartz's current academic work and he believes the same can continue to be true for the Department.

"The world is facing unprecedented challenges that include environmental sustainability, agriculture, energy, water and health. Chemical engineering is more relevant than ever for addressing these challenges. The Department is well positioned to address these challenges through continued excellence in education and research."

4 EXPANSION

1980 – 2000

GROWTH, ACADEMIC DEVELOPMENT AND THE ADVENT OF DEMOCRACY



Nelson Mandela photographed at UCT in 1990 after receiving an honorary doctorate.

In the space of just a few years (1977 – 1981), Chemical Engineering at UCT went through a change of guard: Donald Carr moved from the Department onto the University's Executive, Heinrich Buhr relocated to the USA to explore his industry links, Sydney Miller emigrated to Israel to pursue a long-serving career in water research and technology development, and John de Kock left to take up the position of the first Professor for Extractive Metallurgy at the University of Stellenbosch. Shortly thereafter, Dr Stuart Saunders was confirmed as the University's Vice-Chancellor, a role he occupied for 15 years, during a tumultuous period that would lead the country to democracy.[53]

1979

Duncan Fraser and Cyril O'Connor join the Department, with Geoff Hansford as the incoming HOD.

The arrival of Duncan Fraser and Cyril O'Connor as new senior lecturers in 1979, with Geoff Hansford as the incoming HOD, heralded a new beginning for the Department. The next 20 years would see profound changes in its size and shape, along with significant research growth and increased global outreach, against a backdrop of international isolation in the 1980s. President P.W. Botha's infamous "Rubicon"[54] speech in 1985 further strained diplomatic relations between South Africa and the international community, entrenched the country's isolation and hardened the securocrats' response to growing clamour from universities for greater autonomy. The academic boycott, led in large part by the UK anti-apartheid movement, further complicated conversations around academic freedom and the opportunity for South African researchers to engage their international peers.

53 Saunders, S. (2000) "Vice-Chancellor on a Tightrope", David Philip Publishers, Cape Town.

54 Promoted as an opportunity for South Africa to announce a move away from its apartheid legacy, unban opposition political parties, "free Nelson Mandela", and transition to a democracy, it did none of those; and merely served to underscore the hardline and autocratic views of the South African government of the day.

At the same time, major changes in the shape of the SA chemical industry were underway. Sasol's ascendency in terms of security of liquid fuels supply was only part of that. This period saw the opening up of international energy contracts post 1994, allowing South Africa greater flexibility in sourcing crude oil reserves and commenced a period of greater direct interest from international oil companies in oil and gas prospecting, both on- and off-shore.

Hansford brought many ideas to his role as incoming HOD that had their grounding in his own doctoral study years at the University of Pennsylvania. Apart from establishing a subsequent vibrant research programme in bio-engineering, principal among these were a commitment to research scholarship, a deep appreciation of the role of computing in both teaching and research, and the need to engage industry and government stakeholders in helping to shape the Department's focus.

FINAL YEAR 1980
Back Row: R. Williams, B.C. Adams, R.E. Fasol, P.M. Salmon, S.C. Britz, R. Gerner, B.R. Erlank, A. van Zyl, L. Flach, S.Kherekar
Standing: D. Williams, M. Williams, J. Daniels, G.D.H. Shaw, A.J. Gregory, D.G. McIntyre, A.E. Carr, M.H.S. Berman, J.C.Q. Fletcher, E.W. Randall, H. Sebastian, W. Jacobs
Seated: A. Molnar, D.A. Hill, B.D.A. Paddon, M. Vogel, H.O. Buhr, S.A Baldwin, G.S. Hansford, A.J. Feltenstein, D.M. Fraser, G.P. Fraser, M. Carstens

The digital age dawns in the Department

Bill Randall
Principal Scientific Officer,
Chemical Engineering, 1974 – 2015

In 1974, when Bill Randall joined the Department, things looked a whole lot different than they do today – and not just the physical building or the size of the faculty. The computer age was yet to take off and change the field forever.

"When I look back on it, the lab and computing facilities we had at that time were very rudimentary," says Randall.

It's hard for today's staff and faculty to imagine working with such basic technology, let alone achieving much of value with it. But achieve they did. As Technical Officer, Randall resurrected the Department's electronics workshop and would develop a number of novel instruments during the next 40 years.

When I look back on it, the lab and **computing facilities we had** at that time were **very rudimentary**.

The first instrument was a Dissolved Oxygen Rate Meter for wastewater applications – it was also the first system Randall and his colleagues built using a microprocessor. "It eventually dawned on us that we could sell some of these instruments and some funding slowly started coming in."

The next project that brought in money was a Bubble Size Analyser. It would go on to find success in the mining industry – but it didn't start well. The instrument was based on an original concept developed by Dr Peter Harris at MINTEK and Randall was asked to take a look at it to see if he could "get it going".

"After careful inspection, I decided to power it up. Smoke came out of the cabinet! I had another look and did not like the look of what I saw, so we decided to build another one. Over the years several improvements were made, and we had a reliable instrument used in many minerals processing research projects. The data was published in papers and conferences and the enquiries started rolling in. The team built and sold about 40 of these devices to the mining industry, funding the work of the Electronics Workshop."

Randall's work on a tomography imaging instrument would take him to eight international conferences in the latter years of his UCT career, with the 2012 meeting in Beijing proving particularly memorable.

"The final day of the conference ended with an amazingly elaborate banquet and at the end of the evening I was summoned to the head table and asked if we could have the next meeting in Cape Town. Well, what could I say? Little did I know what I was letting myself in for. Looking for a venue, preparing budgets and replying to hundreds of emails. But, in the end, a very successful meeting was held a year later at the Breakwater Lodge at the Waterfront."

Randall had to endure the upheaval of no less than two building moves during his 41-year career. The department he left in 2015 was very different to the one he joined in 1974, but many of the friendships he formed during that time remain with him: "I was lucky to find a job that I enjoyed, and I still keep in touch with many of the friends I made, wherever they are around the world."

Tapping into the guidance of key stakeholders

In a first for the Faculty of Engineering, one of Hansford's early moves was to establish an industrial Advisory Board in the early 1980s on the recommendation of UCT's Academic Planning Committee. Members of that first Board included Kim Atmore (Anglo American), Colin Schlesinger (AECI, who later went to Chevron in the US), Philip Lloyd (Chamber of Mines), Jan Hoogendoorn (one of the founding fathers of Sasol), and Johann Lubbe (Caltex). Both Lubbe and Lloyd were Department alumni.

The Advisory Board tapped the Department into industry and also provided a meaningful connection to global professional bodies such as IChemE and AIChE to help shape the evolving undergraduate programme, oversee degree accreditation and ensure alignment with industry needs and professional practice topics.[55] For example, in the short period since the Flixborough disaster in the UK, topics of hazard and risk management had become cornerstones of design and operation of chemical plants globally, while the pending start-up of Sasol's Secunda plants in 1983 further brought this into focus, and this needed to be reflected in the programme.[56]

"From the beginning," Anglo American representatives remark, "the Advisory Board was professionally managed with full participation encouraged from the industry representatives. Each subsequent Head of Department added more flair and creativity and it was always a pleasure to participate."

Down the years, the industry Advisory Board broadened in membership in order to become more representative of a fuller stakeholder base. In addition to supporting the Department in making sure its curriculum was up to date and aligned with global developments, the Advisory Board played a distinctive role in supporting the Department to develop a unique and impactful approach to engaging with an increasingly diverse student body, many of whom came from school and family backgrounds scarred by apartheid.

In many respects, it was the input from the Advisory Board that challenged the Department to commence its own Academic Development (AD) journey with a focus on crucial strategic orientation.

"Each subsequent Head of Department added **more flair and creativity** and it was always a pleasure to participate."

– Anglo American statement

IChemE programme accreditation team, 1993: Front row, representing IChemE, Mr Barry Schuffham (UK Industry), Professor Graham Davies (UMIST), and Professor Seddon Harrison (University of Stellenbosch); behind are Cyril O'Connor, Brian Paddon, J.P. Franzidis and Geoff Hansford.

55 Alignment was further consolidated in 1989 with the creation of the Washington Accord, which sought to produce a truly global accreditation oversight mechanism.

56 The North Sea Piper Alpha oil rig explosion in 1988 reinforced this need.

Engineering better solutions for a more sustainable future

Emilio Titus
BSc(Eng) Chem, 1985

"When people ask me today what my career is, I still say 'chemical engineer'," says Emilio Titus, even though he now runs HeartLinc, a consultancy that guides companies and organisations towards reframing business strategy and organisational effectiveness while embracing humanity and sustainability. It may seem a far cry from the world of engineering, but it really is only a bigger and more holistic approach to problem solving, the foundation of which was laid at UCT.

I found myself treated like **any other student and that really was key**, to my self-efficacy in how I evolved through the four years of study.

"Chem Eng taught me to understand the physical sciences while later on, in the human sciences, I learned about the dynamics of what governs the behaviour of people. What I had to come to terms with is realising that the physical sciences inform us that solids, liquids and gases behave in ways that are predictable, but this does not apply to how human beings show up!" This caused a shift in his understanding of the world and over the years shaped his professional focus to finding more holistic people-centred solutions through leadership development, behavioural economics, team dynamics, change management and building financial wealth practices.

Emilio grew up in Schauder township in Port Elizabeth in the tumultuous 1980s. He boycotted school for four months in his final school year to protest against the repressive apartheid Bantu education system and despite not performing to his true potential in his matric results, he was selected as one of the first beneficiaries of the Shell Scholarship Scheme, a post-matric initiative designed to groom high potential black students to study engineering at UCT.

While initially keen on electrical engineering, during his post-matric year as part of the Shell Scheme, he discovered a keen aptitude for chemistry and its application. With the guidance of his father, he was able to secure a place in the Chemical Engineering Department the following year. It was a move and opportunity he embraced, even though there would be plenty of hard work, exhaustion, and self-discovery along the way – with many a night of only two hours' sleep due to having to complete assignments or a hand-in for final year design.

His parents' teaching of never to carry an inferiority complex given the racial segregation at the time, laid the foundation for how well Emilio thrived at UCT, a predominantly white tertiary institution. Because of this and although the UCT Chem Eng environment was known to be tough, he says he never felt or was made to feel like a black scholarship student. "I found myself treated like any other student and that really was key, to my self-efficacy in how I evolved through the four years of study."

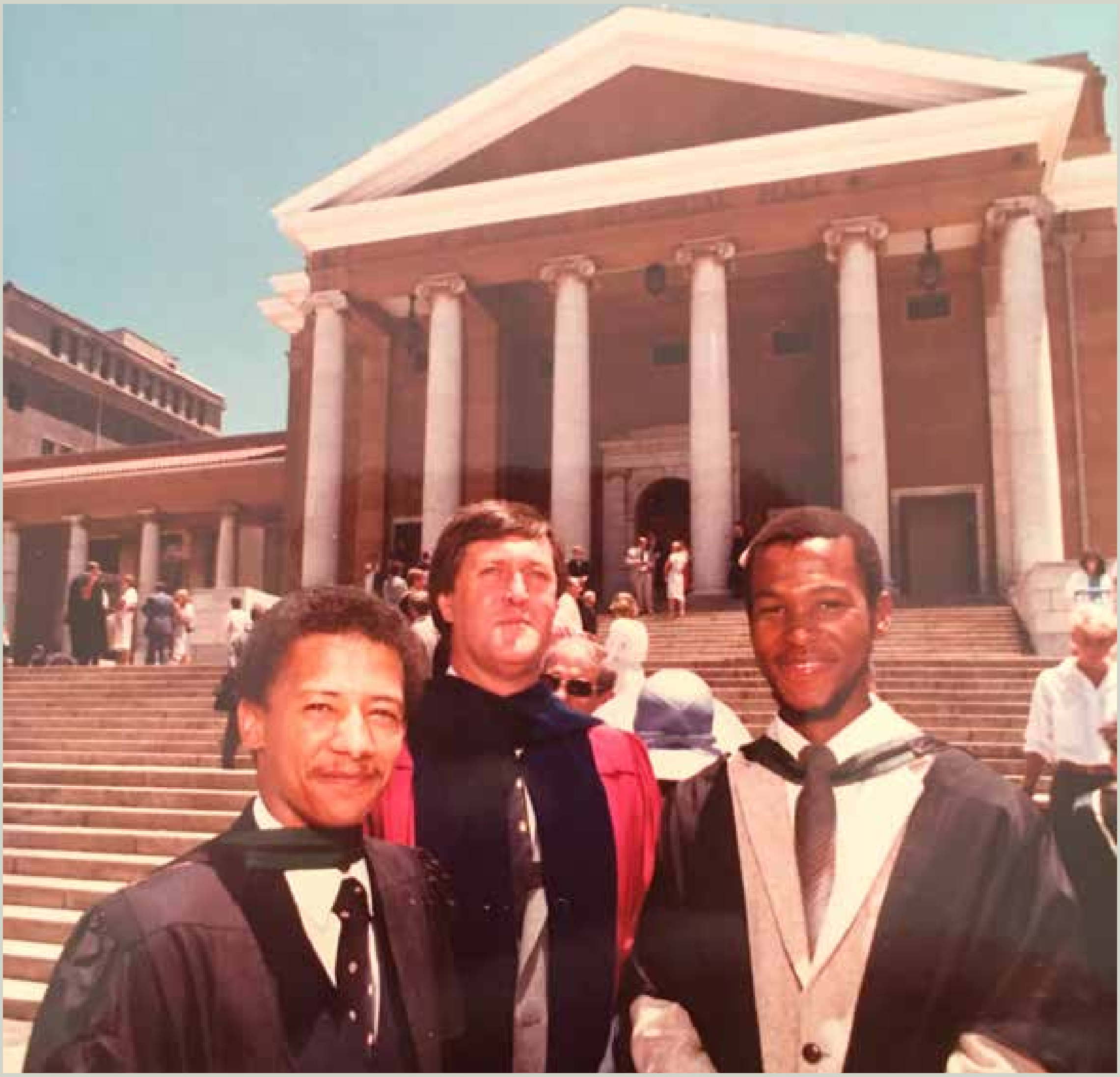
He was also fortunate he says in having strong support from his friends and family, and he drew strength from faculty members, too, especially those lecturers who naturally showed the human connectedness in how they engaged in lectures and one-to-one discussion. "Your learning is enhanced when you can see that the person you are learning from is also a human. It is the psychological safety of learning from someone who is, at their core, a human being."

After graduation he went to work at Shell, first as a process engineer, then as an oil trader and later as a strategy and business change consultant in London. His UCT degree, he says, also prepared him for the global stage by shaping his ability to adapt, bounce back and be more resilient. "As a young engineer, I travelled to The Hague and worked with international engineers quite early in my career and always felt on par with the technical challenges we were solving for in the design work we did. I felt UCT had put me on an equal footing with the most qualified professionals in the world, and later in my business engagements."

As the years passed, Emilio became more interested in the financial economics and investment side of the industry, especially the quest of capitalism and the conflict with sustainability. His concern for social justice, inequality and the environment grew and along with this came the psychological conviction that businesses and corporations need to invest more in the development of social capital and reframe the return on capital criteria.

This led to the co-founding of HeartLinc with his wife, which applies research-based insights into the governing dynamics of change and decision-making for individuals and teams. "One of the key universal questions we seek to answer is why people continue to make decisions which are not in their or others' best interest?"

He is convinced engineers of the future must also look at addressing our societal dilemmas and not just focusing on traditional innovation that leads to only profit motives. "In many instances, solutions can be found to satisfy more than one goal or objective – and benefit humanity for the greater good."



Emilio Titus (left) and Ephraim Msane celebrate their graduation on the steps of Jameson Hall with Geoff Hansford looking on. They were the first Shell-sponsored students to graduate from Chemical Engineering at UCT in 1985.

An invitation to lead change, not follow

Professor Jan Cilliers
Lecturer, 1990 – 1995; PhD, 1995

Professor Jan Cilliers holds a Chair in Minerals Processing at Imperial College London, but it was at UCT in the 1990s that his academic career began. Recognising his potential, the Department of Chemical Engineering snapped him up while he was working in industry and industrial research, before he'd started his PhD.

From the outside it is relaxed, casual even, but underlying this is **a core of competitiveness, and wanting to be the best.**

"For that opportunity, and the change of direction, I will always be grateful," says Cilliers. "Chemical Engineering at UCT was where I learnt how to be an academic, and how to complete a PhD. It is an excellent place for that; opportunities abound, and good work is rewarded."

After submitting his PhD in 1995, Cilliers left UCT for the University of Manchester Institute of Science and Technology. It would end up being a permanent move away from Cape Town, and the experience made a lasting impression on his academic career.

"The link between research and teaching cannot be overstated, and any department that separates the teachers and the researchers is doomed to fail, culturally and financially."

Cilliers has the international perspective and experience to know what excellence looks like in an academic setting, and he's kept close research ties with the Department through the years.

"When I look back at my collaborative publications with UCT, they all are based on the best data, collected using excellent techniques and equipment. What the collaboration achieved is more than just the data; the analysis, the modelling, the interpretation, all bring together what different teams do best. UCT Chemical Engineering plays to its strengths in academic collaborations.

"The Department also has a very particular culture. Anyone who has worked or studied there will recognise it. From the outside it is relaxed, casual even, but underlying this is a core of competitiveness, and wanting to be the best. The students are pushed hard; an MSc from UCT is all but a PhD anywhere else. Undergraduate projects are often publishable or conference-worthy. It carries through into graduate careers.

"The laboratories are the first thing any visitor to UCT Chemical Engineering notices. They are big, full of activity and with great equipment. Facilities like these make a difference – you can do work that others cannot.

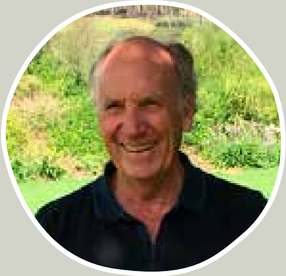
"UCT has been really good at creating its own, specialised equipment. Few places can match that. I cannot think of another university where I would be able to develop not only a low-cost, fast ERT system, and do image analysis of flowing froths, but also establish a Positron Emission Particle Tracking laboratory. These have been used by researchers and industry worldwide."

Cilliers also has views on how the Department can remain relevant in an ever-changing world of scarcer resources and heightened environmental concern.

"Will the Department lead the change? Or follow quickly? I would like to believe that the birthplace of my career will have the courage and confidence to lead. It will need to, if it is to survive the next century as well as it has its first."

Environment and sustainability champion

Dr John Raimondo
Founding Director, Environmental Evaluation Unit, UCT and adjunct member of faculty in Chemical Engineering.



The Department recently said a sad goodbye to long-time friend and collaborator, Dr John Raimondo, who passed away in July 2020.

A chemical engineer himself, as Founding Director of UCT's Environmental Evaluation Unit (EEU), Dr Raimondo built close ties with the Department through the years beginning in the early 1990s – even becoming a part-time faculty member as an adjunct professor in the early 2000s.

Founded in the mid-1980s and housed within the Department of Environmental and Geographical Science, the EEU is an internationally recognised research and practice unit and leading organisation in the field of sustainability and environmental governance. Before Dr Raimondo's passing, he shared memories of the fruitful collaboration with the Department during the 1990s and 2000s.

"The EEU started undertaking Environmental Impact Assessments (EIAs) before they became a legal requirement. These were designed to predict the ecological and social impacts associated with specific projects, such as roads, power and pipelines, factories, mining and so on."

"They were both multi- and interdisciplinary in nature and so we were required to seek outside experts to assist us with identifying these impacts. We also needed rating systems to determine the magnitude, spatial extent and duration of an impact during the construction, operation and decommissioning phases of the development. Our collaboration with the Department of Chemical Engineering was most helpful in this regard.

"The Department's research prominence in the field of life cycle assessment and related systems tools for environmental design and management were particularly helpful. We used them for a wide variety of chemicals and minerals projects, as we together sought ways to eliminate or mitigate negative impacts."

The Department's research prominence in the field of life cycle assessment and related systems tools for environmental design and management were particularly helpful.

Some of these case studies would find their way into new Chemical Engineering research projects, enriching perspectives both within the Department and the EEU.

"What I found most rewarding was not just the increased understanding of the issues associated with the project, but especially the new insights gained via these collaborative efforts. We had meetings between ecologists, chemical engineers, sociologists and others, which would yield new information because they would each be viewing the issue from a different perspective. The questions asked and information volunteered led to new issues and solutions. Our clients enjoyed these interactions, too, as sometimes new design options were suggested, which resulted in an improved project with lower impact and costs."

As Adjunct Professor, Dr Raimondo worked with research students and assisted with undergraduate teaching in the Department.

An ambitious programme for inclusive education

The North Lane Building continued to serve as a home for Chemical Engineering until 2003.

1982

The first Shell-sponsored students enrol in Chemical Engineering.

In the 1970s and 1980s, school boycotts and protests against "Bantu education" with the declared aim of "liberation before education" were increasing in intensity. In this tense atmosphere, international pressure for sanctions in the early 1980s was ramping up, leading several major multinational companies to depart South Africa. Those that remained responded by "upping" their commitment to reducing inequality in tertiary education. Shell and Anglo American were foremost in their efforts, and their actions had an immediate impact on UCT Chemical Engineering.

In 1981, Shell sponsored a post-matric initiative at UCT, which identified black high school graduates who had expressed an interest in engineering and demonstrated potential in maths and science. This paved the way for the first black African students to enter the Department. The following year, the first cohort of students enrolled at UCT with the first graduates in 1985 and 1987 being Ephraim Msane and Emilio Titus (1985); and Themba Joseph, Sisa Mtwa and Sijadu Ndizana (1987).

Following the Shell Scheme, UCT set about establishing foundation programmes that offered students from disadvantaged school backgrounds a different route of access into the University, one that used an additional year to build in any necessary academic support. ASPECT (Academic Support Programme in Engineering at Cape Town) was supported initially by Anglo American, but with other companies joining in due course. While the Department of Chemical Engineering enrolled many students in the ASPECT programme, it also established its own in-house activities to support students. This was groundbreaking because it opened the door to universities exploring different routes to greater inclusivity and created a space that traditional foundation programmes had not occupied before.

Despite these initiatives, one of the major obstacles to increasing the number of black African students at UCT – particularly those from outside of Cape Town – was the inability, by law, to accommodate "non-white" students in residence. Matters came to a head in 1985/86 when Donald Carr, acting Vice-Chancellor in Stuart Saunders' absence, pushed successfully for government to overturn the exclusion policy on student acceptance to residence. Anglo American, along with other sponsors, then came to UCT's assistance by funding the procurement of Liesbeeck Gardens as a new hall of residence. In that last decade of the apartheid government, the opening of student residences was a significant act leading to increased participation by black African, coloured and Indian/Asian students in erstwhile "white" universities.

That same year, in response to a document tabled by Duncan Fraser, the Advisory Board noted that, while the Department was enrolling increasing numbers of black African students, there was concern over their success rates. The industrial advisors argued that the Department had it within its powers to do something to advance not only the academic success of these students, but also their social inclusion, stating that: "Members of the Board agreed that the universities should also endeavour to ensure that black students mixed as much as possible at all levels with their white peers".

This powerful challenge set the Department on a course that directed much of its undergraduate work over this period and saw it sourcing industry funds to support undergraduate students from disadvantaged backgrounds. Fraser was central in these endeavours. A period of study and research leave at Imperial College in the mid-1980s had honed his interests in process systems engineering and the burgeoning research field of pinch analysis for heat and mass exchange networks. But he also brought back to UCT a keen interest in engineering education and the understanding that support was needed throughout the whole undergraduate programme.

Initial interventions were designed to support students and were low key. They focused on teaching methodology, broader mentorship through improved tutoring models, fostering community identity and student counselling. Nevertheless, these simple changes resulted in a notable improvement in the undergraduate pass rates within only three years. Fraser reported in 1993 that the use of collaborative study groups in a key second-year course had resulted in an overall increase of 28% in the course pass rate; for white students this was a 15% increase in the pass rate, and for black[57] students, this was 65%.[58]

28%

overall increase reported in 1993 **in the undergraduate pass rate** through the use of **collaborate study groups** in a key second-year course.

Professor Richard Felder, North Carolina State University, a global leader in chemical engineering education, and a strong supporter of the Department's own initiatives with J.P. Franzidis (left) and Duncan Fraser (right) during one of his visits in the mid-1990s.

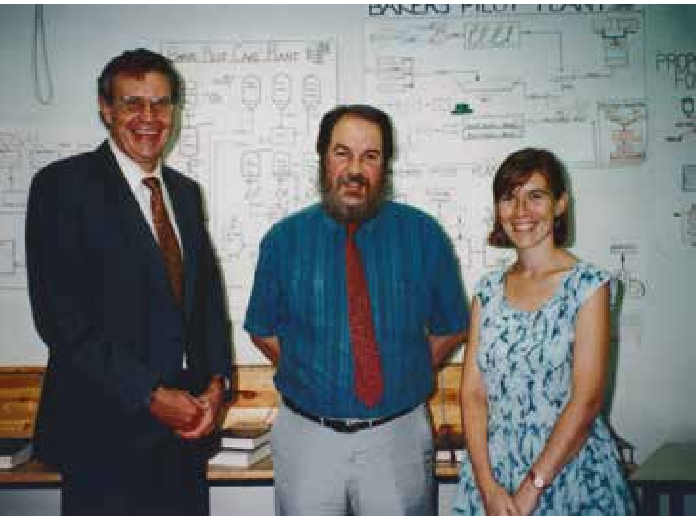
57 Fraser uses the term 'disadvantaged' students in this paper, referring to all students other than white.
58 Fraser, D.M. (1993). "Collaborative Study Groups: A Learning Aid in Chemical Engineering", *Chemical Engineering Education*, **27**, 38–41.

By this time, Fraser's teaching ideas were beginning to coalesce around a more structured set of offerings, supported by international Chemical Engineering colleagues like Scott Fogler[59] and Richard Felder[60] from the USA, and growing collaborations in Europe, Australia and across Africa.[61] All these connections reinforced the need to appoint to the academic staff an individual whose primary academic mission was to foster engineering education.

In 1991, the Department secured a landmark donation of R1 million from Caltex SA for the establishment of an extra academic post focused towards Academic Development (AD). The work of this Education Development Officer would centre on improving teaching and learning taking place in the Department. Counselling efforts were intensified, and voluntary extra classes were established in both first and second year.

The education development officer post was filled in mid-1993 by Wendy Kaschula. And in 1996, Jenni Case, a school science teacher with a Master's degree in education, was appointed to this position. Her arrival coincided with a dramatic increase in first-year intake in 1995, which put a strain on teaching and provided a further spur to the AD approach.

In 1991, the Department secured a **landmark donation** from Caltex SA to support academic development.



The opening of the Caltex Education Development Programme resource centre in 1996: Paul Buley (General Manager and Director, Caltex), J.P. Franzidis (HOD Chemical Engineering), and Jenni Case (Education Development lecturer).

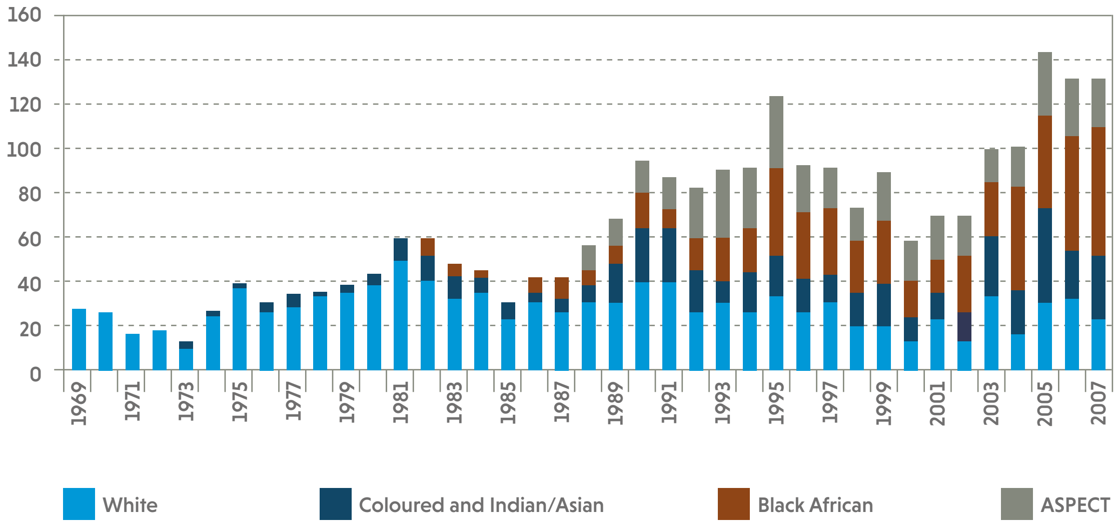
Taking into account the concerns that the curriculum was overloaded, that classes were too large and that the content was not being adequately delivered, the introduction of a customised first-year chemical engineering course was a significant manifestation of the Department's evolving ownership of its AD project. This course, taken by all students, included activities fostering appropriate study approaches for engineering, building a community and connecting to the workplace and possible careers.

In 1997, the position of Director of Undergraduate Studies was established in the Department, which centralised undergraduate administration under a (rotating) academic staff member who was not the HOD, and provided a locus for the coordination of curriculum work and student advising. The first incumbent was Duncan Fraser, who had already been doing much of this work anyway. And in 1999, a system of year counsellors was established.

These many initiatives have paid dividends over the intervening years. Figure 2 shows the significant growth in both size and diversity of the incoming undergraduate class over this period, with a sneak preview through to the 21st century. There are year-on-year fluctuations and periodic spikes in student numbers due to a range of factors, but the overall trend shows that the Department went from a small, largely white class, to a class roughly double in size with representation across all South African race groups. The figure also makes clear the significant role played by the ASPECT programme in providing an alternative route for students from disadvantaged backgrounds who needed extra support in their early years.

59 Fogler ran a course on "Creative Problem Solving".
60 Felder ran several courses on "Effective Teaching".
61 UCT launched an initiative to bring African scholars to UCT for higher degrees, as a way of enhancing academic staffing capacity. Called the University Science, Humanities, and Engineering Partnerships in Africa (USHEPiA), it also opened the door for UCT Chemical Engineering academics to be involved as programme external examiners in African countries including Kenya, Zambia, Tanzania, Mozambique and Mauritius.

Figure 2: Department of Chemical Engineering undergraduate student intake numbers and demographics 1969 – 2007*



*Fraser, D.M. (2007) Improving Student Success and Graduate Quality, Keynote at the RCEE 2007 Conference, Johor Bahru.

FINAL YEAR 1992

Back Row: P.Q. Nesbitt, B.K. Ireland, J.G. Röhm, W.D. Hollaway, B. Cohen, R.J. Roseveare, P.A. Leger, K. Papathanasopoulos, S.P. van der Linde, B.M. Bischoff, S.J. Howlett, M.S. Powys.

3rd Row: S.M. Robinson, E.V. Mahlangu, B.A. Hutchison, A.H. Burton, I.N.P. Loff, T. Spandiel, C.A.G. Cruise, R.H. Senekal, A.M. Barker, J.G. Daniels, C.M. M'Kombe, D. Smith, S.L. Mehlomakulu.

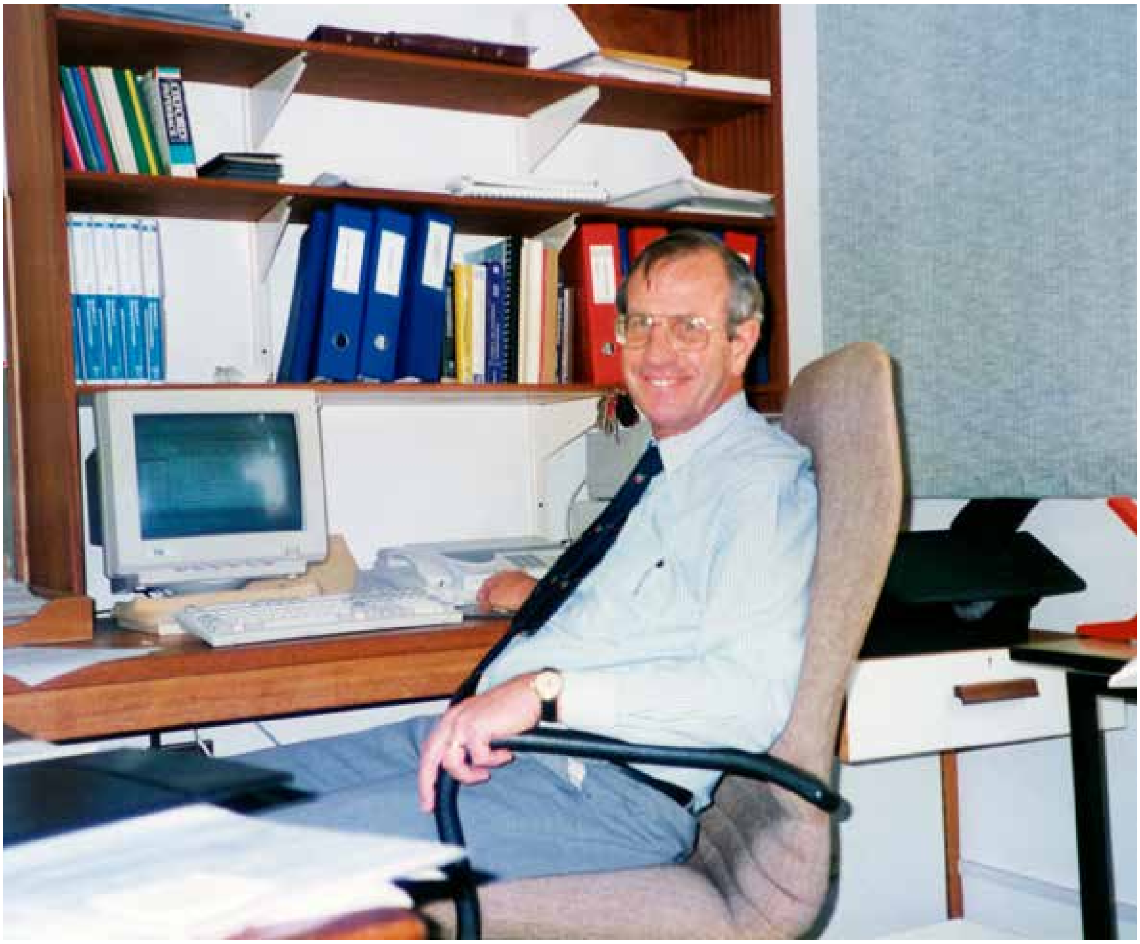
2nd Row: R. Odayar, E.W. Randall, S.H. Ally, S.G. Nieuwenhuys, K. Germishuys, T. Fowler, S.J. Miller, L. Basson, L.S. Johnson, J.P. Tucker, H.J. Kleinhans, M. Mlilo, T.D. Laughton, M.P. Williams, M.A. Clews, H. Brey.

Front Row: B.D.A. Paddon, M. Josias, D.M. Fraser, R.W. Smith, S. Kherekar, C.T. O'Connor, P.K. Bettison, G.S. Hansford, J.P. Franzidis, S.T.L. Harrison, J.J. Cilliers, M.E.T. Winter, L.G. Austin.

Investing in academic excellence

The Advisory Board also spearheaded efforts to support, attract and retain quality academic staff. The limited local pool of suitably qualified professionals was in demand, not only from industry, but from other local academic institutions. Two salary subvention schemes resulted. The first, championed by the South African Institution of Chemical Engineers, was a national initiative supported by several companies. This scheme operated for five years from the mid-1980s.

The second, which came to fruition under Cyril O'Connor's headship in 1990, was supported directly by the Chamber of Mines and latterly by the Minerals Education Trust Fund (METF) "to assist the Department of Chemical Engineering to achieve its vision to be a world-class institution for both teaching and research". The funding was to be used to improve the undergraduate education in minerals processing through distinguished visitors and additional support personnel, to enhance the recruitment of quality students and to upgrade the Department's facilities. O'Connor successfully argued that the METF funding should strike a balance between support for academics involved in minerals-related research activities and general support for the entire academic staff complement.



Cyril O'Connor, Head of Department from the early 1990s, as many may remember him – at his desk but always ready to engage.

Leaning into great challenges

Dr Shehnaaz Moosa
BSc(Eng) Chem, 1991; PhD, 2001

Shehnaaz Moosa's career has followed a different trajectory to many of her peers, but perhaps that was to be expected given her unconventional journey into Chemical Engineering in the late 1980s.

"Being a Muslim female with a headscarf, the Chemical Engineering experience was initially quite traumatic for me. The system was very white and male and there was nothing I could compare it to and draw on for support. As one of the few females from my community to venture to UCT, let alone engineering, I was too scared to even express my discomfort at home."

The first woman of colour to be awarded a PhD by the Department, Moosa's turning point came when she earned a first for one of her courses, Chemical Processing Analysis (CPA). "Professor Duncan Fraser walked past while I was looking at my mark on the board and told me how well I had done. After that something shifted and I started enjoying my time there and feeling more at ease."

Having conquered one intimidating environment, Moosa is now working as a director at non-profit company SouthSouthNorth, focusing on an even more daunting challenging: climate change.

"I oversee three large global programmes and have the privilege of serving on the Global Resilience Partnership Board. My career has taken a different path to many but my degree at UCT has been instrumental in shaping my way of thinking and a distinct mindset when it comes to problem solving."

We must **equip young graduates with the technical skills** but also the empathy needed to tackle the big issues humanity is facing.

Those problem-solving skills are needed in abundance in her profession and Moosa hopes the field of chemical engineering will become part of the solution to the world's climate crisis.

"We must equip young graduates with the technical skills but also the empathy needed to tackle the big issues humanity is facing."

Switching onto the digital era

Another area in which the Department managed to leverage its industry connections to enhance its undergraduate and postgraduate education was that of computing. Of course, significant advances were being made in computing infrastructure during this period and it was essential that the Department keep pace.

The Chemical Engineering curriculum already had a strong foundation in computing. Christopher Swartz, a 1981 Chemical Engineering graduate and later academic in the Department recalls: "I found that my background in computing was strong ... we had an excellent course on chemical engineering computation, taught by Brian Paddon, which involved developing FORTRAN code to solve practical chemical engineering problems. Chemical plant simulation packages were in relative infancy at that time, requiring us to do our own coding for sections of final year design. I do not see this level of comfort with computer coding in many of the students I have encountered in recent years, which seems incongruous given the age of digitalisation."

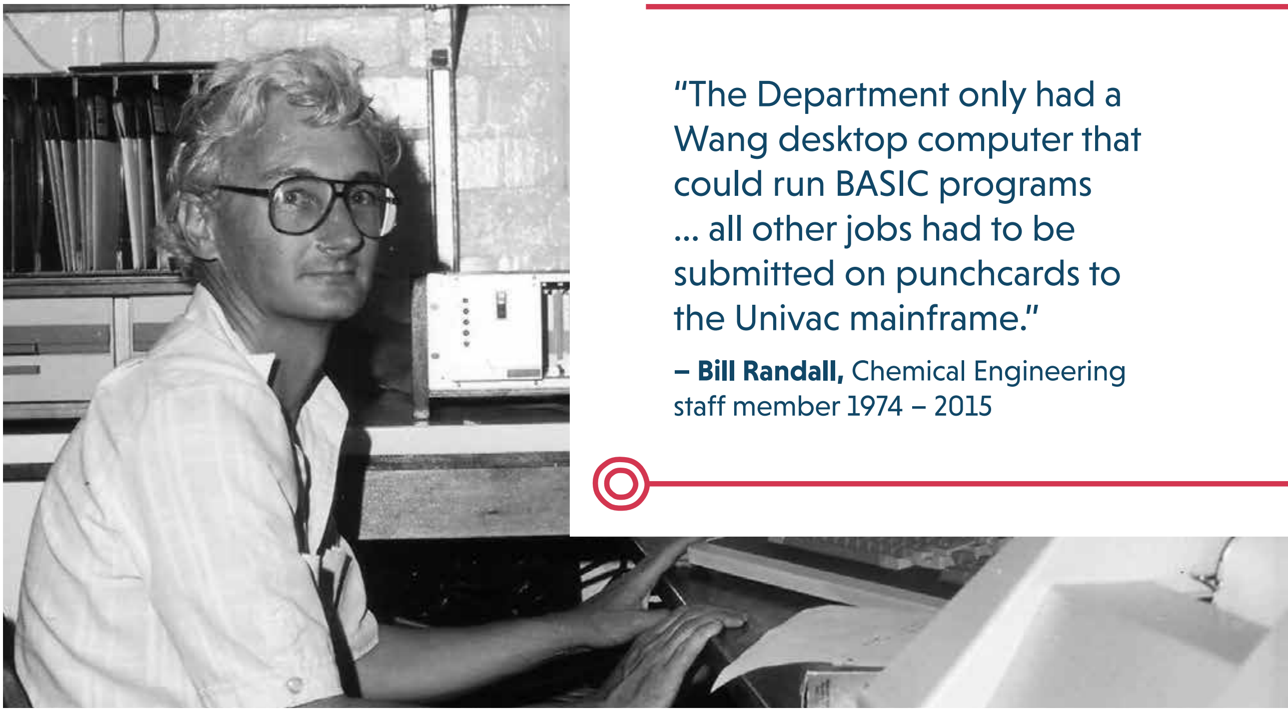
However, in 1980, UCT's computing infrastructure lagged global developments and applications in engineering education by some years. Its centralised mainframe computer (a UNIVAC 1106), which had replaced an IBM 360 only a few years previously, was already overworked by the time Hansford assumed HOD duties. A successful compilation of batch punchcard runs could take up to 24 hours and this certainly added to the time pressure of critical senior courses like Final Year Design. The advent of hand-held programmable calculators in the 1970s helped students with routine calculations, but these fell short when it came to process synthesis. The Department itself boasted only a single dumb teletype terminal, which accessed the UNIVAC, access to which was preciously guarded; and a small Wang mini-computer with cassette tape storage, 16 kB of RAM and a BASIC interpreter. The story goes that Brian Paddon brought this with him when he joined the Department from Mobil in 1969, where it had been routinely used for refinery scheduling.

In the early 1980s, the Department's computing goals were to overcome the bottleneck in design teaching due to limited computing power, to service the growing research infrastructure, and to provide academic staff with personal computers. The global launch of the IBM PC in 1981 opened up significant opportunities both for student learning and, coupled with suitable analog-to-digital interfaces, could provide powerful data storage units for research. Hansford seized on this broad potential, and, by lobbying Advisory Board members, was able to secure funding for a fledgling micro-computer laboratory with a grand total of four PCs, donated by Caltex.

1980

UCT's computing infrastructure lagged global developments and applications in engineering education by some years.

Mr Go-to/Fix it... Granville de la Cruz, who was the soul of the Department for more than three decades.



"The Department only had a Wang desktop computer that could run BASIC programs ... all other jobs had to be submitted on punchcards to the Univac mainframe."

– Bill Randall, Chemical Engineering staff member 1974 – 2015

Bill Randall, who anchored all computing and instrumentation development in the Department for 30 years or so.

Contributions from other local companies followed. South African Nylon Spinners (SANS, an AECI company), which itself had been a significant employer of UCT Chemical Engineering graduates through the years, donated a Digital Equipment Corporation (DEC) PDP 11/23 mini-computer to UCT's Engineering Faculty in the early 1980s. Although this was state-of-the-art equipment for process control software,[62] and promised to bring UCT's Electrical and Chemical Engineering departments into a closer collaborative orbit,[63] the rapid developments in the micro-computer industry made this initiative redundant very quickly.

From these humble beginnings, the Department's computing infrastructure, along with its ability to design bespoke pieces of research equipment with computing interfaces, evolved rapidly. Bill Randall and Granville de la Cruz anchored this development over a period of 30 years or so.

Both the successful experiments and abandoned initiatives are examples of the necessary gestation time for good ideas to bear fruit on the one hand, and the need to demonstrate fleet-footed agility to respond dynamically to exogenous forces on the other. Maintaining flexibility has been key, and over the years, the Department and its occupants have been part of a "living laboratory" in which new ideas are trialled, some chosen for implementation, their successes critiqued, and adjustments made. In many respects, the Department is a living metaphor for the "systems-thinking/design-led/practice-based" model of chemical engineering education that it has come to champion.

Important here, too, is the productive relationship that the Department has developed with UCT's Information and Technology Services division over the years. Chemical Engineering is known as the "go-to" Department for UCT to trial new distributed network systems, internet protocols, and, in recent years, high speed optical fibre links across its expanded building footprints.

62 Used, e.g., at Coalplex Midland Polymers in Sasolburg, SANS in multiple locations and Midrand Polymers.

63 Mainly around the development and application of the rapidly evolving software field. DEC processors ultimately underpinned the development of CP/M and MS-DOS, and hence the micro-computer software industry. The first UNIX code was written on a PDP 11 machine in 1970.

An outlier who opens doors for others

Professor Hamieda Brey Parker
BSc(Eng) Chem, 1992

Hamieda Brey Parker knows what it feels like to be the "outsider". She's been in that position many times in her career, starting as a UCT Chemical Engineering student and coming full circle as a faculty member of UCT's Graduate School of Business (UCT GSB) years later.

"When I started my Chemical Engineering degree in January 1989 I stood out – as the youngest in the class, a Muslim, not white and not male. I didn't tick any of the boxes.

I put in great effort to **help others** who are vulnerable to discrimination.

"Some experiences were memorable, but less positive. I remember doing very well in a course and was pleased to see a notice regarding a scholarship. I promptly applied, but when I arrived at the interview, the interviewer had a shocked look and said, 'I thought that with a surname like Brey, you must be an Afrikaner'. I was not white and was not Afrikaans speaking; I did not fit the interviewer's profile, and the interview lasted about two minutes."

Despite such setbacks, her intelligence and determination enabled her to shine. During her second-year vacation, she worked at SANS Fibres and was invited back to do her third-year vacation work there. They were also quick to snap her up permanently after graduation as the new product development engineer heading up their most cutting-edge project.

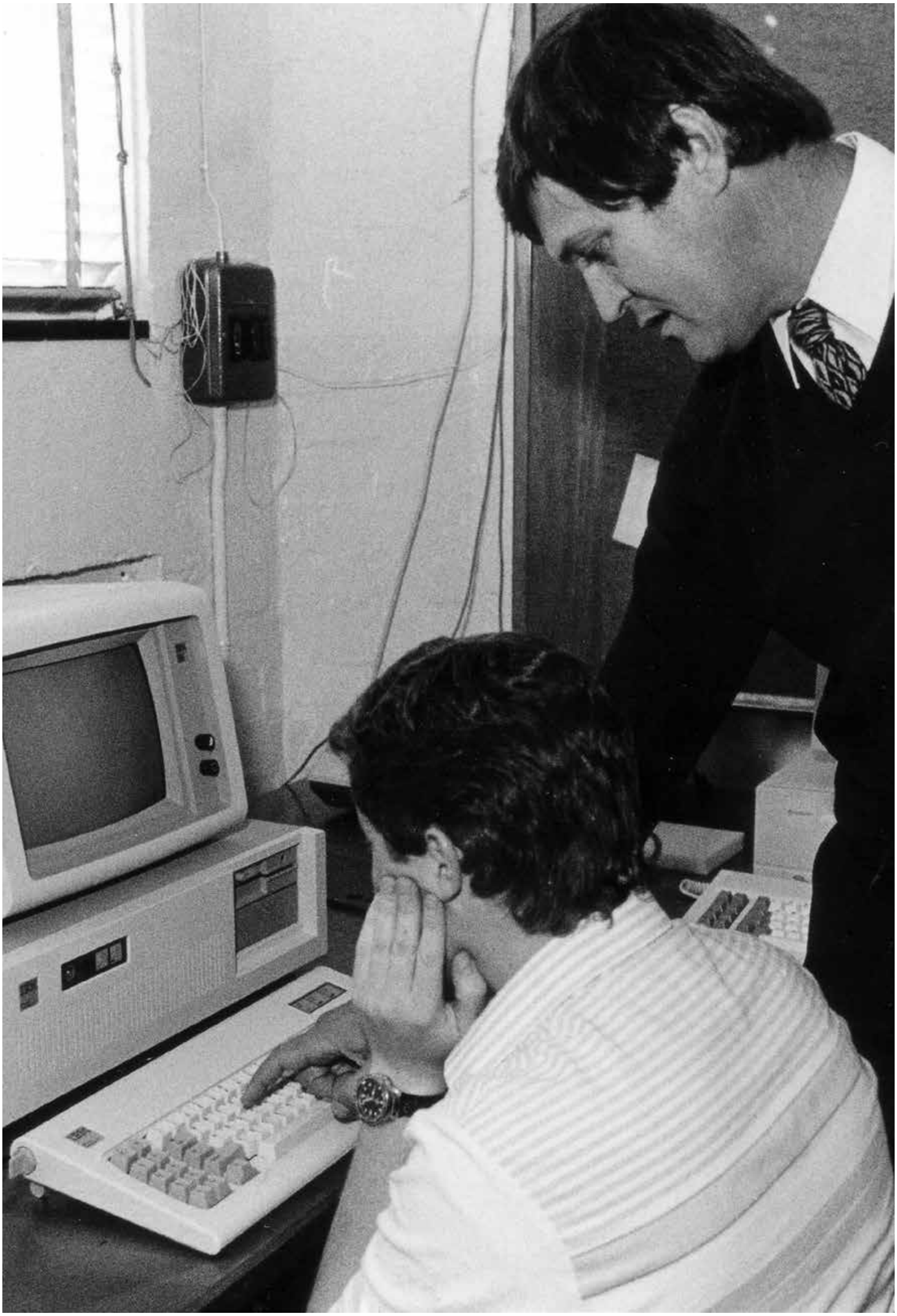
She rewarded their trust when, a few months into her new role, she developed a yarn-making machine that brought in an abundance of new business from Europe. More importantly for Brey Parker, she'd opened the door for women engineers in the previously male-dominated business. "My first year at SANS was tough. The operators and managers had never worked with women engineers before; I happened to be the only one they had encountered. It was an adjustment for them and for me."

SANS would employ three more women engineers over the following three years, but Brey Parker's time there was at an end. She was awarded a scholarship to study an MBA full-time at the UCT Graduate School of Business, and this would mark the end of her engineering days and the start of a new academic career.

She also completed her PhD at the GSB, on a Sainsbury "split-site" scholarship allowing her to spend a year at Oxford's Saïd Business School as part of her studies. She later took on the role of project manager for the Carnegie-funded Faculty Recruitment and Development Programme, through which the UCT GSB recruited and developed a number of new faculty from previously disadvantaged backgrounds.

"I put in great effort to help others who are vulnerable to discrimination and this has had a positive ripple effect in transforming my workplaces in both industry and academia."

Brey Parker was awarded the Harvard-Mandela Fellowship and presented her research on fostering entrepreneurship among disadvantaged communities at Harvard University. She has supervised around 70 MBA research theses during her time at the business school, and, as for her own success, Brey Parker puts it down to sheer hard work: "I entered the workplace in the early 90s; a very difficult time for women engineers of colour. I was an outlier. I realised early on that I needed to exert myself and make sure I delivered over and above what was expected on every project. This strong work ethic yielded numerous benefits, and opportunities to new vistas when I least expected them."



The early days of the PC revolution: Geoff Hansford and student.

Cultivating a sense of social responsibility

Ed Kniel
BSc(Eng) Chem, 1994

Ed Kniel came to South Africa – and the UCT Department of Chemical Engineering – as a mature student in the early 90s – a time of change not only for the country, but also in the field of chemical engineering. He went on to develop a career in environmental management and sustainability in the mining and minerals industries – a direction he says is rooted in his experiences at UCT and in South Africa.

"Throughout my time in the Department, I recall the faculty emphasising, via many practical examples, the degree to which the chemical process industries support society through its economic activities in South Africa, but also globally."

Throughout my time in the Department, I recall the faculty emphasising, via many practical examples, **the degree to which the chemical process industries support society** through its economic activities in South Africa, but also globally.

He recalls that the early 1990s was the era of large programmable calculators, with few spreadsheets and even fewer laptop computers. "The thermodynamics text came with a 5 1/2" floppy disc with BASIC programs for Gibbs free energy calculations."

"Cyril O'Connor was Head of Department and lectured both the Thermodynamics and the Reactor Design/ Process Synthesis course, referencing content spanning from the Fischer-Tropsch Process to *Zen and the Art of Motorcycle Maintenance*! Geoff Hansford did the Unit Operations courses in a most practical way, Sue Harrison lectured us on bioreactors, and Jim Petrie tackled Heat and Mass Transfer courses, breezing through the partial differential equations far more easily than the students attempting to follow in his wake!"

Kniel's final-year project, under the tutelage of Jim Petrie, focused on engineering for environmental performance and upon graduating he was invited to stay on a term as a junior lecturer in the Department. "It was at this time I witnessed the early phase of a transformation in how the Department was delivering on its mandate to shift its demographic profile, driven by dedicated people such as Alison Lewis."

After leaving UCT, Kniel worked as an environmental engineer at a Foskor operation in Richards Bay and within an environmental consultancy headed by Dr John Raimondo, whom he describes as "another chemical engineer with deep connections to UCT and a passion for making a difference in South Africa and the world".

Kniel's own interest in South Africa, and his environmental sensibilities, have shaped his ideas about how the country and the local chemical engineering field could develop to meet the needs of the future. Specifically, he says, it could act as both a hub and a conduit for technology and technical expertise between the world and much of the continent.

Kniel believes the Western Cape in particular may have undiscovered gems hidden within its unique Cape floral kingdom that could be used to develop "pragmatic, made-in-Africa" solutions to challenges such food security, clean water, and medicines: "Humanity has often used chemicals derived from plants as the basis for important industrial and medicinal advances.

"Finding a position at the nexus of these types of win-win combinations that incorporate societal relevance, commercial viability and sustainable production could ultimately allow the Department to achieve its 1:5:50 vision: to remain number one in Africa, be in the top five across the Global South and in the top 50 of all chemical engineering departments globally."

A vision of chemical engineering for a sustainable future

Lenore Rosa Celia Cairncross
BSc(Eng) Chem, 1995; MSc(Eng) Chem, 1998

For Lenore Cairncross, the post-1994 years at UCT are remembered both for the dawning of our new democracy, and the awakening of an environmental sensitivity that has shaped her career to this day.

These years were also the continuation of a proud Cairncross family tradition of studying Chemical Engineering at UCT. Her father, Eugene was the first black student to earn a PhD in the Department, while her aunt Rosalind was the first black woman ever to enrol. Having grown up in Zimbabwe and then Johannesburg, Lenore spent three difficult years studying Chemical Engineering at Wits University, "that I experienced like a psychological onslaught as I regularly felt unwelcome and undervalued as a black female student.

"In February 1994, on the eve of our first universal franchise elections, I transferred to UCT. I was happy to move back to the city of my birth, to one of the most beautiful campuses in the world, a place where my parents met. With a new beginning for our country, it felt like a new beginning for me personally. I voted for the first time, an experience I could share with my grandmother."

Inspired by Professor Jim Petrie's *Introduction to Environmental Process Engineering*, Cairncross registered for a Master's under his supervision. Her thesis on clean-up technologies to remove heavy metals from contaminated water in mining would win the Joseph Arenow Prize for the Best Master's Thesis in the Faculty of Engineering in 1998.

"From Jim Petrie, I learned about concepts such as cleaner production and about cradle-to-grave design, which accounts for the entire life-cycle of the production process and product use. However, I realised that, wherever there was a trade-off between profit and the environment, or profit and people, profit regularly seemed to win."

Cairncross became an active member, and eventually Chair, of the Western Cape Branch of the Environmental Justice Networking Forum (EJNF). "This community-based organisation advocated for environmental justice for communities affected by issues such as air quality and water pollution – problems created by the very industry I was studying to become part of."

That tension remained with her when she entered the industry, first in the process engineering team at Fluor, which designed and built Sasol plants, and later in finance roles within the company and in the banking sector. "My work, facilitating the financing of oil and gas projects that were damaging to local communities and the environment, increasingly conflicted with my personal beliefs."

Cairncross carved her own path reconciling those internal conflicts to make the positive contribution she'd always yearned for: "I was able to combine my engineering training, my interest in finance and my desire to make a positive contribution to environmentally and socially sustainable work. This involved developing green building projects that support transformative housing within South Africa and across Africa, financed by International Finance Corporation, an arm of the World Bank."

Cairncross credits her UCT years with expanding her sustainability outlook and believes a change of focus can write a new future for the field of chemical engineering. "We are living in a time where we are reaping what we have sown. My vision for chemical engineering departments is to introduce approaches, ethics and content, that recognise the needs of the environment and the well-being of all humanity. I feel that we need to make a commitment to the sentiments of medicine's Hippocratic Oath, to 'first do no harm' to our planet and humanity."

Inspiring others and thinking big

Dr Nick Hallale
BSc(Eng) Chem, 1995; PhD, 1998

When it comes to big projects in the field of process engineering, it doesn't get much bigger than those Nick Hallale finds himself working on these days. As a consultant at the multinational engineering firm, Jacobs, Hallale works on oil refinery optimisation.

I'm like an **architect at the very early stages**, when a company is trying to decide where to build a refinery, how **big it should be, what products it should make**, and where it should source the crude oil.

"I'm like an architect at the very early stages, when a company is trying to decide where to build a refinery, how big it should be, what products it should make, and where it should source the crude oil. This very early phase is where you can make or break a project and the investment costs are staggering. At the previous company I worked for, capital costs were between \$2 million and \$20 million; now, they are more like \$2 billion to \$20 billion!"

Even during his years as a student, it was clear Hallale would go on to do big things. He stayed on at UCT after his undergraduate studies to pursue a growing interest in Pinch Technology, working under Professor Duncan Fraser, who was renowned in the field. Under his guidance and encouragement, Hallale published a string of journal articles before graduating with a PhD in 1998.

Those weren't the last pieces Hallale would publish. His post-UCT career took him to the University of Manchester where he worked as a lecturer and then into various consultancy roles in industry, but his most surprising move was the application of chemical engineering in a very unconventional area: helping people improve their physical fitness.

"It sounds totally crazy at first, but in fact it's a perfect application. Chemical engineering is all about transforming raw materials into desired products, and our bodies are no exception. In 2010, I wrote an article called "Engineering a Healthy Body" and *Chemical Engineering Progress* published it as their cover feature."

He continues to write, contributing chapters to a number of textbooks, and in 2014 he won a medal from the Institute of Chemical Engineers for an article on process safety. For someone whose interest in the field was sparked by a magazine article about action movie legend Dolph Lundgren – who happened to have a Master's degree in Chemical Engineering – it's fitting that Hallale has gone on to publish such inspiring works himself.

The challenge of providing industry exposure to students

On the curriculum front, Hansford leveraged Advisory Board linkages and the role of industry lecturers in the teaching of the final-year course on the South African Chemical Process Industries, which had been established under Carr and Buhr. This course provided meaningful exposure to a wide range of South African industries, with a major focus on the commodities sector (minerals, fuels, bulk chemicals). The interaction with leading industrialists[64] led to the establishment of technical study field trips[65] for students mid-way through their undergraduate programme. Brian Paddon began these, and Cyril O'Connor took on that role enthusiastically among a diversified industry base by the mid-1980s, supported by J.P. Franzidis. Projects ranged from simple studies of fluid mass and energy balances, to more complex analyses of particulate systems. A "bucket, stop-watch, pressure gauge and thermocouple" toolkit helped drive home to students the need to both understand processes in terms of their constituent parts, but also be able to synthesise a "bigger-picture" understanding of overall plant performance.

Field trips continued for many years as a seminal learning activity, they also provided **an opportunity for out-of-Department staff-student interaction.**

The mining companies were foremost in supporting this initiative. For example, the Anglo Director, Dave Deuchar had suggested during an Advisory Board meeting that there could be better supervision of the bursars during their required "on mine" industrial assignments, and comments that "a relatively young Cyril O'Connor offered to make sure that this deficiency was rectified and did so with great zeal". These field trips continued for many years as a seminal learning activity; they also provided an opportunity for out-of-Department staff-student interaction. However, the growing pressure of student numbers and the impact on staffing resources (both those of industry and of the Department) eventually forced these activities to cease, thus bringing into sharp focus the ongoing challenge of providing decent exposure to industry practice for Chemical Engineering undergraduates.

The iconic view from Jameson Hall steps, circa 1990 .

64 Many of whom were UCT Chem Eng alumnae and some of whom still, 40 years later, give considerable time to the undergraduate programme by way of design teaching and general professional mentorship. Clive Thorpe deserves an honourable mention here.

65 In previous decades, the Department had trialled shorter site visits to various plants. Of necessity, these provided only cursory exposure for students to process detail.

The undergraduate curriculum broadens

By the late 1980s, the undergraduate programme had broadened in several ways. Two new core courses were introduced into the third-year syllabus, both taught by academics from the Humanities Faculty. The first, called Professional Communication, aimed to give students skills in both written and oral communication. It often received a mixed reception from students at the start of the course, but most would attest that it provided life-long value.

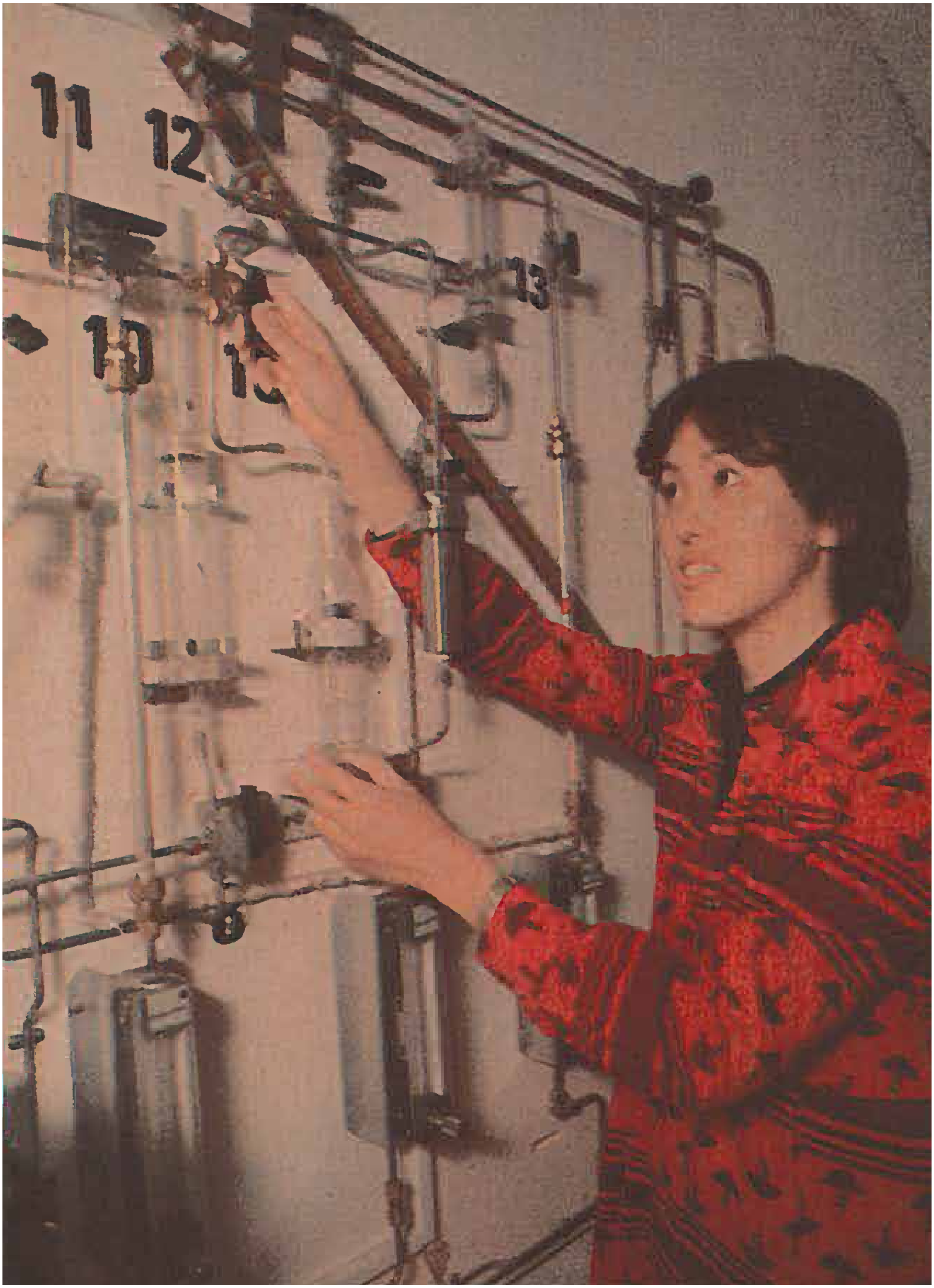
The second course, championed by Masami Kojima, who joined the Department in 1983 and was the lone female academic on the faculty for some years, was called *Introduction to Africa* and run by the Centre for African Studies. It took an American of Japanese heritage to flag that South African engineering students would benefit from participation in such a course of study and to push for Chemical Engineering students to be part of that vanguard. For many years after, the course rewarded all who participated in it.

Engineering Council of South Africa accreditation team from the mid-1990s: L-R Dr Philip Lloyd (independent consultant), Dr Peter Hart (Sentrachem), Professor Uys Grimsehl, University of Pretoria, J.P. Franzidis (UCT Chem Eng HOD). This marked a shift from sole IChemE accreditation to one in which ECSA assumed this role under the Washington Accord. Both Lloyd and Hart obtained both BSc and PhD degrees in Chemical Engineering from UCT.

The undergraduate course content changed in other ways, too, catalysed by changing industry needs, professional body requirements, exciting research opportunities and more. At the same time, the timetable space afforded to the teaching of Chemistry had been shrinking. In the 1960s, Chemical Engineering students effectively completed a BSc in Chemistry in parallel with their chemical engineering courses, including an honours-level course in physical chemistry. By the mid-1970s, that had been reduced to two full-year courses, and a third-year course in physical chemistry, and by the late 1980s, this third-year commitment had gone.

In subsequent years, the conversation was not so much about content, but how best to deliver that content.[66] The discussion of how much could and should be delivered by "service" departments, and how much offered "in house" was not unique to UCT and played out across the global stage. Now, in 2020, courses in chemical thermodynamics and reaction kinetics, surface chemistry, interfacial phenomena, microbiology, mineralogy, and more, have all been incorporated within the Department's portfolio, all managed by Chemical Engineering staff.

66 In part enabled by recruitment of academic staff from a broader background.



Masami Kojima was the first and only female academic staff member in the Department from 1983 to 1989. During her time with the Department she drove a number of teaching initiatives including the *Introduction to Africa* course. She was also the first in the Department to secure a "P" rating from the NRF, awarded to promising young researchers under the age of 35.

Laying down a new management pathway for Chemical Engineering

Professor Cyril O'Connor
Dean of the Faculty of Engineering & the Built Environment, 1998 – 2008; Academic staff member, 1979 – 1998

Professor Cyril O'Connor is, without question, among the most influential people in the Department's 100-year history. He is responsible for seeding two flagship research groups – the Centre for Minerals Research and the Centre for Catalysis Research – and building relationships with some of the Department's biggest industrial backers.

When he retired from academic life in 2009, he did so as UCT's Acting Deputy Vice-Chancellor. He is currently President of the International Minerals Processing Council, a member of the Executive Committee of the South Africa Academy of Engineering and holds an impressive list of industry body fellowships.

For someone who's enjoyed such a stellar career, it's remarkable to think none of this would have come to pass but for an astute and encouraging lecturer at his teacher training college.

At the same time as I was offered a job by both the National Institute of Metallurgy (later MINTEK) and Sasol, **Professor Donald Carr** approached me and **suggested I apply for a vacancy in the Department** teaching thermodynamics, reaction kinetics and reactor design.

"I came from a family where the concept of attending university was quite foreign. I was able to obtain a bursary to attend teachers training college, where I qualified to teach maths and science at high school level. One of my lecturers wondered why I had not gone to university and suggested I register for a BSc degree through the University of South Africa. I did, and graduated with a degree with joint majors in mathematics and chemistry, having obtained a distinction in all my undergraduate courses."

O'Connor would go on to receive a bursary to study an Honours degree in Chemistry at UCT in 1974. This would be the first of many doors to open for him and the start of a lifelong journey with the University. "Having graduated, I was invited by Professor Prout to undertake doctoral studies under his supervision in the field of thermal and photolytic decomposition of azides."

At this point, he came to a fork in the road: deciding between a career in industry or as an academic. "At the same time as I was offered a job by both the National Institute of Metallurgy (later MINTEK) and Sasol, Professor Donald Carr approached me and suggested I apply for a vacancy in the Department teaching thermodynamics, reaction kinetics and reactor design."

His decision to stick with UCT turned out well for everyone. The two competing firms took the rejection well. "Both indicated that, should I be successful in being appointed in the Department, I would be welcome to approach them to undertake research in areas of interest to them."

Those invitations would herald the beginning of O'Connor's research interests in catalysis and flotation and later evolve into the Department's two world-class research centres in minerals research and catalysis. It would also be the start of strong research and funding relationships with Anglo American and its off-shoots, Sasol, Gencor/BHP Billiton, Senmin, Sentrachem, AECI and others.

Cyril O'Connor (right) with Cheryl de la Rey (DVC Research) and Jeremy Galvin (EBE Faculty Manager).

Through the years, O'Connor's influence has extended into an impressive number of research projects. He has supervised or co-supervised around 35 doctoral students and 55 master's students and has had well in excess of 160 journal papers published in the fields of catalysis and flotation.

In 1988, O'Connor was appointed Head of Department, a position he held twice, from 1988 to 1994, and again from 1997 to 1998. At this time, he was appointed Dean of the Faculty of Engineering, which became the Faculty of Engineering & the Built Environment in 1999 and would remain in that role until 2008. He is today a Life Fellow of the University of Cape Town.

Beyond the walls of UCT, O'Connor's honours roll is too long to list in full, but illustrates just how fortunate the Department has been to have him in its midst.

He is also quick to point to the role that others have played in his success, too. "It is fitting for me at this time to pay tribute to a number of special colleagues who joined me on this journey," he says singling out Masami Kojima, Jack Fletcher, J.P. Franzidis, Eric Van Steen, Dave Deglon, Martin Harris, and the late Dee Bradshaw. "I particularly wish to recognise Jack Fletcher and Dave Deglon, both former PhD students of mine, who, thanks to their outstanding leadership, have taken these two research activities to become, in both instances, global leaders. It is also worth noting that today, many former graduates of these two groups occupy senior positions in the respective industries."

A new era of research and relevance

1984

The Foundation for Research Development is established to provide "**appropriate human resources in science and technology** to meet the requirements of the national economy".

Donald Carr (as then Deputy Vice-Chancellor) receives a financial contribution from Johann Lubbe (General Manager and Director, Caltex) to support research and teaching in Chemical Engineering in 1982.

The 1980s heralded a rapid expansion of the department's postgraduate research activity, too. This was due, in no small measure, to the energy, commitment and sheer force of personality of Cyril O'Connor. Trained as a high-school maths and science teacher, with a PhD in physical chemistry from UCT, O'Connor immersed himself immediately in trying to understand the potential value that a new academic could bring to the South African chemicals and minerals industries.

This expansion took place in the context of a new emphasis on research at national level too. A national initiative at that time was the establishment of the Foundation for Research Development (later renamed the National Research Foundation), which introduced a rating system for academic researchers, and accordingly allocated support funding from its limited budget. While the absolute funding amounts were small, they were often catalytic in helping researchers commence new lines of enquiry.

With the recent departure of several academics, Hansford's assumption to the role of HOD, and the reliance on teaching stalwarts like Paddon at the undergraduate level, it was a bold move to commit to new, focused research endeavours, just as undergraduate numbers were picking up after their slump in the mid-late 1970s. The Department relied on part-time teachers, who themselves were nascent researchers, often trying to complete postgraduate degrees in parallel, like Trevor Giddey and Gerhard Hoppe.

O'Connor, not shy of a challenge, pursued two research thrusts in parallel. One was the minerals sector, the other was catalysis. Both, of course, were of vital importance to the South African economy at the time.

A doubling of academic staff

The expansion of the research agenda within the Department during these years was mirrored by a rapid expansion in its academic staff complement. Starting with the appointments of J.P. Franzidis, Peter Dold and Masami Kojima in 1983, the next decade or so marked a period of accelerated staff recruitment, some positions being funded directly by industry, others through research initiatives.

By the mid-1990s, the Department had also recruited Gary Foulds, Chris Swartz, Jim Petrie, Jan Cilliers, Jack Fletcher, Sue Harrison and Eric van Steen. In the lead up to the millennium, Dave Deglon, Alison Lewis, Klaus Möller and Harro von Blottnitz also joined the academic staff. This rapid recruitment mirrored the growth of both student numbers and research potential. At any one time, it represented more than a doubling of the academic staff complement.

From that list, and chronologically, Franzidis, Petrie, Dold, Fletcher, Swartz, Foulds, Lewis, Möller and von Blottnitz were all UCT Chemical Engineering undergraduate alumni. Harrison was a UCT Science Faculty graduate. And Kojima and van Steen were international recruits. Both Cilliers and Deglon came via Wits Chemical Engineering and Metallurgy. Franzidis, Swartz, Harrison and von Blottnitz had obtained their PhDs overseas;[67] Dold, Petrie and Lewis had obtained their PhDs in other UCT engineering departments.[68] Fletcher completed his PhD as one of Cyril O'Çonnor's first doctoral students, and Möller followed suit some years later. Both Cilliers and Deglon were recruited to support the rapidly growing minerals research programmes, and both completed their PhDs while at UCT in that role.

All were recruited for their commitment to "making a meaningful contribution" to the evolving South African tertiary education sector, and excited by the prospect of **working in a Department with real opportunity to advance novel research ideas.**

All on that larger list were recruited as "entry-level" academics and only a few had prior industry exposure. And, interestingly, none had extensive prior teaching experience. All were recruited for their commitment to "making a meaningful contribution" to the evolving South African tertiary education sector and excited by the prospect of working in a Department with real opportunity to advance novel research ideas. Maybe of itself, that last is not a surprising statement on the global stage, but in the context of South African chemical engineering, it represented a massive individual commitment. To join a department finding its feet; to commit to a balanced career of teaching, research, governance and outreach; and to do so in South Africa in those critical transitional years spoke volumes. None of which would likely have been possible without the nurturing environment provided by UCT and the Chemical Engineering senior staff in those years.

Deglon, Fletcher, Harrison, Lewis, Möller, van Steen and von Blottnitz remain on staff in 2020, and Harrison and Lewis, after having also served as HODs, have assumed senior UCT executive roles.[69] Fletcher and van Steen also served as HOD at various times from the late 1990s. In addition, the Department had begun to offer teaching

67 Franzidis at Open University, UK; Swartz at University of Wisconsin; Harrison at University of Cambridge; von Blottnitz at RWTH Aachen, Germany.

68 Dold and Lewis in the Water Research Group of UCT Civil Engineering; Petrie at the Energy Research Institute, housed in UCT Mechanical Engineering.

69 Alison Lewis is Dean of the Faculty of Engineering & the Built Environment; Sue Harrison is DVC Research.

opportunities to its senior research staff. Dee Bradshaw and Martin Harris, both minerals processing researchers, Kim Clarke in bioprocess engineering and Michael Claeys in catalysis and reaction engineering, all began teaching across the undergraduate and postgraduate programmes from the mid-1990s.

UCT was one of the first universities in South Africa to examine its processes for academic staff development and advancement. It made explicit that every academic was expected to contribute meaningfully to teaching and learning, research, and something called "outreach". Through the years this last criterion has opened the door to advocacy and community engagement. The balance has always been a matter of departmental priorities, individual goals and opportunity, and the mix was a drawcard for new academic appointees into Chemical Engineering.

All those new recruits gravitated to UCT Chemical Engineering because of the culture of the Department that had been created by the long-serving academic staff. From Carr and Buhr, to Hansford and Paddon, and latterly Fraser and O'Connor, there existed almost an expectation that UCT Chemical Engineering could continue to demonstrate a *modus vivendi* informed by vision, passion and commitment. It was a good place to work, based on its sense of community.

The Department famously didn't recruit for particular fields but for general academic excellence. Geoff Hansford was singular in campaigning always to **"recruit the best and put them to the test".**

The departmental culture ensured that all new appointees were supported on arrival. On the research front, new staff were invited to explore collaborations with existing research thrusts in the Department within a collegial "mentoring/buddy" system and were purposefully introduced to existing industry contacts to strengthen those collaborations. At the same time, new academics were encouraged to pursue new research fronts. The Department famously didn't recruit for particular fields but for general academic excellence. Geoff Hansford was singular in campaigning always to "recruit the best and put them to the test".

Alison Lewis joined the staff in the run up to the millennium and went on to become both HOD and later Dean of the Faculty of Engineering & the Built Environment.

The emergence of minerals research **as a mainstay of the Department**

Research in the Department has always been driven by its people who are given free rein to pursue their research interests. John de Kock had brought along his research interest in coal processing, fossil energy interests and particle technology more generally in the 1970s; and in the 1980s, UCT Chemical Engineering was building its research on the fledgling minerals processing thrust that the Department was incubating.

This thrust was being led primarily by Hansford, whose growing interest in minerals bioprocessing already presaged a keen interest in understanding sulphur management within a global industry increasingly underpinned by beneficiation of sulphidic ores. Hansford had initiated research in mineral bioleaching and biooxidation, using iron and sulfur-oxidising microorganisms to contribute to solubilising sulfidic minerals, and he had been involved with the development of South Africa's BIOX® process, to understand the microbial consortia present.[70] He focused on mechanism and kinetics, particularly of the microbial ferrous-iron oxidation sub-process. When Sue Harrison joined the academic staff in the early 1990s, this research received a major funding boost from Gencor, later Billiton and ultimately BHP Billiton, on mineral oxidation, particularly in the extraction of gold from arsenopyrite ores using tank leaching, later expanding into the bioleaching of copper from copper-bearing sulfidic minerals such as chalcopyrite and chalcocite ores through heap leaching. Other SA minerals companies, notably Anglo American and Gold Fields SA also contributed to this work, which has remained a core focus of the Centre for Minerals Research (CMR).

A key (and often overlooked) contribution was the role played by Brian Paddon. His years in industry flagged him in that Departmental era as the "go-to" person to provide critical perspective on the challenges being faced by local industry, and how a UCT undergraduate Chemical Engineering programme might evolve to address these. Although his professional background was in the petrochemical sector, Paddon took the prescient move in the early 1980s to invite Dr Barry Wills from the UK to spend a semester in the Department to teach a course based on his recently published textbook, *Mineral Processing Technology*. From that initial connection has grown a strong and rewarding

The SA minerals sector support for bio-hydrometallurgy research in 1994: Professor Wieland Gevers, DVC Research, Geoff Hansford, and Alan Wright (CEO Gold Fields Group).

"I have been pleased to see the Department grow into **an institution of truly international standing.**"

– Dr Barry Wills, Senior Partner (UK) and Editor-in-Chief of Minerals Engineering International

70 The process now operates worldwide and the Department still conducts research on it.

1990s

The **relaxation of sanctions** meant that the Department **could expand its international networks** to aid the development of proprietary technology for the sector.

Martin Harris, the longest serving member of the Minerals Research group in Chemical Engineering.

professional relationship. Wills, who is now Senior Partner (UK) and Editor-in-Chief of *Minerals Engineering International,* has repeatedly invited Department staff as advisors to MEI's international conferences. He points to the Department's international reputation being bolstered by O'Connor being President of the International Minerals Processing Council, and Jochen Petersen being the Editor-in-Chief of the prestigious Elsevier journal *Hydrometallurgy.* Wills comments that, "I have been pleased to see the Department grow into an institution of truly international standing, not only for teaching but for its involvement in cutting edge research in the whole field of minerals engineering from comminution to biohydrometallurgy."

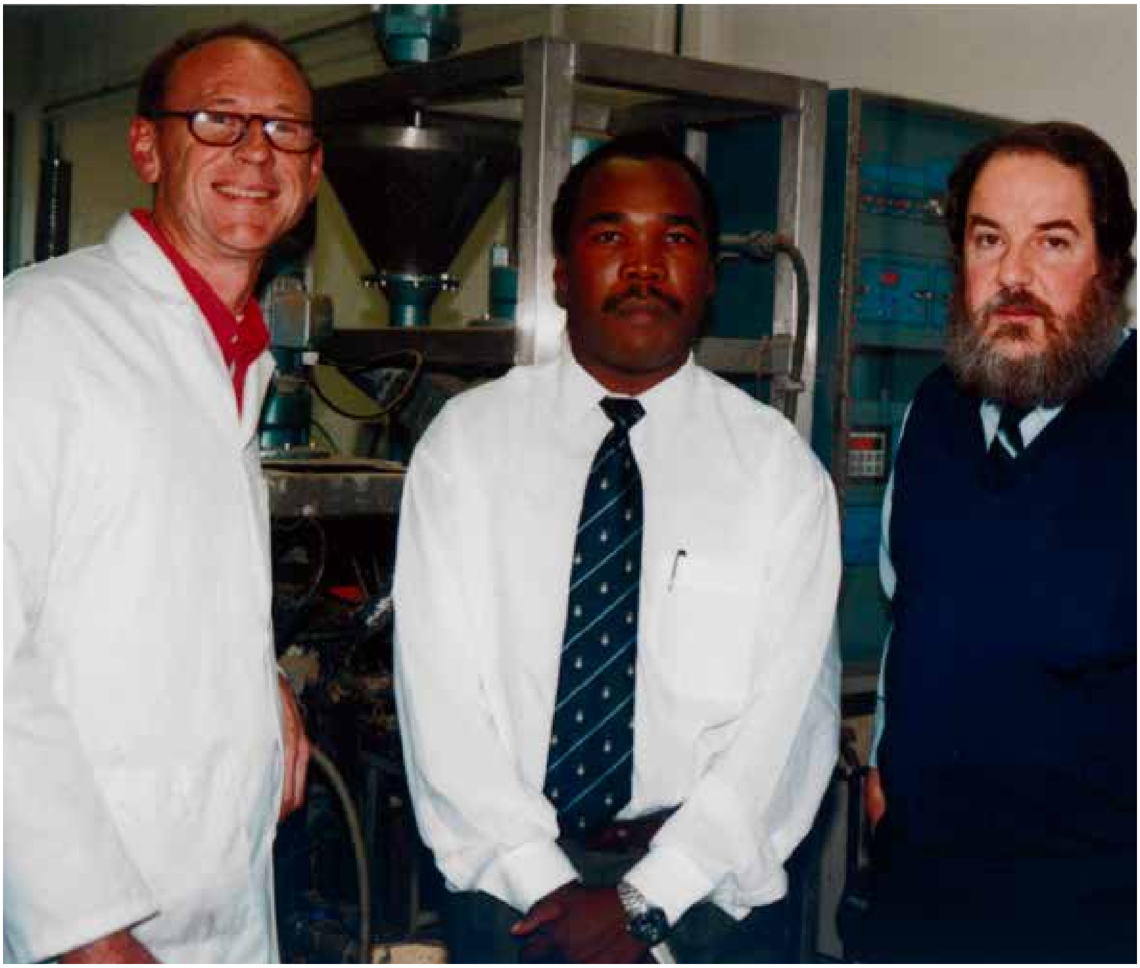
O'Connor's interest in flotation chemistry for minerals concentration was timely for three reasons. There was growing interest from the Chamber of Mines and the National Institute for Metallurgy (NIM), soon to be rebranded as MINTEK, to develop research collaborations with leading academic institutions; the South African mineral resource base was growing in complexity, often accompanied by declining ore grades; and there was a need to develop improved selective beneficiation technologies.

With time, the research expanded to areas such as the role of reagent interactions, the effect of the froth phase, fine coal flotation and the investigation of novel flotation cells (such as flotation columns). Key researchers during this time period were J.P. Franzidis, Dee Bradshaw, and Martin Harris, who, aside from Cyril O'Connor, is now the longest serving member of the CMR. Key industry partners included Anglo American (Dave Deuchar), Gencor (Alan Haines), Impala Platinum, MINTEK/NIM (Rob Dunne) and Senmin (Hymie Singer, Jules Aupiais).

This expansion coincided, too, with distinct changes in the shape of the South African mineral sector. Peter Craven, former Vice President Technology at BHP Billiton, points to the six massive so-called mining houses, which dominated the South African stock exchange in the 1980s, and, due to the international sanctions at the time, were dependent on locally developed technology and technical support. "A remarkably high degree of cooperation between the mining houses was apparent," Craven recalls. The professional metallurgical staff capabilities were among the strongest globally and the mining houses all had bursary schemes and structured graduate training programmes. This motivated both the industry and universities to invest in high-level engineering graduates and support fundamental research programmes. The relaxation of sanctions in the 1990s meant that, while the mining house environment fragmented and most of the collaborative R&D programmes were dissolved, universities' chemical engineering departments could expand their international networks to aid the development of innovative, proprietary technology for the sector.

Within the minerals research thrust, a major development in 1997 was the formation of the comminution research group by Malcolm Powell, who was recruited from MINTEK. Powell was eventually recruited by the Julius Kruttschnitt Mineral Research Centre (JKMRC) at the University of Queensland, and the comminution activity is now led by his successor and current Head of Department, Aubrey Mainza. Powell also went on to form MPTech, the Centre's technology transfer group, in 2002. MPTech applies technology and research to the design, operation and optimisation of industrial comminution and flotation circuits. Technology transfer is achieved through industrial surveys and audits, process optimisation studies, design reviews, training courses and programmes and laboratory test work. Since its inception, MPTech has played an important role in both the development and relevance of research in the Centre due to its close interaction with industry. On Powell's departure to the JKMRC, MPTech was managed by Jenni Sweet, who was subsequently recruited by Anglo American. The Centre is currently run by Andre van der Westhuizen.

Another significant development in the late 1990s was the formation of the Depressant Research Facility (DRF) with the aim of establishing a centre for the characterisation and research of polymeric depressants in flotation. The DRF was an industry collaboration between the flotation chemistry researchers and selected South African platinum producers: then Anglo American Platinum (Sandy Lambert), Impala Platinum (Dave Marshall) and Lonmin Platinum (Craig Goodall). The DRF was managed by Dee Bradshaw, and Peter Harris, who was recruited from MINTEK, played a major role for many years. The DRF was eventually rebranded to the Reagent Research Group (RRG) in 2008 to investigate interactions of the major flotation reagents in an integrated manner.



Visitors to the Department in 1996 herald the growing international links of the Minerals Research Group. From left, Dr David Ralph from Murdoch University, Australia and Professor Steven Simukanga, University of Zambia, with J.P. Franzidis.

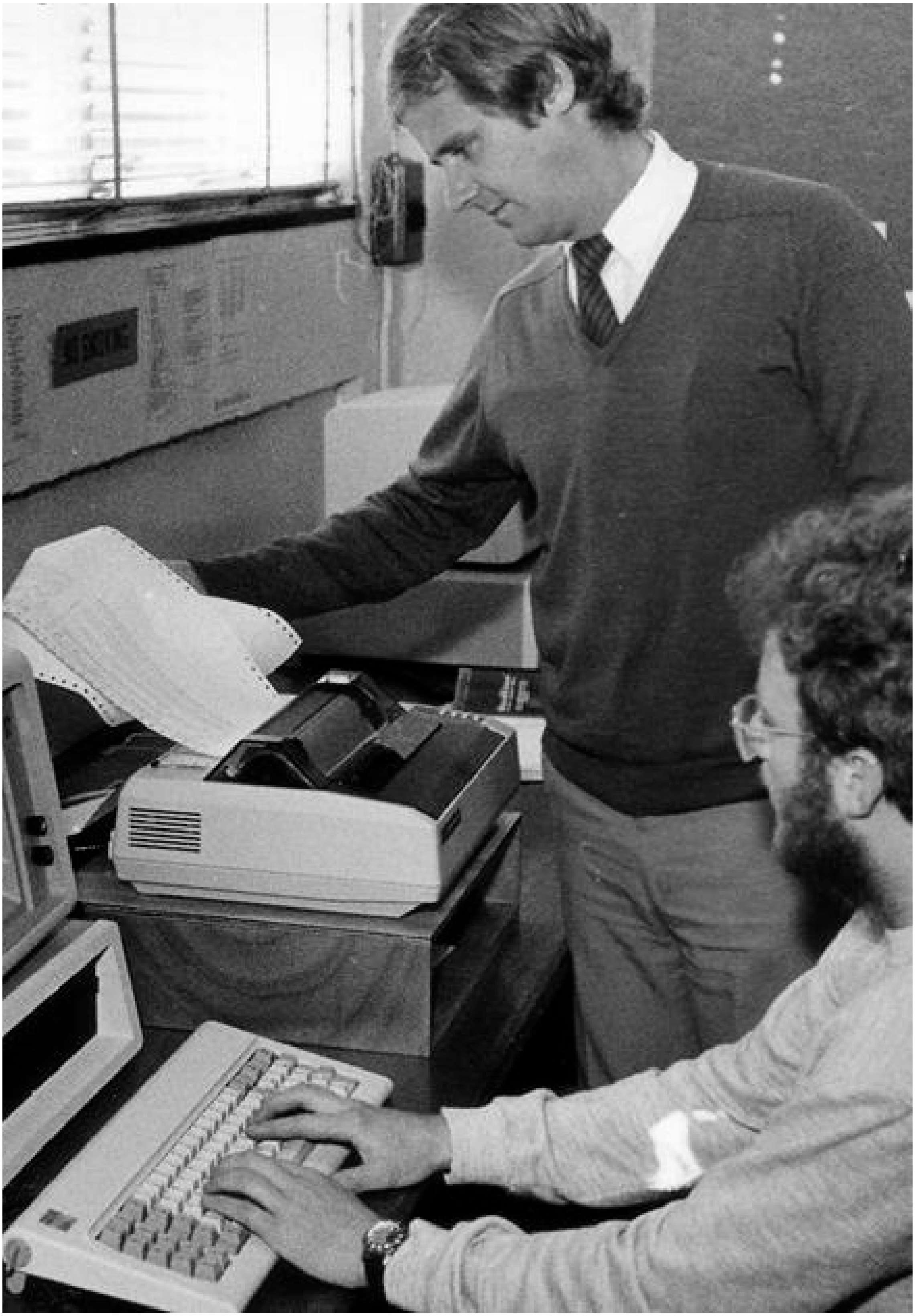
Catalysis research,
the second major research thrust for Chemical Engineering

O'Connor was also instrumental in driving the second major research thrust of the Department at this time, in catalysis. He had reached out to Sasol, which in the early 1980s was about to commission Sasol II and Sasol III coal-based synthetic fuel plants in Secunda, Mpumalanga. Some 40 years later, these remain the largest plants of their type globally. Arie Geertsema, then Managing Director of Sasol's Sastech R&D, teamed up with like-minded colleagues at Sentrachem and AECI to try to plug the gap in the knowledge and understanding of graduates in dealing with multi-faceted issues in the chemical industry. Their aim was to further the knowledge and understanding of undergraduates in what the industry really needed. UCT was selected as the preferred university to collaborate with in the training of graduates. The three companies decided that catalysis was the ideal area to provide additional impetus, and, under the leadership of O'Connor and with support from UCT authorities, the foundations were laid for the new Catalysis Research Unit. Mutually beneficial collaborations developed, the Unit grew more influential and, through further industrial and international alliances such as with the Engler-Bunte-Institute at the University of Karlsruhe in Germany, gained international renown.

A 04:00 wake-up call on research safety, caused by failure of a thermowell in a high pressure gas environment in the catalysis laboratories, 1987.

Cyril O'Connor in his capacity as HOD (far right) takes receipt of a R2 million investment into catalysis research from the Foundation for Research Development (FRD), the National Energy Council (NEC), Sasol and AECI in 1991. This was a prime example of collaborative industrial research underpinned by government funding. He is pictured here with, from left, Dr Roger Jones (Assistant Research Manger, Chemicals, AECI), Mr Peter Cox (General Manager, Sasol), Dr Reinhardt Arndt (President, FRD), Dr Arie Geertsema (General Manager, Research and Development, SASTECH), and Dr Bob Scott (Group Executive NEC).

UCT had been collaborating with Professor Hans Schulz at the Engler-Bunte-Institute on zeolites and their use as catalysts since the 1980s. The collaboration expanded into research and student exchanges and O'Connor spent his sabbatical year at the Karlsruhe university as visiting professor. "About 20 former students of this exchange still regularly come together for reunion meetings", marvels Schulz. In the mid-1990s, two students of Schulz, Eric van Steen and Michael Claeys, joined the Department as postdoctoral fellows in O'Connor's research group after having completed their PhDs in Fischer-Tropsch chemistry. Both went on to become full professors at UCT and were instrumental in the establishment of what is now the DST-NRF Centre of Excellence in Catalysis. "These strong, lasting relationships", Schulz concludes, "have been a testament to networks and their power to contribute to scientific progress, international collaboration and social links."



Modelling water treatment processes in the mid-1980s, enabled by expanded use of microcomputers: Dr Peter Dold with Lance French.

Other research green shoots in environmental process engineering, bioproducts and biosystems

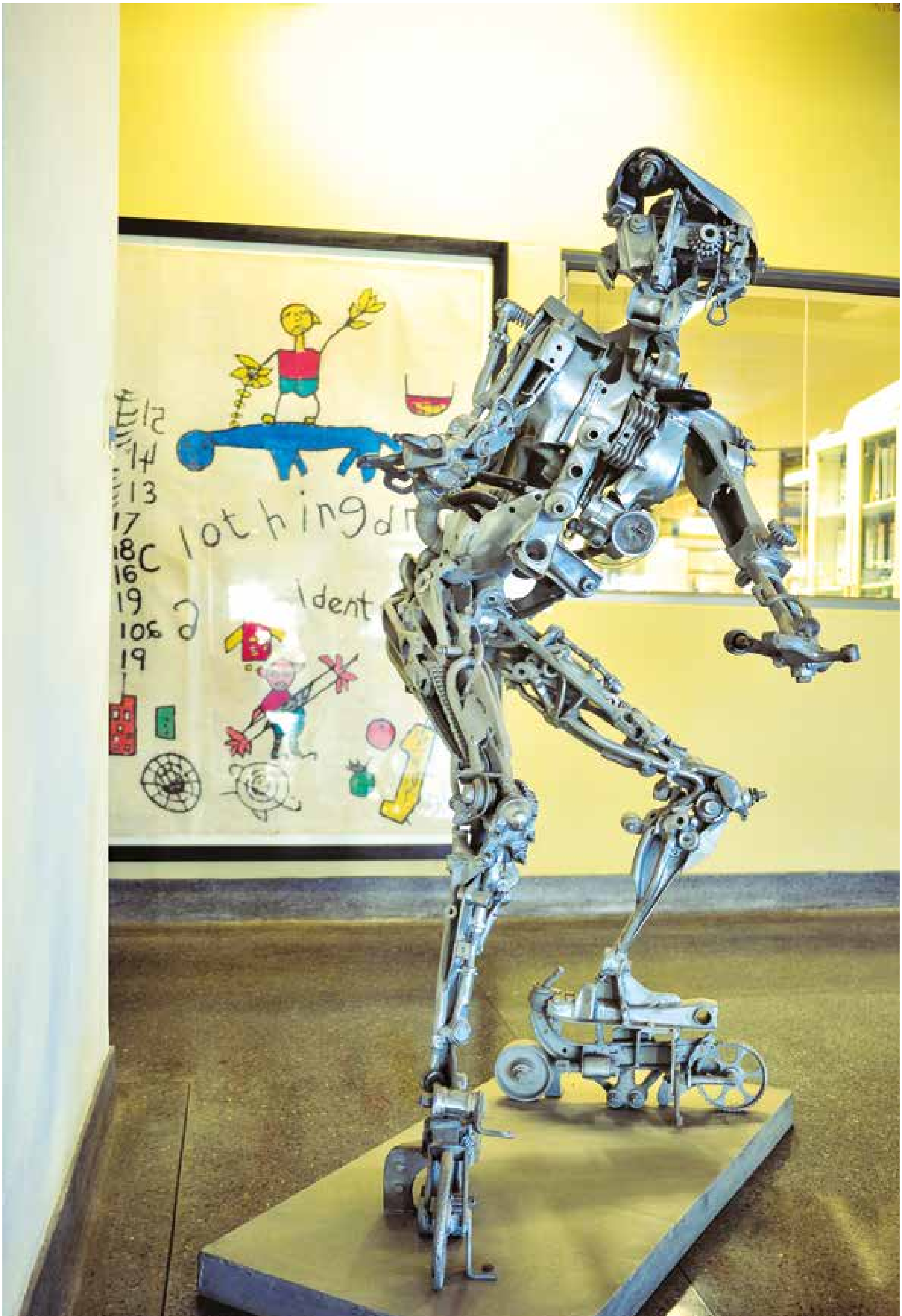
Additional significant research thrusts for the Department that emerged in this time were in environmental process engineering and bioproducts and biosystems. The environmental thrust started in 1990 with the appointment of Jim Petrie, springboarding off his collaborations with global mentors like Roland Clift, then at the University of Surrey, UK. Much of the research involved collaborative work with the resources sector industries, including energy and minerals, and sought, in the first instance, to quantitatively understand impacts of solid wastes within the emerging science of life cycle assessment (LCA). Over the years, the research broadened into consideration of process design to explicitly include cradle-to-gate environmental impacts and to develop decision support tools for this purpose. Importantly, this research found common ground with emerging professional bodies such as SETAC[71] and ISIE,[72] both of which were interested in formalising the role of LCA and related tools in public policy and decision support for industry.

This research found an intellectual home within the evolving new discipline of Industrial Ecology, specifically through its work in LCA. With much of its focus being related to understanding mining environmental impacts, it resonated, too, with entities such as the Global Mining Initiative.[73] By the mid-1990s, this research activity had grown to include an enthusiastic group of postgraduates housed in an open-plan office known as "The Green House", many of whom remain linked to the Department in 2020. Harro von Blottnitz and Jochen Peterson are full professors, Brett Cohen and Philippa Notten are affiliated as adjunct associate professors. In more recent years, Jenny Broadurst has joined that cohort.

As the focus of this research group has become more systems-orientated, a logical partnership developed with the process systems work of Duncan Fraser and Adeniyi Isafiade, who was to be recruited to the Department in the early 2000s. As the understanding of the sustainable development *problematique* has evolved globally, the group's focus has gradually expanded into inter- and transdisciplinary collaborations beyond Chemical Engineering, including formative links to other UCT research groupings.

Also at this time, in the 1990s, the Department's research portfolio in bioproducts and biosystems expanded considerably, sparked by the arrival of Sue Harrison who joined the team in 1991. A recent PhD graduate of the University of Cambridge, she was already well-versed in her research in fermentation, bioreactor systems, bioproducts and downstream processing in biosystems. In addition to her research work with Geoff Hansford in biohydrometallurgy, other key research projects were undertaken. One with South African Breweries, to understand the stress induced on yeast during its processing, particularly informing equipment design and selection. Another with Sasol, to explore the use of their low-concentration process water streams containing fatty acid for the production of single cell protein and fine chemicals such as g-linolenic acid (GLA), traditionally extracted from marigolds. Collectively, this research portfolio underpinned the formation and growth of CEBER, the Centre for Bio-Engineering Research, in the next decade.

71 Society for Environmental Toxicology and Chemistry.
72 International Society for Industrial Ecology.
73 Founded by the CEOs of the world's leading mining and minerals companies. It morphed into the International Council for Mining and Minerals in 2001.



The well-loved artwork *Roller skater*, by Willie Bester, in the foyer of the Chemical Engineering Building at UCT.

Changing the world for the better

Dr Mary Stewart
PhD, 1999

My memory of the Department is one of **warm generous people**, a strong sense of community, and an **absolute commitment to academic excellence**.

"I will always count myself lucky that I answered an ad in the Sunday newspaper and was able to attend UCT," says Mary Stewart, CEO of Energetics, now based in Sydney, Australia.

The advert in question that brought Stewart to UCT to do her PhD was for a project that aimed to assess the environmental performance of the South African mining and minerals processing industry. It was hosted by the Department of Chemical Engineering and run in conjunction with the Environmental Monitoring Group of the Western Cape, an NGO addressing both technical and social justice dimensions of environment and sustainability.

"The interdisciplinary nature of the project let me use my chemical engineering skills at the same time as it allowed me to address one of my passions: the need to protect the natural environment. This was groundbreaking work at the time, and unusual for an engineering department to step so far outside a pure technology focus. I count myself lucky as being in on the ground floor of this type of work.

"My memory of the Department is one of warm and generous people, a strong sense of community, and an absolute commitment to academic excellence. There was also a cheerful hum in the building as people walked, and worked, and shared a coffee or a joke in the communal area. The design of the building had a lot to do with this sense of community – and a lot of light and space made it a special place to work and learn. My previous experience of engineering buildings was one of dark, airless places with echoing corridors and a lot of closed doors."

Stewart has gone on to build a career around her passion, which she credits in large part to her time at UCT: "The teaching, mentoring and friendship of my supervisor, research colleagues and the whole Department are very precious to me and a large part of why I am who I am today. It helped me develop the skills and networks I needed as the foundation on which to build my career."

"I now work in the general field of energy and climate risks, building government policy as well as strategies for large companies, which enable them to address the challenges of climate change."

Alongside her PhD work at UCT, Stewart got involved in a number of significant global networks, including the life cycle Initiative of the United Nations Environmental Programme (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC).

"I was also involved in the Global Mining Initiative's *Mining, Minerals and Sustainable Development* project in a number of different roles, as the chief rapporteur on life cycle assessment for the project, and on a specialist working group surveying the sustainability performance of the sector.

"It was also to the credit of UCT Chemical Engineering that I was chosen as a lead researcher in a multinational project for South Africa's Department of Environment Affairs, focusing on integrating environmental legislation into a single legislative instrument post-apartheid. The high standing of the postgraduate Department in Chemical Engineering at UCT made it possible for me to play a seminal role in these international research processes."

A Department connected to the outside world

The now thriving research scene within the Department coupled with the re-entry of South Africa into the international arena also resulted in a flowering of research connections beyond the country's boundaries. A key development in 1996 was the establishment of a highly successful joint research venture between the CMR and the JKMRC at the University of Queensland, as part of the "AMIRA P9" project.[74] The P9 project is the world's largest and longest-running university-based mineral processing research project and led to a period of rapid growth for the Centre. This was initiated by J.P. Franzidis going on sabbatical to the JKMRC. He ultimately led the P9 project for many years while based at the University of Queensland. Tim Napier-Munn and Cyril O'Connor played an important role in marketing this project to South African mining companies, of which 16 joined as active participants out of 38 globally. The collaboration, which continues to the present day, yielded significant advances in the technology and fundamental understanding of flotation and comminution.

16

The number of South African companies involved in the **P9 project, a globally significant minerals research endeavour.**

According to Napier-Munn, staff and students were constantly travelling between Cape Town and Brisbane, and strong and enduring personal friendships developed, which were crucial to the success of the venture. One such success was the JKMRC-UCT project on the relationship between flotation rate and bubble surface area flux. The work was done by a JKMRC student in Australia, using UCT's bubble-size analyser to determine bubble size in an industrial cell for the first time. "It was a seminal discovery which led to a radical re-alignment of flotation modelling in the AMIRA P9 project," Napier-Munn points out. "And it would not have been possible without UCT's invention of the analyser."[75]

The South African component of the P9 project led to the development of the Collaborative Research Venture (CRV), which was formed in 1998 and consisted of South African mining companies and key researchers, chaired on a rotational basis by one of the member companies. The CRV played a major role in both directing the South African component of P9 research and administering funding from the Technology and Human Resources for Industry Programme (THRIP), which was leveraged from industry funding.

THRIP funding enabled the development of significant capacity within the Centre, particularly in the area of Computational Fluid Dynamics (CFD), Discrete Element Modelling (DEM) and Process Mineralogy. Key industry partners included Martin Wright, Sandy Lambert and Neville Plint (all Anglo Platinum), Bert Knopjes (Lonmin Platinum), Dave Marshall (Impala Platinum), Jules Aupiais (Senmin) and Tony Anyimadu (AngloGold Ashanti). Peter Gaylard and Richard Beck played an important role in managing the South African component of the P9 project. Beck was Chief Consulting Metallurgist at Gold Fields SA (GFSA) at the time, which, with Northam Platinum, put forward a major sponsor and test site for work. "It was only when the project was running, that I appreciated the full value of the work UCT got us involved in," says Beck, who went on to become Research Coordinator and Regional Manager of AMIRA International.

74 Amira is the Australian Minerals Industry Research Association.
75 Gorain B.K,. Franzidis J.P. and Manlapig, E.V. (1997) "Studies of impeller type, impeller speed and air flow rate in an industrial scale flotation cell. Part 4: Effect of bubble surface area flux on flotation performance.", *Minerals Eng.*, **10**(4), 367–379.

Teaching and research:
Two sides of the same coin

1988

The US National Academy of Sciences released the ***Frontiers of Chemical Engineering*** report, which rapidly became known as the **"Amundson" report.**

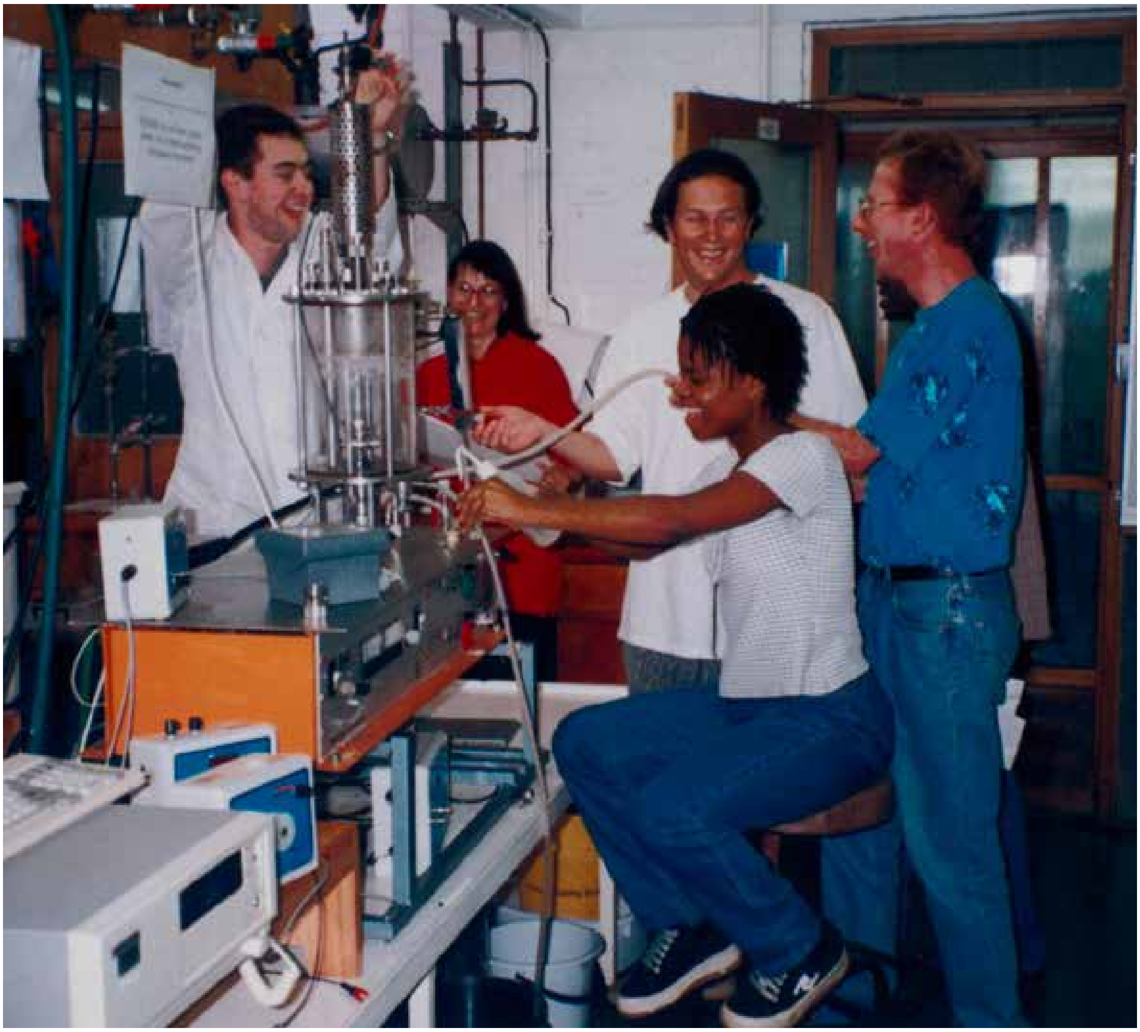
Professor John Martin (DVC Research, left) and Dr Frank Raimondo (CEO of UCT's Organisation for Applied Research), both champions of Chemical Engineering. To the right in this photo is Dave Wright, in his role as UCT Chemical Engineering Advisory Board member.

The growth in research productivity in the Department brought with it an increasing need to expand the curriculum to support that activity. Not only did students need to be prepared for possible research careers as postgraduates, but it was important to develop a contemporary chemical engineering curriculum that fed into the Department's research interests and resonated with South Africa's development needs.

In preceding decades, the Department had trialled a model of major course streaming (late 60s),[76] and a sandwich degree option (early 80s). Neither found traction, for various reasons. The first because it could not keep abreast of the rate of technology deployment in industry. The second because it fell foul of the military conscription demands on many of the young graduates.[77] Few students were willing to shoulder the additional time commitment before they could commence their professional careers.

In 1988, the US National Academy of Sciences released the *Frontiers of Chemical Engineering* report, which rapidly became known as the *Amundson* report after its Committee chair.[78] With a defined focus on research, and not without its detractors globally, the report argued that while the chemical engineering curriculum "core" should not change, its "flavour" needed to do so substantially in order to address growing challenges and opportunities. Obvious connections to energy, systems, materials and biology run through the report. And now, some 30-odd years later, its message has been shown to be prophetic. "Research-led" teaching now carries paramount importance in all leading programmes globally. Those challenges and opportunities resonated strongly with UCT Chemical Engineering.

76 This model was intended to offer a clear delineation between industrial careers and research/academic careers, informed by the notion of being able to differentiate chemical engineering "science" from chemical engineering "practice". It fell away, almost naturally, with the evolution of a semester teaching model.
77 Compulsory for all white males. Over the years it moved from nine months to 24 months plus random camp "call-ups".
78 Amundson, N.R. (1998) "Frontiers of Chemical Engineering: Research Needs and Opportunities", National Academy Press, Washington DC.



A group of postgraduate students in the late 1990s working in the CeBER labs in the old Chemical Engineering building. From left are Clive Erasmus, Donovan Crickmore, Andrew Robinson, and, sitting in front, Malose Mamashela. Lab manager, Debbie Collings, is looking on.

While academic staff were encouraged to pursue their passion for research enquiry, new recruits to the Department learned quickly that teaching responsibilities held primary place in anyone's calendar.

Connecting with students was paramount and seen by many as the defining element of departmental "culture". The Department aimed to be equitable in allocating its teaching responsibilities. Here, too, O'Connor led by example, sharing a similar teaching load to everyone else. The culture of equitable teaching load distribution has continued with subsequent HODs. Most importantly, the fact that UCT actively encouraged academics to reach out to their academic peers and explore opportunities for study and research leave overseas was a major drawcard to attract new Chemical Engineering academics. The Department also had at its disposal a significant bequest to support study and research leave. This immediately benefited the Department: for example, a period of study and research leave at the University of Delaware had brought O'Connor into the orbit of Stanley Sandler, a global leader in teaching of classical and engineering thermodynamics – undergraduate classes in thermodynamics at UCT would never be the same again after that!

Innovations in staffing appointments

"The ability to blend fundamental work with **strong industry application** while providing **first-class education** to a wide range of students is an outstanding achievement."

– Dr Ray Shaw, Director of Minetometal Pty Ltd

Jill Stevenson (right) and Sue Buerger were among the administration and senior research staff recruited in the 1990s. Leslie Petrik is in the background.

To support both teaching and research within the Department, a number of research support staff were recruited around about this time. Many were mid-career women with technical skills and who, for a variety of reasons – including family – had taken a career gap. Often, they returned on a part-time basis to fulfil roles as laboratory technicians, research and administrative assistants. Meg Winter,[79] Linda Harrower, Sue Jobson,[80] Helen Divey,[81] Pam Link, Sue Buerger, Heather Sundstrom, Jenny Wiese, and Lee-Anne Kallam are good examples of this move. Apart from research appointments, the Department saw some significant additions over this period among its administration staff. Most arrivals stayed for a long time, displaying a generous commitment to the Department and to maintaining its culture, namely Nan Simpson, Pauline Bettison, Jill Stevenson, Zedre Hartman and Debbie de Jager. Collectively, these admin and research support staff added much to the Department's culture of inclusiveness. Anyone who has served on the academic staff since the mid-1980s will testify to the huge contribution made by all these women and their contemporaries.

New appointments were also made in this window to both mechanical and instrumentation workshops and all their related support services, without which the rapid acceleration in research productivity would have stalled. Major contributions were made to the Department, both in terms of teaching facilities and research activities by the technical workshop staff, including, among others, Paddy O'Neill, Bill Randall, Ken Wheeler, Richard Gerner, Tony Barker, Rob Senekal, James Daniels, Peter Dobias and Joachim Macke.

As research productivity increased, individual groups sponsored new research appointments in targeted areas. While not intended to be a comprehensive list, it is important to mention Dee Bradshaw[82] and Martin Harris[83] who both joined the Minerals Research Group in the late 1980s. Leslie Petrik[84] , Walter Böhringer, Michael

79 Meg Winter ultimately assumed administrative oversight for all the conferences that the Department has hosted down the years.
80 Sue Jobson has been the chief administrator of the Bio-engineering Research Group for almost 30 years.
81 Helen Divey moved from a minerals research support role to become the Main Laboratory manager until her retirement.
82 Apart from a stint with the JK Minerals Research Unit at the University of Queensland, Dee spent her entire academic career with UCT Chem Eng.
83 Martin Harris is the longest-serving research appointee in UCT Chemical Engineering.
84 Now Professor of Environmental and NanoSciences, University of the Western Cape.

Claeys and Rein Weber joined the Catalysis Group, Harro von Blottnitz joined the Environmental Research Group, and Kim Clarke (*nee Anziska*) joined the Bio-engineering Group.

As the 1990s drew to a close, the Department also made a significant number of adjunct and honorary staff appointments to assist with teaching and research support. Early appointees included Mark Dry (Sasol), who was pivotal to the Catalysis research initiative, Peter Gaylard (BHP Billiton) and Peter Harris (MINTEK)), who both made substantial contributions in the area of minerals processing and spearheaded the Department's taught MSc offerings in this space, Syd Allison (MINTEK), Martin Wright (Anglo American) and Ray Shaw (Rio Tinto). Those whose professional backgrounds were allied to Minerals Engineering were instrumental in the establishment of a graduate development programme for minerals engineers.

UCT was also able to retain the services of several retired Chemical Engineering professors from other local universities. Seddon Harrison and Nico Louw (UCT alumnus) from the University of Stellenbosch provided valuable contributions across the undergraduate curriculum for several years.

Dr Ray Shaw, now Director of Minetometal Pty Ltd, comments that the quality of staff, students and technical output from the Department has been one of its most impressive qualities and will stand it in good stead for the challenges ahead. "The ability to blend fundamental work with strong industry application while providing first-class education to a wide range of students is an outstanding achievement."

Dee Bradshaw engages with final-year undergraduates in research-based teaching.

Leveraging funding to pay for expansion

Few of these appointments were funded by the University's central account. Instead, the money came from the rapidly growing research budget. The Department introduced a novel cross-cutting scheme to finance this cost by tithing all research groups proportionally. By the early 1990s, it was clear that the Department's vitality and viability was underpinned by its research and its ability to inject that excitement back into its undergraduate teaching. The bigger the research group (measured by postgraduate students and research contracts) the more they would be expected to contribute. Without such a scheme in place, it is doubtful whether the Department could have achieved its growth trajectory and been able to sustain it. Two other major funding sources influenced the evolving research profile of the Department.

The UCT Particle Technology Centre was launched in 1994, supported by THRIP funding. At the official launch were, extreme left and right, Dr Simon Nunes and Leon de Jager, both representing the equipment suppliers. Others in the photo are Cyril O'Connor and Jim Petrie (both seated), and Professor David Woods, UCT Deputy Vice-Chancellor.

The first was THRIP (developing Technological Human Resources for Industry Programme). This was a government-led initiative, driven by the Department of Trade and Industry, but managed by the National Research Foundation. Here was an opportunity to leverage industry research income with parallel government funding to support capacity development. This scheme provided a "win-win" for both industry and universities. By the time of its introduction in the mid-1990s, UCT Chemical Engineering was well-placed to access these funds because of its significant applied research base and industry engagements. In the early years of the scheme, the Department's researchers were (by some way) the biggest recipient of THRIP monies nationally, supporting projects across its research portfolio. Perhaps most meaningfully, THRIP provided an opportunity for South African industry to exercise some influence over the country's evolving research agenda. Those academic institutions and programmes with strong industry links could capitalise on this and UCT Chemical Engineering was quick to do so. Catalysis, minerals processing, bio-engineering, energy and environment research activities all benefited considerably from THRIP.[85] The core of a Particle Technology Centre was created on the back of THRIP funding and immediately found value with all research groups.

The second initiative was one internal to UCT. In the early 1990s, UCT began to look critically at modifying the structure of its degree programmes to make them more accessible and coherent, to reduce duplication and overlap, and also to leverage synergies within existing programmes. The architects of this were professors Wieland Gevers and John Martin, both part of UCT's executive team and globally recognised scholars in their fields of medicine and engineering, respectively. They recognised the growing need to promote interdisciplinary research as a key driver for improved coherence. This led to an evolving structure called the "UCT Signature Research Themes" in the early 2000s. Here, too, UCT Chemical Engineering was well positioned to take advantage of this restructuring opportunity, and, over the next decade, saw several of its research programmes elevated to "centre" status, which brought more visibility, more funding and greater prospects for outreach across disciplines.

In the early 1990s, UCT began to look critically at modifying the structure of its degree programmes to make them **more accessible and coherent**, to reduce duplication and overlap, but also to **leverage synergies** within existing programmes.

Martin Williams, a long-serving technical staff member, commissioning new research equipment, circa 2000.

85 THRIP funding has declined in importance in recent years as it has been reshaped by evolving government priorities. It now focuses more on support for SMMEs and the promotion of entrepreneurship.

On the cusp of the new millennium

1996

Vice-Chancellor Dr Mamphela Ramphele sets UCT firmly on its transformation path.

If Carr's tenure as HOD defined the first era of the "modern" department, then O'Connor's input certainly confirmed the arrival of the second epoch. The big difference between the two personalities was in their management style. On Carr's shoulders, in the early 1960s, fell the challenge of steering the resurgence of a revived department within a fairly monolithic university structure, which empowered HODs absolutely and left little opportunity for consultative decision-making. Carr fought tenaciously for the Department's due recognition within UCT, often about academic turf between Engineering and Chemistry – not dissimilar to debates that were taking place globally at the time. The institutional governance model required a singular and unequivocal response, and Carr rose to the challenge. In contrast, in the mid-1980s, while government tried to impose a "top-down" oversight model for universities, UCT itself was encouraging greater autonomy across its structures, and inviting a more participative and collective form of governance. Stuart Saunders, as Vice-Chancellor, was the key driver behind this model.[86] This was the decade in which UCT founded the Academics Association, the rights of professional and administrative staff were enshrined in new workplace agreements, and student bodies led the voices of dissent which rose to challenge the increasingly oppressive government regime.

Against this background, first Hansford, and then O'Connor set out on a new management pathway for the Department which was rapidly growing in student and staff numbers and research productivity. The Advisory Board structure provided a template for consultative decision-making with external stakeholders. Within the Department, O'Connor also ensured that the administrative, laboratory and workshop staff all had a voice in decision-making alongside academic staff. From this inclusive management style, the Department grew from strength to strength having managed to use its culture of innovation and research to imagine how to effect change in its pedagogical and curricular approaches that impacted positively on student success.

On the eve of the new millennium, Chemical Engineering at UCT was ready to change gear, yet again. Specifically, it was ready to embark on an ambitious programme of inclusive education across both undergraduate and postgraduate courses under the new University leadership of Dr Mamphela Ramphele,[87] who assumed the role of Vice-Chancellor in 1996 and was poised to set UCT firmly on its transformation path.[88]

The biggest problem for the Department at that time, as J.P. Franzidis remembers, was a shortage of space. This was being addressed, he says, "by making internal alterations to the building, or appropriating space in other buildings".

While this attested to the success and growth of research in the Department, it was ultimately very frustrating. What was really required was a new and larger building, for which the Department agitated for at least 15 years before this finally came about in 2003. But that's a story for the next chapter.

86 He was supported by an Executive which rallied to this cause: Len Reid as Registrar, followed by Hugh Amoore and a DVC roster which included over that time John Reid, Donald Carr, Martin West, Mike Savage, Wieland Gevers, Dave Woods, John Martin and Mamphela Ramphele.

87 Dr Ramphele was the first woman, and first black African, to be appointed to the role of Vice-Chancellor at a South African university.

88 Dr Ramphele had lived through the "Permit System" which largely denied black students access to tertiary education in courses of their choosing in the 1960s; she was imprisoned at the time of the Soweto Riots in 1976, banned until 1984 to a rural town; and she worked as a labour research advocate at UCT before taking on senior executive roles.

5 RECOGNITION

2000 – 2020

CHEMICAL ENGINEERING TAKES ITS PLACE ON THE GLOBAL STAGE

On the millennium change, the Advisory Board had some words of caution for the Department: "There are critical changes taking place in the external environment that could have serious implications for Chemical Engineering at UCT. The Department needs to start thinking in terms of a response to the pressures and opportunities posed by globalisation (including Africanisation), the unbundling of companies to improve competitiveness, and more. The key challenge going forward will be to produce graduates who are internationally competitive".[89]

The Department has risen to this challenge as it has blossomed in size and stature. The annual Engineering & the Built Environment (EBE) Faculty handbook entries offer an interesting snapshot of how the Department's human resources developed over the past two decades, which mirrored its growth in impact and the consolidation of its capacity. In 2000, the listing of staff took up one page and by 2020 this extended to three pages. In 2000, the Department had two professors and two decades later these numbered 11. Over this period, the number of University-funded academic staff positions had only increased from 12 to 14, but by the end of the period the Department had supplemented this by a further 17 externally funded academic staff positions. In 2000, the Department had three technical staff and two administrative staff listed in the handbook; this has grown to 27 technical staff and seven administrative staff in the present listing.

Former academic staff member, Mark Williamson, teaching Mass Transfer to the third-year Chemical Engineering class.

The Department remains an increasingly vibrant and multicultural place. In 2003, as it made its move into new, expanded accommodation, then Dean Cyril O'Connor remarked that:

"Chemical Engineering is proud of the Department's transformation process that has led to a student body comprising candidates from 17 countries, speaking more than 22 languages. Currently the Department's undergraduate student profile is 75% black, and black African students make up about two thirds of the graduating class. Women graduate numbers have more than doubled in the last decade, and more than one third of the graduate student population is female". Figure 3, on page 128, gives an overview of the racial and gender make-up of the student intake over the full period 2000 to 2020.

89 Academic Advisory Board Report 1999.

Donald Mjonono, who completed his MSc in CeBER in 2019 (with distinction).

In 2000, the **listing of Chemical Engineering staff** in the Faculty Handbook **took up one page** and **by 2020**, this extended to **three pages.**

STAFF AND FINAL YEARS 2011

Back Row: Murray Armstrong, Baveer Doolabh, Jason Nikiforakis, Andrew Payne, Julius Magabane, Hilton Rossenrode, Selelo Koko, Ronald-Phemelo Phefo, Hebert Simbarashe Nyakunuhwa, Lefu Dlamini, André Lubbe, Nathan Rafferty, Matthew Ferreira, Lungisani Mnodwala.

5th Row: Siphesihle Radebe, Xolani Melane, Estelle Mills, Maloba Gerard Tshehla, Farai Takunda Mashayamombe, Ronan Jones, Kreevin Ekambaram, Fadzai Kadzinga, Timothy Arthur, Stewart Buchanan, Craig Zinn, Glen Jansen, Tim Egan, Jason Daniels, Nicole Maduray, Bheka Khumalo.

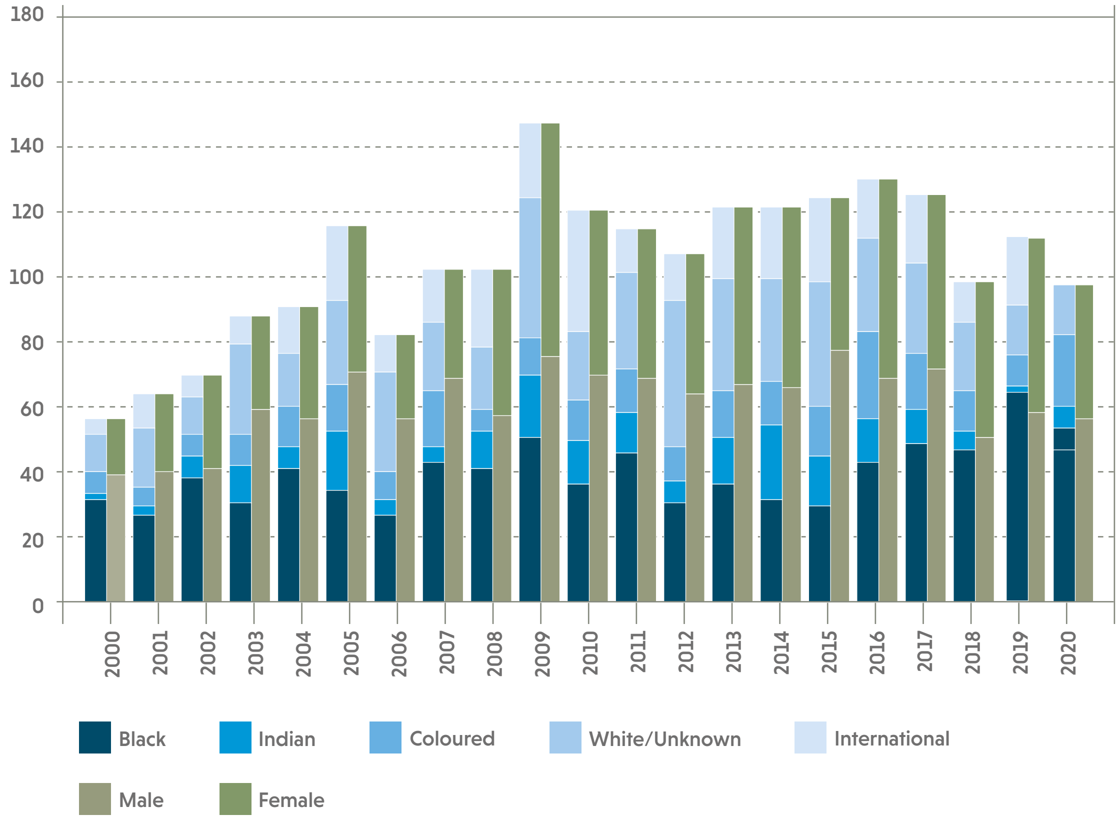
4th Row: Mncedisi Nyaweni, Msawayo Pereira, Faizal Panjwani, Karabo Naleli, Shivashkar Singh, Collin Norman, Tanaka Shumba, Wandile Mamba, Steven Nkadimeng, Mopeli Khama, Rotondwa Radzilani, Sandeep Valodia, Damian Stevens, Julie Broadley, Monde Bekaphi.

3rd Row: Marc Bagley, Tito Sepoloane, Michelle van Ryneveld, Lily Kuiper, Annie Porter, Kelly Whitehead, Susan Taylor, Rizqah Mohamed, Firhaat Abrahams, Thabo Tshelane, Khensani Chauke, Bill Randall, Lindani Chili, Andisani Masindi, Roshan Osman, Walter Böhringer, Lingeka Nelly Dili.

2nd Row: Sairisha Ramnanan, Sharon Wushe, Velani Myende, Philasande Xalabile, Seipati Mabote, Zonke Ntshangase, Selaelo Lekoloane, Nomvuyo Gwiji, Razelle Naidoo, Jacqualine Magodo, Colleen Jackson, Carl Masuret, Leshego Ledwaba, Bridgette Cloete, Ngokoana Modiba, Motena Takalimane, Helen Divey, Catherine Lukwago..

Front Row: Dr Olaf Conrad, Prof J.P. Franzidis, Prof Sue Harrison, Dr Maria Fernandez-Torres, Prof Duncan Fraser, Prof Klaus Möller, Dr Sanet Minnaar, Prof Jack Fletcher, Prof Alison Lewis, A/Prof Jochen Petersen, Dr Mark Williamson, Prof E van Steen, Dr Aubrey Mainza, Prof Dave Deglon, Dr Adeniyi Isafiade.

Figure 3: Department of Chemical Engineering undergraduate student intake numbers and demographics 2000 - 2020



The National Executive Committee of WomEng, a student-driven organisation to promote the participation of women in engineering. Chemical Engineering students have been very involved over the years. Seen here at their annual conference in 2010 are: from left, Mandisa Mazibuko (Civil Eng); Lebogang Mahlare (Chem Eng); Sarah Kiggundu (Civil Eng); Emily Schuiling (Chem Eng); Hema Vallabh (Chem Eng); Sarashree Traci Reddy (Chem Eng); Mabohlale Mampuru (Civil Eng); Naadiya Mosajee (Civil Eng).

A protest during the #FeesMustFall period on the steps of Sarah Baartman Hall continuing a proud tradition of student protests at the institution. The student-led protest movement began in mid-October 2015 in South Africa. The goals of the movement were to stop increases in student fees as well as to increase government funding of universities.

The power of networks and mentors

Dr Marijke Fagan-Endres
BSc(Eng) Chem, 2008; Academic staff member, current

Marijke Fagan-Endres has never strayed too far, for too long, since graduating from the Chemical Engineering Department in 2008. She's been part of the Department's academic teaching team since 2014 and describes it as "a job I love to this day".

I believe it's incumbent on chemical engineering professionals **to be the thought leaders and change implementers** we need to tackle our world's climate emergency.

With a research interest in bioprocess engineering, Fagan-Endres' journey from student to academic took her via the Centre for Bioprocess Engineering Research (CeBER) as a research assistant, before she completed a PhD in chemical engineering at Cambridge University's Trinity College. She came back to CeBER for her post-doctoral studies and from there it was a natural progression into the Chemical Engineering academic team.

Her teaching has focused primarily on courses in reactor design, first-year chemical engineering and final-year design – and it's not lost on her just how challenging the latter can be for the Department's final-year students. She was once one of them herself!

"Some of my best memories of being a student centre around all the crazy classmates who become like family, especially in fourth year when we spent an unhealthy amount of time together down in the Design Studio. And, of course, I remember all the tears during final-year Design."

She believes strong networks are crucial for the future of the Department and for the field: "I have benefitted massively from having strong female role models in the Department and Professor Sue Harrison, in particular, has been a critical network link for me. She connected me with my Cambridge PhD project and subsequently brought me back to UCT.

"I believe it's incumbent on chemical engineering professionals to be the thought leaders and change implementers we need to tackle our world's climate emergency, for which we have massive historical responsibility.

"Maintaining and growing our academic and industry links both locally and internationally is so important because collaborative, relevant and forward-thinking research that can be translated into practice is needed in our field, now more than ever."

Helping others to succeed

Dr Malibongwe Manono
BSc(Eng) Chem, 2010; PhD, 2019;
Academic staff member, current

He has been described as a wunderkind and Malibongwe Manono has indeed achieved much in his 32 years: obtaining a PhD in Chemical Engineering in only three-and-a-half years, teaching himself higher grade mathematics and physical sciences in high school because his school only offered these subjects at standard grade, and becoming the first member of his family to go to university – where he would make the Dean's Merit List at the end of his first year.

It took grit and determination, many sleepless nights and plenty of doubt, but Manono credits the mentors he has had along the way. "The UCT Department of Chemical Engineering is a wonderful place. They really want us to succeed. There is true mentoring and coaching here. Everyone cares about what everyone else is doing because we are ambitious about our outcomes."

Manono could have gone on to work anywhere in the world, but, after a brief stint working in industry, he chose to return to UCT, his alma mater, to become a senior lecturer in the Department of Chemical Engineering. "It's not just about being a black lecturer," he reflects. "In the lecture theatre I seek out the students who are quiet and are struggling. I notice them. Just like I was noticed when I was a student."

Manono was born in Khayelitsha and moved to the Eastern Cape as a young child to live with his grandmother. He returned to Khayelitsha to complete his final three years of schooling at the Joe Slovo Engineering School. After graduating with his Chemical Engineering degree from UCT, he joined ArcelorMittal in Saldanha Bay as a candidate engineer. Two years later, in 2013, he was formally appointed as an engineer in Vanderbijlpark. From here, he went to the Department of Metallurgical Engineering at the Vaal University of Technology (VUT).

There is true mentoring and coaching here. **Everyone cares about what everyone else is doing** because we are ambitious about our outcomes.

When an opportunity came for a contract lectureship at UCT through a Minerals Qualification Authority (MQA) partnership with UCT, he jumped at it even though it was not a permanent position. He soon knew that he had made the right decision. "The support from the Department and the MQA was great, it was clear that this was about developing young academics from disadvantaged backgrounds, to enable them to be highly competitive in this space." He was also able to finish his PhD, which examines water quality in froth flotation.

He sees his future at the Department – and in the lecturing space. "I love seeing the results of students who get the confidence to start engaging. I am very proactive in connecting with class reps and finding out what issues are currently under way in the class. I want to know what's going on because I know I can make a difference."

A new tradition of rotating leadership

Leadership has always been key to the success of the Department. And from the late 1990s, the Department moved to strengthen its leadership structures by adopting a system of rotating three- to five-year headships. HODs are appointed by the Dean with input from across the Department, akin to the US Chair model. This has given senior academics direct exposure to Departmental management, while ensuring that research productivity was not compromised during this period of exceptional growth. The system has worked exceptionally well, in part because of the degree of "buy-in" from all staff to preserve the Department's culture of equity, service and shared common purpose which had been created over the previous decades.

The successive HODs all brought their particular strengths and interests to the role, and their leadership contributions shaped the Department in the new millennium.

In the early 2000s, the Department was led by Sue Harrison, who promoted interdisciplinary research both within and external to the Department. Eric van Steen (2003–2008) oversaw the Departmental move to its new building and was an initial champion of the taught MSc model, which was being promoted by various research groups to strengthen the research preparedness of their PhD students. Jack Fletcher (2008–2012) devoted a large part of his tenure to negotiating the construction of the New Engineering Building (NEB), adjacent to the Chemical Engineering Building, thus ensuring adequate new space for the rapidly expanding and changing Chemical Engineering programme. Alison Lewis (2013–2015) oversaw the introduction of the new curriculum and strove to develop a more coherent professional outreach agenda for the Department as a whole. Van Steen, in his second stint as HOD (2015–2018), steered the Department through the #FeesMustFall protests, by engaging students directly and seeking their commitment to the programme. He also completed the curriculum upgrade started by his predecessor. And most recently, Aubrey Mainza, who took over the role in 2018, has focused his headship on student mentorship while ensuring continued research prominence. All have been committed to staff development and to improving academic success rates.

The Department's weekly academic staff meeting is considered a real strength of its inclusive style and sense of community.

To address the growing complexity of managing a rapidly expanding department, the Department built significant administrative support structures and successive HODs played important roles in innovating and strengthening how these worked. In addition to the role of Director of Undergraduate Studies, the Department introduced the role of Director of Postgraduate Studies, and successive academic staff have made strong contributions in managing the increasingly complex programmes in both these domains. The Department has retained its weekly academic staff meeting, which is considered by many to be a real strength of its inclusive style and of its community. Eric van Steen added to this a regular general Departmental representative meeting that now also deals with issues such as the building, space, safety, finance and administration. Representatives of the various groupings within the Department, academics, administrators, technical people, postgraduate students and postdoctoral fellows serve as the core group for this meeting.

Following the end-of-year tradition; the Department letting its hair down against the hallowed backdrop of Newlands cricket ground: Duncan Fraser, Granville de la Cruz, and J.P. Franzidis in 2013.

Celebrating Graduation 2016 from left, Megan Becker (Associate Professor in Chemical Engineering, Lucy Little (graduand), Jenny Wiese (now retired longstanding technical staff member in the CMR), and Aubrey Mainza (current HOD of the Department of Chemical Engineering).

A Department shaped by its people

One of the extraordinary features of the Department over its lifetime has been the length of association that many staff have with it. This is due, in part, to the effectiveness of the leadership and support structures it has put in place. A significant number of staff have served most or all of their careers in the Department. The salary subventions no doubt also played a role in retaining people, but there are many other reasons that people choose to stay. Over the decades, many academic staff came into the Department early on in their careers, and in its environment, they flourished and became intellectual and academic leaders in their field at UCT and internationally. Donald Carr's example in this regard was followed by Cyril O'Connor who had taken on the Deanship of the Faculty in the 1990s, and subsequently served as Acting DVC. In the new century, the Department delivered two more leaders to the institution, with Alison Lewis as Dean from 2015 to the present and Sue Harrison as Deputy Vice-Chancellor from 2019.

The Department also evinced a tradition of "boomerang" careers with academics returning to its fold after some time abroad. These include Jack Fletcher, who had returned from an industrial research career in Germany in the late 1990s; J.P. Franzidis, who returned from the University of Queensland (UQ) in 2007; Dee Bradshaw, who also returned from UQ in 2015; and Jim Petrie who, on retirement from the University of Sydney in 2007, returned to an honorary position.

Funding from the **Minerals Qualification Authority (MQA)** has been instrumental in boosting academic recruitment within the Department.

Nelly Dili, for many years the welcoming face of the Department for all visitors.

In this period, the Department both broadened and diversified its university-funded academic staff complement, and significantly increased its research staffing complement.

Academic staff alumni over this period include Stephanie Burton (2001–2009; PhD Rhodes); Paul Musonge (2002–2006; PhD Imperial College); Aninda Chakraborty (2004–2006; PhD University of Illinois); Randhir Rawatlal (2005–2014; PhD University of KwaZulu-Natal); Sanette Minnaar (2009–2012; PhD University of Free State) and Linda Kotta (2006–2011; PhD UCT). They represented a mix of entry-level and mid-career appointments. Their research productivity helped consolidate existing research thrusts and strengthened interdisciplinary linkages. In some instances, they also brought in fresh research impetus. For example, Burton brought to the Department a new set of research focus areas to complement the existing bioprocess engineering research focus and capacity namely, bio-catalysis and bio-transformations. Perhaps the most productive and widely recognised focus area of research she spearheaded during her tenure at UCT was on a group of oxidising enzymes, which are known for their unique capacity to catalyse oxidation reactions, and their ability to support novel products with beneficial properties such as antioxidants and nutraceuticals. After leaving UCT, all but Chakraborty and Minnaar have continued to pursue academic careers.[90]

90 Burton, DVC at University of Pretoria; Musonge, Durban University of Technology; Rawatlal, UKZN; Kotta, University of Sheffield, UK.

Hilton Heydenrych (right), one of the many BSc Chemical Engineering graduates turned academic staff member, sits with with CeBER postgraduate student Rony Azegele in the Chemical Engineering Library.

Many of the new academic staff recruited in the last decade were graduates of UCT Chemical Engineering and are still in the Department in 2020. They include Hilton Heydenrych (BSc(Eng) Chem, 1990 and MSc(Eng) Chem, 2001), who came into an academic development lecturer position following a period of contract lecturing and has gone on to play a key role in the undergraduate programme; Marijke Fagan-Endres (BSc(Eng) Chem, 2008), who joined the academic staff on completing her PhD in bioprocess engineering at Cambridge; and Malibongwe Manono (BSc(Eng) Chem, 2010) who was appointed through a Minerals Qualification Authority (MQA) contract lectureship and thereafter to a permanent academic staff position. Thabo Mokone joined after having completed his PhD in hydrometallurgy in the Department in 2010.

A key focus in the past two decades has been on the recruitment of black South Africans into academic positions. Here the MQA assisted with generous funding of contract positions. Another MQA recruit who is now in a permanent position is Tokoloho (TK) Rampai, a materials engineering researcher who specialises in ceramics, who was appointed shortly after registering for her PhD in the adjacent Department of Mechanical Engineering. "It was my dream job," she remembers. "It turned out to be a great marriage of all the things I needed – metallurgy, a research-focused position, and teaching – I love teaching. I thought it would take 10 years to get this, but it came when I had only just started my PhD."

Rampai's research has taken her in unexpected directions, too – specifically to the South Pole – as part of a team of global researchers to study winter conditions in the Southern Ocean and Antarctica's sea ice. They needed someone skilled in modelling materials, she explains. And now she is finding herself taking a sabbatical to learn how to be a glaciologist! By so doing, she is pushing the boundaries in other ways: "There are no African researchers currently in this area."

The Department has also been successful in recruiting young Africans to permanent academic staff positions after they attended the University to further their studies. These include Adeniyi Isafiade (Nigeria), whose research interests lie in process modelling and optimisation, and Aubrey Mainza (Zambia) and Lawrence Bbosa (Uganda), both of whom are minerals comminution researchers. The Department also continues to recruit academics internationally, examples being Pieter Levecque in reaction engineering and catalysis, and Siew Tai, in bioprocess engineering. A full staff list for 2020 is included in Appendix B.

Lecturer Tokoloho (TK) Rampai teaching undergraduate students in one of the new Snape lecture theatres.

Jessica Heynes and Busisiwe May, both technical staff, working with the SpectrAA atomic absorption spectrometer in the Analytical Lab.

Chemical Engineering PhD graduate, Dr James Mwase, with supervisor Jochen Petersen after the June Graduation in 2016.

All of these new, young recruits speak to the support and encouragement that they have received from colleagues in the Department, as well as to the broad collegiality that is a hallmark of Chemical Engineering at UCT. Says Lawrence Bbosa, who first came to the Department as a postgraduate student: "There was a level of closeness and familiarity which was very enjoyable and led to many of us getting to know one another and becoming very good, close friends. Later on, as I became an academic, I learned that this was part of the culture of the building because the academics regularly met at the Friday staff meeting and tried to associate as much as possible during teatime breaks, which were very much ingrained into the Departmental culture. I have found that to be something I have appreciated over the years."

Other significant factors for these young academics is that the Department is well known internationally and that they are given a lot of freedom once they get there. "You are not forced to join a particular research group. You have the freedom to pursue problems that interest you and you think are important. To become really good at the things you are good at," comments Isafiade.

Global perspectives grounded in Africa

Mondli Guma
BSc(Eng) Chem, 2006; MSc(Eng) Chem, 2010

Mondli Guma credits the UCT Department of Chemical Engineering as a foundational influence on what has flourished into a global career with a proud "Afropolitan outlook".

"By far, the most impactful consequence of my time at UCT was the opportunity to not only conceptualise, but to actively pursue a truly global and multi-faceted natural resources career," he says.

MtM's **multi-disciplinary research approach** encouraged me to think beyond the technical engineering career domain.

"My first trip abroad ever was through the Department's International Travel Scholarship. This afforded me the opportunity to spend my third-year undergraduate summer break at Australia's University of Queensland as part of the Department's partnership with the Sustainable Minerals Institute, alongside other partnerships with some of the best minerals processing research institutions in the world." Opportunities like that do not come along every day!

Guma's postgraduate studies, as convened by the Department's signature Minerals to Metals (MtM) initiative, expanded his professional horizons even further. His research investigated a systems approach to developing minerals beneficiation flowsheets for eco-efficiency.

"MtM's multidisciplinary research approach encouraged me to think beyond the technical engineering career domain to engender a much broader systemic perspective of the world of natural resources. This continues to shape my career outlook today."

After various roles with Anglo American, Guma went on to study an MBA at Harvard Business School, followed by two years at Morgan Stanley's EMEA Natural Resources Group in London. He is now Group Corporate Development and Strategy Manager for Vivo Energy plc.

To him, UCT Chemical Engineering remains "a beacon of education and research within Africa's premier higher education institution" and his links with the Department remain strong.

"I have kept in touch with my research supervisor, Professor Harro von Blottnitz, throughout my career. Not only has he provided valuable insights on key sustainability themes that have in part informed my career decisions, he has continued to directly challenge my thinking and evolve my perspective as an African business professional."

Leveraging an international brand of excellence

Lebogang Mahlare
BSc(Eng) Chem, 2012

Like many young Chemical Engineering graduates, Lebogang Mahlare entered the job market idealistic and with a lot of enthusiasm, but no firm idea of how to channel it.

"After completing my degree, I pursued a career in financial services without much of a clear direction at first. My aim was to utilise a basket of skills ranging from a complex engineering degree to foundations in economics to realise my passion to positively impact the world. The question was 'how'?"

Through a process of deep questioning, Mahlare realised the answer lay in infrastructure development: "It quickly became clear to me that the broader issues of the economy – namely unemployment, water stress, energy insecurity and so on – could be solved through adequate infrastructure development and investment, and that is what landed me in a career in infrastructure finance.

"I'm currently based in New York, having completed my Master's in Urban Infrastructure Systems Engineering and Management at New York University. I'm working for a local utility in a team that finances solar energy, providing financial structuring and modelling to see how solar energy assets will perform over their 20- to 35-year project life."

It's a long way from Chemical Engineering but Mahlare says her time at UCT opened many doors for her and instilled a work ethic that has helped her succeed.

"Many Chemical Engineering alumni will remember arriving at UCT and having to confront the reality that their marks at university contrasted sharply with their final matric A-grades. It was a rude awakening, but a passageway to lessons of hard work, opportunities for growth, discipline and time management.

Having strong faculty, great support staff and colleagues to lean on **made for an environment that propelled us** to take on a career with the full confidence of a strong name brand, solid quantitative foundations and the **ability to take on the world.**

"Having strong faculty, great support staff and colleagues to lean on made for an environment that propelled us to take on a career with the full confidence of a strong name brand, solid quantitative foundations and the ability to take on the world."

A new and award-winning home

2003

The **Department moves to its third home**, the new **Chemical Engineering Building** that integrates it more closely with other engineering departments.

Following exceptional growth in student numbers at both undergraduate and postgraduate levels, growth in staffing and growth in externally funded research, the Department found itself facing significant space challenges as the new century opened. The 1960s building was bursting at the seams and various spill-overs had already occurred. By the early 2000s, Chemical Engineering was occupying space across three distinct precincts on Upper Campus. At the same time, the Department was supporting teaching laboratories at the two technical universities in greater Cape Town.[91] Additionally, human resource shortages in the Department meant it needed to recruit more people, but it had nowhere to put them. It was time to move.

By early 2001, UCT had produced an "architects' brief" for a new, and self-contained Chemical Engineering building. Much was made in this brief of "the campus context" and the desire to see Chemical Engineering more closely integrated with the other Engineering departments. It had remained a challenge for decades that Chemical Engineering was physically more closely aligned with Chemistry than it was with Engineering on the Upper Campus.

While a new building alone could not overcome all the Department's constraints, the brief took many ideas which had had helped create the distinctive North Lane space and positioned people front and centre.[92] Key requirements were to integrate dynamic research activity within a stimulating teaching facility and to ensure ready student access to academic staff through an inviting open-plan space that actively fostered collaborative and interdisciplinary research. The aim was to create a unique sense of identity, which would resonate with all occupants and maximise the "living laboratory" feel of the place.

91 The Cape Technikon (city-centre based) and the Peninsula Technikon (adjacent to UWC in Bellville) were subsequently merged in 2005 to form the Cape Peninsula University of Technology (CPUT). This chemical engineering collaboration emanated from the Western Cape Mineral Processing Initiative.

92 For those unfamiliar with UCT's geographical footprint, the Chemical Engineering move from its North Lane location to its new home on South Lane in 2003 might suggest a bigger reach than intended. The two roads are only 100m apart, running east from Ring Road, renamed in 2014 in honour of Nelson Mandela as Madiba Circle.

The architects aimed to create a **unique sense of identity** which would resonate with all occupants and maximise the **"living laboratory"** feel of the place.

The formal sod-turning ceremony to launch the creation of a new building for Chemical Engineering in 2002. From left, an unnamed praise singer; Jack Fletcher (in-house project manager); Sue Harrison (HOD Chemical Engineering); Cyril O'Connor (Dean of EBE); Professor Njabulo Ndebele (UCT VC); Dave Deuchar (Anglo American, retired); and Donald Millwood (Tshikululu Social Investments, Anglo Chairman's Fund).

The architects' execution of this vision was groundbreaking and its design received an Award of Merit from the South African Institute of Architects. In addition to state-of-the-art research facilities, the new building also embodies the Department's commitment to undergraduate education. The ground floor houses an Experiential Learning Facility, which has the capacity to demonstrate the core learning elements of chemical engineering practice in a direct manner. The strong link between research and teaching and learning ensures and delivers a detailed understanding of developing engineering technologies, some of which have not yet been adopted in industry. The basement of the building contains the Design Studio, in which final-year students undertake computer-based project work for their final-year design.

What marked the development of the new Chemical Engineering building as unique was the significant corporate funding it received from minerals and mining companies, including Anglo American Platinum, Anglo American, De Beers, BHP Billiton, Lonmin Platinum, Impala Platinum, Anglo Gold and Xstrata. In addition, Anglo American's Dave Deuchar chaired the building committee that assisted with scoping, costing and financing the project. An essential element of the building's location and design was the recognition by UCT's Spatial Planning Unit that the new Chemical Engineering building should serve as a natural starting point for any future expansion of the Engineering precinct. This expansion happened just 10 years later with the commissioning of the New Engineering Building.

Envisioning a new type of chemical engineer

Claire Janisch
MSc(Eng) Chem, 2000

"Why do we have to make things in ways that are destructive to life? Surely, we can design processes that perform the functions we want, without leaving a destructive footprint?'"

That question has become the driving force in Claire Janisch's career. It was the reason she signed up to do postgraduate research in the Department of Chemical Engineering back in 2000 – and that has now expanded into the nascent field of biomimicry. Over time, the question has evolved to be even more ambitious in its scope. She's now asking: "How can we make things in ways that nourish life?

"How can a spider spin a material that is stronger than steel (gram per gram) and equivalent to Kevlar in strength and flexibility, yet make it using benign materials (insects and water) at such low temperatures – and yet is so life-friendly as a process and product?'"

Having worked in the field of biomimicry for over a decade, I now know **it's completely feasible for us to meet all the functional needs** of products and processes in **ways that nourish life**.

After a week-long biomimicry immersion in the Amazon rainforest in 2007, Janisch joined the first cohort of the Biomimicry Professional Programme at Biomimicry 3.8 – the world's leading bio-inspired consultancy offering biological intelligence consulting, professional training and inspiration.

She remembers her time at UCT Chemical Engineering as a foundational step in her search for new ways of thinking about the subject: "The Environmental Process Engineering Research Group I was part of at UCT was pioneering a new way of considering the role of chemical engineering in minimising our impact on the environment.

"It was an important grounding for me to explore all the ways we could reduce our footprint and that eventually sparked a new enquiry: can we leave a regenerative footprint, rather than just reduce a negative one? The people and networks I interacted with in and around Cape Town and in the Faculty led me to these deeper questions. Cape Town is a place that sparks innovative thinking."

Janisch believes a regenerative type of engineering is possible and hopes this vision will shape how the field develops over the next 100 years: "Having worked in the field of biomimicry for over a decade, I now know it's completely feasible for us to meet all the functional needs of products and processes in ways that nourish life – where plastics are food for aquatic creatures, where agriculture is regenerative and where cities provide valuable ecosystem services."

The power of a focused mindset

Mpumelelo Mhlongo
BSc(Eng) Chem, 2016; PhD, current

Mpumelelo Mhlongo is not your average PhD student. In fact, "average" is not a word you'd ever use to describe this paralympic world record holder who's balancing a career as a global entrepreneur and athlete with PhD studies in Chemical Engineering at UCT.

Mhlongo currently holds the world record in the 100m, 200m and long jump events in the T44 class and walked away from the Dubai 2019 World Championships with two medals – making him the best-performing South African athlete of the tournament.

It's not been easy juggling sport and studies, and Mhlongo credits support from the Department for seeing him through his undergraduate years: "Fourth-year Design was definitely one of the most unbearable and remarkable experiences of my studies. It was the same year I was preparing for the Rio Paralympic Games and I spent more time competing in international competitions than I did back home in the design lab.

"The Chem Eng family (staff and friends) kept me in check every step of the way to finish off the year with success. It did require endless nights with no sleep in the Design Lab and short-term memory loss for basic necessities such as eating."

Mhlongo has since started a healthcare company serving hospital groups around the world and has just entered the South African market – he's also on track to complete his PhD in 2021.

"UCT, in particular Chem Eng, has been essential to my career evolution – from having the necessary skillset to be both a global athlete and entrepreneur, to the ability to draw on an international network of people and businesses. The single most valuable attribute I received from UCT is the power of a focused mindset with a global and sustainable perspective."

The Chem Eng family (staff and friends) **kept me in check every step of the way to finish off the year with success**. It did require endless nights with no sleep in the Design Lab and short-term memory loss for basic necessities such as eating.

Mhlongo's inspiring journey is far from over, and he sees a future supporting other African entrepreneurs and young leaders to succeed: "Africa is the youngest continent with an average age of 19.7, yet an average leadership age of 77. My hope is that the Department keeps incorporating a leadership aspect into the curriculum that links the content you learn in lectures to the place it can strategically occupy on the continent.

"In my own future I hope to bridge chemical engineering principles and business management systems to create a new wave of entrepreneurs who are set up for success in Africa."

The New Engineering Building

UCT's strategic development plan from the early 2000s committed to an increase in engineering candidates (across all disciplines) of 3.5% per annum over a 10-year period leading to 2020. This projected growth paralleled the national imperative for more engineering professionals. The new engineering graduates were envisaged to be drivers for innovation and entrepreneurship, while simultaneously continuing to support South Africa's traditional chemical process- and resource-intensive industry base. Many have done just that. This steady expansion meant that the 2003 Chemical Engineering building was quickly stretched to capacity necessitating further expansion.

The New Engineering Building (NEB), which was occupied in 2013, has served as a valuable shared space for the UCT Faculty of Engineering & the Built Environment, providing the extra space needed for Chemical Engineering staff, as well as a home for the Aaron Klug Centre for Imaging and Analysis, which is administered by the Faculty. The combination of Chemical Engineering and NEB spaces have alleviated space constraints for the Department over the foreseeable future, even taking into consideration likely growth across all programmes.

At the time of planning for the New Engineering Building, the prediction was that the **Department's annual intake would grow by 5%**

At the time of planning for this latest building, the prediction was that the Department's annual intake would grow by 5%, and that there would be 450 undergraduates and 130 postgraduates in the programme within 10 years (by 2014). The Department met this target and surpassed it. The undergraduate body has continued to grow to such an extent that most lectures now take place in the new Snape Teaching and Learning Facility, which is directly linked to the NEB, and hence to Chemical Engineering.

The 2013 New Engineering Building expansion (pictured above and on the next page), and the 2003 Chemical Engineering building before it, have attracted significant praise from visitors from all over the world as among the finest chemical engineering facilities to be found anywhere.

The quad in front of the New Engineering Building featuring the artwork *Mechanical Man* by Lippy Lipschitz.

The road less travelled

Heather Coombes
BSc(Eng) Chem, 2003

Heather Coombes is proof that sometimes the unconventional path is exactly the one you are meant to take. She recalls her journey in Chemical Engineering at UCT with a degree of humour, describing it as "the scenic route". "I managed to fail two subjects in my third year, pushing me into a five-year degree. This was truly devastating at the time, but it turned out to be the best thing for me. I took a few extra medical-related courses and I had more time to get involved with what the university had to offer."

Coombes graduated with a desire to enter the field of biomedical engineering, but was told it couldn't happen without a mechanical or electrical engineering background. Not one to be easily dissuaded, she did some research on biomedical engineering companies in South Africa and landed a meeting with a biomedical engineering company manager. It was a meeting that changed the course of her career. "My intention was purely to find out what the view was in the field and if I had any options. I arrived wearing a t-shirt, shorts and flip flops, only to meet the MD of eight biomedical engineering companies. He offered me a job and I started working two weeks later."

Years later, Coombes was contacted by a team of researchers at the UCT Medical School in what turned out to be another career-defining moment: "They asked if I would be interested in starting up a company developing heart valves designed specifically for poorer nations. We're aiming to address rheumatic heart disease, which can create an autoimmune response that destroys your heart valves in five to 15 years."

She believes her undergraduate studies played a pivotal role in shaping her approach to problem-solving: "Chemical Engineering taught me how to think laterally and to stay focused on the problem; how to identify and concentrate on the core issue. These are skills I use every day."

Always striving to do better

Simba Nyakunuhwa
BSc(Eng) Chem, 2011; MSc(Eng) Chem, 2019

Simba Nyakunuhwa is both pragmatic and determined, so it's no surprise he's gone on to enjoy a successful career as an engineer with mining giant Anglo American. And he's used his two degrees from UCT to propel him forward each time.

"I first joined Anglo after graduating with a BSc in Chemical Engineering in 2011 and progressed up to senior metallurgist level. I then went back to Chemical Engineering to complete my Master's in 2019, rejoining Anglo as a technical specialist."

Describing his BSc as the "backbone" of his career, Nyakunuhwa also credits the broader UCT experience for his professional success: "The linkages and synergies built during my time at UCT continue to play a significant role in my career development and my exposure to influential networks."

"Graduating with two degrees in Chemical Engineering from the best university in Africa is a memorable experience and it always gives me the motivation to strive to do better at home, at work and everywhere I am."

Drawing on his practical industry experience, Nyakunuhwa believes the three most important strategic priorities for the Department going forward should not lie in technical knowledge alone, but in real-world skills like problem solving, change and risk management, and teamwork.

Above all, he says it's his laser focus on "fundamental and practical problem solving" that will continue to shape his own career and, hopefully, the chemical engineering professionals of the future.

Orienting
towards Africa

One of the important forces shaping the growth of the Department in this period has been the continued push to align chemical engineering education with the aspirations of the newly democratic South Africa.

Professor Njabulo Ndebele succeeded Dr Ramphele as UCT Vice-Chancellor in 2000. He brought to his role an explicit commitment to strengthen UCT's links across Africa. That mandate was reinforced by subsequent VCs with the appointment of Dr Max Price in 2008 and Professor Mamokgethi Phakeng in 2018. During Ndebele's tenure, UCT set out to address its global standing, including through its relationship to the rest of Africa. A university founded on colonial structures was readjusting its focus to serve its postcolonial mandate.

UCT Chemical Engineering's efforts in this regard were well under way at this point. Its undergraduate programme had always had Zimbabweans enrolled in it and this cohort had grown substantially and become more racially representative during the 1990s thanks in part to initiatives such as the University Science, Humanities, and Engineering Partnerships in Africa (USHEPiA) launched by the University in the 1990s to bring African scholars to UCT for higher degrees, as a way of enhancing academic staffing capacity. The Department's collaborative minerals research programmes had enabled it to bring in a growing number of postgraduate students from other African countries, a trend which continues to this day. Some were new graduates; others were mid-career professionals. The Department and the University were rapidly gaining in global standing. As the absolute number of South African students was increasing and their demographics changing, so, too, was the number of African scholars who were keen to be associated with UCT Chemical Engineering.

Chemical Engineering postgraduate graduands after the June Graduation in 2016.

A focus on sustainability

2002

New core course called **"Business, Society and Environment"** launched.

UCT's vision statement to be "an outstanding teaching and research university, educating for life and addressing the challenges facing our society",[93] spoke to the challenges and opportunities raised by some on the Chemical Engineering Advisory Board at the time. These included producing engineering graduates who could both fulfil "basic" engineering roles and also aspire to "champion technology innovation and become leading researchers". While those sentiments might reflect the aspirations of chemical engineering programmes globally, the distinct challenges posed to universities by South Africa's pressing development challenges were both obvious and deserving of critical attention.

Harro von Blottnitz, with postgraduate student Nicole Mulenga Malanda, who completed her MSc in Chemical Engineering in 2016.

In 2002, South Africa hosted the UN "Earth Summit" in Gauteng, 10 years after the pivotal summit in Rio de Janeiro. That earlier event had introduced the concepts of climate change frameworks, conventions on biodiversity, and the "Agenda 21" platform to "think global, act local".[94] The UN's Millennium Development Goals[95] of 2000 had further highlighted the need for universities to develop capacity to help address these challenges. The provision of equitable energy and water access, the growing challenges of urbanisation, the need to stimulate an economy with potential beyond the resource bounty of extractive industries, and the need to develop the "next generation" of chemical engineers all came sharply into focus, with UCT wanting to play a leading role in this engagement.

Also in 2002, the Department introduced a core course called "Business, Society and Environment" to its senior undergraduate students, supported by UCT academics in the Graduate School of Business (GSB).[96] This course deliberately elevated the role of civil society to set the parameters for acceptable development in a massively constrained economy, including environmental stewardship. It also started a serious conversation among students, and with industry sponsors, about "licence to operate". Harro von Blottnitz and Environmental & Process Systems Engineering (E&PSE) researchers, working from a systems analysis basis, provided structure to this course via case studies across South Africa's industrial and infrastructural sectors, including minerals extraction and beneficiation, electricity generation and liquid fuels, agriculture, biofuels and food production, textiles, metals-finishing and packaging. Resource recovery, recycling and the provision of secondary raw materials were also important themes, both from wastewater treatment, and from industrial and general solid wastes.

93 UCT vision statement from VC Max Price, 2010.
94 Cheryl de la Rey, then DVC Research at UCT, talked about "UCT wishing to be locally relevant and globally competitive". Professor de la Rey subsequently became VC at the University of Pretoria, a position she held until 2019. She has since been appointed as VC at the University of Canterbury, New Zealand.
95 Repurposed in 2016 to the "Sustainable Development Goals".
96 Nick Segal (a University of Witwatersrand Chemical Engineering alumnus) was GSB Director at the time. Hamieda Brey Parker, a UCT Chemical Engineering graduate from the early 1990s, helped shape and deliver the course content.

From this time, UCT Chemical Engineering began to contribute insights and trained professionals into South Africa's green economy programmes working with government stakeholders and NGOs, as well as industry. As but one example, it now works closely with GreenCape, the Western Cape Provincial green economy sector development agency, which employs a significant number of UCT Chemical Engineering graduates.

Research in the broad energy and environment sphere has been a mainstay of the E&PSE group since the 1990s. Much of this early work was focused on bioenergy, including many studies on sustainability of liquid biofuels, but also laboratory- and field-based research on biodiesel and biogas, as well as on bioenergy supply chain network optimisation. As the evidence increasingly pointed to major sustainability concerns regarding crop-based biofuel production, emphasis shifted to enabling waste-based biogas production to commence in South Africa. Through the years, this research interest has attracted the involvement of other research groups in the Department, covering projects as diverse as the sustainability assessment of bioprocesses, consideration of waste fuels as feedstock for synthesis gas production and acid mine drainage challenges and their impact.

Collaboration with UCT's Energy Research Centre (ERC)[97] also continued, and, in 2020, the ERC's energy systems modelling group was enfolded into Chemical Engineering.

In parallel with this research activity, the Department established the first chemical engineering Master's course on sustainable development, which ran successfully for five years in the mid-2000s. When it became clear that the coverage of this topic in the fourth-year core course *Business, Society and Environment* was best expanded into interdisciplinary postgraduate settings, UCT started offering a range of these Master's courses. Between 2002 and 2005, five academics within the EBE, including Harro von Blottnitz, trialled one such Master's course with the ambitious title *Restructuring Industrial and Urban Systems for Sustainable Development.*

2011

The African Climate and Development Initiative (ACDI) founded at UCT to **promote the significance of climate research** in understanding development imperatives.

EBE was undergoing significant restructuring around this time, motivated in part by the establishment of research signature themes. One such example was the establishment of the African Centre for Cities in 2007, in recognition of the critical role which cities are playing in Africa's development.[98] Von Blottnitz served on its advisory board for its first eight years and championed, among other systems approaches, the value of Industrial Ecology in analysis of development opportunities and their impact. In parallel, the Faculty introduced an interdisciplinary Master's programme in *Urban Infrastructure Design and Management*, to which E&PSE contributed one of the four core courses, on *Sustainable Urban Systems*, evolving out of an earlier course. Over the next decade, this course was taken by over 200 Master's students, many of whom were practising professionals returning to university.

In 2011, UCT founded the African Climate and Development Initiative (ACDI) as a strategic research initiative to promote the significance of climate research in understanding development imperatives. Its mandate, said Dr Max Price, Vice-Chancellor, was to **"**facilitate and substantially extend climate change research and education at UCT with the specific context of addressing the development challenges of Africa from an African perspective**".**

The Department's ability to tap into and contribute to UCT's overall response to sustainability challenges has helped to raise its profile within the University, which in turn has fed back into the research and teaching focus of the Department.

97 This collaboration with the ERC, and its predecessor, the ERI, had been in place since the early 1980s.
98 With Professor Edgar Pieterse as Founding Director.

Consolidating research strengths

The past two decades have seen a consolidation of the Department's research strengths and the emergence of distinct research groupings, many of which have achieved the highest level of recognition from the University and at national level. The Department's 2014 annual report committed it to a conjoint vision of "improved global standing through partnerships", leveraging its research base to the fullest to achieve this. In this, its mineral research links and industrial research connections have proved to be an ideal platform on which to build and achieve that outreach and impact.

Centre for Minerals Research

30

Number of years that Cyril O'Connor directed the CMR before handing over to Dave Deglon in 2013.

CMR staff and students enjoying the Centre's MiniQuiz in 2015.

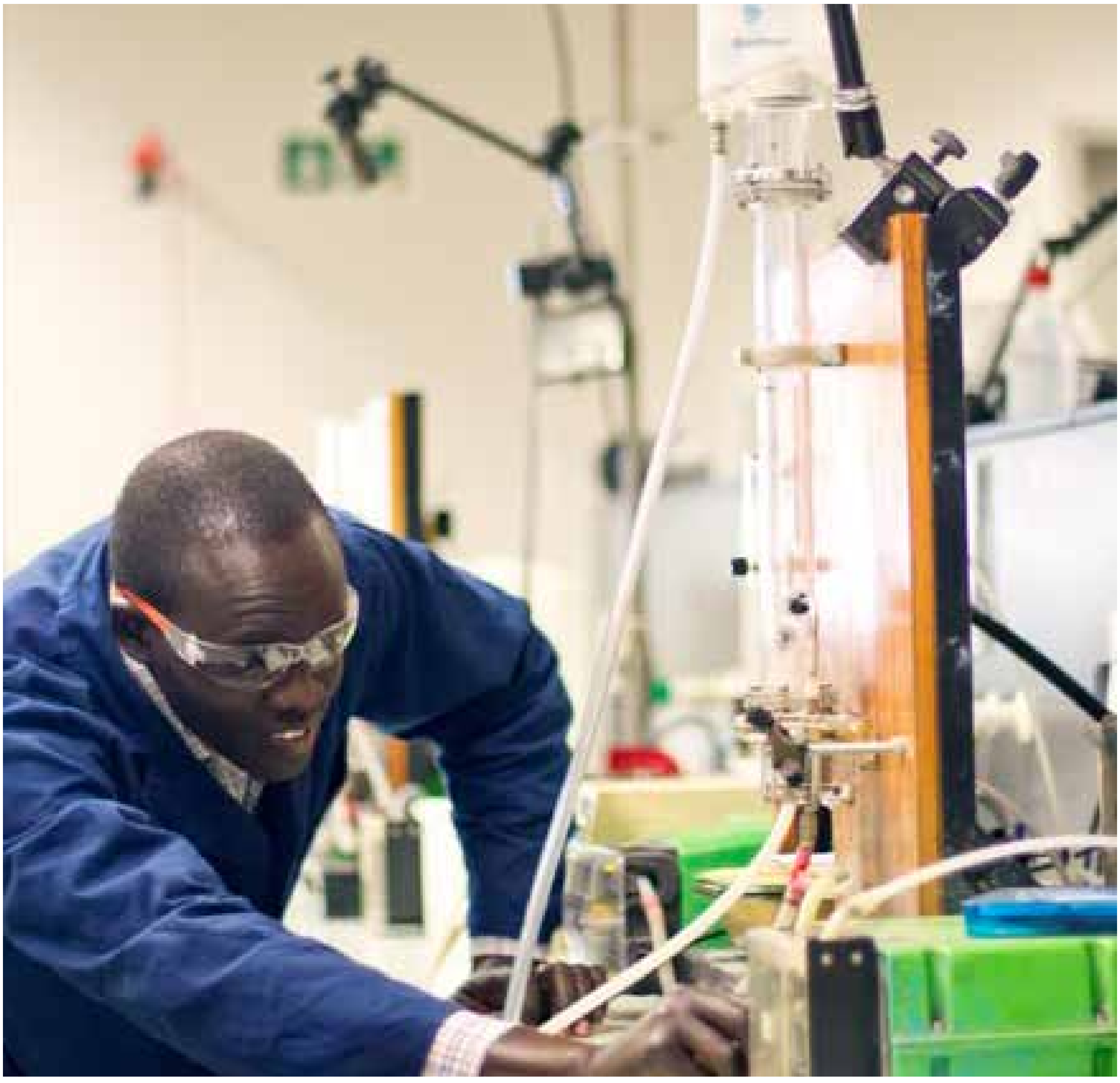
What had started as Cyril O'Connor's flotation research group in the early 1980s had expanded to include comminution in 1997 and process mineralogy in 2004. In 2006, the University recognised this research activity with the status of a centre, and thus was born the Centre for Minerals Research (CMR), now a multidisciplinary, inter-departmental, high-profile grouping at UCT. O'Connor directed the research group for nearly 30 years before handing over to Dave Deglon in 2013, who assumed the Anglo American Platinum endowed Chair in Minerals Processing at the same time. Picking one of a long list of successful associations, Anglo American's Paul Dempsey considers the close collaboration established between the Department and the Sustainable Minerals Institute of the University of Queensland (SMI) as the key to the establishment of the Centre for Minerals Research.

In the early 2000s, research in the Centre was significantly strengthened by the development of a strong process mineralogy activity. This was championed by Dee Bradshaw, who was ultimately recruited by the JKMRC and SMI at the University of Queensland. The process mineralogy activity is now led by her successor, Megan Becker. A key development in this area has been the application of QEMSCAN (Quantitative Evaluation of Mineralogy by Scanning Electron Microscopy) donated to the Centre by Anglo American Platinum, facilitated by Neville Plint and Robert Schouwstra.

The engagement with mining house sponsors has always had a strong component focused on undergraduate education. Students with a bursary from a mining house were required to complete elective courses in the area of minerals processing. To deliver the practical laboratory work associated with these courses, the Western

Cape Mineral Processing Facility (WCMPF) was established as a collaboration with departments at the University of Stellenbosch and the Cape Peninsula University of Technology, funded through the Minerals Education Trust Fund (METF). WCMPF was a highly successful model that "really got things going in mineral processing" according to GFSA's Richard Beck. "The laboratory practicals are planned on a mineral-specific basis where students can see the carry through of the processing of a specific mineral from comminution to extraction."

Another important development in the early 2000s, and one of the most successful and longest running industrial relationships, was the formation of the Anglo Graduate Development Programme (AGDP). The AGDP is a structured, two-year training programme at a level equivalent to a Postgraduate Diploma in Engineering. Key to the effectiveness of the AGDP is the methodology employed whereby the courses are delivered at mine site. The AGDP is more than just an industrial training course and involves a successful combination of training, technology transfer, research and process improvement. The first cohort enrolled in 2004, and the programme has been evolving and improving since, with nearly 300 graduates to date. The AGDP was initiated by Mike Halhead and Peter Charlesworth from Anglo American Platinum and was managed through MPTech. Neville Plint from Anglo American Platinum played an important role in the further development of the AGDP.



PhD graduate Innocent Achaye using a continuously operated bench-scale column flotation cell.

Minerals to Metals (MtM) Research Initiative

Another significant development, enabled by UCT's support for signature themes to promote interdisciplinary research activity, was the Minerals to Metals (MtM) Research Initiative in 2007. Before this initiative was formed, collaboration between mineral-related research groups in the Department had been informal for many years. The MD of Senmin, Jules Aupiais, points out that the pioneering concept of SAMMRI (The South African Minerals to Metals Research Institute), was to ensure cooperation between government, industry and academia on this important aspect of the economy. "The idea was to promote sustainable development of the South African minerals processing industry through the development of globally competitive, innovative technology, driven by people with world class skills," Aupiais says, and Chemical Engineering had the foresight and the vision to make this idea a reality. In many respects MtM provided the model for SAMMRI.

According to its founding director, J.P. Franzidis, MtM "aims to develop solutions focused on enhanced value addition and resource productivity through the conversion of minerals to metals in a manner congruent with providing a sustainable future for African people and their environment".

"I was struck by J.P.'s vision and then **captivated by the magic** being worked by Dee Bradshaw to **turn MtM into something very special** for Africa, a magic tragically cut short by her death in 2018."

– Don McKee, Emeritus Professor, University of Queensland.

PhD candidate, Alex Opitz, working in the CeBER labs.

MtM was set up as a top-end model relying on internationally recognised leadership and a core of active researchers, in addition to a critical mass of participating academics and students, but it has also delivered on the criterion of the "development" mandate, growing a cohort of researchers. MtM connects and incorporates fundamental knowledge and understanding for addressing complex problems of the mining industry at a systems level. It draws on the expertise of five research groups in the Department, combining the ability to work beyond the technical arena with an extensive network of partners and collaborators in other faculties at UCT, in other organisations and institutions nationally and internationally. Its research portfolio is aligned around five higher level themes: mineral value chains, technical innovation, strategic minerals, licence-to-operate and value from wastes, including post-consumer wastes.

A good example of this alignment is MtM's two-year Master's of Philosophy (MPhil) programme specialising in Sustainable Mineral Resource Development. The programme was launched as part of the UN's Education for Sustainable Development in Africa (ESDA) initiative[99] and targets students from all over the world, but particularly from southern Africa. It is offered and delivered collaboratively by UCT and the University of Zambia (UNZA).

University of Queensland Emeritus Professor, Don McKee, who has visited the Department a number of times as a reviewer of the MtM initiative over the last 10

99 The ESDA started as a project of Tokyo's United Nations University Institute for Sustainability and Peace (ISP) in October 2008 to develop and test, with the participation of eight leading African universities, a graduate-level education programme for professionals to be engaged in sustainable development in Africa.

years, comments: "I was struck by J.P.'s vision and then captivated by the magic being worked by Dee Bradshaw to turn MtM into something very special for Africa, a magic tragically cut short by her death in 2018." He expects that the magic "will continue because of the passion of Jenny Broadhurst, Megan Becker and others – and because of MtM's home in Chemical Engineering."

Excellence in catalysis research

In 2006, the same year as the formation of the CMR, the Catalysis Research Group was renamed as the Centre for Catalysis Research. The Centre is currently part of the Catalysis Institute, which was established in 2015.

Research in the Catalysis Group from the mid-1980s had initially focused on propene oligomerisation via synthesis and modification of zeolites. This soon expanded into other areas. With the arrival of Eric van Steen in the early 1990s from the Engler-Bunte-Institute, Fischer-Tropsch synthesis rapidly became one of the major research themes of catalysis research at UCT. This research was initially supported by Sasol in the form of student projects, but in 2000, Sasol and UCT went into a long-term research collaboration. The aim was to support Sasol's own R&D in the development and testing of their Fischer-Tropsch catalysts, as well as to investigate operational problems. The ongoing collaboration is unique in that active research is pursued by both partners to come up with workable solutions for problems at industrial sites. A tangible output of this collaboration has been the development of the magnetometer to monitor, in situ, the degree of reduction of catalysts comprising of ferromagnetic materials. It is a central component in the understanding of the Fischer-Tropsch catalysts (comprising the ferro-magnetic materials, cobalt or iron) under industrially relevant conditions. According to Jack Fletcher, the Sasol–UCT magnetometer development is an exceptional development in industry–university relations. "Sasol supported the financial investment, including ongoing operating costs, while the Catalysis Institute provided the operating personnel. It really could only happen via this relationship – something which required years of earlier collaboration to build sufficient trust on which to found the project. Moreover, the scientific outputs from this project are surely of the best the Institute has ever delivered and akin to the best in the world!"

The focus on the synthesis of liquid fuels increased further when the Catalysis Research Unit became the host of the DST-NRF Centre of Excellence in Catalysis in 2004. C*change is a virtual, national centre comprising research activity across 11 different universities with Jack Fletcher as its founding director. It was one of the first seven centres of excellence to be established nationwide and enabled a widening of research focus in the Department to include not only the direct CO hydrogenation route, but also the subsequent process, wax hydro-cracking. Engler-Bunte-Institute veteran Professor Hans Schulz praises the Centre for "developing innovative on-line catalytic instrumentation, providing internationally highly rated publications, performing outstanding research in excellently equipped laboratories, organising a series of international syngas conversion conferences, serving on boards of international scientific societies and practising industrial collaboration."

2004

c*change, the DST NRF Centre of Excellence in Catalysis is established; **a national centre** comprising research activity across 11 different universities.

Another significant expansion of research activity took place with the establishment of the Hydrogen Catalysis Competence Centre, HySA/Catalysis in 2007. It was established with the overall aim of transforming South Africa from a resource-based economy to a knowledge-based economy, adding value to the country's mineral wealth. The Centre has focused on the development of expertise in the field of electro-chemistry and hydrogen fuel cell testing with a particular focus on the production of the membrane electrode assembly (MEA), a key component in PEM-fuel cells. HySA has established a spin-off company in 2014, to produce and market, in particular, MEAs.

Beyond research, the Catalysis Institute and its predecessors have been involved in postgraduate teaching for catalysis professionals. Here, too, the collaboration with Sasol has been pivotal, with the company seconding personnel to the Department for extended periods of time. This model survived until 2016, after which it was overhauled to include more practical components in the programme.

Much of the success of the Catalysis teaching programme can be put down to the strength of its international linkages. The Catalysis Institute has always been strong in international connections with exchange students from, in particular, Germany and the Netherlands. Today, research students in the Catalysis Institute are regularly performing a part of their studies overseas. Looking to the future, the Catalysis Institute is turning its efforts to greater alignment with renewable energy opportunities including those linked to the hydrogen economy via fuel cell technologies, to utilising wastes as feedstocks, and to greater CO_2 utilisation.

Looking to the future, the Catalysis Institute is turning its efforts to **greater alignment with renewable energy** opportunities.

Nabeel Hussain working in the HySA Catalysis lab.

The Centre for Bioprocess Engineering Research (CeBER)

The goal of the Centre for Bioprocess Engineering Research (CeBER), established in 2008 with Sue Harrison as Director, is to provide for and contribute to South Africa through an advancing knowledge of bioprocess engineering that will fuel South Africa's developing bioeconomy. The Centre's approach strives to contribute to innovative bioproducts focused on health, nutrition and environmental sustainability, the circular economy and resource efficiency, and to drive environmentally sustainable processes and socially responsive solutions in its translation and application.

150

the number of MSc and **PhD graduates** produced by CeBER in the past 20 years.

Research is centred on the fundamental tenets of biokinetics, bioreactor design, bioprocess analysis and an understanding of metabolic processes, often mediated by their modelling, in single culture or mixed microbial communities, with a focus on understanding the dynamics of mixed microbial communities to provide robust process solutions to complex challenges.

Siew Tai, a senior lecturer in the Department.

CeBER's researchers collaborate with colleagues across UCT, including in the Science, Health Sciences, Commerce and Law faculties, as well as the Civil and Electrical Engineering departments within EBE. CeBER has also partnered with institutions around the world in their research around minerals and the sustainable development of mineral resources in which bioprocesses form an essential theme.

A notable early focus for CeBER was to extend its historical research in bio-hydrometallurgy with the establishment of improved heap bioleaching research projects, with partners at CSIRO Minerals in Australia and the University of British Columbia (UBC) in Vancouver, Canada, and the support of six international mining companies. Mineral bioprocess engineering research has gone from strength to strength with the integration of the modelling of the heap bioleach, the understanding of fluid flow, mineral leaching and microbial colonisation as well as biokinetics.

The Centre works closely with the MtM initiative, in collaboration with J.P. Franzidis and Jenny Broadhurst, to study the prevention of acid mine drainage through an understanding of how sulphidic mine waste can be managed in situ. This has expanded into ongoing studies of mine waste minimisation and repurposing, mine water management (focusing on remediation of thiocyanate- and sulphate-contaminated waters), development of post-mining economic potential and the treatment of acid mine drainage by biological sulphate reduction.

CeBER's current algal biotechnology research is focused on low energy reactor systems, upgrading of both metal and nutrient-contaminated wastewater, CO2 capture into biomass and innovative processes for pigments and nutraceuticals. In the health biotech space, its researchers focus on probiotics for skin application and to treat bacterial vaginosis, as well as the development of cancer therapeutics and evaluating scale-up options for vaccine products.

In the commodity bioproducts area, CeBER targets products with potential for enhancing resource efficiency through waste biorefinery, including energy products, platform chemicals and innovative commodity products. In biocatalysis, it works with enzymes required in adding value from lignocellulosic wastes, as well as exploring innovative approaches to alkane activation for resource efficiency and fine chemical products through cytochrome P450 biocatalysis, other oxidoreductases and use of tandem catalytic systems. CeBER is exploring nature-inspired bioprocesses to upgrade contaminated water streams for fit-for-purpose applications, addressing decision making on the selection of water streams for each use and exploring applications to address both organic and inorganic contaminants. This diverse research activity underpins several significant interdisciplinary research partnerships across UCT. These include the Department of Molecular and Cell Biology through the Biopharming Research Unit (BRU); the Environmental and Geographical Sciences Department focused on water; the Department of Immunology on cancer therapeutics and probiotics; and the School of Economics and Faculty of Law on leveraging bio-engineering to help ensure sustainable economies for post-mining communities.

CeBER can point to many achievements over its evolution. Beginning with its bio-hydrometallurgy work, which positions it as a world-leader, it has expanded to recognition in both acid rock drainage treatment and prevention, as well as new approaches to mine waste management. Research into algal biotechnology has led to a paradigm change in the approach to understanding system performance.[100] This algal research is recognised through the filing of three patents over the past three years, alongside a further eight current patents within the CeBER portfolio. But perhaps its greatest achievement is in terms of human resource development, through which it has produced a graduate complement of 150 MSc and PhDs over the last 20 years. It represents a genuine success story for South Africa's national research stimulation initiatives.

Melinda Griffiths, PhD candidate, with her supervisor, Sue Harrison in the CeBER lab.

100 Griffiths, M.J., and Harrison, S.T. (2009) "Lipid productivity as a key characteristic for choosing algal species for biodiesel production", *Journal of Applied Phycology*, 21(5), 493–507.

Crystallization and Precipitation Research Unit

While the large research groups in the Department continue to benefit from clear structural signifiers and scale, enabling their branding as "Institutes" and "Centres", the Department has also seen growth of more technically-narrow research endeavours, which, because of their agility, have been able to forge distinctive profiles in their own right, while also providing direct contributions into some of the bigger groups.

The establishment of the Crystallization and Precipitation Research Unit (CPU) under the leadership of Alison Lewis in 2000 was built on the back of an ongoing collaboration with researchers from TU Delft in the Netherlands.[101] "Although CPU is a very small unit," Lewis remarks, "we are the only such research entity in South Africa with this specialisation and depth of expertise, and thus are the main port of call for research nationally as well as internationally, with a significant amount of our funding coming from international funders."

Established in 2000, CPU is the only research entity in South Africa specialising in crystallization and precipitation and thus is the main port of call for researchers in this field nationally and internationally.

Alison Lewis, left, in the CPU ice lab with students.

101 Lewis, A.E., Seckler, M., Kramer, H.J.M., and van Rosmalen, G.M. (2015) "Industrial Crystallization: Fundamentals and Applications", Cambridge University Press, London.

Despite the narrower technical focus, the number of possible applications is extremely wide, with most major industries (such as pharmaceutical, food, petrochemical, bioprocessing, mining, agricultural, fracking and water treatment) using precipitation and crystallization in some form."

Improving the efficiency of minerals processing processes by developing modern approaches to industrial precipitation, prototyped and implemented with a range of industrial partners, has been a major focus – for example, working with Anglo American Platinum to dramatically improve the recovery of high-value rhodium, and with other industry partners on metal sulphides removal. The second area where this group has been very influential is by shifting the thinking from waste being a liability that needs to be disposed of to being a potential source of revenue and resource recovery.

In the technology development field, the CPU has been most successful with its Eutectic Freeze Crystallization (EFC) project, which has generated national and international media, researcher and industrial interest. Currently, CPU and its industrial partners are commercialising this technology for multiple sites.

Hydrometallurgy Research Group

60

Number of part-time students graduated by the **Hydrometallurgy Research Group**.

Bio-hydrometallurgy heap leaching studies circa 2005, featuring research assistant Kefilwe Ntshabele.

Another technology-focused research effort is the Hydrometallurgy Research Group, which was established formally under the leadership of Jochen Petersen in 2016, building on the collaboration with Geoff Hansford from the early 2000s. It enjoys international recognition through collaborations as wide-ranging as Norway, Sweden and South Korea, mainly in the field of heap-leaching kinetic studies.

These studies were focused initially on using cyanide, then thiocyanate and ferricyanide for the direct leaching of PGMs in heap leaching, with some patented outcomes, as well as copper sulphide ores in chloride and sulfate systems with organic additives. More recent work on ammoniacal leaching of copper and nickel sulfides is central to work on leaching post-consumer e-waste PC boards to recover copper and gold, which has garnered major research funding through the MtM initiative.

The hydrometallurgy research focus also underpinned a taught MSc course with industry participants, supported by Peter Gaylard from BHP Billiton and Professor Mike Nicol from Curtin University in Australia, former Vice President and Director of Hydrometallurgy, MINTEK, South Africa. This course ran from the early 2000s, graduating about 60 part-time students. Driven by industry demands, its model has now changed to more direct research-led project work. As current director of the MtM initiative,[102] Petersen brings his hydrometallurgical expertise to collaborative projects in the areas of rare-earths extraction, alternatives for mercury in artisanal gold mining and comprehensive metallurgical flowsheet analysis of base metals production.

102 Since the untimely passing of Professor Dee Bradshaw in 2018.

Designing a sustainable future

Jane Reddick
BSc(Eng) Chem, 2004; MSc(Eng) Chem, 2006

"UCT Chemical Engineering is in an incredible position to foster and build the next generation of innovative leaders. My vision for our profession is that chemical engineers are considered leaders in innovation and are not afraid to take calculated risks on trying new innovative solutions to the challenges we face."

Jane Reddick has built a career in the green economy since graduating from UCT and completing an MPhil in Engineering for Sustainable Development at the University of Cambridge. She now works as a water sector analyst at GreenCape, a not-for-profit organisation that aims to unlock barriers to the green economy. "I started on this journey when I undertook a Master's in Chemical Engineering in the Environmental and Process Systems Engineering research group at UCT. The Master's introduced me to the concept of cleaner production, and the challenges and opportunities associated with it. After studying at Cambridge, I had the opportunity to gain practical experience across different green sectors. Among these roles, I co-founded a solar PV development company, worked in local government in the UK as a sustainable energy officer and consulted on sustainability and cleaner production in South Africa."

Many of Reddick's colleagues at GreenCape are UCT alumni, too, and the organisation has strong links with the Chemical Engineering Department. Reddick believes this is not by accident. "I have found that employers, clients and other stakeholders hold a degree in UCT Chemical Engineering in high regard, which opens doors. My years at UCT helped me build a strong technical foundation, as well as analytical and problem-solving skills that I have applied throughout my career."

At the cutting-edge of research and innovation

Nicholas Rice
BSc(Eng) Chem, 2012

Despite postgraduate years at Cambridge University, Nicholas Rice claims his formative years in UCT's Chemical Engineering Department are the ones that fundamentally shaped his career in process engineering.

"It's increasingly evident that the core, hard-engineering skills taught in the undergraduate programme at UCT have been critical to both my research career and my current engineering role.

"The work ethic the programme required is also instrumental in giving me a sense of how hard I can push, and what things are required for successful work and research. I draw daily on the skills, experience, knowledge – even old lecture notes and specific lectures – in order to do the job I'm currently in."

That job is Senior Process Engineer in a UK start-up.

"We're focusing on scaling up a proprietary fabrication technique for metal-organic frameworks (MOFs), which are a class of high porous solid materials set to become important in many commercial applications, ranging from gas storage and transport to drug delivery."

Rice is tasked with transforming the lab-based synthesis into a licensable, industrial-scale manufacturing process and believes much of the future innovation we need to see in the world will call upon the unique skills of chemical engineers.

Expanding
research capacity

An influx of research funding in the first 10 years of the new century has played a crucial role in enabling the Department to grow postgraduate enrolments and appoint honorary and adjunct staff to drive the research agenda. In 2017, a detailed cohort analysis covering the years 2005 to 2016 was conducted to evaluate the progress of postgraduate students. Total enrolment was in the order of 160 to 180 postgraduate students over this period, of which around 45% were PhD students. While a "steady state" between intake and graduation has been achieved with MSc students, the PhD cohort is still growing. The generous and sustained funding by industry partners has been an important thread through the Department's history, as well as the leveraging of opportunities coming through the State. One initiative that needs a special mention is the Department's exceptional record in garnering SARChI chairs. In 2006, the South African Research Chairs Initiative (SARChI) was established by the Department of Science and Technology (DST) and the National Research Foundation (NRF). The chairs are held by individuals in recognition of their global research standing and relevance to South Africa's development. Their purpose is to strengthen the ability of public universities to produce high-quality research and nurture students. The programme also recognises the interdependence between teaching and research. UCT Chemical Engineering has been successful in securing four such appointments:

SARChI Research Chair in Minerals Beneficiation:
J.P. Franzidis (2008–2014)
Jochen Petersen (2015–interim chair)
Dee Bradshaw (2015 –2018)
Jochen Petersen (2018–)

SARChI Research Chair in Reaction Engineering:
Eric van Steen (2018–)

SARChI Research Chair in Bioprocess Engineering:
Sue Harrison (2008–2019)
Jenny Broadhurst (interim 2020–)

SARChI Chair in Nano-materials for Catalysis
Patricia Kooyman (2015–)

UCT's Vice-Chancellor, Momokgethi Phakeng, snaps a "selfie" with Chemical Engineering PhD graduate Malibongwe Manono in 2019.

Staff and students mingle in the new Chemical Engineering Building.

The influx of external funding for research activities enjoyed by the Department in the past decade or so has had a significant impact, not just on postgraduate education, but also at the undergraduate level.

From the 1990s, the Department had begun to offer teaching opportunities to its senior research staff and made it possible for them to be promoted through the academic ranks, which further strengthened the research/teaching relationship. In 2002, the Department created a system of one-year contracts to facilitate postgraduate students being involved in teaching in a formal manner. In addition, the Department appointed junior lecturers on a part-time basis to build out its teaching capacity in specialised areas. These are all examples of appointment innovations which the Department has pursued in order to both showcase specialised teaching focus areas and build capacity through the next generation of academics.

The Department has continued to host outstanding engineers and scientists as they work actively in the Department as honorary members or adjunct professors following their professional retirement. Many have demonstrated that an association with UCT Chemical Engineering rapidly becomes an allegiance, and, for some, a binding commitment. In addition to appointments made in the late 1990s, the Department welcomed John Raimondo (African Environmental Solutions) and Dave Wright (ex Engen/Petronas) as honorary professors. Wright served on the Advisory Board, and continues to shape the final-year Design capstone course. He recalls that he "asked what an adjunct professor's job description is and was told by Jack Fletcher, who was HoD in 2012, that it is 'whatever the HoD wants you to do!' I am pleased to say my contribution to the Department has always been on a mutually agreed basis!"

A new curriculum for a new millennium

2006

Second **Education Development Officer** post established with funding from Xstrata.

2011 field trip to a local wastewater treatment plant near Strandfontein. The second year field trip is a highlight of the undergraduate curriculum.

Since its inception, the Chemical Engineering curriculum has been continually re-evaluated in terms of its content and efficacy. All the teaching and learning innovations at undergraduate level that the Department has championed in recent times have been focused on graduating engineers who could take up entry-level positions in industry and, equally, could grow into research and academic careers at the forefront of their discipline. (See Appendix C to view the 2020 curriculum).

At the start of the new millennium, South Africa's engineering education stakeholders had begun to recognise that the professional development of its young engineers could benefit from additional focused training after graduation. As the South African economy was opening up post-1994, globalisation pressures became more acute and national development pressures suggested the need to graduate more engineers. At the same time, employers wanted higher levels of immediately accessible skills. These competitive pressures were keenly felt by the Department, which responded by expanding its work in the postgraduate arena, offering a suite of postgraduate programmes that had components of coursework and were strongly oriented to the workplace.

Pressure was mounting, too, from professional accreditation bodies to focus on "exit outcomes" and "graduate attributes".[103] UCT Chemical Engineering found itself well-positioned to respond to these shifts, having already developed strong in-house capacity in engineering education research and development.

In 2006, the Department established a second Education Development Officer post with funding from Xstrata, a South African minerals company, to further intensify its efforts to improve the academic and career success of students, especially those from a disadvantaged background. Appointed to this post was Linda Kotta, a chemical engineer from the University of the Witwatersrand, who had also completed a Master's degree in engineering education. As a key initiative, she established a second-year field trip aimed at helping students to "transfer theoretical concepts and knowledge to real life problems". This, of course, echoed the field study visits the Department had run in earlier times, but was intended to be more closely aligned with the evolving curriculum. The second-year field trip continues into the present as a key part of the undergraduate experience.

103 The Engineering Council of South Africa (ECSA) had succeeded IChemE in this space, a decision motivated by South Africa's rather unique educational landscape and the evolving needs of local industry. ECSA continued to follow guidance offered by signatories to the Washington Accord.

Curriculum innovation is a key aspect of how the Department conceptualises academic development. In 2007, the Department began discussions around the desirability and feasibility of wholesale curriculum reform for the undergraduate programme. This work picked up in earnest in 2009 and became a focus for Departmental meetings. Initially a small task team led this process but eventually it involved nearly all academic staff in weekly meetings planning out parts of the curriculum. A new first year was trialled in 2013, and the decision was made to roll out the entire new curriculum starting with the 2014 intake. The first graduates from the new curriculum emerged in 2017, a full decade after this work began.

The new curriculum aims to support the academic success of all students, and to increase the relevance of the curriculum with regards to contemporary developments in the chemical engineering profession. Notably, this includes a stronger focus on sustainable development. Ensuring alignment with the Department's professed commitment to "research-led" and "practice-based" teaching and learning has required radical curriculum renewal.

Ensuring alignment with the Department's professed commitment to "**research-led**" and "**practice-based**" teaching and learning has required **radical curriculum renewal**.

Postgraduate workstations are cleverly configured in the new Chemical Engineering building.

The new curriculum is shaped by what the Department discerned to be current best practice in engineering education, customised to fit the particular demands and foci of the UCT programme. It has a "project-centred" structure that involves a spine of project work running from first year through to final year. Core topics are delivered in intensive blocks to allow for student focus and integration with project work. The structure involves holistic assessment across all blocks, with the use of vacation time for supported preparation for supplementary examinations where needed (nicknamed "boot camps"). It builds towards year-by-year coherence and progression through the programme, thereby overcoming obstacles that befell students in previous generations. It also includes a substantially enlarged space for elective topics where students can choose technical focus areas, as well as a targeted engagement with relevant social topics. Many of the personal vignettes in this narrative attest to the value which students, who took longer to graduate than the minimum four years, found in courses outside the engineering discipline, often leveraging that opportunity to directly shape their subsequent careers.

The Department has evolved its system of class representatives, to offer real-time feedback to ensure buy-in as it has innovated its curriculum. The role of academic "Year Advisors" has been expanded further as the new curriculum has been rolled out, involving even tighter coordination between the academic staff delivering the programme. Mentorship takes many forms. Over the last 10 years, the Department has focused much of its efforts in providing support for first-year students, including a highly effective engagement scheme run by senior students and a popular weekend "first-year camp". Here, too, graduates from previous generations might ask (and correctly so), "where were such initiatives in my day?" To which the answer can only be that the Department is a living laboratory. Learning by doing.

2011

Young Engineers Scholarship launched by alumni Harshad Bhikha and Sergio Cieverts.

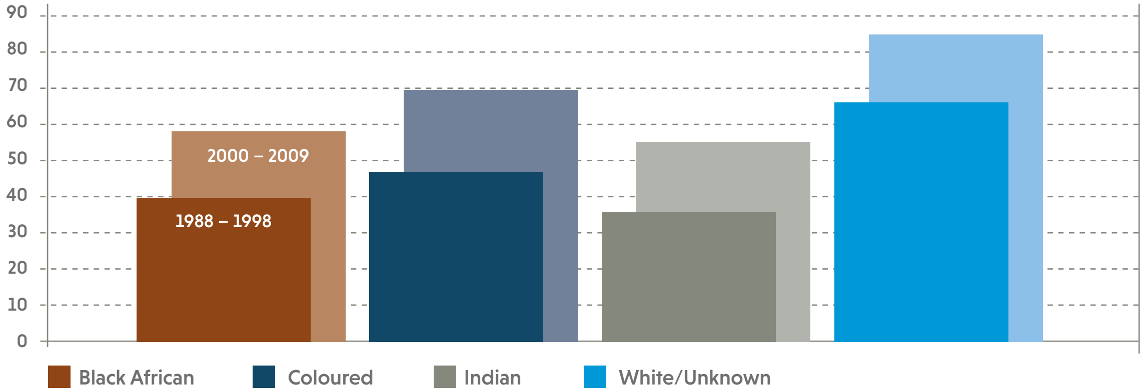
From left, Arthur Mabentsela, an alumnus and contract lecturer at that time, with Marijke Fagan-Endres, Sergio Cieverts and Nandipha Nocuze (two of the co-founders of the YES initiative), and Jenni Case.

A new support initiative is the Young Engineers Scholarship, an alumni initiative that aims to sponsor engineering students who, despite the odds, were able to excel at school and without a scholarship of this nature, may not be able to pursue their dream of studying engineering at university. The scholarship was founded in 2011 by Harshad Bhikha and Sergio Cieverts, both UCT Chemical Engineering alumni, and, over the past nine years, they have sponsored and mentored 15 students across UCT and Wits.

The Department has continued the tradition, started by Duncan Fraser, of closely tracking student success statistics, and has produced various cohort analyses comparing these with Fraser's earlier analysis from 1988–1998. The 2000–2009 analysis is heartening: while some gaps remained, the success rates for all groups had increased impressively, and, overall, 70% of entering students were graduating in the programme, which compared very well both with South African and international statistics (Figure 4).[104]

During the period 2015–2017, the UCT campus community experienced significant student protest action in relation to calls for the UCT-focused #RhodesMustFall and the nationwide #FeesMustFall campaigns, which brought the need to deliver on post-apartheid education promises into stark focus. This led to the disruption of the academic calendar during these years. Yet, in 2018, the Department recorded the highest proportion (70%) of graduates who completed the degree in minimum time and had the highest number of first-class honours. UCT has seen much political disturbance and social unrest in its 100 years. Chemical Engineering, while not necessarily being a microcosm or a barometer of these pressures, has been, and continues to be, a crucible to develop and nurture diverse opinion. At its heart, student welfare and success, research, scholarship and eminence remain its key drivers.

Figure 4: Comparison of throughput for UCT Chemical Engineering cohorts for the periods 1988 – 1998 and 2000 – 2009



104 Heydenrych, H., and Case, J.M., (2015) "Academic development in the mainstream: A case study in an undergraduate engineering programme in South Africa", *South African Journal of Higher Education*, **29**(5), 179–200.

First-year 2013 Chemical Engineering students, from left, James Bleloch, Kimaya Reddy and Lelia Nelson Lelia, work on their newly acquired laptops. The students were among the first to benefit from UCT's Laptop Project, which thanks to generous financial aid, sought to equip all students with their own laptop to facilitate out-of-class learning and collaboration. Once again at the forefront of pedagogical innovation, the Department was one of the pilot sites for this project. One of the few limitations was that UCT did not yet have sufficient plug points for charging in all lecture theatres and so some students moved into the corridor to continue working there.

A new outreach model

During the 1990s the Department, under Cyril O'Connor, established an outreach initiative for secondary schools, focused on an annual Teachers' Day to inform schools about Chemical Engineering in general and its career prospects. It was unashamedly a recruitment drive. While academics also engaged with various career events for school learners, including energetic annual involvement in running the local "Minquiz", building strong links with schoolteachers was expected to have even more impact. Based on these relationships, and in response to requests from teachers for more up-to-date resources, in 2007, the Department embarked on a new level of work with schoolteachers, sourcing industry funding to develop classroom materials that were responsive to new topics in the curriculum with good links to chemical engineering. The Mining and Minerals Engineering Resource Pack, sponsored by Anglo American and Anglo American Platinum, was delivered to 3,000 teachers nationally in 2008 and 2009 in the context of interactive workshops that introduced teachers to these materials and fresh approaches to teaching physical science. Following hot on its heels, a Chemical Industries Resource Pack, sponsored by c*change, Sasol and PetroSA, was developed and delivered nationally to 6,000 teachers in between 2010 and 2012. The project received significant applause and national recognition, and the materials remain available and can be accessed by teachers via the web.

Jenni Case was awarded the UCT Distinguished Teacher Award in 2007 – one of only two that are presently held across the Faculty of Engineering & the Built Environment. She was also the second in the Department to be awarded a P-rating (NRF President's Award) for her research.

Recognition and ranking

At the end of the second decade of the century, UCT Chemical Engineering is riding the crest of a wave of recognition for the impact and quality of its work. It would take a whole book on its own to list all the awards that were garnered and so what follows is just a selection of highlights.

An impressive group of Chemical Engineering academics have received UCT's highest scholarly honour, that of the designation of Fellow: Sue Harrison, Alison Lewis, Aubrey Mainza, Cyril O'Connor and Eric van Steen.

Thanks to the Department's strong commitment to undergraduate education with its impactful industrial support, of only two UCT Distinguished Teacher Awards that are presently held across Engineering, one was awarded to Jenni Case in 2007.

In terms of the research ratings that are given by the NRF, only a small handful of researchers in the EBE Faculty have received the top honour of the A-rating, and one of these is Cyril O'Connor, who held this rating at his retirement. In 2017, O'Connor was elected to the United States National Academy of Engineering, and at the time was only the third South African to be elected and the only extant South African member. In 2020, Sue Harrison also received this exceptional honour, one of only 18 new international members elected in that year.

While global university rankings are a subject of much debate, in recent years, UCT has continually reported as Africa's top university. At a programme level, two academic subjects, mining and mineral engineering, were ranking in the top ten by the 2017 Shanghai Global Rankings of Academic Subjects (GRAS), bolstered in part by the Department's strong research and teaching in minerals processing.

What lies behind these accolades is nothing less than 100 years of hard work. The Department's clear and enduring commitment to research-led teaching and a dedication to developing a community of scholars over a century has meant that it has been able to attract exceptional staff, students and industry collaborators, who have gone on to add to and enhance that. With a good balance between institutional memory – thanks to many long-serving and dedicated staff and associates – and a restless, entrepreneurial drive to push the boundaries, it is likely that the Department of Chemical Engineering at UCT will continue to be a beacon for excellence over the next century. Watch this space.

Eric van Steen (centre), one of five Chemical Engineering scholars to have been designated a Fellow of the University pictured here with fellow UCT researchers and an intercontinental research team from Brazil, India and South Africa. The team was an IChemE Global Awards 2020 finalist in the Energy category for their decentralised diesel system, which aims to produce fuel from waste.

Transitioning to a green economy in Africa

Dr Rethabile Melamu
BSc(Eng) Chem 2005; MSc(Eng) Chem, 2007; PhD, 2014

I am convinced that **Africa is well-poised for a transition to a greener economy** if its bold policy pronouncements are anything to go by.

Thabi Melamu could easily succumb to the pessimism that surrounds much of the conversation around climate change. As General Manager for the Green Economy Unit at The Innovation Hub – the innovation agency of Gauteng Province – she's exposed daily to the challenges that come with transitioning to a green economy. But Melamu has always preferred to focus on solutions.

"I am convinced that Africa is well-poised for a transition to a greener economy if its bold policy pronouncements are anything to go by. I'm persuaded that if society acts collaboratively, creatively and with a sense of urgency, we will truly refuse to bear the brunt of climate change and economic backwardness," she comments.

The green economy is not a distinct economic sector, says Melamu, but rather, a philosophy for economic growth that is pervasive across economic sectors, and that requires an "all hands on deck" approach at all levels of society – not to mention heaps of vibrant innovation.

"I believe that innovating towards a greener economy is a much-needed catalyst for economic growth and the creation of jobs for the predominantly youthful population in our country and continent. Innovation has the potential to accelerate the deployment of low-carbon technologies, the implementation of circular economy approaches, the promotion of sustainable agriculture and the bolstering of water security and sanitation efforts, while accelerating global efforts to curb greenhouse gas emissions.

"What has been encouraging in the past few years is the emergence of a creative and vibrant entrepreneurial community. This community, with the support of academia, governments and civil society, is exploiting market opportunities through the commercialisation of green technologies and business model innovations."

Melamu believes that a systemic change is necessary to propel our country and continent towards a greener future with far-reaching impact.

"To realise this goal, it is not enough to support and celebrate a few pockets of excellence. Instead, much broader and system-wide interventions are critically needed. These include policy certainty and supportive regulatory reforms, the promotion of scientific excellence and multidisciplinary research, nurturing of the intellect and creativity of our youthful population, as they are future technology developers and jobs creators and sharpening the entrepreneurial capabilities of our youth."

6 VISIONING ...

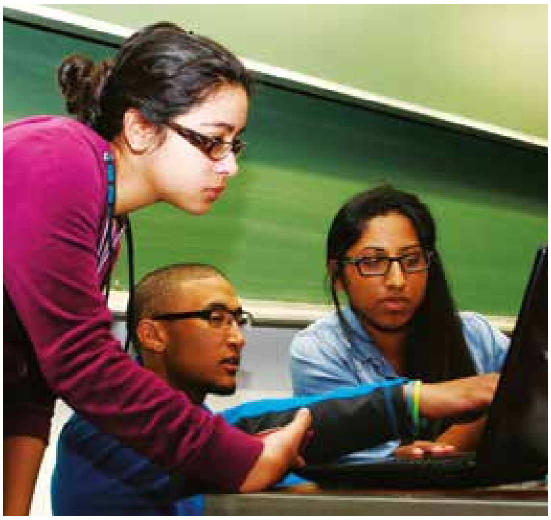
THE NEXT 100 YEARS

The first 100 years of Chemical Engineering at UCT have seen the growth of a world-class, globally recognised Department that is working on challenges of national and global significance. Its success has been due in large part to the passion and energy of its many people – faculty, staff, students and collaborators – who have helped drive it forward. But how will the Department engage with the challenges of the 21st century? And how can it prepare itself to continue to be a leading force in the profession?

"Our societies and institutions have a role to educate the profession. They also represent the profession in its interactions with the community."

– Robin Batterham

We are living with daily reminders that the world is increasingly more complex and uncertain. In 2020 alone, we are experiencing a global health pandemic, gross economic strife and increasing levels of inequality, growing geopolitical tensions and a continued assault on human rights, as well as continued poor stewardship of commodity chemicals.[105] These sit alongside the existential challenges of climate change, consumption behaviour and its impacts (including plastic pollution). On the technology front, the pace of change is relentless, with innovation leading to the creation of disruptive technologies across many fields, including energy, healthcare, communications, data analytics and transport, all just in this last decade.



Students in the 2013 first year class (from left to right) Abeedah Kadri, Leolyn Alexander and Theona Mudley.

What does any or all of this mean for the discipline of Chemical Engineering, and for UCT particularly?

In 2020, the current Head of Department, Aubrey Mainza, knows that these pressures challenge chemical engineers in profound ways, as the profession seeks to meet its obligations and responsibilities to serve society, building on scientific principles and sound engineering practice to develop and provide technologies that improve the lives of people everywhere. At the same time, he is acutely aware of the shifting priorities of both internal and external stakeholders the Department engages with, the ongoing need to transform the student body and achieve racial justice, and the obligation to align programmes with immediate economic development imperatives in Southern Africa. Here, he notes, that the Department has particular strengths in the form of its new curriculum and culture of ongoing reform, as well as its commitment to working with the strengths offered by its diverse people.

105 An unsecured stockpile of roughly 3,000 Te of ammonium nitrate exploded in a port warehouse in Beirut, Lebanon, on 4 August 2020, causing massive destruction to the city and significant loss of life.

As a leading academic department in the Global South, UCT Chemical Engineering also needs to be cognisant of its role in influencing the profession of chemical engineering as it continues to evolve. As Robin Batterham said in 2003, "Our societies and institutions have a role to educate the profession. They also represent the profession in its interactions with the community. Therefore, they also have a role to educate the community with regards to the profession."[106]

In looking for a way forward as to how to do this, it is fitting to turn to the guidance from professional institutions and societies. A good starting point is to cast back to the beginning of the millennium, to the 2001 World Congress of Chemical Engineering, held in Australia. This forum resulted in a combined declaration by 20 international professional chemical engineering bodies in the so-called "Melbourne Communique", to which leading professional bodies such as IChemE and AIChE were signatories.[107]

2001

World Congress of Chemical Engineering held in Australia, leading to the issuing of the Melbourne Communique.

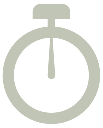
Key aspects of this declaration included commitments to meeting society's needs by using chemical engineering skills to strive to improve quality of life and advance economic and social development and environmental protection; designing high quality products and processes that make the best use of scarce resources; eliminating practices that are unsustainable; developing a public understanding of the challenges and choices facing the world; and promoting lifelong professional development.

In 2005, The Royal Academy of Engineering published a set of 12 guiding principles for engineering for sustainable development, in a document which also provided examples and applications for curriculum implementation.[108] Key aspects included the need to innovate and be creative, to seek engagement from all stakeholders, give sustainability the benefit of the doubt, and adopt an holistic, "cradle-to-grave" approach. Most importantly, the principles included the requirement to "do things right, having decided on the right thing to do"; and to "practice what you preach", underscoring ethical considerations.

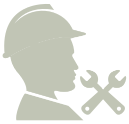
Other professional institutions have committed to a similar agenda in more recent years. Some have focused explicitly on the implications for chemical engineering education and curriculum development. One such was the initiative spearheaded by the US National Academy of Sciences (NAS) and led by MIT in 2005. This "Frontiers of Chemical Engineering Education" exercise echoed some key trends in the profession:

The chemical industry is cyclical, and increasingly global.

Chemical engineering is no longer dominated by petrochemicals/ bulk chemicals.



The time to market new products has dramatically decreased.



Graduates can expect to have multiple professional jobs across a broad range of careers.

106 Batterham, R. (2003) "The Chemical Engineer and the Community", in *Chemical Engineering: Visions of the World*, R. Darton, D. Wood, and R.Prince (eds), Elsevier, Amsterdam.
107 UCT Chemical Engineering was an early adopter of the principles behind this declaration which has shaped its evolving programmes in the years since.
108 Royal Academy of Engineering (2005) "Engineering for sustainable development: Guiding principles", The Royal Academy of Engineering, London.

The NAS also argued that chemical engineering should pursue a close, broad coupling to the sciences – chemistry, physics and biology – to "impact across all scales and different levels of focus to provide interdisciplinary perspectives on technology innovation and development".[109]

In 2007, IChemE published its "Roadmap for 21st Century Chemical Engineering", which identified desirable societal outcomes, and a range of chemical engineering inputs across teaching, research and professional practice in pursuit of these outcomes. It went further to develop a set of strategic interventions and action plans consistent with these goals. And in 2016, IChemE updated its "Chemical Engineering Matters" strategy to map core chemical engineering skills and professional issues onto the critical challenges of the 21st century. This matrix model targets four key focus areas: energy, food and nutrition, health and well-being, and water, priorities echoed by many others. It also reinforces the need for the profession to take an holistic approach in addressing these challenges.

Most recently, in 2018, the American Institute of Chemical Engineers revisited its visioning exercise from its own centenary in 2008,[110] which also highlights just how rapid change has been even in a single decade.

Younger contributors to the 2018 AIChE review have variously expressed this position through such statements as: "Chemical Engineering must aim to address the biggest problems facing humanity. To be welcoming to all. To connect theory, simulation, experiment, and analysis. To promote openness, reproducibility, civility and reason."[111]; and "The most successful chemical engineers will be those who are willing and brave enough to take risks, not with safety or the environment, but by taking on leadership roles, learning from failure, and by challenging the status quo with new ideas, new questions, and new connections with other fields. It is not enough to produce students with good grades who can solve idealised problems if they do not reach their full potential in the face of real-world challenges". [112]

Ten years ago, UCT Chemical Engineering laid out its own medium-term vision, to "embrace imagination, integration and multidisciplinary thinking, to make innovative and creative contributions to the world around us".[113] As Alison Lewis, the current Dean of the Faculty says: "We know that we need to do things differently and that it is time for creative and innovative thinking. We need to educate students who will be able to think out of the box, who can go out into the world and contribute to the transformation of the resource-based economy. We need to equip students with the skills to address the global challenges that the world is facing around climate change, water, energy, renewables and limited resources."

> We need to educate students who will be able to **think out of the box**, who can go out into the world and **contribute to the transformation** of the resource-based economy.
>
> **– Alison Lewis**

This vision statement committed the Department to thinking about "multiple pathways and plurality, diversity and difference; about the connections and reconnections between people and ideas, networks and flows; and the richness of diversity and multiplicity." It remains a distinctly aspirational vision aiming to drive excellence in research and teaching, to encourage independent and creative thought, to develop future leaders, to ensure international recognition, and to apply its collective energies to 21st century problems which have particular regional importance. Rather than attempting to "cherry pick" technology winners around which to build the next generation of chemical engineers, the focus was on the development of students' professional "character", grounded in a core skill set of basic and engineering sciences, able to manage complexity and focused on engineering for life.

109 Robert Armstrong, MIT Chevron Professor of Chemical Engineering, and Director, MIT's Energy Initiative.
110 Westmoreland, P.R., McCabe, C., (2018) "Revisiting the Future of Chemical Engineering", *CEP*, **14**(10), 26–38.
111 Professor Jim Stapleton, University of Oregon.
112 Professor Julie Champion, Georgia Tech.
113 UCT Chemical Engineering Annual Report (2013).

UCT students in the Chemical Engineering labs.

Mainza emphasises that the realisation of this vision will have everything to do with how the Department delivers on its programmes, while being mindful to build in flexibility, responsiveness and agility to ensure a dynamic and responsive capability to changing circumstances. He is sharply aware that the successes of the past do not translate directly into the future.

Going forward, he says that the Department is committed to providing ongoing support for the research strengths that have put UCT Chemical Engineering on the world map and ensuring that newer research areas can be internationally competitive in the way the major research groups in the Department have been. The current academic plan (to 2025) calls for the continued opportunity and need for externally-funded research, rapid growth in postgraduate students to sustain research productivity, and the need to increase the staff to student ratio to ensure effective delivery and quality outcomes for its programmes.

The Department is now well resourced in terms of its physical infrastructure. With its own custom-designed building and enjoying a large share of the New Engineering Building, its current teaching and research footprint is likely to suffice for the next generation or more, provided it continues to follow its strategic growth plan in terms of both undergraduate and postgraduate students. There will, of course, be many pressures to pursue a more rapid growth trajectory, and it will be an interesting dynamic as to how these competing models resolve in the future.

In recent years, various research groupings have demonstrated agility in adjusting their profiles to embrace new and exciting fields of enquiry. Some examples include Catalysis's foray into fuel-cell development and the hydrogen economy; the Centre for Minerals Research's work on the sustainability of the minerals/energy complex and resource stewardship; and the work of the Centre for Bio-engineering Research into bio-catalysis, nutraceuticals and therapeutics.

The Department is well positioned, too, to continue forging an increasingly transformed staff and student body, as the democratic South Africa moves towards its fourth decade. Globally, racial injustice requires urgent and focused intervention, and in South Africa, this cannot be separated from the need to address economic deprivation and inequity. The students coming into the Department are likely to increasingly want clear signals as to how the culture of this Department is in tune with the progressive visions of the day. Alumni of the Department, who are playing a vital role in transforming South African society, as is evident from the stories in this publication, will continue to serve as important role models for the next generation.

On the teaching front, it is likely that pressure to align programmes with immediate economic development imperatives in Southern Africa will continue. For example, the continent will see an increased commitment to growing its SMME base by stimulating entrepreneurship across the board. Innovation in the conversion of indigenous resources to useful products is also likely to become more important. Manufacturing supply chains will see significant overhauls, enabled by smart technologies. And there will almost certainly be growth in distributed energy systems, powered by renewable energy.

How the Department engages with these, and other opportunities, while retaining a commitment to its "core" curriculum, will demand foresight, effective leadership and good stakeholder engagement. What is clear is that the Department's ability to fulfil its vision is rooted in its own history, building on its legacy, and reinforced by the strong commitment to keep evolving.

Of course, the Department is not an island, and it will face these challenges and opportunities with the full support of the University of Cape Town's leadership. At the time of writing, UCT has embarked on a "Vision 2030" exercise, the key objectives of which are to:

1

Produce graduates who are **"resilient agents of change"**, and can use their knowledge, skills and sense of responsibility to shape and to be at the service of society locally and globally.

2

Provide both contact and digitally mediated education framed by sound pedagogy aimed at **developing creativity, analytical thinking,** complex problem-solving abilities, collaboration **and social responsibility** across disciplines and fields of study.

3

Recognise that excellent interdisciplinary research must be built on a strong disciplinary foundation. Solutions to the grand challenge problems facing Africa require the **development and maintenance of strong partnerships.**

4

Develop new, transformative and inclusive pedagogies that **support new classroom relationships** between lecturers and students and between students themselves.

It is fair to say that Chemical Engineering has embraced these objectives wholeheartedly and has already achieved demonstrable success in key areas. Which is not to suggest that journey is in any way complete ...

Some thoughts on our future

In the writing of this history, the views of dozens of alumni, staff – past and present – and students were solicited to talk about their experiences and memories and to share their vision for the Department's next 100 years. We gratefully received many striking responses, of which we want to share a small sample here, handing the last word over to the people who have shaped and will continue to shape this inspiring Department of Chemical Engineering.

"My vision would be for chemical engineering departments to introduce, into their programming, approaches, ethics and content that recognise the needs of the environment and wellbeing of all humanity."

Lenore Rosa Celia Cairncross

BSc(Eng) Chem, 1995;
MSc(Eng) Chem, 1998

"The environmental, social and economic aspects of sustainability are all linked and during times of resource constraints, like drought or load-shedding, industries are very vulnerable. It is critical we build these considerations in at the design stage, when they can be most cost-effectively applied."

Jane Reddick

BSc(Eng) Chem, 2004;
MSc(Eng) Chem, 2006

"Our field is absolutely critical in addressing challenges including climate change, energy security, water, defence, housing, sanitation, healthcare and medicine and the whole of the process industries. I think we will see chemical engineers occupying important positions in the solution of these challenges, from the commercial, technical and policy-making perspectives. The skills, knowledge and approach used in chemical engineering serve all of these positions almost equally well – and are fairly unique in this way."

Nicholas Rice

BSc(Eng) Chem, 2012

"The world is facing unprecedented challenges that include environmental sustainability, agriculture, energy, water and health. Chemical engineering is more relevant than ever for addressing these challenges. This includes not only chemical engineering fundamentals, but also problem-solving skills and systems approaches to framing and tackling complex multi-disciplinary problems. The UCT Chemical Engineering Department is well positioned to address these challenges through continued excellence in education and research."

Christopher Swartz

BSc(Eng) Chem, 1981 ; Academic staff member, 1989 – 2000

"Chemical engineers are well positioned to create the new economy in which environmental sustainability and social responsibility outweigh corporate gain. Resource depletion and waste are being addressed using fundamental chemical engineering principles. It is very clear from today's student body that the new generation of chemical engineers want to be involved in an economy that benefits society without the many deleterious impacts of past practices such as polluted water, climate change and ecosystem destruction."

Susan A. Baldwin

BSc(Eng) Chem, 1980

"UCT Chemical Engineering's vision might include some emphasis on developing entrepreneurial skills among its students. Launching a business is scary and we need to give at least some of our students the best launching pad that we can."

Clive Thorpe

BSc(Eng) Chem, 1961

"Curricula are being changed to incorporate concepts of systems thinking, sustainability, ecology and life cycle assessment. Diversity, equity and inclusion are also now key principles to guide present and future education to ensure that chemical engineers serve all sectors of society. The Department can continue on its very well-trodden and, so far, very successful path of working with and for the South African mining industry. But the industry will be facing profound changes in the next decade, and this means the Department will have to change too. Society will ask whether the environmental and social costs of producing gold, or copper or iron are worth it. People will be willing to pay more for products in which the metals have been recycled, are traceable from cradle to grave, and from which they can be recycled again. The change to mining will be profound. Green metals will cost more but will drive dirty metals out. Water will become scarcer, clean energy the only way. What role will UCT Chemical Engineering have in this?"

Jan Cilliers

**Academic staff member, 1990 – 1995;
PhD, 1995**

"South Africa is a country that occupies a unique place within the world, positioned within the African continent and blessed with both a vibrant social dynamic and an abundance of natural resources. The location and infrastructure provide access to the much larger 'economic catchment' of the sub-Saharan continent and its estimated one billion people. There's an opportunity for the University and the Department to act as both a hub and a conduit for technology and technical expertise between the world and much of Africa. More significantly, if one is prepared to contemplate a non-traditional perspective of chemical engineering and consider the primary needs of these one billion people, then the pressing need for food, clean water, sanitation, medicines and consumer goods could provide many opportunities for the Department to collaborate in academic, commercial and government partnerships aimed at developing pragmatic, made-in-Africa solutions."

Ed Kniel

BSc(Eng) Chem, 1994

"As the world becomes more complex and more uncertain, there is great opportunity to leverage a UCT Chemical Engineering degree to move into quantitative analytical careers. In my case that was fisheries science/natural resource management, underpinned by predictive analytics. This capacity is now sought after in economic sectors as diverse as insurance, banking, telecommunication, and manufacturing industries. What is needed most urgently is the ability to build on the core skill of systems-thinking, to engage with the many ethical and political considerations which define complex decision making. This will require some re-shaping of chemical engineering curricula."

Michael Bergh

BSc(Eng) Chem 1979

"We are a country most in need of change but least able to make this change. We have a huge decarbonisation burden and limited resources with which to achieve this imperative. I challenge all present graduates to take this up. You will be required to make decisions that have long-term implications for global sustainability; use your knowledge and privilege to make the right ones!"

David Walwyn

BSc(Eng) Chem, 1979

"To produce chemical engineers that are most relevant to society we need them to think independently, be educated in biology in addition to the traditional classes, and be cognisant of society's needs, like health, global warming, energy requirements, drinking water needs, and growing pollution, and environmental threats such as non-degradable plastics. We need to encourage students to think about problems facing society. Every chemical engineering student should have a basic understanding of proteins and DNA, and they should be asked to read general and technical articles on society's needs."

Georges Belfort

BSc(Eng) Chem, 1963

"The priorities for the profession of chemical engineers and the UCT Department of Chemical Engineering must be to look at how to solve human-centred socio-economic problems; poverty, inequality, and unemployment. My final year project was Shell sponsored and looked at how to reduce water content of coal during the flotation process. We can solve these things, but how can we solve some of humankind's challenges, how can we focus more towards our collective humanity? I would encourage chemical engineering students to think about studying psychology, economics and data science, and to invest their social time into community-based work. This allows us to remain in touch with our human spirit, and develop our intuitive intelligence alongside the cognitive development and insights, which is the hallmark of a great UCT Chem Eng experience."

Emilio Titus

BSc(Eng) Chem 1985

APPENDICES

APPENDIX A

Chemical Engineering graduands 2020 to 1920

The compilation of this list of graduates has required reconciliation of paper records (pre-1978), and various computer system records since. While the editors have attempted to resolve any omissions or anomalies, we recognise that some may have slipped through. To those individuals, we apologise. Please note, the 2020 statistics are incomplete as final academic records were not available at the time of going to print.

Doctor of Philosophy

Gorden Gambu.....2020
Tomas Hessler.....2020
Alexey Cherkaev.....2019
Andries Van Zyl.....2019
Cledwyn Mangunda.....2019
Didi Makaula.....2019
Edmund Engelbrecht.....2019
Jafaru Egieya.....2019
Jestos Taguta.....2019
Lebohang Macheli.....2019
Linus Naik.....2019
Mahdi Ghadiri.....2019
Malibongwe Manono.....2019
Nosaibeh Nosrati Ghods..2019
Petrus Van Staden.....2019
Xolisa Goso.....2019
Adrian Fortuin.....2018
Alisa Govender.....2018
Anna Petersen.....2018
Bernelle Verster.....2018
Moritz Wolf.....2018
Phumlani Masilela.....2018
Colleen Jackson.....2017
Innocent Achaye.....2017
Marc Brighton.....2017
Mehdi Safari.....2017
Rissa Niyobuhungiro.....2017
Robin Abrahams.....2017
Allan Nesbitt.....2016
Christian De Vries.....2016
Cindy-Jade Africa.....2016
Gerard Leteba.....2016
James Mwase.....2016
Lucy Little.....2016
Mariam Ajam.....2016
Michael Short.....2016
Molefi Matsutsu.....2016
Olubode Adetunji.....2016
Olumide Ogunmodimu...2016
Thandazile Moyo.....2016
Elaine Govender.....2015
Evan Smuts.....2015
John Mc Coy.....2015
Paul Bepswa.....2015
Rhiyaad Mohamed.....2015
Sarah Jones.....2015
Doreen Nabaho.....2014
Johannes Steyn.....2014
Margreth Tadie.....2014
Noko Ngoepe.....2014
Rethabile Melamu.....2014
Bulelwa Ndlovu.....2013
Lawrence Bbosa.....2013
Neehal Mooruth.....2013
Oluwafemi Olaofe.....2013
Zandile Chonco.....2013
Athanasios Kotsiopoulos..2012
Daramy Kallon.....2012
Harish Appa.....2012
Madelyn Johnstone-Robertson.....2012
Ramoshibidu Mogorosi...2012
Waldo Coetzee.....2012
Yousef Ghorbani.....2012
Linda Kotta.....2011
Melinda Griffiths.....2011
Nico Fischer.....2011
Oluwatosin Azeez.....2011
Candice Goodwin.....2010
Dyllon Randall.....2010
Josias Nieuwoudt.....2010
Sameer Morar.....2010
Thebe Mokone.....2010
Carl Viljoen.....2009
Case Bakker.....2009
Michael Hughes.....2009
Virginia Cheang.....2009
Youqi Zhuang.....2009
Bamikole Amigun.....2008
Caryn Fenner.....2008
Christopher Anderson.....2008
Freeman Ntuli.....2008
Idan Chiyanzu.....2008
Jurie Swart.....2008
Kevin Harding.....2008
Mfandaidza Hove.....2008
Oluwaseun Oyekola.....2008
Peter Cairns.....2008
Pieter Van Helden.....2008
Adeniyi Isafiade.....2007
Andrew Newell.....2007
Cathrin Welker.....2007
Glen Heinrich.....2007
Gordon Forbes.....2007
Tunde Ojumu.....2007
Brandon Collier-Reed.....2006
Christian Nissing.....2006
Elizaveta Burdukova.....2006
Elvera Viljoen.....2006
Giles Searby.....2006
Jennifer Broadhurst.....2006
Natalie Shackleton.....2006
Nyaradzo Chigorimbo-Tsikiwa.....2006
Ryan Stevenson.....2006
Sandile Ncanana.....2006
Bernard Bulawayo.....2005
Clive Garcin.....2005
Douglas Hatfield.....2005
Evans Mabaso.....2005
Ochieng Aoyi.....2005
Sashnee Raja.....2005
Velaphi Msimang.....2005
Bangaru Balasundaram...2004
Noko Phala.....2004
Ada Chirinos Maruri.....2003
Bonakele Mehlomakulu...2003
Gillian Balfour.....2003
Vratislav Malysiak.....2003
Philippa Notten.....2002
Thomas Potgieter.....2002
Uwe Wilkenhoner.....2002
Warwick Duncan.....2002
Andrew Dustan.....2001
Andrew Robinson.....2001
Bryan Brack.....2001
Heiko Manstein.....2001
Peter Schwan.....2001
Shehnaaz Moosa.....2001
Zwanani Mathe.....2001
Ashley Breed.....2000
Linda Van Steen.....2000
Mary Stewart.....2000
Trevor Harris.....2000
Frank Heese.....1999
Brett Cohen.....1998
Dave Deglon.....1998
Hans Roeger.....1998
Joachim Petersen.....1998
Julian Young.....1998
Nicola Brown.....1998
Nissim Hallale.....1998
Reinier Weber.....1998
Ansgar Schnitzler.....1997
Deirdre Bradshaw.....1997
Johannes Theron.....1997
Michael Schnobel.....1997
Robin Nash.....1997
Roderick Ross.....1997
Suzanne Illing.....1997
Alex Vogel.....1996
Gary Sewell.....1996
Mark Betts.....1996
Sarah Sealy.....1996
Anthony O'donovan.....1995
Andrew Bailey.....1994
Johannes Cilliers.....1994
James Vaughan.....1993
Michael Howden.....1993
Craig Goodall.....1992
Miles Van Niekerk.....1992
Peter Mills.....1992
Bo Andersen.....1991
Paul Stonestreet.....1991

Stephan Schwarz 1990
Klaus Moller........................1989
Guy Anderson 1988
Deaghlan Mcclean........... 1987
Kim Clarke.......................... 1987
Christiaan Schutte..............1986
Marc Rautenbach 1986
Jack Fletcher 1984
Trevor Baden Sydney Giddey 1979
Duncan McKenzie Fraser...1977
Eugene Kenneth Cairncross........................ 1974
David William Boydell 1973
Paul Trehair Hadingham....1973
Eric Anton Horsten.............1971
Michael Anthony Connor..1971
Otto Molnar........................1970
Heinrich Otto Buhr............ 1967
Anthony Watson Bryson...1966
Michael Robin Judd 1965
Reinhard Johannes Nachenius 1963
Philip John Lloyd...............1961
Peter Miles Goyen Hart....1958
Gabriel Gideon Cillie 1957
Ronald Hanley Marks.........1957
Christo Renaldo Lotz.........1956
Andrew Donald Carr 1953
Douglas John Lloyd...........1942

MSc in Engineering

Sarah Tetlow 2020
Benita Aspeling 2019
Blessing Chirume 2019
Brigette Nagel 2019
Dawid Kruger 2019
Dominic De Oliveira 2019
Donald Mjonono...............2019
Hebert Nyakunuhwa 2019
Jonathan Gertzen.............2019
Mathew Dzingai 2019
Mohamed Moydien 2019
Natasha Davids 2019
So-Mang Kim 2019
Zaynab Sadan.....................2019
Adri Uys..............................2018
Annah Moyo 2018
Armand Geldenhuys 2018
Ashcaan Khazali 2018
Clare Rodseth 2018
Cody Burcher-Jones 2018
Dayle Nel 2018
Genevieve Harding 2018
Godknows Chiodza 2018
Ilyaas Abdullah 2018
Junfeng Guo......................2018
Kemi Jegede......................2018
Lorren De Kock..................2018
Lucia Dzinza........................2018
Marianne Werle Van Der Merwe 2018
Mohamed Parker...............2018
Muhammad Motala 2018
Nobuhle Mpofu 2018
Relebohile Tseka 2018
Resoketswe Manenzhe 2018
Rony Azegele.....................2018
Sarah Adam 2018
Sithembiso Ntlhabane......2018
Thomas Jordaan 2018
Wijnand Marquart.............2018
Winfull Msipa.....................2018
Christopher Chikochi 2017
Darryl Brown 2017
Francois De Flamingh........2017
Matthew Myers..................2017
Mekia Makhubu.................2017
Pierre Cilliers 2017
Saliya Muketekelwa 2017
Theophilus Dzingai 2017
Uwais Ahmed.....................2017
Ayesha Rawoot..................2016
Buhle Manana 2016
Chiara Maharaj 2016
Clayton Jacobs...................2016
Jennifer Couperthwaite ...2016
Mark Gituma 2016
Matthew Burke 2016
Matthew Stevenson 2016
Motlalekgomo Mogale 2016
Motlokoa Khasu.................2016
Nanji Sheni 2016
Ngoni Mhonde..................2016
Nicole Malanda 2016
Niels Luchters.....................2016
Tamzon Jacobs 2016
Tarisayi Matongo 2016
Thobile Dube.....................2016
Wesley Van Niekerk 2016
Yannick Ilunga...................2016
Adolph Mwale.................. 2015
Bridget Fundikwa............. 2015
Caelin September 2015
Charl Van Schalkwyk 2015
Courtney Thompson......... 2015
Darin Dickson.................... 2015
Debora Jooste................... 2015
Diane Taggart 2015
Franschua van der Walt.... 2015
Garren Edwards 2015
Gorden Gambu................ 2015
Jestos Taguta..................... 2015
Kathija Shaik....................... 2015
Latifa Mrisho...................... 2015
Malikaah Galant 2015
Michael Duncan................ 2015
Michael Van Heerden 2015
Mildred Mutenure 2015
Mitchel Jardine 2015
Mpendulo Ncongwane 2015
Ntandoyenkosi Hlabangana 2015
Philasande Xalabile 2015
Precious Hlongwane 2015
Prince Owusu Gyebi......... 2015
Riddhi Maharaj 2015
Seipati Mabote 2015
Shilpa Rumjeet.................. 2015
Sibongile Muziki 2015
Sibongiseni Gqebe........... 2015
Simone Daniels................. 2015
Tadiwanashe Chidzanira 2015
Tapiwa Chivengwa............ 2015
Thulani Nyathi 2015
Tiisetso Moimane 2015
Wadzanai Nyabeze 2015
Wonder Chimonyo 2015
Zaheera Ahmed................ 2015
Andre Steynberg...............2014
Avela Kunene.....................2014
Bismark Sarpong 2014
Colleen Jackson.................2014
Cong Liu 2014
Constance Nyambayo 2014
Dirren Govender...............2014
Edward Peters...................2014
Fadzai Kadzinga................2014
Faustine Ngoroma 2014
Gregory Crymble.............2014
Hundzukani Vukeya 2014
Joanne Crimes...................2014
Kabwe Musonda 2014
Keshree Pillay.....................2014
Lebohang Macheli............2014
Li-Hsin Tsui.........................2014
Makhosazane Chucky Kunene 2014
Malebelo Maphutha 2014
Mamohlomi Senoko 2014
Martin de Beer...................2014
Matthew Koen 2014
Melissa Sikosana 2014
Monica Kalichini.................2014
Monique Smit 2014
Motena Takalimane...........2014
Nicole Meyer 2014
Noluntu Dyantyi 2014
Onyinye Iroala 2014
Pharaoh Muzanenhamo...2014
Steven Nkadimeng 2014
Tafadzwa Marozva.............2014
Thulile Khoza......................2014
Timothy Magezi Ndamira 2014
Tsundukani Nwaila 2014
Vuyiswa Dube....................2014
Zethu Dlamini.....................2014
Adrian Fortuin.................... 2013
Alexander Opitz 2013
Alistair Hughes.................. 2013
Aliya Gani........................... 2013
Brian Willis 2013
Chandon Bezuidenhout... 2013
Christopher Shields Scully.................................. 2013
Conrad Ndimande 2013
Hartmut Brodner............... 2013
Ian Scott 2013
Jacobus van der Merwe .. 2013
Jemitias Chivavava 2013
Jude Bonsu 2013
Karthik Shekhar 2013
Kubefu Maduna................. 2013
Kyle Moskovitz................... 2013
Lerato Kotelo...................... 2013
Luke Venkatesan................ 2013
Megan Rose....................... 2013

Melody Jera 2013
Mogamat Nacerodien 2013
Mopeli Khama 2013
Moses Nduna 2013
Murray Meissner 2013
Mussa Lisso 2013
Nathan Simunika 2013
Nicole Jansen van Rensburg 2013
Nozonke Dumani 2013
Ntokozo Shabalala 2013
Peter Wynne 2013
Pratish Keshav 2013
Qubekani Ngulube 2013
Rukaya Stracey 2013
Santosh Pani 2013
Steve Marc Piaget 2013
Susan Taylor 2013
Tanaka Shumba 2013
Timothy Egan 2013
Yefon Persis 2013
Yi Zhou 2013
Ziningi Madonsela 2013
Abraham Durant 2012
Anne Gabathuse 2012
Ashton Drummond 2012
Caroline Muzawazi 2012
Claire Wright 2012
Eustice Vries 2012
Gracia Munganga 2012
Jacob Taute 2012
Jacqueline Binneman 2012
Jacques Vogeli 2012
Jason Waters 2012
Jonathan Ledgerwood 2012
Joseph Kabwe 2012
Kudzai Changunda 2012
Lehlogonolo Chiloane 2012
Matthew Hill 2012
Michael Kapembwa 2012
Mihajlo Dabic 2012
Molefi Matsutsu 2012
Molladi Maseloane 2012
Muhammad Cariem 2012
Nobathembu Mangesana 2012
Rissa Niyobuhungiro 2012
Tapiwa Chimbganda 2012
Tawanda Sango 2012
Thendo Madala 2012
Tracey Van Heerden 2012
Tsepang Khonthu 2012
Wendy van der Merwe 2012
Adrian de Beer 2011
Brett Clapham 2011
Brian Chaponda 2011
Christian Kazadi Mbamba 2011
Christine Richardson 2011
Daniel Castelyn 2011
Dion Lusinga 2011
Ditend Tesh 2011
Emily Musil 2011
Frederik de Klerk 2011
Grant Apsey 2011
Harikrishna Sudhakaran 2011
Herman Fuls 2011
Ilhaam Dalwai 2011
Jacques Bezuidenhout 2011
Jasper Dick 2011
Joachim Becker 2011
Lara Truter 2011
Magdalena Hauman 2011
Malebogo Ralefala 2011
Malibongwe Manono 2011
Mariam Bibi Royker 2011
Maxwell Phiri 2011
Mpho Namane 2011
Muhammad Amod 2011
Muhammad Parak 2011
Murray Fraser 2011
Neale McCulloch 2011
Nobert Paradza 2011
Olubode Adetunji 2011
Porogo Duku 2011
Rashed Shah 2011
Reay Dicks 2011
Ross Burnham 2011
Sancha Nagooroo 2011
Trisha Daya 2011
Vinayak Bhardwaj 2011
Wesley Massey 2011
Wing-Kin Fung 2011
Alexander Hesketh 2010
Alexey Cherkaev 2010
Alister Inglesby 2010
Allison Kasozi 2010
Botlhe Mokgethi 2010
Cornelia Ras 2010
Deborah Erasmus 2010
Eugene Julius 2010
Jitendra Mishra 2010
Kateula Sichalwe 2010
Lindizwe Zibi 2010
Linus Naik 2010
Lucinda Ross 2010
Lynsey McEwan 2010
Matthew Fry 2010
Mluleki Mnguni 2010
Mohau Shikwane 2010
Mpho Ramonotsi 2010
Nabeel Hussain 2010
Ndishavhelafhi Mbedzi 2010
Nicholas Langley 2010
Nicola Chapman 2010
Nicolas Eleftheriades 2010
Nomonde Solomon 2010
Petrus Basson 2010
Premesh Govan 2010
Rebecca Chiume 2010
Rineshkumar Jivanji 2010
Roanne Lahee 2010
Sabatha Mhlanga 2010
Zamier Khan 2010
Andrew McMahon 2009
Andries Van Zyl 2009
Bongani Mthombeni 2009
Chipo Mupure 2009
Eunice Zwane 2009
Harshad Bhikha 2009
James Mwase 2009
Jennifer Case 2009
Jennifer Wiese 2009
Jezreel Cloete 2009
Kyle Mason-Jones 2009
Lizelle Kruyswijk 2009
Mduduzi Mbonambi 2009
Mkhululi Sibanda 2009
Mondli Guma 2009
Murehwa Mangere 2009
Rendani Ramaru 2009
Sarah Dowling 2009
Takalani Gangazhe 2009
Thapelo Letete 2009
Yu-Lun Chiang 2009
Abinash Ramasary 2008
Brendan Beeming 2008
Hema Vallabh 2008
Jeffrey Kuhn 2008
Jia Fan 2008
Karen Field 2008
Melissa Julius 2008
Philip Le Grange 2008
Ross Kukard 2008
Thelma Grobler 2008
Tyrone Kotze 2008
Xoliswa Gwagwa 2008
Barry Mc George 2007
Danie Diedericks 2007
Gwakisa Mwakyusa 2007
James Manchisi 2007
Kopano Moeketsi 2007
Lawrence Bbosa 2007
Lorato Kgari 2007
Martina Mcknight 2007
Melanie van Eck 2007
Nazneen Karbanee 2007
Rene Malan 2007
Rethabile Melamu 2007
Shamudulu Shamaila 2007
Thierry Kamunga Kazadi 2007
Yatish Daya 2007
Adam du Toit 2006
Alistair Fernsby 2006
Andrew Krige 2006
Bilainu Oboirien 2006
Carlo Accolla 2006
Celestino Mausse 2006
Jacobus Malherbe 2006
Jane Reddick 2006
Jason Germanis 2006
Jonathan Cohen 2006
Olukayode Ajayi 2006
Wisani Jonathan Maluleke 2006
Andries Van Der Westhuizen 2005
Angel Modutwane 2005
Ashton Swartbooi 2005
Athanasios Kotsiopoulos 2005
Evelyn Dhliwayo 2005
Happy Makhongela 2005
Hemant Gopal 2005
Jacobus Schulze-Messing 2005
Jacques Kleinsmidt 2005
Jasmina Martinovic 2005
Johannes Brits 2005
John Ntshabele 2005
Mark Pickering 2005
Peta Williams 2005
Seyed Sadat Rezai 2005
Tiffany Brown 2005
Gregory Hangone 2004
Hemita Anand 2004
Herbert Biel 2004
Mamabolo Mphahlele 2004
Mofoluwake Daramola 2004
Seneliso Zwane 2004
Tshepo Mailula 2004
Venasan Pillay 2004
Clive Robertson 2003
Glen Heinrich 2003
Jason Mcpherson 2003
Jeeten Nathoo 2003

Jonathan Lewis 2003
Khayelihle Ndwandwe 2003
Lucrecio Biquiza 2003
Rodney Hundermark 2003
Sean Marr 2003
Shilpa Seewoo 2003
Theo Van Schalkwyk 2003
Tyron Botha 2003
Valerie Lamaignere 2003
Zimiti Mudondo 2003
Andrew Msiza 2002
Ashley Sissing 2002
Edward Theka 2002
Evelyn Dhliwayo 2002
Frederick Botes 2002
Karen Peterson 2002
Malose Luescher-Mamashela 2002
Mohammed Jaffer 2002
Mukayi Mutsago 2002
Noko Phala 2002
Paul Shortridge 2002
Benjamin Knights 2001
Brigitte Comley 2001
Caleb Hattingh 2001
Cayle Sharrock 2001
Craig Beautement 2001
Damien Guillard 2001
Elizabeth Jeevaratnam 2001
Hilton Heydenrych 2001
John Nkosi 2001
Maqbool Dalvie 2001
Michael Halhead 2001
Njodzi Zizhou 2001
Stephen Roberts 2001
Bryne Rwodzi 2000
Christian Dempers 2000
Claire Janisch 2000
Clive Erasmus 2000
Craig Jewell 2000
Craig Sweet 2000
David Seaman 2000
Edward Siame 2000
Evans Mabaso 2000
Gert Van Wyk 2000
Imraan Bacus 2000
Jonathan Centurier-Harris 2000
Mgcini Tshwaku 2000
Neil Ristow 2000
Patrick Smith 2000
Rhoda Baker 2000
Richard Macrosty 2000
Stjohn Bunkell 2000
Tendai Furamera 2000
Vincent Smith 2000
Anthony Knobel 1999
Daniel Egya-Mensah 1999
Jeannette Sweet 1999
Kirsten Stieger 1999
Ntombizonke Gigaba 1999
Richard Walsh 1999
Zanele Magagula 1999
Cornwell Tepa 1998
Erik Theron 1998
Erna Van Schalkwyk 1998
Gregory Dickason 1998
Jarrod Hart 1998
Lenore Cairncross 1998
Paul Galatolo 1998
Paul Henry 1998
Sibusiso Gcaba 1998
Sooviraj Hurgobin 1998
Stefan Robertson 1998
Dorothee Van Scherpenzeel 1997
Karen Archer 1997
Richard Ballard 1997
Clifford Meyer 1996
Francis de Beer 1996
Jo-Ann Robinson 1996
Lauren Basson 1996
Mark Seager 1996
Sanjiv-Kumar Dabee 1996
Terry-Ann Fowler 1996
Chamu M'kombe 1995
Gillian Balfour 1995
Graham Davies 1995
Jacobus Breytenbach 1995
Kim Johnson 1995
Leon Johnson 1995
Michael Reynders 1995
Norman Lotter 1995
Robert Austin 1995
Trevor Hadley 1995
Ann Coleman 1994
Grant Loveday 1994
Harro Bloch Von Blottnitz .. 1994
Rajan Thavar 1994
Sara Pearce 1994
Gerard Hwang 1993
John Sharpe 1993
Reinier Weber 1993
Sikhumbuzo Mkhize 1993
Steven Langford 1993
Ashley Breed 1992
Joachim Schubert 1992
Sean Von Holt 1992
Klaus Schommarz 1991
Deborah Miller 1990
Andrew Bailey 1989
John Chapman 1989
Julian Glyn 1989
Noel Gillespie 1989
Radleigh Hartford 1989
Russell Simon 1989
Robert Copcutt 1988
Alison Ozinsky 1987
Lester Jacobs 1987
Martin Harris 1987
Paul Dickens 1987
Stefan Harms 1987
Stephan Bocken 1987
Stephen Russo 1987
Louise Barker 1986
Marianna Drossou 1986
Ronald Fickling 1986
Anna Dimou 1986
Adam Dabrowski 1985
John Venn 1985
Michael Bowley 1985
Robert Duncan 1985
Roy Movsowitz 1985
Steven Harris 1985
Athanasios Martalas 1984
Werner Schumann 1984
Ana Botelho De Sousa 1983
Arona Feltenstein 1983
Ronald Fasol 1983
Arnold Van Zyl 1982
Bruce Hendry 1982
Lawrance Flach 1982
Gerhard Hoppe 1981
Paul Kennet 1980
Sydney Benjamin Miller 1978
Richard Stewart Henkel 1978
Cyril Issadore Baskir 1977
Emmanuel Milis 1977
Charles David Levy 1976
Clifford Mark Kavonic 1976
Jean-Paul Franzidis 1975
John Malcolm Travers Greensmith 1976
Nicholas Paul Harris 1975
Richard Cleverly O'Donnell 1975
Gregory Neil Steenveld ... 1974
Peter Frank Basic 1974
Roger Nelson Davey Price 1974
Victor Rudolph 1974
William Whitely Thomas 1974
Harold Ian Henry Richter 1973
Trevor Baden Sydney Giddey 1973
Michael Pavely Warren 1972
Richard Henry George Promnitz 1971
Robert Alexander Louw 1971
Peter Michael Maughan Brown 1968
Spiro Theodore Paizis 1968
Peter William Rein 1967
Harald Hans Jawurek 1962
Conrad Miles Basson 1958
Nicolaas Jacobus Louw 1958
Robert Greer St Leger 1958
Peter Duncan 1952
Francis Paul Robinson 1949

Master of Philosophy

John Harrison 2020
Corey Beavon 2019
David Viljoen 2019
Lewis Tumbama 2019
Lesley Sibanda 2019
Kabangu Sakuwaha 2018
Sizwe Vidima 2018
Bonisile Shongwe 2017
Lee Mudenda 2017
Shuhei Kato 2017
Ayanda Manqoyi 2015
Takunda Chitaka 2015
Veronica Munyongani 2015
Karen Ma 2012
Lesley Sibanda 2011
Disaapele Mogashana 2007

MSc in Applied Science

Amy Barty 2010
Cindy-Jade Africa 2009
Erika van Tonder 2009
Jack Fletcher 2009
Prosper Bamara 2009
Annalie Blignaut 2008
Christopher Brough 2008
Liesel Harmse 2008
Oluwafemi Olaofe 2008
Ronald de Beer 2008
David Barkhuizen 2007
Nicholas Spurr 2007
Roelof Kriek 2007
Thiloshini Naidoo 2007
Veronica Patterson 2007
Oliver Sumani 2006
Teboho Maidza 2006
Willem Erasmus 2006
Craig Werner 2005
Nilenindran Govender 2005
Raymond Hunt 2005
Hermanus Lombard 2004
Marie Ting 2004
Babalwa Mbuce 2003
Natalie Shackleton 2003
Kelvin Jacobs 2002
Michele Cowley 2002
Phalali Motsoetsoe 2002
Riki Ferreira 2002
Elvera Viljoen 2001
Genevieve Joorst 2001
Kriveshini Pillay 2001
Abdool Saib 2000
Dick Van Beers 2000
Frans Prinsloo 2000
Kgolole Maripane 2000
Samantha Harding 2000
Melissa Petersen 1999
Patricia Forbes 1999
Marina Hop 1998
John Bunt 1997
Noelene May 1997

Bachelor of Science in Chemical Enineering

Between 1927 and 1956, degrees were awarded as BSc Applied and Industrial Chemistry

Langa Hlongwane 2020
Lucy Gibbons 2020
Radhia Pather 2020
Ahmed Syed 2019
Amy Hislop 2019
Anam Dweba 2019
Anam Magudu 2019
Avuyile Wali 2019
Ayanda Mncina 2019
Azra Khan 2019
Bafana Sibiya 2019
Basani Mbhalati 2019
Boitumelo Matjomane 2019
Boitumelo Matlakala 2019
Caitlin Govender 2019
Carla Cloete 2019
Charles Houston 2019
Charles Myrtle 2019
Chesley Rogerson 2019
Chloe Wileman 2019
Christine Court 2019
Daichong Song 2019
Danaly Govender 2019
Dane Smith 2019
Daniel De Oliveira 2019
Dennis Matogo 2019
Dillon Pillay 2019
Everjoice Nyaruwata 2019
Faizel Mohamed 2019
Farhana Allie 2019
Felix Guni 2019
Fhulufhelo Mathegu 2019
Graeme Betty 2019
Ilse Du Plessis 2019
Imrah Kamedien 2019
Jabulani Nyathi 2019
Jacques Bagraim 2019
Jason Botha 2019
Jason September 2019
Jody Smith 2019
Julius Mbimbi-Ikoli Manjo 2019
Justin Marcus 2019
Karen Ssekimpi 2019
Kate Murphy 2019
Katlego Sejanamane 2019
Kelly Fahn 2019
Laurence Midgley 2019
Laylaa Ebrahim 2019
Lebohang Mphono 2019
Liam Moran 2019
Linda Mwendia 2019
Lisa Kumadiro 2019
Lobiane Ponto 2019
Louis Frans Jacobus Wentzel 2019
Luke Garrod 2019
Lunako Mthenjana 2019
Lusanda Hlela 2019
Mandisa Shozi 2019
Matome Malatji 2019
Matthew Shaw 2019
Megan Denny 2019
Mellisa Mundida 2019
Michael Azih 2019
Michael Ngau 2019
Michael Thomson 2019
Mkhuseli Mbhele 2019
Mosola Xaba 2019
Mumdouh Mohamed 2019
Namhla Juqu 2019
Natasha Nkabi 2019
Ngcebo Gwala 2019
Philip Kridiotis 2019
Piers Johnston 2019
Reagan Makhanya 2019
Reuben Walters 2019
Riyaal Cerpath 2019
Rudolf Makhubela 2019
Rufaro Mukwenya 2019
Saphron Brown 2019
Scott Pinto 2019
Sethosa,Tumelo Jacob 2019
Sharlene Naidoo 2019
Sheanesu Fungura 2019
Sheena Bemanya 2019
Shurah Sheikh 2019
Sibabalwe Boko 2019
Sifiso Mpila 2019
Simbarashe Mariwande 2019
Siyabulela Majikija 2019
Takudzwa Ngwenya 2019
Tawanda Mutataguta 2019
Terri Lakey 2019
Terri-Anne Glass 2019
Tsepang Khoboko 2019
Tshiamo Geneke 2019
Tyler America 2019
Uzair Kadir 2019
Victor Xaba 2019
Aaron Smith 2018
Alexander Brock 2018
Andrew Vogel 2018
Anmar Petersen 2018
Anotidaishe Spencer 2018
Apollonia Charamba 2018
Archippe Manzila 2018
Bibi Suhootoorah 2018
Bonolo Bonokoane 2018
Bradley Raasch 2018
Brandon Matthews 2018
Brian Tlale 2018
Caitlin Grüning 2018
Cameron Grinyer 2018
Cassandra Da Cruz 2018
Christopher Mullins 2018
Dasmi Maharaj 2018
Deborah Chikukwa 2018
Divine Ssebunnya 2018
Donovan Paine 2018
Dylan Harrison 2018
Elsie Manaswe 2018
Emily Makgoe 2018
Emma-Kate Chetty 2018
Evren Turan 2018
Fabio Torino 2018
Farouq Mnjira 2018
Gabin,Matthew Brian 2018
Grant Christopher Soll 2018
Grant Turner 2018
Hannah Ho 2018
Hélda Mandlate 2018
Isabella Kriegler 2018
Itoote Rubombora 2018
James Hockey 2018
Jason Foulkes 2018
Jerry Gwarada 2018
Joshua Williams 2018
Kalpana Maraj 2018
Karina De Kock 2018
Kassandra Byaruhanga 2018
Kaylen Moodley 2018
Kreshan Govender 2018
Kuda Maneta 2018

Leanne Lewis 2018
Lebohang Nku 2018
Lee Gordon 2018
Lisa Van Oudtshoorn 2018
Litha Tywakadi 2018
Mathew George 2018
Meesha Parbhoo 2018
Megan Roux 2018
Michael Tatham 2018
Mikyle Marajh 2018
Mishael Moodley 2018
Motloheloa Mokhethi 2018
Muhammad Imaad Davies 2018
Natasja Wanblad 2018
Ndivhuwo Magondo 2018
Neo Maliela 2018
Nicholas Cowen 2018
Nolihle Ndamase 2018
Ntokozo Mzolo 2018
Nuraan Manuel 2018
Nyasha Mawungwe 2018
Oabile Mogomelo 2018
Oliver Marr 2018
Omishka Ranganthan 2018
Phemelo Moses 2018
Pierre Viviers 2018
Raeesah Gani 2018
Rebecca Tod 2018
Richard Ogg 2018
Robin Lavers 2018
Rosabeth Matsikidze 2018
Ryan Stableford 2018
Sagar Gandhi 2018
Sally Berge 2018
Samuel Stein 2018
Sarah Jamieson 2018
Sejal Bhikha 2018
Senzesihle Buthelezi 2018
Sheldon Govender 2018
Silethukuthula Mathe 2018
Siobhan Johnson 2018
Sonka Tatsi 2018
Stephen Cotterrell 2018
Steven Sutton 2018
Tafadzwa Ndlovu 2018
Tanaka Tafirenyika 2018
Tasleen Mahmood 2018
Tasnika Goorhoo 2018
Thabang Matimbi 2018
Thabisile Vilakazi 2018
Thabiso Matlakala 2018
Thabo Malatji 2018
Thando Nxumalo 2018
Thato Lieta 2018
Thomas Andrew 2018
Tshiamo Ramano 2018
Urvashi Chundunsing 2018
Victor Spencer 2018
Vuyo Hlongwane 2018
Washington Wachira 2018
William Jamieson 2018
Wiseman Shabane 2018
Yatheshthrao Ragoo 2018
Zandile Matutu 2018
Abeedah Kadri 2017
Akshi Singh 2017
Alexander Brandt 2017
Alison Sanders 2017
Amulya Mathew 2017
Andrew Mandeya 2017
Anjalee Ramjee 2017
Anthony Balladon 2017
Anthony Warren Mchendrie 2017
Areesen Reddy 2017
Argon Poorun 2017
Ashlen Mammen 2017
Avashnee Govender 2017
Blessing Rapotu 2017
Boitumelo Moloto 2017
Bongani Mtetwa 2017
Brits Van Zyl 2017
Colin Blake 2017
Dakalo Nemauluma 2017
Damien Erasmus 2017
Dandré Pienaar 2017
Daniel Zilesnick 2017
Danielle Sympathie Goho 2017
Dimitri Pavlou 2017
Ever Nyama 2017
Fathima Esak 2017
Gcinisizwe Dlamini 2017
Gianluca Shaer 2017
Heaven Nemaungane 2017
James De Beer 2017
Jarryd Naicker 2017
Jean-Claude Araujo Carreno 2017
Jené Ford 2017
Jonathan Gertzen 2017
Joshua Nel 2017
Kreelan Chetty 2017
Lara Auzet 2017
Lawrence Taderera 2017
Leboea Tigeli 2017
Lelethu Roto 2017
Leolyn Alexander 2017
Lerato Mahwayi 2017
Lesedi Ngoato 2017
Liam Metcalfe 2017
Lindelwa Tigere 2017
Loren De Koker 2017
Luthando Jona 2017
Lydia Ramushu 2017
Makalima,Bafana 2017
Malcolm Mapeta 2017
Mark Hambrock 2017
Masana Mhinga 2017
Matthew Jackson 2017
Matthew Ries 2017
Merrick Pringle 2017
Michel Amato 2017
Mihlali Dilima 2017
Mogammad Malick 2017
Mogammad Yaameen Jardien 2017
Mohamed Moydien 2017
Nadia Laric 2017
Naidoo,Jeovana Carolyn 2017
Naomi Harrisankar 2017
Nasseela Hytoolakhan Lal Mahomed 2017
Ncube,Nkululeko 2017
N'Goran Nogues Ollier 2017
Nikhil Vallabh 2017
Nisa Mirza 2017
Nkululeko Mhlongo 2017
Noloyiso Mamputa 2017
Olivier Tambwe 2017
Petro Pavlou 2017
Phetogo Mogotsi 2017
Preshanthan Reddy 2017
Robert James 2017
Ruane Govender 2017
Sarah Tetlow 2017
Sello,Maunetlala 2017
Shaniq Pillay 2017
Shivonne Mooniyen 2017
Simon Innes 2017
Sinethemba Mhlongo 2017
Stuart Bleloch 2017
Tafadzwa Kwaramba 2017
Thandile Mpompo 2017
Thanushri Pather 2017
Timothy Rezelman 2017
Tita Labi 2017
Tlaleng Lemeke 2017
Trisha Ganisyeje 2017
Tumelo Morakile 2017
Tzu-Ting Lin 2017
Verona Subroyen 2017
Veroushia Padayachee 2017
Vimbainashe Dzimbanhete 2017
Yashna Kisten 2017
Yi-Jou Chen 2017
Zekun Zhang 2017
Ziba Shabir Hussein Somjee Rajan 2017
Adam Howa 2016
Alexander Bada De Cominges 2016
Alexander Wilmot 2016
Alexandra Himunchul 2016
Alexandra Stuart-Smith 2016
Ameerah Van Der Fort 2016
Anderson Chimphango 2016
Andile Ngubane 2016
Andrea De Goede 2016
Andrew Thompson 2016
Andrew Williams 2016
Ashleigh Hein 2016
Basetsana Mohlabine 2016
Benedict Jantjies 2016
Benjamin Andrew Hall 2016
Blessing Chirume 2016
Brandon Hinrichsen 2016
Brenda Mehlo 2016
Brian Thobela 2016
Cara Davidson 2016
Claire Duncan-Brown 2016
Daniel Bada De Cominges 2016
David Viljoen 2016
Dawid Kruger 2016
Delisha-Ann Naicker 2016
Emma Horn 2016
Érika Utui 2016
Fred Chibwana 2016
Herbert Hill 2016
Hylton Crous 2016
James Robinson 2016
Jason Delaney 2016
Jenni Hinds 2016
Jordan Delbridge 2016
Keabetswe Skee 2016
Kimaya Reddy 2016
Kristin Johnson 2016
Leigh Barrow 2016
Lelia Lelia 2016
Liam Kingsley Hitchcock 2016
Linda Foster 2016
Lindiwe Mthimunye 2016
Lisa October 2016

Ljiljana Vasic....2016
Lungile Zwane....2016
Mahalihali Zabangwa....2016
Mandiwakhe Ntlabathi....2016
Marianne Werle Van Der Merwe....2016
Maseloko Mokone....2016
Mashudu Muridili....2016
Masoi Mhlophe....2016
Matimba Mabonda....2016
Matthew Gorven....2016
Mavis Lewis....2016
Mikyle Potts....2016
Minenhle Moyo....2016
Mishka Slamang....2016
Mivashya Govender....2016
Mpho Tsotetsi....2016
Mpumelelo Mhlongo....2016
Mvano Mgam....2016
Nancy Nanhua Yu....2016
Nesta Sebopa....2016
Nicolas Harris....2016
Nikhyle Govender....2016
Nishtha Singh Kukreja....2016
Nomalha Wittika....2016
Nontsikelelo Dyasi....2016
Nonzwakazi Nkahle....2016
Norman Mpofu....2016
Nqobile Ntobela....2016
Olga Guseva....2016
Olivia Venter....2016
Onkarabile Matome....2016
Otinell Dlamini....2016
Pfumbisani Makhuvha....2016
Pieter Hugo....2016
Poloko Lefifi....2016
Priyashnie Govender....2016
Relebohile Tseka....2016
Reuben Dlamini....2016
Richard Martin....2016
Robin Hall....2016
Ross Shardlow....2016
Ruvarashe Ndoora....2016
Sean Pillay....2016
Shafick Bruintjies....2016
Sibusisiwe Nxumalo....2016
Sinovuyo Zipete....2016
Siphiwo Ndabula....2016
So-Mang Kim....2016
Srikesh Ramdari....2016
Storm Strydom-Smith....2016
Suhail Musa....2016
Takunda Kondo....2016
Tasekela Ng'ambi....2016
Tayla Gordon....2016
Thakhani Ramaru....2016
Thapelo Selekane....2016
Theona Mudley....2016
Thuso Bulala....2016
Timothy Pons....2016
Tinashe Ndemera....2016
Tracy Mbiyu....2016
Verona Moodley....2016
Victoria Blackbeard....2016
Wesley Collair....2016
Yadi Hu....2016
Yuma Langenbach....2016
Zipporah Nyokangi....2016
Alexander Platts....2015
Amisha Desai....2015
Brandon Pieters....2015
Brian Mayengo....2015
Caitlin Courtney....2015
Cameron Hoey....2015
Caroline Still....2015
Chabala Kaongwa....2015
Chelsea Lyn Tucker....2015
Chiara Maharaj....2015
Christopher Molteno....2015
Christopher Zaayman....2015
Clare Rodseth....2015
Claudia De Sousa....2015
Cody Burcher-Jones....2015
Corey Beavon....2015
Dale Heyns....2015
Daniel Bresgi....2015
Darren Ho....2015
Darryl Brown....2015
Dayle Nel....2015
Desania Govender....2015
Devin Marder....2015
Didier De Villiers....2015
Dominic De Oliveira....2015
Erin Trenor....2015
Felix Zimmermann....2015
Genevieve Harding....2015
Gilbert Ncube....2015
Hilda Khunoana....2015
I-Chen Wu....2015
Ilyaas Abdullah....2015
Jade Holt....2015
Jaishal Naidu....2015
Jenny Robertson....2015
Julia Mc Gregor....2015
Kagiso Modukanele....2015
Karabo Ramonnye....2015
Keith Mutambirwa....2015
Kelebogile Makhema....2015
Kyle Naidoo....2015
Lauren Mc George....2015
Lebogang Lucia Machethe....2015
Lelethu Beseti....2015
Lenned Kujoana....2015
Likoze Simenda....2015
Lineo Matumane....2015
Luvo Luna....2015
Maisha Molepo....2015
Mashudu Mokhithi....2015
Mohamed Dawood Jogiat....2015
Mosetsanagape Mokgosi....2015
Muhammad Amirudin....2015
Murray Shaw....2015
Mveleli Mbombo....2015
Nicola Embling....2015
Nkhulang Matsepe....2015
Nobuhle Mpofu....2015
Nompumelelo Precious Mhlongo....2015
Nontobeko Moyo....2015
Onawanda Voyi....2015
Peter Beare....2015
Pierre Cilliers....2015
Prelisha Sewnarain....2015
Queen Rugaimukamu....2015
Ramsay Collins....2015
Rony Azegele....2015
Rorisang Ntoane....2015
Rosalind Stegmann....2015
Rowan Dalton....2015
Rumbidzai Zireva....2015
Rutendo Mutsekwa....2015
Saphokazi Mgqamqo....2015
Sarah Adam....2015
Senzo Mgabhi....2015
Shalisa Lodewyk....2015
Shaun Foulkes....2015
Sigourney Wilson....2015
Smanga Ngcobo....2015
Songo Momoti....2015
Sphamandla Ngema....2015
Tanya Hodgson....2015
Thabo Mabuka....2015
Tshegofatso Maila....2015
Usisipho Gogela....2015
Veleshia Govender....2015
Vukile Ntozakhe....2015
Wanjiadai Ju....2015
Wen Tian Helen Xie....2015
William Cahill....2015
Yamkela Mgwebi....2015
Yandisa Sojola....2015
Yuan-Shiun Wu....2015
Zaynab Sadan....2015
Zinwe Ngculu....2015
Zolisa Hohana....2015
Aileen Brandt....2014
Alexa Boje....2014
Alexandra Wheeler....2014
Amna Ghafeer....2014
Andrew Bestbier....2014
Arthur Gajewski....2014
Ashcaan Khazali....2014
Ashton Marsden....2014
Aviwe Roro....2014
Bagcinele Dlamini....2014
Bianca Jansen....2014
Brett Gait....2014
Buhle Katanga....2014
Buhle Manana....2014
Byeronie Epstein....2014
Caroline Blaylock....2014
Chanel Pillay....2014
Christopher Barraclough....2014
Craig Lawrence....2014
Daniel Schwartzkopff....2014
David Baron....2014
Delincia Chandarman....2014
Donattelo Mzilethi....2014
Dududu Zweni....2014
Edwina Papiah....2014
Esther Mazvidza....2014
Farirai Sanyika....2014
Firdous Alexander....2014
Francois De Flamingh....2014
Ghulaam Amoo....2014
Gordon Dodge....2014
Grace Hudson....2014
Hannah Peacocke....2014
Ismail Brey....2014
Jade Robinson....2014
Jaime Davidson....2014
Jason Moss....2014
Junfeng Guo....2014
Justin Malherbe....2014
Katherine Murray....2014
Katleho Mothapa....2014
Keenan Heynes....2014
Kemi Jegede....2014
Kershin Gounden....2014
Kirsten Peacocke....2014
Kuki Mothata....2014
Laura Smith....2014
Lauren Green....2014

Lihlonono Hopewell Molefe.......2014
Lindsay Williams.......2014
Louis Oudin.......2014
Luke Mortimer.......2014
Mangetane Moto.......2014
Marasi Monyau.......2014
Marc Bagley.......2014
Marvin Phalole.......2014
Masego Mosupye.......2014
Matthew Myers.......2014
Mekia Makhubu.......2014
Michelle Fang.......2014
Michelle Voerman.......2014
Mmaphala Mathobela.......2014
Monché Samuels.......2014
Monwabisi Scott.......2014
Motlokoa Khasu.......2014
Mpho Mukhaninga.......2014
Muhammad Davids.......2014
Muhammad Mohd Fauzi..2014
Nanina Grunert.......2014
Nanji Sheni.......2014
Nastassia Brugger.......2014
Ndivhuwo Nemakonde.......2014
Ngoni Mhonde.......2014
Nicola Mitchell.......2014
Nicole Dixon.......2014
Nicole Erispe.......2014
Nicole Uys.......2014
Onkokame Setidisho.......2014
Pfano Nembudani.......2014
Philippus Steenkamp.......2014
Philisiwe Sithole.......2014
Pieter van Wyk.......2014
Rachel Finlayson.......2014
Raseekele Radingwana.......2014
Rory Stott.......2014
Roxanne Pieterse.......2014
Saad Panjwani.......2014
Saajidah Moolla.......2014
Sanda Mahlakahlaka.......2014
Sashen Reddy.......2014
Selby Shubane.......2014
Sibusisiwe Maseko.......2014
Sijabulile Ndzimandze.......2014
Sithembile Cele.......2014
Sizwe Vidima.......2014
Sunghun Jung.......2014
Tariq Allie-Ebrahim.......2014
Tatenda Dinha.......2014
Tebatso Mangena.......2014
Tebogo Mphepya.......2014
Tesha Seeparsad.......2014
Thabo Tokwe.......2014
Thandekile Nkala.......2014
Thanzi Ramukosi.......2014
Thembelani Shozi.......2014
Theophilus Dzingai.......2014
Tilden Hellyer.......2014
Tito Mashilo.......2014
Tshedisegang Molatedi.......2014
Unathi Swartbooi.......2014
Uthmaan Solomon.......2014
Wesley Neutt.......2014
Yagna Vij.......2014
Zafeerah Omar.......2014
Abdul-Baasit Abdullah.......2013
Alice Wong.......2013
Ayesha Rawoot.......2013
Bo Guo.......2013
Boon Hwee Chan.......2013
Bridget Fundikwa.......2013
Buhle Nxiwa.......2013
Caelin September.......2013
Caitlin Dunn (nee Morris).2013
Catherine Edward.......2013
Christopher Chikochi.......2013
Clayton Jacobs.......2013
Daniella Faria.......2013
Dean Michael Grant.......2013
Devon Edwards.......2013
Douglas Tilbury.......2013
Emma Dawson.......2013
Geoffrey van Ryneveld.......2013
Gerald Mbele.......2013
Gorden Gambu.......2013
Hiren Makkan.......2013
Ian Van-Rooyen.......2013
Imraan Kaprey.......2013
Jarred Devar.......2013
Jennifer Couperthwaite.......2013
Johannes Mateus.......2013
Julia Wilson.......2013
Katlego Loeto.......2013
Kevin Thomson.......2013
Kusheel Amritlall.......2013
Kwaku Rwexana.......2013
Lindani Buthelezi.......2013
Lunga Patso.......2013
Lynette Nyagah.......2013
Makgabo Moloto.......2013
Mark Dryden.......2013
Martha Hatutale.......2013
Mathabatha Legodi.......2013
Meesha Sadanath.......2013
Megan Bennett.......2013
Megan Raymond.......2013
Mogammad Martin.......2013
Mohamed Logday.......2013
Motshamonyane Phasha..2013
Nangani Mugodo.......2013
Natalie Howlett.......2013
Nicholas Fleischman.......2013
Nicholas Munsami.......2013
Nicole Malanda.......2013
Nishaat Latief.......2013
Ntandoyenkosi Hlabangana.......2013
Obakeng Olehile.......2013
Pfariso Mbedzi.......2013
Phathutshedzo Mamathoni.......2013
Phathutshedzo Mashele.......2013
Piniel Bengesai.......2013
Pratik Gandabhai.......2013
Relebohile Sefako.......2013
Resoketswe Manenzhe.......2013
Riddhi Maharaj.......2013
Romina Nair.......2013
Ronald van der Merwe.......2013
Rory Harley.......2013
Rumbidzaishe Chipakwe..2013
Ruvarashe Gumbo.......2013
Sandile Buthelezi.......2013
Sibongile Muziki.......2013
Sibongiseni Gqebe.......2013
Sibusiso Hlatshwayo.......2013
Sibusiso Msani.......2013
Sikhulile Ntaka.......2013
Simone Daniels.......2013
Sonalia Ramnarain.......2013
Soorayya Yadallee.......2013
Stacey Wilding.......2013
Tadiwanashe Chidzanira.......2013
Takunda Chitaka.......2013
Tayana Raper.......2013
Thandeka Ndlovu.......2013
Thobile Dube.......2013
Thokozani Malinga.......2013
Tiaan Nkuna.......2013
Timothy Desmond.......2013
Tinjombo Baloyi.......2013
Tracy Fullard.......2013
Tyrone Williams.......2013
Velaphi Vilakazi.......2013
Veronica Munyongani.......2013
Vezubuhle Moatshe.......2013
Victoria Campbell.......2013
Vusi Lukhele.......2013
Wadzanai Nyabeze.......2013
William Vuyelwa.......2013
Xue Jun Jian.......2013
Yannick Ilunga.......2013
Yasir Gamieldien.......2013
Zita Clayton.......2013
Adri Uys.......2012
Alan Homewood.......2012
Andrew Kleyn.......2012
Arlette Giron.......2012
Astrid Boje.......2012
Bheka Khumalo.......2012
Bokai Liu.......2012
Brandon Nair.......2012
Brent Hazell.......2012
Bronwyn White.......2012
Caitlin Moir.......2012
Camille Damons.......2012
Catherine Lukwago.......2012
Champion Mtileni.......2012
Chanelle Leukes.......2012
Claudia du Plooy.......2012
Cloe Legrand.......2012
Colleen Jackson.......2012
Collin Norman.......2012
Cornelius Mynhardt.......2012
Courtney Thompson.......2012
David Vogel.......2012
Deepti Charitar.......2012
Dewald Vercueil.......2012
Faakhirah Waggie.......2012
Fadzai Kadzinga.......2012
Firhaat Abrahams.......2012
Garth Barry.......2012
Gregory Crymble.......2012
Hlayisi Baloyi.......2012
Jaime Plaatjes.......2012
Jamie Srubis.......2012
Joanne Crimes.......2012
Joel Bombile.......2012
Jon Janet.......2012
Kabwe Musonda.......2012
Karabo Rabolele.......2012
Katie Mann.......2012
Kavir Parthab.......2012
Keboihile Molatodi.......2012
Kelly Bokelmann.......2012
Keneuoe Letsela.......2012
Kholo Mneno.......2012
Laetitia Thuysbaert.......2012
Lauren Appel.......2012
Lebogang Mahlare.......2012
Lesego Moumakoe.......2012
Lindani Chili.......2012
Lucy Little.......2012
Lungisani Nodwala.......2012

Martin de Beer.................. 2012
Matthew Burke 2012
Matthew Koen 2012
Mayaba Shakankale 2012
Melissa Sikosana 2012
Mesuli Zondo..................... 2012
Mohamad Omar............... 2012
Muhammad Manan 2012
Murray Meissner................ 2012
Natasha Steinmann 2012
Natasha Warambwa.......... 2012
Navern Naidoo 2012
Nhlamulo Ndzovela 2012
Nicholas Burman 2012
Nicholas Rice..................... 2012
Nicolas Boonzaier.............. 2012
Nicole Gounder 2012
Niel Naude 2012
Nikita Turck 2012
Onyinye Iroala 2012
Oswald Alembong............ 2012
Paul Nieuwoudt................. 2012
Peter Smaill......................... 2012
Pharaoh Muzanenhamo... 2012
Philasande Xalabile........... 2012
Sairisha Ramnanan 2012
Sandisiwe Mrubata 2012
Sarvesha Moodley 2012
Scott Taylor 2012
Seipati Mabote 2012
Senzo Xulu.......................... 2012
Shehzaad Mukaddam....... 2012
Shilpa Rumjeet................... 2012
Sibongokuhle Gxavu........ 2012
Sivuyile Shabane 2012
Stubbe Adu-Poku 2012
Sureka Lekharam 2012
Tafadzwa Marozva............ 2012
Tamara Habile.................... 2012
Tamlyn Froneman.............. 2012
Tessa Langley 2012
Teza Chipeta....................... 2012
Thilisha Moodley 2012
Timothy Magezi Ndamira .. 2012
Tsepo Serakalala 2012
Velani Myende 2012
Warren Little 2012
Wesley Van Niekerk.......... 2012
Yolanda Mbola 2012
Zethu Dlamini..................... 2012
Zhehua Xu.......................... 2012
Akanyang Phineus
Hottie................................ 2011
Andisani Masindi 2011
Andre Lubbe...................... 2011
Andrew Payne 2011
Anesu Wushe..................... 2011
Annie Porter 2011
Baveer Doolabh 2011
Brandon De Gee 2011
Carl Masuret 2011
Cindy-Lee Smith............... 2011
Craig Zinn 2011
Damian Stevens 2011
Dihajo Fransman............... 2011
Elizabeth Kuiper................ 2011
Estelle Mills........................ 2011
Farai Mashayamombe 2011
Glen Jansen....................... 2011
Hebert Nyakunuhwa 2011
Hilton Rossenrode 2011
Jacqualine Magodo.......... 2011
Jason Daniels 2011
Jason Nikiforakis............... 2011
Julius Magabane 2011
Karabo Naleli...................... 2011
Kelly-Anne Whitehead..... 2011
Kgowane Kgokolo 2011
Khensani Buhlungu........... 2011
Kreevin Ekambaram.......... 2011
Kyle de Swardt.................. 2011
Lefu Dlamini 2011
Lerato Moira Chauke 2011
Leshego Ledwaba 2011
Mahomed Panjwani.......... 2011
Maloba Tshehla................. 2011
Matthew Ferreira.............. 2011
Michael Baxter 2011
Michael Short..................... 2011
Michelle van Ryneveld..... 2011
Mncedisi Nyaweni 2011
Mopeli Khama 2011
Motena Takalimane........... 2011
Msawayo Pereira 2011
Murray Armstrong............. 2011
Nathan Rafferty.................. 2011
Ngokoana Modiba............ 2011
Nickiel Bharat 2011
Nicole Maduray 2011
Nomvuyo Gwiji 2011
Ntuthuko Khumalo............ 2011
Razelle Naidoo 2011
Reabetswe Mabe............. 2011
Rizqah Mohamed............. 2011
Ronald Phefo 2011
Ronan Jones...................... 2011
Roshan Osman.................. 2011
Rotondwa Radzilani 2011
Salome Masweu 2011
Samson Radebe 2011
Sandeep Valodia.............. 2011
Selaelo Lekoloane............ 2011
Selelo Koko 2011
Sello Malefane................... 2011
Shivashkar Singh............... 2011
Sihle Sibande 2011
Steven Nkadimeng 2011
Stewart Buchanan............. 2011
Susan Taylor....................... 2011
Tanaka Shumba................. 2011
Theodore Subramoney.... 2011
Timothy Arthur.................. 2011
Timothy Egan 2011
Tito Sepoloane 2011
Wandile Mamba............... 2011
Xolani Melane 2011
Zonke Ntshangase............ 2011
Adam Lampard.................2010
Adrian Fortuin....................2010
Alex Madden 2010
Amukelani Baloyi..............2010
Angela Webb 2010
Arthur Mabentsela 2010
Beatrice Mohononi 2010
Chad February...................2010
Emily Lewis 2010
Evedance Masuku 2010
Imtiaz Parker......................2010
Jonathan Ledgerwood 2010
Karthik Shekhar 2010
Katlego Phage 2010
Kevin Japp.........................2010
Kurt Schafer 2010
Lucas Dube 2010
Lusani Mulaudzi.................2010
Malcolm Meyer.................2010
Malibongwe Manono 2010
Mark Gituma 2010
Mark Middelhoven 2010
Martin Conibear 2010
Matthew Amundsen 2010
Matthew Hill......................2010
Meakin Marange 2010
Mogamat Nacerodien......2010
Moipone Lelibane 2010
Molefi Matsutsu................2010
Mpfunzeni Razwiedani.....2010
Mthokozisi Maluleka 2010
Muhammed Suleman.......2010
Mulalo Denga 2010
Musawenkosi Dlame 2010
Nandipha Nocuze 2010
Nazarene Hanslo 2010
Nkosikhona Zengezi 2010
Nozonke Dumani 2010
Rukaya Stracey 2010
Sakhile Nkosi 2010
Sarah O'Carroll...................2010
Sean Dale...........................2010
Shikaar Singh......................2010
Sneh Chureetur 2010
Tapiwa Chivengwa...........2010
Teboho Moseme..............2010
Timothy Crombie 2010
Trevor Lobban 2010
Tumiso Thathane 2010
Wade Swannell..................2010
Yefon Persis 2010
Yi-ting Cheng 2010
Alister Inglesby 2009
Andrew Harris.................. 2009
Ashendri Naidoo............. 2009
Ashlene Claasen 2009
Brett Clapham 2009
Caitlin Bergh...................... 2009
Carla Dyer......................... 2009
Christopher Shilubane..... 2009
Clara Amaguru-Togboa... 2009
Damon De Boor 2009
Daniel Castelyn................. 2009
David Beatty...................... 2009
David Dogon 2009
Dilshaad Booley................ 2009
Elaine Govender 2009
Emily Musil........................ 2009
Fa-eez Karodia 2009
Fezekile Beauty Mdluli 2009
Garren Edwards 2009
Gomolemo Seboko......... 2009
Graham Marsden 2009
Grant Apsey 2009
Gregory Luyt.................... 2009
Guy Austin 2009
Hartmut Brodner............. 2009
Ilhaam Dalwai................... 2009
Japhet Angombe............. 2009
Jean-Paul Pienaar............ 2009
Jesse Levendal 2009
Jody Smit.......................... 2009
Karen Ma.......................... 2009
Kate Bladen 2009
Kathryn Mc Bain................ 2009
Kevin Munsamy 2009
Khuselwa Asanda
Wayi................................. 2009
Kyle Moskovitz.................. 2009

Lehlogonolo Nchabeleng 2009
Lehlohonolo Teba 2009
Lesego Malla 2009
Lesley Sibanda 2009
Lev Rushforth 2009
Lungile Mbuyisa 2009
Mariam Bibi Royker 2009
Mark Hosking 2009
Mphengwa Mabala 2009
Mussa Lisso 2009
Neehal Mooruth 2009
Nerisa Moodley 2009
Porogo Duku 2009
Precious Chuma 2009
Puleng Khumalo 2009
Ramogohlo Debeila 2009
Reay Dicks 2009
Rendani Munandi 2009
Sabelo Mkhwanazi 2009
Salima Zyambo 2009
Shanen Jelliman 2009
Simphiwe Njikelane 2009
Siphumelele Shabalala 2009
Sonya Samson 2009
Sophia Czarnocki 2009
Tapiwa Chimbganda 2009
Thabang Lejakane 2009
Thendo Madala 2009
Tokelo Kosana 2009
Tracey Van Heerden 2009
Tsepang Khonthu 2009
Tshepo Ntsane 2009
Tshilidzi Rambau 2009
Tsunduka Makumbani 2009
Varun Patel 2009
Wesley Potts 2009
Wing-Kin Fung 2009
Yuan Cheng 2009
Yuvan Naidoo 2009
Zwelethu Fatman 2009
Adinda Preller 2008
Albert Sehoana 2008
Allison Kasozi 2008
Ashalen Reddy 2008
Christopher Paterson 2008
Danielle Bearman 2008
Danielle Louw 2008
Dion Lusinga 2008
Doreen Nabaho 2008
Eugene Mbolekwa 2008
Fisokuhle Mayisela 2008
Frank Stoddart 2008
Gracia Munganga 2008
Harry Schuurman 2008
Ilhaam Bougard 2008
Jared Smyth 2008
John Mc Coy 2008
Kim Taylor 2008
Kripal Daby 2008
Lara Truter 2008
Lauren Miller 2008
Lehlogonolo Chiloane 2008
Leigh Pearce 2008
Lindsey Nhlamulo Tlangelani Miyen 2008
Lucinda Ross 2008
Lufuno Musenwa 2008
Maanda Tshifularo 2008
Marijke Fagan 2008
Melikhaya Ndingane 2008
Michael Long 2008
Mitesh Chauhan 2008
Mohau Shikwane 2008
Muhammad Amod 2008
Muhammad Cariem 2008
Muhammad Parak 2008
Muhammed Roomanay 2008
Muneer Asmal 2008
Muneera Deaney 2008
Murray Fraser 2008
Nabeel Hussain 2008
Nawaal Dawood 2008
Niven Harkhu 2008
Parusha Ramjee 2008
Phosa Lebelo 2008
Rashed Shah 2008
Rebecca Chiume 2008
Richard Strubing 2008
Rineshkumar Jivanji 2008
Robert Pott 2008
Sabatha Mhlanga 2008
Samantha Botha 2008
Sancha Nagooroo 2008
Saud Edries 2008
Sergio Cieverts 2008
Setta Mbalamba 2008
Shannon Boonzaier 2008
Shareefa Brey 2008
Simon Pattison-Emms 2008
Siphiwe Msipho 2008
Sipho Maswanganyi 2008
Sixolile Dlamini 2008
Siyabonga Hlongwane 2008
Siyabonga Mthimkhulu 2008
Tendai Tambudze 2008
Tracey Richards 2008
Tracy Khothule 2008
Tshegofatso Tlhapi 2008
Waseem Ahmed 2008
Adrian de Beer 2007
Alexander Opitz 2007
Bella Mphahlele 2007
Bongani Msimango 2007
Bonolo Tsimanyane 2007
Botlhe Mokgethi 2007
Bryan Maas 2007
Bulelwa Ndlovu 2007
Caitlin Smit 2007
Cebo Omelo 2007
Christina Trautmann 2007
Daniel Petrie 2007
Devan Matthews 2007
Edith Tshenyoethata 2007
Emile Esterhuizen 2007
Fazila Rakhda 2007
Harikrishna Sudhakaran 2007
Jandro Paxton 2007
Jasper Dick 2007
Joachim Becker 2007
John Terreblanche 2007
Kgotlelelo Sedibe 2007
Kitso Kemoreile 2007
Lambertus Louw 2007
Lerata Mofokeng 2007
Li-Hsin Tsui 2007
Lindizwe Zibi 2007
Loice Badza 2007
Louie Eggers 2007
Luqmaan Salie 2007
Luvuyo Nonyathi 2007
Lynsey McEwan 2007
Magalane Legodi 2007
Majoang Mokhosi 2007
Malikaah Galant 2007
Mark Vonk 2007
Marvin Welby-Solomon 2007
Matthew Fry 2007
Megan van der Scholtz 2007
Michael Malagas 2007
Mohamed Ebrahim 2007
Motlatsi Mabaso 2007
Nhlanhla Cele 2007
Nicholas Langley 2007
Nobathembu Mangesana 2007
Peter Dawson 2007
Ramoshibidu Mogorosi 2007
Rendani Ramaru 2007
Reneta Pillay 2007
Ridovhonani Rambau 2007
Rilwele Kutama 2007
Robert Moffat 2007
Ruramai Chikuku 2007
Saima Kadhila-Amoomo 2007
Sean Gotora 2007
Tamara Bernitz 2007
Thamsanqa Mkhonza 2007
Tshepo Mashile 2007
Velemseni Nxumalo 2007
Vhutshilo Malivhoho 2007
Waheed Adam 2007
Wesley Massey 2007
Yu-Lun Chiang 2007
Zamier Khan 2007
Zuko Deleki 2007
Adrian Hammond 2006
Alistair Hughes 2006
Amy Tacon 2006
Andrea Schoeman 2006
Andrew McMahon 2006
Annah Mlotshwa 2006
Arthur Sikhundla 2006
Avhasei Masikhwa 2006
Barry Shean 2006
Bongani Mthombeni 2006
Bradwin Roper 2006
Brendan Beeming 2006
Cherise Small 2006
Danna Mhango 2006
Dyllon Randall 2006
Fabian Petersen 2006
Fulufhelo Mamathoni 2006
George Motlhasedi 2006
Goitseone Kgwele 2006
Harshad Bhikha 2006
Jacobus van der Merwe 2006
James Vardy 2006
Kamila Bialek 2006
Khanyile Gwija 2006
Lawrence Tjatindi 2006
Lebona Moholoopa 2006
Linus Naik 2006
Luambo Masia 2006
Marlon Bowman 2006
Michelle Bennett 2006
Mokete Letsoalo 2006
Mondli Guma 2006
Motene Matshediso 2006
Musawenkosi Dlamini 2006
Nalisha Chetty 2006
Nicole Jansen van Rensburg 2006
Nicolene Ramsunder 2006
Nokuzola Sofute 2006
Nokwazi Zuma 2006

Nomonde Solomon......... 2006
Noncedo Tuswa................ 2006
Nthabiseng Mphela......... 2006
Ntokozo Shabalala............ 2006
Peter Wynne 2006
Philip Le Grange............... 2006
Premesh Govan 2006
Prince Charingira.............. 2006
Rene Lombard.................. 2006
Rosemary Kohler 2006
Ross Kukard 2006
Rui Manuel 2006
Sandra Barry 2006
Sarah Dowling 2006
Sean Knight 2006
Siyabonga Ndlovu 2006
Sonwabo Mlisana............. 2006
Sudhir Thakurdin 2006
Tamaryn Napp 2006
Tyrone Kotze 2006
Abdul Petersen..................2005
Bathandwa Cobo 2005
Bernedict Kheswa 2005
Candice Brill 2005
Carla Moerdyk 2005
Disaapele Mogashana......2005
Donald Gardner 2005
Hedley Gerhardt...............2005
Hema Vallabh 2005
Ian Philander......................2005
Kudzai Changunda............2005
Louise Bircumshaw 2005
Lucky Mogashana 2005
Lynn Mortinson..................2005
Malik Jasson 2005
Martina Mcknight..............2005
Matthew Heyns 2005
Mayven Naicker.................2005
Mduduzi Mbonambi 2005
Motlokwe Sebake 2005
Muzi Mbutho 2005
Nadia Barnes......................2005
Nhlamulo Baloyi 2005
Nicola Toma........................2005
Nomfundo Sibiya 2005
Pakama Tsabedze 2005
Patricia Emilia Dias Dos Santos 2005
Perfect Magubane 2005
Philip Saville 2005
Rethabile Melamu.............2005
Rhengu Hlekane 2005
Riyard Kahn 2005
Ruth Ishimwe 2005
Sagwadi Ngcamu.............2005
Sarashree Reddy 2005
Tawanda Sango 2005
Theresa Janse Van Rensburg 2005
Thomas Mathebula 2005
Thulani Zwane....................2005
Tsebo Molapo....................2005
Tshegofatso Monama.......2005
Wandile Ngcobo 2005
Yatiso Khanye.....................2005
Zandile Mhlungu...............2005
Alexander Hesketh 2004
Alon Brauer 2004
Ashvin Goorah.................. 2004
Bianca Carlse 2004
Bonginkosi Ngubane....... 2004
Carlo Accolla 2004
Catherine Snowden......... 2004
Celestino Mausse 2004
Christopher Ayers............. 2004
Donatius Kalumbu............ 2004
James Othapile................. 2004
Jane Reddick 2004
Jonathan Cohen 2004
Kate West........................... 2004
Keabetswe Molala............ 2004
Leonard Eiman.................. 2004
Lianne Andrews................ 2004
Lindiwe Dlamini................ 2004
Matshediso Marota 2004
Meryl Pick 2004
Michael Hughes 2004
Mzamo Cele 2004
Nazneen Karbanee 2004
Nicholas Smart 2004
Nompumelelo Majola 2004
Nomsa Yumba................... 2004
Ntshiuwa Mathibe............ 2004
Oliver Stotko 2004
Paul Barron 2004
Peter Hidden 2004
Reginald Mbatha.............. 2004
Roger Wilmot 2004
Samantha Streicher 2004
Sean Charteris................... 2004
Segoelele Mapheto......... 2004
Siphiwe Buthelezi............. 2004
Sizwe Radebe 2004
Soraya Thomas.................. 2004
Thabani Dlamini................ 2004
Virginia Cheang................ 2004
Wisani Jonathan Maluleke......................... 2004
Bertha Kgokong 2003
Bryan Maytham..................2003
Christophe Van Den Heuvel.............................2003
Christopher Anderson......2003
Christopher Khoza............2003
Eugene Delport.................2003
Grace Makgopo 2003
Guy Richards......................2003
Heather Coombes 2003
Jason Germanis 2003
Jason Vardy 2003
Kyle Zietsman 2003
Lerato Tsaoane...................2003
Lorato Kgari 2003
Mbongiseni Gama 2003
Mohau Lekopa...................2003
Musa Ngobeni...................2003
Ndabezinhle Ndabeni-Ncube 2003
Nkateko Mathonsi 2003
Pono Mogoera 2003
Rosanna Martin..................2003
Ryan Jones 2003
Sameer Morar 2003
Seyed Sadat Rezai 2003
Sfundiso Mqadi 2003
Sharrol Allison 2003
Sicelo Nyoni 2003
Simangele Soni..................2003
Siphiwe Mthembu 2003
Thabiso Mokwena.............2003
Thapelo Letete...................2003
Thapelo Molefe.................2003
Thehzeeb Akbar 2003
Thuthuka Mnyandu...........2003
Youqi Zhuang.....................2003
Zukiswa Acquah.................2003
Agnes Mncube.................2002
Angel Modutwane............2002
Angela Storey 2002
Ashton Swartbooi.............2002
Bo Robertse 2002
Bonizwa Nkosi....................2002
Chih-Chao Pai 2002
David Katondo...................2002
Feng-Chi Shen-Yu 2002
Frans Ngako 2002
Gregory Abramowitz........2002
Happy Makhongela..........2002
Hemant Gopal 2002
Hemita Anand....................2002
Ian Mazibuko.....................2002
Jacques Kleinsmidt 2002
Jaffer Dawood...................2002
Kevin Harding....................2002
Khevna Naran 2002
Kopano Moeketsi 2002
Laurence Adams................2002
Lazarus Mokakala...............2002
Malindile Nkambule 2002
Mareike Beckers 2002
Matilda Mongalo...............2002
Maynard Lombard 2002
Mduduzi Mnyandu 2002
Michael Fletcher................2002
Mohammed Allie...............2002
Mpeke Makara...................2002
Mpendulo Mhlongo.........2002
Mpho Setlhaku 2002
Neil Robertson...................2002
Neil Robinson 2002
Neo Kgatuke 2002
Nicola Sceales 2002
Nongezile Zondo 2002
Ntombikayise Motloung..2002
Phillip Mphahlele 2002
Richardt Rabe 2002
Steven Schrieff...................2002
Suhayl Mitha.......................2002
Tamryn Foster 2002
Thandiwe Nkatlo 2002
Thato Manare.....................2002
Venasan Pillay 2002
Vusumuzi Chiliza................2002
Vuyani Chavunduka..........2002
Yatish Daya 2002
Aislin Radjoo 2001
Alistair Fernsby...................2001
Bongani Gamede..............2001
Chamunorwa Kazembe....2001
Deon Adams 2001
Dominic Milazi 2001
Donovan Jacobs................2001
Elizaveta Burdukova..........2001
Ephraim Mabunda 2001
Glen Heinrich.....................2001
Hylton Ball 2001
Isaac Pule 2001
Jawad Kriel 2001
Jeeten Nathoo...................2001
Joanne Mutungi 2001
Kar Luk................................2001
Khayelihle Ndwandwe.....2001
Luvuyo Mkontwana 2001
Makgopa Tshehla 2001
Mamokotsi Thibedi 2001
Mangaliso Mpela 2001

Marjorie Ngwenya 2001
Mcebisi Ngubane 2001
Meshack Bulunga 2001
Michelle Schroder 2001
Mlungisi Cele 2001
Molojwa Keikelame 2001
Mpendulo Mkhwanazi 2001
Mpho Ramonotsi 2001
Nhlanhla Tsela 2001
Nomvula Luxomo 2001
Olatoye Amosun 2001
Patrick Kgwadi 2001
Peta Williams 2001
Peter Cairns 2001
Punish Chikowero 2001
Ryan Stevenson 2001
Sakumzi Ndlebe 2001
Seneliso Zwane 2001
Shahin Mohomed 2001
Shaun Bergoff 2001
Shilpa Seewoo 2001
Sifiso Sibiya 2001
Stuurman Machaea 2001
Teboho Meloa 2001
Thembisile Salman 2001
Thizwilondi Nemakololwe 2001
Tiffany Brown 2001
Tshepo Pitse 2001
Tyron Botha 2001
Wesley Warild 2001
Yin Ho 2001
Zamokwakhe Mthethwa 2001
Zanethemba Nkabi 2001
Zimiti Mudondo 2001
Zweli Hlatshwayo 2001
Zwelithini Dlamini 2001
Andre Hugo 2000
Andrew Watson 2000
Athanasios Kotsiopoulos 2000
Bheki Mnisi 2000
Bhekisisa Nsibandze 2000
Bhekiwe Ngema 2000
Bodrick Munyungano 2000
Brendan Pingyin 2000
Brett Cocks 2000
Chaneen Wessels 2000
Clive Robertson 2000
Devraj Reddy 2000
Dylan Campbell 2000
Edward Theka 2000
Francis Percy 2000
James Connolly 2000
John Creese 2000
John Ntshabele 2000
Karen Field 2000
Karen Peterson 2000
Katherine Levy 2000
Kathleen Haigh 2000
Kenneth Kamurasi 2000
Langa Ntondini 2000
Lasath Punyadeera 2000
Lehlogonolo Ledwaba 2000
Lerato Motsilanyane 2000
Livhuwani Magidimisa 2000
Madelyn Johnstone-Robertson 2000
Mamabolo Mphahlele 2000
Mandy Roberts 2000
Margery Van Den Berg 2000
Matthew Cole 2000
Michael Howe 2000
Mofoluwake Daramola 2000
Mohammed Kariel 2000
Mosimanegape Ramashilabele 2000
Mothupi Mametja 2000
Mudzielwana Marageni 2000
Nawahl Gierdien 2000
Nicholas Roberts 2000
Ndivheni Marema 2000
Paul Jacobson 2000
Peter Hart 2000
Richard Gxavu 2000
Semano Sekatle 2000
Senzeni Ndlovu 2000
Sibusiso Sibulela 2000
Tendai Mubako 2000
Thabo Kgogo 2000
Thivhafuni Tshithavhane 2000
Troy Ganten-Bein 2000
Tshepo Mailula 2000
Tshepo Molefe 2000
Abel Mudau 1999
Andrew Msiza 1999
Andrew Prince 1999
Ashley Sissing 1999
Benjamin Knights 1999
Bishop Khumalo 1999
Brigitte Comley 1999
Bryne Rwodzi 1999
Carol Matthews 1999
Catherine Van Hoogstraten 1999
Cayle Sharrock 1999
Charles Malan 1999
Clement Maila 1999
Comfort Mthethwa 1999
David Evans 1999
Dineo Teffo 1999
Douglas Hatfield 1999
Elias Tshephe 1999
Elizabeth Jeevaratnam 1999
Eunice Chidoda 1999
Evelyn Dhliwayo 1999
Fortiscue Helepi 1999
Gareth Smith 1999
Georgina Auld 1999
Gilbert Mkhabela 1999
Glodina Gordon 1999
Glory Nxumalo 1999
Gouwah Diedericks 1999
Jan Sithole 1999
Jason Mcpherson 1999
John Nkosi 1999
Kevin Dunn 1999
Lebogang Rathebe 1999
Mark Pickering 1999
Martin Mosia 1999
Matthew Duddy 1999
Mmatsebe Matlala 1999
Mukayi Mutsago 1999
Mxolisi Khutama 1999
Natasha Harding 1999
Nokhwezi Mnguni 1999
Noko Phala 1999
Nothemba Mxenge 1999
Obed Sebona 1999
Petros Zwane 1999
Phinda Vilakati 1999
Rowan Nairn 1999
Sakhekile Melane 1999
Sam Mthimkulu 1999
Sarah Macrosty 1999
Sethabile Ndlovu 1999
Sharon Gumbanjera 1999
Shingairai Masango 1999
Siyabonga Malevu 1999
Stephen Roberts 1999
Stuart Finn 1999
Tessa Meyer 1999
Timothy Deane 1999
Vusumuzi Ndebele 1999
Waheed Sulaiman 1999
Wayne Wright 1999
Andre Titus 1998
Andrew Canham 1998
Andrew Krige 1998
Bethuel Legabe 1998
Bongani Radebe 1998
Bongumusa Tfwala 1998
Christian Dempers 1998
Chuene Mohlaba 1998
Clive Erasmus 1998
Craig Paxton 1998
Darshana Rama 1998
David Seaman 1998
Desigan Govender 1998
Donovan Crickmore 1998
Evans Mabaso 1998
Fatima Ebrahim 1998
Felihle Dumisa 1998
Fortune Nsibande 1998
Giles Searby 1998
Gordon Scott 1998
Helen Pooe 1998
Janet Stent 1998
Jonathan Centurier-Harris 1998
Juleiga Regal 1998
Karen Rowe 1998
Khathutshelo Mapasa 1998
Kim Palmer 1998
Lance Petersen 1998
Lola Westwood 1998
Lucinda Wood 1998
Martin Cassidy 1998
Melicia Motswane 1998
Mgcini Tshwaku 1998
Mhairi Kelly 1998
Michael Halhead 1998
Michael Ranft 1998
Moagi Sewawa 1998
Motshewa Matimolane 1998
Mphedziseni Masakona 1998
Musa Ndwandwe 1998
Nicholas Petersen 1998
Njodzi Zizhou 1998
Nokuthula Siyaka 1998
Orhovelani Shikwambana 1998
Patrick Smith 1998
Philip De Souza 1998
Puthucode Venkiteswaran 1998
Rhoda Baker 1998
Richard Macrosty 1998
Rodney Hundermark 1998
Rory Leisegang 1998
Samkelo Matsebula 1998
Sandile Mbulawa 1998
Shadrack Nkutha 1998
Simon Wolfe-Coote 1998
Stanton Smith 1998
Stefaans Ramoolla 1998

Talitha Tabane 1998
Tendai Furamera................1998
Tendekai Chaza..................1998
Thuto Mosholi....................1998
Tyrone Chan.......................1998
Alfred Seema..................... 1997
Barry Mc George.............. 1997
Bernard Katz...................... 1997
Brian Mc Guigan............... 1997
Bruce Souter...................... 1997
Caleb Hattingh 1997
Catherine Pitsoe 1997
Celokuhle Nkosi 1997
Charles Van Der Merwe ... 1997
Charlie Xue......................... 1997
Christopher Loans............. 1997
Craig Beautement............. 1997
David Sekgororwana........ 1997
Gaolatlhe Selome............. 1997
Johanna Manamela........... 1997
Jomo Khomo 1997
Julian Stewart..................... 1997
Kgomonare Mosiane........ 1997
Lebogang Mosaka............ 1997
Marianne Walker 1997
Matlou Mabokano 1997
Mogoeletsi Modise 1997
Mohammed Jaffer............ 1997
Mothogobeng Hlabangana..................... 1997
Natasha Ristic 1997
Nirvasen Moonsamy......... 1997
Pathmenadin Padayachee. 1997
Paul Ayers........................... 1997
Paul Waugh........................ 1997
Peter Fiene 1997
Security Mohlaping 1997
Siphiwo Lucas 1997
Stella Constan-Tatos.......... 1997
Stephen Pietersen............. 1997
Yvonne Hansen 1997
Alvin Naidoo......................1996
Ashley Scheepers..............1996
Benedict Allott...................1996
Bradford Plaatjes...............1996
Brendan Davids.................1996
Bryan Brack........................1996
Cantor Mocke 1996
Chloe Cornelius.................1996
Christopher Molefe 1996
Clinton Simpson 1996
Conrad Arendse................1996
Craig Sweet........................1996
Daniel Marokane...............1996
Danver Isaacs 1996
Darryl Howard...................1996
David Rambuda 1996
Derek Delmar.....................1996
Elias Zacharias.....................1996
Erwin Shiluama 1996
Fikree Davids 1996
Gareth Coetzee 1996
Gray Africa..........................1996
Hugh De Vries 1996
Imraan Bacus......................1996
Jeanne Marais....................1996
Jeannette Sweet...............1996
Marco Williams 1996
Matshela Koko 1996
Mduduzi Mthembu 1996
Michael Dalby....................1996
Mohamed Sarvan.............1996
Murray Roos.......................1996
Mziwakhe Ngwane...........1996
Nicole Kok 1996
Nkhanedzeni Lugisani 1996
Ntombizonke Gigaba.......1996
Paul Musgrave 1996
Paul Shortridge..................1996
Rafene Makhothe.............1996
Rashaad Goosein 1996
Rhonwen Sutherland........1996
Richard Walsh 1996
Steven Horn 1996
Trevor Harris.......................1996
Victor Bester.......................1996
Wageed Kamish 1996
Warwick Duncan 1996
Zaheed Yacoob..................1996
Zanele Magagula...............1996
Adam Foreman..................1995
Andrew Robinson 1995
Anthony Diab.....................1995
Anthony Knobel 1995
Barry Lipchin 1995
Belinda Eastes 1995
Brett Paton..........................1995
Clinton Van Vught 1995
Craig Jewell........................1995
Dayanand Rajaram 1995
Fahmeeda Khan................1995
Geraldo Geduld................1995
Henry Xaba 1995
Imthiaz Ahmed 1995
Jarrod Hart.........................1995
Jennifer Pearse..................1995
Kerry Gelling......................1995
Lenore Cairncross.............1995
Maqbool Dalvie.................1995
Mark Howells.....................1995
Mark White.........................1995
Michael Clucas...................1995
Michelle Coetzee 1995
Molupe Thelejane.............1995
Nissim Hallale.....................1995
Philippa Notten 1995
Rafahl Domouzis...............1995
Richard Beart.....................1995
Richard Tait.........................1995
Rosemary October...........1995
Russell Abrahams 1995
Sabatha Mahote 1995
Siegmund Thetard 1995
Simon Khoncha.................1995
Simon Mafora....................1995
Sooviraj Hurgobin.............1995
Stephen Neethling............1995
Steven Kristafor.................1995
Thabiso Manne.................1995
Ursula Diekmann 1995
Alexander Gawanab.........1994
Andile Ndabankulu...........1994
Bradley Bischoff.................1994
Charmaine Mckinney........1994
Craig Micklethwaite..........1994
Darryl Phipps 1994
Donny Pisane.....................1994
Fatima Hamdulay 1994
Gary Rorke.........................1994
George Kniel......................1994
Gregory Dickason.............1994
Horst Weyermuller............1994
Ian Zondo 1994
Judy Woods.......................1994
Karen Archer 1994
Karin Delmarco..................1994
Kevin Chaplin.....................1994
Laureen Van Aswegen 1994
Linda Van Steen................1994
Macs Maboka....................1994
Marco Valle........................1994
Mkhululi Mazibuko............1994
Nathan Williams................1994
Nicholas Barton 1994
Nkosinathi Solomon..........1994
Raymond Tshabalala.........1994
Roland Leuzinger..............1994
Sanjiv-Kumar Dabee.........1994
Sieghart Drews..................1994
Stefan Robertson...............1994
Thea Jones 1994
Thomas Heinzle.................1994
Vincent Smith.....................1994
Werner Thetard 1994
Andrew Dustan..................1993
Andrew Hall 1993
Andrew Titterton 1993
Andrew Watt......................1993
Birgit Dinkelmann..............1993
Catherine Hanger 1993
Cindy Adamson.................1993
Clifford Meyer 1993
Crispian Dillon....................1993
David Amm 1993
Deon Dhlomo....................1993
Eric Roberts........................1993
Gerson Urib........................1993
Gillian Balfour.....................1993
Graham Davies 1993
Jo-Ann Robinson 1993
John Russell........................1993
John Stewart 1993
Kim Johnson.......................1993
Lance Livingstone 1993
Louise Hess 1993
Mark Davel 1993
Mark Powys.......................1993
Mark Seager.......................1993
Michael Daniels 1993
Mncedisi Mlilo 1993
Mohendra Rajh..................1993
Nicola Brown......................1993
Paul Galatolo......................1993
Peter Gunther 1993
Peter Nesbit........................1993
Pieter Richards...................1993
Richard Viljoen...................1993
Roderick Ross 1993
Rowan Goeller...................1993
Saskia Veldhuis..................1993
Simphiwe Mehlomakulu..1993
Slawomir Jaroslawski 1993
Stephen Amos 1993
Stephen Van Der Linde 1993
Stuart Robinson 1993
Terry-Ann Fowler 1993
Tracy Smith 1993
Trevor Hadley 1993
Trevor Laughton 1993
Tshakalisa Matiwaza...........1993
William Hollaway...............1993
Winston Africa 1993
Adrian Deneys...................1992
Allan Burton........................1992
Brett Cohen.......................1992
Brian Ireland.......................1992

Bruce Hutchison 1992
Chamu M'kombe 1992
Christopher Cruise 1992
Dennis Smith 1992
Graeme Newcomb 1992
Hamieda Parker 1992
Helene Kleinhans 1992
Ian Sheard 1992
Ignatius Loff 1992
Johannes Mouton 1992
Joseph Rohm 1992
Karen Germishuys 1992
Konstantyn Papathanasopoulos 1992
Lauren Basson 1992
Leon Johnson 1992
Marius De Villiers 1992
Melanie Clews 1992
Peter Leger 1992
Ramala Odayar 1992
Richard Roseveare 1992
Sayed Ally 1992
Sean Nieuwenhuys 1992
Stephen Howlett 1992
Steven Macdonald 1992
Stewart Calder 1992
Svenja Miller 1992
Timothy Spandiel 1992
Vusumuzi Mahlangu 1992
Andrew Brown 1991
Anthony O'donovan 1991
Christopher Wortley 1991
Daryl Henwood 1991
David Singleton 1991
Douglas Mzamo 1991
Frank Jaschinski 1991
Gary Sewell 1991
Gregory Phillips 1991
Ian Cohen 1991
James Brice 1991
Jon Kock 1991
Keith Hines 1991
Mark Epstein 1991
Molahlehi Msimanga 1991
Morne Bowers 1991
Reinier Weber 1991
Robert Austin 1991
Robert Nohamba 1991
Sara Pearce 1991
Sean Jordan 1991
Shehnaaz Moosa 1991
Simon Pressinger 1991
Steven Wynter 1991
Suzanne Illing 1991
Tanya Wootton 1991
Tlamelo Leeuw 1991
Ulla Norval 1991
Andrew Robinson 1990
Antoinette Murray 1990
Antonio Pick 1990
Ashley Mcleod 1990
Erich Teichmann 1990
Gerard Hwang 1990
Grant Loveday 1990
Harro Bloch Von Blottnitz 1990
Hilton Heydenrych 1990
Ian Gorin 1990
Ian Saunders 1990
Julian Young 1990
Leon Daniels 1990
Mark Vinnicombe 1990
Mbuyiseni Buthelezi 1990
Megan Kroon 1990
Michael Potts 1990
Mziwandile Nomkonwana 1990
Robert Colussi 1990
Ronald Duigan 1990
Ross Plumbley 1990
Sarah Sealy 1990
Sathieseelan Pillay 1990
Simon Smith 1990
Solwazi Majola 1990
Vishvakala Lakhoo 1990
William Bent 1990
Alexander De Sousa 1989
Andrew Coxon 1989
Ashley Breed 1989
Craig Henderson 1989
David De Villiers 1989
David Louw 1989
Deon Carter 1989
Gavin Blyth 1989
Ingrid Schoeman 1989
James Vaughan 1989
John Munro 1989
Kenneth Inglis 1989
Megan Jobson 1989
Paul Statham 1989
Peter Myburgh 1989
Rowan Joseph 1989
Sikhumbuzo Mkhize 1989
Simon White 1989
Steven Langford 1989
Yassiem Dollie 1989
Yusuf Dollie 1989
Brandon Miller 1988
Brendan Fitzgerald 1988
Brian Twiggs 1988
Christopher Whitehouse ..1988
David Tannahill 1988
Dawid De Villiers 1988
Douglas Murray 1988
Errol Fransman 1988
Gary Raubenheimer 1988
Glenn Zamudio 1988
Graham Twiggs 1988
Gregory Hangone 1988
Judith Cargill 1988
Klaus Schommarz 1988
Lisa Melville 1988
Maurice De Vries 1988
Mfundo Mabusela 1988
Michael Hawkins 1988
Michael Lunney 1988
Miles Van Niekerk 1988
Nicolas Von Solms 1988
Peter Mills 1988
Richard De Koning 1988
Richard Mcwilliams 1988
Richard Powell 1988
Robert Meihuizen 1988
Sean Von Holt 1988
Steven Venables 1988
Thomas Hearne 1988
Wendy Kaschula 1988
William Finlay 1988
Andrew Bailey 1987
Andrew Maclean 1987
Bharat Chavda 1987
Bradman Page 1987
Ian Robinson 1987
John Worsley 1987
Meeta Jadav 1987
Mohamed Kootbodien 1987
Neil Wiltshire 1987
Noel Gillespie 1987
Peter Fairlamb 1987
Peter May 1987
Radleigh Hartford 1987
Robert Stewart 1987
Roy Harris 1987
Russell Kleyn 1987
Russell Simon 1987
Sijadu Ndizana 1987
Sisa Mtwa 1987
Stefan Bohlke 1987
Stephen Wayland 1987
Terence Parker 1987
Themba Joseph 1987
Verena Jonson 1987
Alan Johnson 1986
Alan Lathwood 1986
Alex Vogel 1986
Andre Wills 1986
Anthony Davids 1986
Bo Andersen 1986
Chantal Botha 1986
Cheryl Chalmers 1986
Clive Deetlefs 1986
Cornelis Hollenbach 1986
David Kelfkens 1986
Edmund Smith 1986
Errol Middleton 1986
Gavin Halse 1986
Gavin Ritson 1986
Glen Denton 1986
Gregory Fenton 1986
Ian Barrand 1986
James Whitehouse 1986
John Clayton 1986
John Le Patourel 1986
John Zachariades 1986
Karen Wright 1986
Keith Ricketts 1986
Louis Melis 1986
Marion Walls 1986
Mark Holtes 1986
Mark Zaal 1986
Nicholas Hughes 1986
Paul Stonestreet 1986
Philip Preston 1986
Rees Brislin 1986
Robert Urquhart 1986
Stephen Hegarty 1986
Stuart Reneke 1986
Alastair Fannin 1985
Alessandro Borean 1985
Alison Ozinsky 1985
Amanda Felton Beer 1985
Ann Coleman 1985
Bruce Rackham 1985
Charles Bromley 1985
Craig Goodall 1985
David Pfeil 1985
David Young 1985
Debra Mitchell 1985
Donovan Muller 1985
Douglas Austin 1985
Douglas Mccready 1985
Emilio Titus 1985
Ephraim Msane 1985
George Gill 1985
Gregory Haylle-Dick 1985
Helen Emmett 1985

John Little 1985
John Neale 1985
Jon Feldman 1985
Kevin Knott-Craig 1985
Lance French 1985
Marco Reolon 1985
Mark Farrell 1985
Mark Siedle 1985
Martin Coates 1985
Michael Meiring 1985
Milton Stroud 1985
Morag Mcgarvie 1985
Nazir Kader 1985
Nicholas Mccabe 1985
Nigel Eastaugh 1985
Paolo Avondo 1985
Paul Horrell 1985
Paul Petter-Bowyer 1985
Paul Sam-Soon 1985
Paul Young 1985
Peter Russell 1985
Richard Gosnell 1985
Robert Bell 1985
Robert Laubscher 1985
Robert Morris 1985
Robert Reynolds 1985
Stephan Bocken 1985
Stephan Schwarz 1985
Stephen Russo 1985
Sven Thiele 1985
Wayne Hubert 1985
Alan Cousins 1984
Andrew Wilson 1984
Barry Hemans 1984
Christian Kujawa 1984
David Jackson 1984
Deon Van Zyl 1984
Edward Munnik 1984
Ernst Griebel 1984
Francoise Hill 1984
Geoffrey Brent 1984
Gerard Lowe 1984
Grishka January 1984
Hanjorg Drews 1984
Harry Fine 1984
Helen Fawkes 1984
Jeremy Scott 1984
John Vivian 1984
Keith Ashley 1984
Kevin Still 1984
Lester Jacobs 1984
Lewis Josman 1984
Mark Digby 1984
Mark Vides 1984
Michael Twine 1984
Paul Archdeacon 1984
Robert Copcutt 1984
Robert Fickling 1984
Robert Henderson 1984
Rolfe Eberhard 1984
Russell Burke 1984
Simon Tripp 1984
Stefan Harms 1984
Stephen Mccarney 1984
Stephen Thorne 1984
Alan Mcrindle 1983
Andrew Brodrick 1983
David Van Wyk 1983
Gail Duursma 1983
Gary Foulds 1983
Geoffrey Cragg 1983
Graeme Jack 1983
Guy Anderson 1983
Howard Albert 1983
Ian Williams 1983
John Parker 1983
Kenneth Strickland 1983
Klaus Moller 1983
Llewellyn Delport 1983
Louise Barker 1983
Mark Ponsonby 1983
Martin Harris 1983
Matthew Marx 1983
Mungo Graham 1983
Neville Du Plessis 1983
Nicola Illing 1983
Peter Van Halderen 1983
Petrus Claassens 1983
Richard Blackbeard 1983
Russell Green 1983
Shaune Cooke 1983
Adam Dabrowski 1982
Adrian Estcourt 1982
Anthony Benson 1982
Charles Galloway 1982
Christine Tucker 1982
Christopher Way 1982
Deaghlan Mcclean 1982
Donovan Gordon 1982
Douglas Ewing 1982
Eric Waugh 1982
Gordon Kemp 1982
Graham Juby 1982
Gregory Downes 1982
Jeffrey Price 1982
Jeremiah Zietsman 1982
John Messenger 1982
John Richards 1982
Klaus Gerstle 1982
Kurt Malzer 1982
Lesley Fraser 1982
Michael Bowley 1982
Nazmie Adams 1982
Neal Reynolds 1982
Peter Simpson 1982
Peter Theron 1982
Philip Morkel 1982
Pieter Grobler 1982
Robert Duncan 1982
Robertus Herholdt 1982
Robin Kloot 1982
Ronald Fickling 1982
Ross Murdoch 1982
Roy Movsowitz 1982
Saul Mirkin 1982
Stephen Law 1982
Steven Harris 1982
Werner Schumann 1982
Adrian Reeve 1981
Alan Wilson 1981
Alistair Burch 1981
Allon Brent 1981
Andre Rautenbach 1981
Andrew Carr 1981
Ania Grobicki 1981
Athanasios Martalas 1981
Christine Mullord 1981
Christopher Swartz 1981
David Hill 1981
Deirdre Bradshaw 1981
Derek Ramsay 1981
Diego Roland 1981
Graham Ballenden 1981
Grant Harman 1981
Grant Stubbs 1981
Kevin Ashby 1981
Marc Rautenbach 1981
Martin Schulze-Hulbe 1981
Mogamat Manan 1981
Pamela Massie 1981
Peter Baylis 1981
Robert Feyder 1981
Simon Cleasby 1981
Stephanus Britz 1981
Stephen Viljoen 1981
Andrew Gregory 1980
Arnold Van Zyl 1980
Arona Feltenstein 1980
Attila Molnar 1980
Boris Erlank 1980
Brian Adams 1980
Claude Brent 1980
David Mcintyre 1980
Duncan Price 1980
Gareth Shaw 1980
Gavin Fraser 1980
Gregory Garzolini 1980
Jack Fletcher 1980
John Ferguson 1980
Lawrance Flach 1980
Lawrence Chaplin 1980
Mark Berman 1980
Mark Pretorius 1980
Peter Salmon 1980
Ronald Fasol 1980
Susan Baldwin 1980
Alistair Rickards 1979
Anthony Rund 1979
David Liddell 1979
David Walwyn 1979
Eberhard Goelkel 1979
Ephraim Schayek 1979
Eugene Gill 1979
Francois Du Plessis 1979
John Venn 1979
Jonathan Schaffer 1979
Leon Lizamore 1979
Mark Matzopoulos 1979
Michael Bergh 1979
Nicholas Johnston 1979
Quinton Stuurman 1979
Rodney Dry 1979
Rohan Surridge 1979
Roy Cooper 1979
Trevor Miles 1979
Andrew Julian Cohen 1978
Andrew David Sieborger 1978
Anthony Trevor Williams 1978
Arthur James Hanslo 1978
Barry Ivor Platt 1978
Christopher Denham Wall 1978
Daniel Evert Van Der Merwe 1978
Ian Louis Ahrens 1978
Josef Sargon Lovkis 1978
Kim Gail Anziska 1978
Michael John Gale 1978
Paul Charles Kennet 1978
Peter Lorimer Dold 1978
Peter Vernon White 1978
Peter MacDonald Williams 1978
Robert John Edmonds 1978
Sydney James Carter 1978
Alan Ivan Miller 1977

Anthony Walter Largier 1977
Candida Mary-Rose Polson 1977
Cyril John Arnold Stevens 1977
David William Mills 1977
Dean Edward Trattles 1977
James David Jacka 1977
Julian Averin Fortuin 1977
Mohamed Hanief Ismail 1977
Moses Aaron Zitron 1977
Patrick John Largier 1977
Peter Vincent Rademan 1977
Yunus Osman 1977
George Christou Charalambous 1977
Jeffrey Allan Dahmer 1977
Abraham Mark Lenhoff 1976
Anthony Michael Watermeyer 1976
Christopher van Niekerk 1976
Edward St George Linton Ramsay 1976
James Gerard Petrie 1976
John George Carvounes 1976
Robert Anthony Heather 1976
Russell Thompson 1976
Ruth Eva Herzstein 1976
Anton Adriaan Eberhard 1975
David Richard James 1975
Francis Piers Portal Baker 1975
Frank David Rule 1975
Graham Lesley Wells 1975
Hamied Kariem Mazema 1975
Jacques Pierre le Grange 1975
Jeffrey Charles Engel 1975
Johannes Stephanus de Bruyn 1975
Kevin McConnachie 1975
Michael John Dry 1975
Nicholas Paul Harris 1975
Oliver Noel Courtenay St Quinton 1975
Pierre Guillaume van Eeden 1975
Stephan Hugh Walker 1975
Wilfred Arthur Fickling 1975
Bruce Alexander Hendry 1974
Donald Stewart Miskin MacIntyre 1974
Eldred Hilton Chimowitz 1974
Gavin Solomon Kotze 1974
Georffrey David Carter 1974
Graham Robert Smythe 1974
John Alan Mather 1974
John Pitkin 1974
Michael Carl Oppenheimer 1974
Phillip Danvers Smart 1974
Pieter Emile Taute 1974
Richard Stewart Henkel 1974
Roderick Ian King 1974
William Anthony Cook 1974
Alexander Ian Wood 1973
Charless Newton Booth 1973
Christopher James Moore MacDonald 1973
David Lowenthal 1973
David Bramwell Marriner 1973
Edward John Coombes 1973
Fadl Hendricks 1973
Johannes Jochemus Taljaard 1973
John Malcolm Travers Greensmith 1973
Kevin Adair Gilbert 1973
Peter Anthony Hay Nicol 1973
Peter David Jenkins 1973
Peter Hugh Brierley 1973
Sandor Donner 1973
Shaukat Allie Karjeker 1973
Thomas Robert Curr 1973
Trevor Douglas Marè 1973
Andrew Michael Bacon 1972
Angelo Joseph Stipinovich 1972
Athol Alistair Trickett 1972
Brian Peter Scallan 1972
Charles David Levy 1972
Cyril Issadore Baskir 1972
Daniel Nicolaas Klopper 1972
David Gavin Barnes 1972
Eduard Christian Le Roux Horn 1972
Geoffrey Frank Muller 1972
Hans-Peter Frohlich 1972
Jean-Paul Franzidis 1972
John Robert Totterdell Sharpe 1972
John Tebbitt Batley 1972
John Venning Bryant 1972
Kevin John Hay 1972
Kevin Michael Chomse 1972
Michael Dudley Copeland 1972
Olaf Joachim Winkler 1972
Paul Frederick Sorenson 1972
Paul Leon Graylin 1972
Peter John Campbell 1972
Richard Cleverly O'Donnell 1972
Rosalind Cairncross 1972
Victor Eli Jacobson 1972
Victor Rudolph 1972
William Barry Rickards 1972
William Whitley Thomas 1972
Alastair Lindsay Crawford 1971
Anthony Peter Kallis 1971
Benjamin Barry Lapiner 1971
Clive Albert Wolfe-Coote 1971
David Russel Thalrose 1971
Donald Neil Timm 1971
Edward John Coogan 1971
Emmauel Paul Papadopoulo 1971
Erik Petrus Gouws 1971
George Diederik van den Berg 1971
Gerald Andrews 1971
Graham Glenday 1971
Harald Ian Henry Richter 1971
Matthys Henrik Christiaan Bester 1971
Michael Jesse Ernest Graham 1971
Peter Melville Baker 1971
Stephen David Unterhalter 1971
Trevor Baden Sydney Giddey 1971
Vanessa Joy Cohen 1971
Anthony Raymond Gibb 1970
Arnold Julian Miller 1970
Brian Peter Richardson 1970
Christopher John Breen 1970
Eugene Kenneth Cairncross 1970
Francis David Hanauer 1970
Gerard John Luener 1970
Grenvil Marquis Dunn 1970
Roger Nelson Davey Price 1970
Jan Hendrik Hofmeyr 1970
Joseph Mooney Shirley 1970
Julian Ernest Hugh Glyn 1970
Max Louis Shwer 1970
Paul Arthur Hugill 1970
Peter Charles Linnegar 1970
Rodney Harold Pachter 1970
Roger Nelson Davey Price 1970
Andrew Nicholas Murray 1969
Anthony Lewis Hannaford 1969
Anthony Ryall Butler 1969
Barry Sorenson Hicks 1969
Christopher Murray Moore 1969
David Eric Watson 1969
Denis Lesch Cornelius 1969
Dennis Basil Hammar 1969
Donald Somerled Cook 1969
Henry Penderis 1969
Ian Beith Law 1969
Ian Delafield Graham 1969
James Denwood Lancaster 1969
Johannes Hendrik Smidt 1969
John David McKenzie 1969
John Herbert Ross Norton 1969
John Raymond Trathen 1969
Llewellyn Patrick 1969
Llewelyn David Alexander Wright 1969
Michael John Ellman 1969
Michael Pavely Warren 1969
Richard Henry George Promnitz 1969
Robert Alexander Louw 1969
Victor Charles Moore 1969
Annette Jane Campbell-White 1968
Anthony John Dryburgh 1968
Arthur Baigel 1968
Brian William Fraser 1968
Eleanor Samson 1968
Errol Thomas Amm 1968
Gregory Neil Steenveld 1968
Jeffrey Owen Read 1968
Joseph Anstey 1968
Michael Arthur Williams 1968
Patrick John Broli 1968
Paul Jonathan Buley 1968
Paul Trahair Hadingham 1968
Peter John Stewart Gibb 1968
Robert Douglas 1968
Robert Paul Arthur Siaens 1968
Schalk Willem Pienaar 1968
Spiro Theodore Paizis 1968
William Austen Jackson 1968
Zalman Zitron 1968
Andrew Patrick Pearce 1967

Anthony Son Hing............. 1967
Basil Louis Joffe 1967
Cecil Dombey Cawood.... 1967
Colin David Sive 1967
David John Bennett.......... 1967
Duncan McKenzie
Fraser................................ 1967
Henry Ronald
Mendelsohn 1967
Ian Hilton Goulden........... 1967
Jan Harmse Nieuwoudt... 1967
Martin Dajohn Viljoen....... 1967
Patrick John Dillon 1967
Peter Stewart Forbes 1967
Richard Edgington
Walker 1967
Stanley Max Rogow 1967
Colin Michael Ross 1966
David Robert Webb 1966
Eric Anton Horsten............1966
Frank Roger William
Richards............................1966
Gerald Norman Rosing 1966
Leon Tabic 1966
Mark Swerling....................1966
Martin John Robert
Westcott...........................1966
Otto Friedrich Ahrens.......1966
Ralph Arderne Jones........1966
Reginald Claude Terry
Carter................................1966
Robert Rudolf
Schalscha 1966
Roger Ernst Raimund
Falls 1966
Roger John Kelley............1966
Ronald Claude Sylvester
Eastes................................1966
Ronald Claude Terry
Carter................................1966
William Beverley Lawler...1966
Zavel Sacks.........................1966
David Allan Katz.................1965
David Ian Harris.................1965
Duncan William Munro
Ashby..................................1965
Edgar Christopher
Schonfelder........................1965
Eric Copans........................1965
Etienne van de Sandt
de Villiers 1965
Garth David Hutton...........1965
David Stern.........................1965
Jack David Zoutendyk.......1965
John Ashely Rich 1965
John Peter Hoeks..............1965
Leonard Padowitz 1965
Michael Anthony Connor..1965
Michael Gilbert
Lancaster 1965
Melvyn Edwin Cohen.......1965
Peter Michael Maughan
Brown.................................1965
Peter William Rein.............1965
Ralph Arderne Jones........1965
Robert Michael
Silbermann 1965
Roderick Charles Prior......1965
Roger Ernst Raimud Falls .1965
Roger John Kelly 1965
Spiro Theodore Paizis 1965
William Beverley Lawler...1965
Zavel Sacks..........................1965
Michael Anderson.............1964
Adrian Victor van Reenen
Schweitzer........................1964
Angus Edgar Macdonald
Quail 1964
Brian John Hill...................1964
David James Brice.............1964
Eksteen Pieter Slabbert 1964
Ernest Lawrence
Langford 1964
Francis Grenville Lomax ...1964
Franklin David Jenkins......1964
George John Dilmitis 1964
Gerald Ernest Lewinsohn...1964
Graham Malcolm Comrie
Dewar 1964
Henry Leslie Robertson....1964
Jack Arthur Roy Ingle........1964
John Fleming 1964
John George Kirkland......1964
Keith William Davidson 1964
Leslie Frank Bergman 1964
Mark Metcalfe
Haythornthwaite.............1964
Peter Frank Auld 1964
Peter John Watkins 1964
Robert Selwyn Lockitch ...1964
Walter Freedman 1964
Anthony Stephen
Fricke 1963
David Howel Griffiths 1963
David James Percy
Meachin 1963
Edward Charles
Borcherds........................ 1963
Geoffrey William
Campbell 1963
Georges Belfort................. 1963
Hugh Micheal Wakeling .. 1963
Jabobus Marinus van
Westing 1963
John Steele Adams 1963
Johannes Francois
Lubbe 1963
John Arthur Bewsey.......... 1963
John Neville Marriott........ 1963
Leslie Hewitt Blatch........... 1963
Nicolaas Willem
Hanekom 1963
Patrick George Walton..... 1963
Peter Rolf Oppenheim..... 1963
Rolf Leonhard Ball 1963
Theodor John Stewart...... 1963
Anthony Watson Bryson... 1962
Aubrey Schwartz............... 1962
Bernard Kuntz 1962
Donovan John Fitzpatrick .. 1962
Geoffrey Margolis............. 1962
Hugo Lindeque
Slabbert............................ 1962
Lester Jack Maisel............. 1962
Michael John Lang............ 1962
Neil Jochelson 1962
Raymond Catzel 1962
Richard Evian Bennett 1962
Simon Penwarne Scott 1962
Walter Lennox Impey 1962
Walter Stephen Geoffrey
Oosthuizen 1962
Aart Roukens de Lange.... 1961
Alan David Montlake 1961
Alan Joseph Morris 1961
Clive Reader Thorpe......... 1961
George Homolka 1961
Jack Faure Goedhals 1961
Leonard Cecil Samols 1961
Simon Penwarne Scott 1961
Tertius Moritz de Vos 1961
Alan Peter Berrisford 1960
Brian Stewart Bennett.......1960
Colin Walker.......................1960
David Arthur Samols 1960
Drumond Berwick
McQueen.........................1960
Geoffey Owen Rutter.......1960
Geoffrey Spearing
Hansford 1960
Hamo Robert Percy
Hammond 1960
Harald Hans Jawurek........1960
Ian Leiper Duff...................1960
Jacques Pierre Joham
Malan.................................1960
Micheal Barry Hanley........1960
Richard Sidney Birkhill 1960
Robin Keith
Brooke-Sumner...............1960
Rodney Wilfred Lewis
Morgan.............................1960
Sydney Benjamin Miller....1960
Wilfred Teper.....................1960
William Geoffrey Donnan
McIlleron..........................1960
Armin Maxmilian Kessler .. 1959
Arthur John Milton............1959
Bernhard Lochner 1959
Cyril Leonard Baldachin ...1959
David Vernon Wellesley
Brink 1959
David William Boydell 1959
Gerhard Friedrich Arndt
Spitzner 1959
Hirsh Barry Ginsberg 1959
Ivan Daniel Dirmeik...........1959
John Walter Treger 1959
Simon Saul Litvin 1959
Alan Thomas Lewis Jolley 1958
Allen Maurice Hamilton
Rose-Innes.......................1958
Bruce Meredith Ilsley........1958
Cedric Lionel Moroukian . 1958
Clive Michael Harraway ... 1958
David Glasser.....................1958
Gerard Redvers Voltelyn
Damp.................................1958
Ivor Martin Simmons.........1958
Micheal John Gluckman .. 1958
Myndert Trevor Scholtz 1958
Nicholus Jacobus 1958
Philip John Lloyd...............1958
Anthony Thomas
Cartwright.........................1957
Colin Anolick 1957
Heinrich Otto Buhr.............1957
Micheal Robin Judd 1957
Nicolaas Jocobus Louw.....1957
Roy Duncan MacPherson..1957
Stewart Percival Wood......1957
Warner Belger 1957
Arbutus Johannes Janse
van Rensburg 1956
Arnold Philip Harris...........1956
Barry Charles Zackon 1956

Conrad Miles Basson 1956
Elkan Jacobson 1956
Francis Louis Dirk Cloete ..1956
Gordon Frame McIntyre ..1956
Harry Israel Hurwitz 1956
John Harding.....................1956
John William de Kock.......1956
Leslie Glasser.....................1956
Michael van Breda Smith .1956
Robert Campbell...............1956
Robert Greer St Leger 1956
Peter Miles Goyen Hart....1955
Alan Frank Goodman 1954
Brian David Alan Paddon .1954
Douglas Niland Malan......1954
Willem Andriaan
Lombard 1954
Christopher Martin
Wilson Orpen.................1953
Christo Renaldo Lotz.........1953
Jurie Wynand Wessels 1953
Mordaunt Julian
Lomberg 1953
Peter John Stubbs.............1953
Ruxton Herrer Villet 1953
Christopher Goyen Hart ..1952
Conrad William Ehmke.....1952
Derek Kenneth Edwards ..1952
Geoffrey Lumley Head 1952
Isaac Alec Amato 1952
John Wilfred Delano
Barnes...............................1952
John Bentley Wiggill 1952
Robert James Denis
Acheson 1952
David Allen Lewis.............1952
Frederick Richard
Chichele Hewitt 1952
John Whitburn Hueton....1952
Leon Pearl...........................1952
Morris Mizrahi 1952
Ronald Hanley Marks........1952
Anthony Peter Brien..........1951
Keith John Scott.................1951
Louis Armand du Plessis...1951
Ralph Tartley Harris 1951
Victor Alan Barker.............1951
Basil Alfred Beeming.........1950
Brian Reynolds Lynch 1950
Chester Centlivres Chase ..1950
Colin Graham Murdoch ...1950
Donald Kleinman...............1950
Ian Hartley Keith 1950
Hendrickus Willem
Kropholler........................1950
Keith Robert Fortescue
Arkell 1950
Kenneth Gordon
Carr-Brown.........................1950
Albertus Wynand Louw ...1949
Andrew Donald Carr 1949
Christopher Adrian
Lomberg 1949
David Joseph Movsovic...1949
Denis James Taylor............1949
Derick Alfred Gell.............1949
Guy Harold Dudley
Hinde...............................1949
Noel Michael Wilkins........1949
Peter Nairn Boyes.............1949
Ransford Buchan Ritchie ..1949
Robert George Keith........1949
Ronald Lance Mercer 1949
William Leonard
Dowsley 1949
David John Louw 1948
David John Marlow...........1948
Edward Thomas
Woodburn.......................1948
Harold Schwartz 1948
Izak De Villiers Retief 1948
John Edward Hodgkiss....1948
Paul Hougaard
Cruywagen......................1948
Peter Nairn Boyes.............1949
Peter Neil Trewartha 1948
Donald Raymond Inggs... 1947
Douglas John Leslie.......... 1947
Behr Synrodin 1947
Julius Zlotnick.................... 1947
Angus Farquhar
McDonald 1947
Uriel Joseph Marks............ 1947
Benjamin Uranovsky 1946
Bernard Louis Stoch 1946
Jakobus Justin Theron 1946
Mendel David Cohen.......1946
Rocco Pierre de Villiers 1946
Sidney Arthur Semer.........1946
Simeon Aaron Wilk 1946
Victor Tarica 1946
William Hendry
Whittaker 1946
John Nelson Wanklyn.......1945
Barry Peck 1944
Charles Maurice Abrams ..1944
Jacob Zlotnik......................1944
Johan Adam du Preez 1944
Johannes Roelof Steyn.....1944
Olaf Eugene Bergh 1943
Peter Noval Duncan..........1943
Abraham Rabinowitz 1942
Adriaan Hendrikus
Stander 1941
Gabriel Gideon Cillie........1941
Robert George Honeyman
Farmer 1941
Frank Saul Robinson 1940
Malcolm Robert Jesse
Wyllie...............................1939
Ronald Austin Webb.........1939
Athol Claughton Munday 1938
Goerge William Fletcher.. 1938
Meyer Sacks 1938
Cecil Herbert Jenner 1937
Douglas John Lloyd...........1937
Micheal Frederick Aylwin
Dawes...............................1937
Emmanual Meltzer 1934
Hans Montagu Murray 1934
Jacobus Meintjies..............1934
Kurt Ronaasen 1934
Abraham Orlek 1933
Eric Charles Schiffman 1933
Pieter Barendse Bosch
Vosloo...............................1933
Solly Rabinowitz 1933
Bernard Gersholowitz 1932
Hurbertus Moorees
de Vaal..............................1932
Robin Ralph Jamison 1932
Frank Edward Buch 1931
Harry Jacobs 1931
William Henry Dering
Addison............................1931
Andries George Hendrik
Loubser 1930
George Ronald Atikins 1930
Harold Nicholas Hepkar...1930
Isaac Donan........................1930
Louis Nathan Cohen 1930
Arthur Lewis Abbott..........1929
Walter Driver......................1929
Edward Nicolas Bills...........1927
Jacobus Hugo Scholtz.......1927
Jacobus Lodiwicus
Goedhals 1927
Maurice Maynard Clark 1927
Brian Wolfe Crowhurst 1926
Coenraad Stephen van
der Poel............................1922

APPENDIX B

Chemical Engineering staff 2020

Professor and Head of Department

Aubrey Mainza, BMinSC UNZA PhD *Cape Town*

Professors

Michael Christian Claeys, Dipl Ing(Eng) Chem Dr Ing *Karlsruhe*

David Alan Deglon, BSc(Eng) *Witwatersrand* MBA PhD *Cape Town* MSAIMM FSAAE

Jack Calvin Quintin Fletcher, BSc(Eng)Chem PhD *Cape Town* MACS FSAAE

Susan Therese Largier Harrison, BSc(Hons) *Cape Town* PhD *Cantab* MSAIChE SASM FSAIMM FSAAE ASSAf FWISA

Patricia Jane Kooyman, Drs Chemie MSc *Leiden* PhD ChemE *Delft University of Technology* MSAIChE

Alison Emslie Lewis, PrEng BSc(Eng)Chem MSc PhD *Cape Town* FSAIChE FSAIMM MASSAf FSAAE FIChemE

Klaus Peter Möller, BSc(Eng)Chem PhD *Cape Town*

Jochen Petersen, BSc(Eng)Chem *Witwatersrand* PhD *Cape Town* MSAIMM

Eric van Steen, MSc(Eng) *Eindhoven* Dr.-Ing. *Karlsruhe* FSAIChE FSAAE AFIChemE

Harro von Blottnitz, PrEng BSc(Eng)Chem *Cape Town* BSc(Hons) UNISA MSc (Eng) *Cape Town* Dr- Ing. *Aachen*

Associate Professors

Megan Becker, BSc(Hons) Geology MSc *Cape Town* PhD *Pretoria*

Jennifer Lee Broadhurst, BSc(Hons) MSc *Port Elizabeth* PhD *Cape Town*

Kirsten Claire Corin, BSc(Hons) PhD *Cape Town*

Nico Frederik Fischer, Dipl.-Ing.(Eng) Chem *Karlsruhe* PhD *Cape Town*

Adeniyi Adediran Jide Isafiade, BSc(Hons) *Ilorin* MSc *Ife* PhD *Cape Town* AMIChemE (Director of Postgraduate Studies)

Pieter Berthold Jan Levecque, MSc(Eng) PhD *Leuven*

Belinda Julie McFadzean, BSc(Hons) MSc *Port Elizabeth* PhD *NMMU*

Emeritus Professors

Jean-Paul Franzidis, BSc(Eng) MSc(Eng) Chem *Cape Town* PhD *Open*

Cyril Thomas O'Connor, PrEng BSc *UNISA* STD *Natal* BSc(Hons) PhD *Cape Town* DEng *Stellenbosch* FSAIMM FSAIChE FSAAE FRSSAf

Honorary Professors

Jennifer Margaret Case, BSc(Hons) *Stellenbosch* HDE MSc *Cape Town* MEd *Leeds* PhD *Monash* MASSAf

Paul Cleary, BSc(Hons) *Monash* PhD *Monash*

Indresan Govender, BSc *UDW* BSc(Hons)Physics PhD *Cape Town* HDE *UNISA*

Christopher Hebling, Dipl.(Phys) PhD (Phys) *Konstanz*

Graham Hutchings, BSc(Eng) Chem PhD *UCL* DSC (Heterogeneous Catalysis) *London* FIChemE FRS CBE

Michael Nicol, BSc(Hons) PhD *Witwatersrand* FSAIMM, FAUSIMM

JW (Hans) Niemantsverdriet, BSc (Phys+Math) MSc *Amsterdam* PhD *Delft* (TechSciences)

Jim Petrie, C.Eng., BSc(Eng) Chem *Cape Town*, MSc (Eng) *Houston*, PhD *Cape Town;* FIChemE

Adjunct Professors

Brian Joseph Chicksen, MBChB *Harare* FCP (SA) *Durban* MBA *Johannesburg*

Paul Dempsey, NHD Metallurgy *Wits Technikon* BSc *UNISA* MDP *UNISA*

Caroline Digby, BA Hons(Econ) *Trinity College Dublin* MA(Econ) *British Columbia* MSc(Environment) *London School of Economics and Political Science*

Jeremy Mann, BSc(Eng) Extractive Metallurgy *Witwatersrand* MBL *UNISA*

Robert Pieter Schouwstra, BSc(Hons) *NWU* MSc *Johannesburg* DSc *NWU*

Michael Henry Solomon, BSc(Eng)Mining, *Witwatersrand*, FSAIMM, FIQ, Mine Manager's Certificate of Competency (Metalliferous), MDP(Mining) *South Africa*

Wynand van Dyk, BEng (Chemical, Extractive Metallurgy) PhD *Stellenbosch*

David William Wright, C.Eng, BSc(Eng)Chem *Natal* MSAIChE FSAAE FIChemE

Adjunct Associate Professors

Brett Cohen, BSc(Eng)Chem PhD *Cape Town*

Philippa Notten, BSc(Eng)Chem PhD *Cape Town*

Senior Lecturers

Lawrence Sidney Bbosa, BSc(Eng)Elec-Mech MSc PhD *Cape Town* MSAIMM

Marijke Antonia Fagan-Endres, BSc(Eng)Chem *Cape Town* PhD *Cantab*

Hilton Roy Heydenrych, BSc(Eng)Chem MSc *Cape Town*

Thebe Philip Mokone, BSc (Hons) Chem *UFS* MSc *UFS* PhD(Chem Eng) *Cape Town*

Malibongwe Shadrack Manono, BSc(Eng)Chem MSc *Cape Town* PGDip Business Management *Regenesys* PhD *Cape Town*

Siew Leng Tai, BSc(Hons)*UMIST* MSc PhD *Delft* (Director of Undergraduate Studies)

Lecturer

Tokoholo Rampai, BSc(Hons) MSc *Cape Town*

Contract Lecturers

Sherry Bremner, BSc (Physics) *Cape Town*, BSc(Hons) NASSP *Cape Town*, MSc (Physics) *KwaZulu-Natal* PhD (Physics) *Cape Town*

Catherine Joanna Edwards, BSc(Eng)Chem *Cape Town*

Elaine Govender-Opitz, BSc(Eng)Chem PhD *Cape Town*

Resoketswe Martha Manenzhe, BSc(Eng)Chem MSc *Cape Town*

Disaapele Mogashana, BSc (Eng) Chem, MPhil PhD, *Cape Town*

Muven Naidoo, BSc(Eng)Chem Eng *UKZN*

Tracy van Heerden, BSc(Eng)Chem MSc *Cape Town*

Honorary Research Associates

Madelyn Johnstone Robertson, BSc(Eng)Chem PhD *Cape Town*

Melissa Petersen, BSc(Physics) MSc *Cape Town* PhD *Cantab*

Sarah Jones, BSc(Biochemistry) BSc(Hons) Biotechnology MSc(Biochemistry) Rhodes PhD Bioprocess Engineering *Cape Town*

Chief Research Officer

Martin Colquhoun Harris, BSc(Eng)Chem MSc *Cape Town*

Senior Research Officers

Alison Gray Hughes, BIng *Stellenbosch*, MSc(Eng) *Cape Town*

Athanasios Kotsiopoulos, BSc(Eng) MSc PhD *Cape Town*

Andrew Marquard, BA *Cape Town*, MA *Rhodes*, PhD *Cape Town*

Bruno Merven, BScEng , ScEng, MScFinMaths *Cape Town*

Andries Petrus Pepler van der Westhuizen, BEng *Stellenbosch* MSc *Cape Town*

Research Officers

Mogamat Fadiel Ahjum, BSc(Hons) *Perth*, MSc(Eng) *Cape Town*

Paul Aaron Bepswa, BSc(Eng)Metallurgical *Zimbabwe* PhD *Cape Town*

Robert Huddy, BSc(Hons) PhD *Cape Town*

Mohamed Islam Fadlalla, BSc(Chem) MSc PhD *Durban-University of KwaZulu-Natal*

Niels Theo Johan Luchters, BTech *Leiden* MSc *Cape Town*

Armand Stefan Geldenhuys, BEng (Chem) *Stellenbosch*, MSc (Chemeng) *Cape Town*.

M Richter, BSc (Physics) *Cape Town*, BSc (Hons) *Cape Town*, MSc (Physics) *Cape Town*, PhD (Physics) Cape Town

Bryce McCall, BSc(Hons), MScEng *Cape Town*

Rhiyaad Mohamed, BSc(Hons) (Chemistry) MSc NMMU PhD(Chem Eng) *Cape Town*

Thandazile Moyo, BEng(Hnrs) (Eng) *Zimbabwe*, PhD, (Eng) *Cape Town*

Mariette Smart, BSc(Hons) MSc *Stellenbosch* PhD *Cape Town*

Jason Gordon Waters, BTech(Chem Eng) *Cape Technikon* MSc *Cape Town*

Junior Research Fellow

Nodumo Nokulunga Zulu, BSc(Hons) (Biochemistry) *Johannesburg* MSc(Molecular and Cell Biology) *Cape Town* PhD(Biochemistry) *Germany*

Chief Scientific Officer

Jemitias Chivavava, B(Eng) *NUST* MSc(Eng) *Cape Town*

Keshree Pillay, BSc (Hons) *UKZN* MSc *Cape Town* Pr. Sci. Nat.

Shireen Govender, BTech (Chemistry), MPhil (Environmental Management)

Principal Technical Officer

Holger Joachim Macke, Dip Mechanical Engineering Technician, *Germany*

Chief Technical Officers

Mugammad Ameen Jakoet, BSc (Eng) Mechatronics *Cape Town*
Portia Teresa Johnston, BSc *Cape Town*
Tichaona Samkanga, NITC NTC NH(Eng)Elec *Harare* Polytechnic MBA *Rhodes*

Senior Technical Officers

Rachel Belinda Cupido, NDip(Analytical Chemistry) BTech(Chemistry) MTech(Chem) *CPUT*
Waldo Pieter Ernst Koorts, BTech(Chem Eng) MTech *CPUT*
Chantal Ashlene Le Roux, NDip *CPUT* BTech(Chem) *UNISA*
Sharon Rademeyer, NDip(Chem Eng), BTech(ChemEng), MEng(Chem Eng), *CPUT*

Technical Officers

David John Bramble
Gary Victor Groenmeyer

Department Laboratory Manager

Alvira Mentoor, BSc(Hons) MSc *Stellenbosch*

Analytical Laboratory Manager

Sandeeran Govender, BSc(AppChem) Hons(Chem) MSc *UKZN*

Research and Technical Assistant

Russell Geland
Kenneth Maseko
Refilwe Moalosi
Ngobile Dingiliswe

Department Manager

Sarojini Imelda Pillay

Building Supervisor

Mogamat Eghsaan Matthews

Workshop Assistant-Electronic Workshop

Curwin Franklin Nomdoe

Laboratory Assistant

Shene Porche Klink
Sibongile Nyimbinya
Monde Bekapi
Lauren Nkemba

Administrative Staff

Bridgette Belinda Cloete (Undergraduate Administrator)
Belinda Julie Davids (Postgraduate Administrator)
Lingeka Nelly Dili (Receptionist)
Denise Lesch (Finance Assistant)
Kheziya Mfundisi (Administrative Assistant)
Flora Silwana (Purchaser)

Centre for Minerals Research Administrative Staff

Heather Sundstrom (Administrative and Finance Manager)
Nicola Davies (Project Administrator)
Clare Pomario (Admin Assistant)

Catalysis Institute Administrative Staff

Reinier Willem Weber (Centre Manager)
Stephen John Roberts (Contracts Manager)
Lee Anne Kim Kallam (Finance and Operations Manager)
Yolanda Amsterdam (Finance and Admin Officer
Shireen Heugh (Finance and Admin Officer)

HySA/Catalysis Administrative Staff

Sharon Louise Blair (Director: HySA)
Darija Susac (Research and Technology Development Manager)
Jessica Chamier (Key Technology Specialist)
Firdaus Hendricks (Technical Assistant)

Centre for Bioprocess Engineering Administrative Staff

Susan Jobson (Administrative and Finance Manager)
Lesley Mostert (Science Writer and Curator)
Ruegshana Ederies (Adninistrative Assistant)
Tolbert Golela (Research Assistant)
Shilpa Rumjeet (Research Administrator)

Crystallisation & Precipitation Research Administrative Staff

Nikita Bam (Administrative Assistant)

Minerals to Metal Administrative Staff

Mymoena Shaik (Finance Administrative Officer)

Environmental and Process Systems Engineering (E&PSE) Administrative Staff

Carol Carr (Administrative Assistant)

APPENDIX C

Chemical Engineering curricula 1995-2013 and since 2014

UNIVERSITY OF CAPE TOWN

IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

CURRICULUM FROM 1995-2013[1,2]

YEAR 1

CEM1000W - Chemistry 1000
CHE1004W - Chemical Engineering I
MAM1003W - Mathematics 103
MEC1002W - Engineering Drawing
PHY1010W - Physics 110

YEAR 2

CEM2007F - Physical Chemistry & Spectroscopy
CEM2008S - Organic & Inorganic Chemistry
CHE2031F - Material & Energy Balances
CHE2032Z - Design of Chemical Processes
CHE2033W - Chemical Engineering Laboratory I
CHE2035S - Thermodynamics I
CHE2040S - Fluid Flow & Heat Transfer
MAM2080W - Mathematics 280

+ Approved elective courses*

YEAR 3

CHE3040S - Solid Fluid Operations
CHE3044F - Reactor Design I
CHE3046F - Thermodynamics II
CHE3049W - Chemical Engineering Laboratory II
CHE3050S - Chemical Process Unit Design
CHE3053S - Separation Processes
CHE3054S - Reactor Design II
CHE3062S - Professional Communication
CHE3063F - Mass Transfer
MAM3080F - Numerical Methods
CHE3000X - Workplace Experience

+ Approved elective courses*

YEAR 4

CHE4048F - Business, Society & Environment
CHE4049F - Process Synthesis & Equipment Design
CHE4029Z - Professional Communication Studies
CHE4036Z - Chemical Engineering Design
CHE4042F - Process Dynamics & Control
CHE4045Z - Chemical Engineering Project

+ Approved elective courses*

*ELECTIVE COURSES

ADVANCED ENGINEERING ELECTIVES

CHE3035S - Bioprocess Technology I
CHE3039S - Catalysis
CHE3064S - Mineral and Metallurgical Processing I
CHE3065S - Numerical Simulation for Chemical Engineers
CHE3066S - Crystallisation & Precipitation

CHE4024F - Introduction to Environmental Process Engineering
CHE4050F - Mineral & Metallurgical Processing II
EEE4103F - Nuclear Power Sources

HUMANITIES GROUP

This group consists of courses typical of studies in the Humanities. A list of courses satisfying this requirement is available from the Academic Administration Officer in the Department of Chemical Engineering, and is provided to students during registration. Courses not on this list require the approval of the Programme Convenor.

Alternatively, students may wish to take any EBE course at or above the Third Year level (including Master's level) for which they meet the course entry requirements. Such courses must be approved by the Programme Convener.

NOTES

[1] Over the years, minor alterations are made (e.g. courses change names/codes, are split, are combined, etc.). The curriculum shown is a snapshot from a particular year and may not reflect the exact set of courses in a different year.

[2] The curriculum shown is for the four-year programme. Many students also graduate through the Aspect (five-year) programme. In this programme, core-courses from Year 1 to Year 3 are spread across four years and some Maths and Physics courses are replaced by others with equivalent content but a higher level of formal support.

YEARS OF CHEMICAL ENGINEERING at UCT

Building on a legacy, visioning the future

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

CURRICULUM SINCE 2014[1,2]

The 4-year undergraduate BSc degree in Chemical Engineering is made up of

- Chemical Engineering Core courses,
- Science fundamentals and specialisation courses,
- Chemical Engineering Specialisation courses, and
- a choice of electives.

YEAR 1

CEM1000W - Chemistry 1000
CHE1005W - Chemical Engineering I
MAM1020F - Mathematics 1A for Engineers
MAM1021S - Mathematics 1B for Engineers
PHY1012F - Physics A for Engineers
STA1008S - Statistics for Engineers

YEAR 2

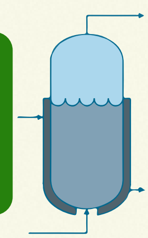
CHE2000X - Field Trip
CHE2005W - Chemical Engineering II
MAM2083S - Vector Calculus for Engineers
MAM2084F - Linear Algebra and DEs for Engineers

+ Approved elective courses*

YEAR 3

CHE3006F - Fundamentals of Chemical Engineering III
CHE3007S - Non-ideal systems in Chemical Engineering
CHE3008S - Chemical Eng Project Management & Unit Operation Design
CHE3000X - Workplace Experience

+ Approved elective courses*



YEAR 4

CHE4048F - Business, Society & Environment
CHE4049F - Process Synthesis & Equipment Design
CHE4036Z - Chemical Engineering Design
CHE4045Z - Chemical Engineering Project

+ Approved elective courses*

*ELECTIVE COURSES

SCIENCE ELECTIVES

Biotechnology
BIO1000F - Cell Biology
CHE2006S - Introduction to Biotechnology

Chemical Sciences
CEM2005W - Intermediate Chemistry

Mineralogical Sciences
GEO1009F - Introduction to Earth and Environmental Sciences
GEO2006S - Applied Mineralogy for Chemical Engineering

HUMANITIES ELECTIVES

AGE - Archaeology
AXL - Anthropology, Gender Studies, African Studies
HST - History
PHI - Philosophy
POL - Politics
SOC - Sociology

The following specific courses have also been approved as options:

END1019L - Social Infrastructures: Engaging with Community for Change
END1023S - Citizen Professionals in Engineering & the Built Environment
FAM1001 - Film and Media studies
REL1006S - Judaism, Christianity and Islam

ADVANCED ENGINEERING ELECTIVES

CHE3067S - Design and Operation of Catalytic Reactors
CHE3068S - Bioprocess Engineering Fundamentals
CHE3069S - Mineral and Metallurgical Processing
CHE3070S - Numerical Simulation for Chemical Engineers

CHE4057F - Industrial Ecology for Chemical Engineers
CHE4058Z - Life Cycle Assessment
CHE4067F - Heterogeneous Catalysis
CHE4068F - Bioprocess Engineering Design
CHE4069F - Mineral & Metallurgical Processing II
CHE4070F - Numerical Optimisation for Chemical Engineers

YEARS OF CHEMICAL ENGINEERING at UCT
Building on a legacy, visioning the future

LANGUAGE ELECTIVES

Students must do any language course at UCT that will give them exposure to a language other than English that they do not already speak at this level.

FREE ELECTIVES

Students may do any course at UCT for which they meet the prerequisites, and where they have not already covered that content in another course.

NOTES

1 Over the years, minor alterations are made (e.g. courses change names/codes, are split, are combined, etc.). The curriculum shown is a snapshot from a particular year and may not reflect the exact set of courses in a different year.

2 The curriculum shown is for the four-year programme. Many students also graduate through the Aspect (five-year) programme. In this programme, core-courses from Year 1 to Year 3 are spread across four years and some Maths and Physics courses are replaced by others with equivalent content but a higher level of formal support.

Core Chemical Engineering course descriptions (2014 curriculum)

CHE1005W CHEMICAL ENGINEERING I

Introduces the field of chemical engineering, its underpinnings in material and energy balances; process analysis and design fundamentals, natural foundations, spatial perspectives, modelling and computational tools; and the over-arching professional development context in which chemical engineers operate.

CHE2000X FIELD TRIP

Exposes student engineers to industrial scale equipment and processes, as well as opportunities for application to real systems in the regional context. It also provides experience of industrial safety requirements, and opportunities for meaningful engagement with industry professionals

CHE2005W CHEMICAL ENGINEERING II

Delivers further understanding of chemical engineering theory and practice, to parallel project work in an integrated manner. All traditional unit and process operations are exposed and analysed. This is reinforced by engineering practice imperatives, including commitments to sustainability, environment & economics, safety & health, communication, and teamwork. It draws heavily from project work; supported by practical skills' development, covering topics such as computing and flow-sheet development, problem framing and heuristics, and data analytics.

CHE3000X WORKPLACE EXPERIENCE

Students complete a minimum of four weeks of workplace experience in their third year of study. This (largely project-based) exposure introduces the practical dimension of the "process engineering work environment". With the diversity of graduate employment opportunities, this work-placement experience is increasingly diverse. What it serves to achieve is an understanding of the difference between theory and practice.

CHE3006F FUNDAMENTALS OF CHEMICAL ENGINEERING III

Develops further the understanding of chemical engineering theory and practice, focusing on a (still largely) unit and process operations model, but underpinned by rigorous analysis of molecular-scale interactions and phase behaviour. This course drills down into the particularities of those process industries of highest relevance to South Africa's development.

CHE3007S NON-IDEAL SYSTEMS IN CHEMICAL ENGINEERING

Reinforces core concepts such as dynamics and uncertainty across all systems. It introduces coupled phenomena and system interactions, covering all transport phenomena, kinetics and equilibria. The focus is on comparing theoretical descriptions and empirical data with experimentally observed phenomena.

CHE3008S CHEMICAL ENGINEERING PROJECT MANAGEMENT AND UNIT OPERATION DESIGN

Couples design and project management around a set of process units, building on traditional conceptual design protocols.

CHE4036Z CHEMICAL ENGINEERING DESIGN

Often described as a "capstone" course, this is structured around an open-ended design problem. While these "'problems" have been focused traditionally on bulk chemical processes, they are increasingly concerned with the potential of novel technologies, intending to capture innovation and entrepreneurship potentials. Most importantly, this course leverages the integrative thread of "design thinking" from previous years of study.

CHE4045Z CHEMICAL ENGINEERING PROJECT

Challenges students to manage and deliver on a 12-week research project in their final year. These projects are increasingly diverse in scope. Academic guidance is principally related to guidance on research methodology, including the "scientific method", survey of the literature, design of experiments, relevant analytical equipment and techniques, safety in the laboratory, the handling of wastes, data analytics, report writing and presentation of research findings.

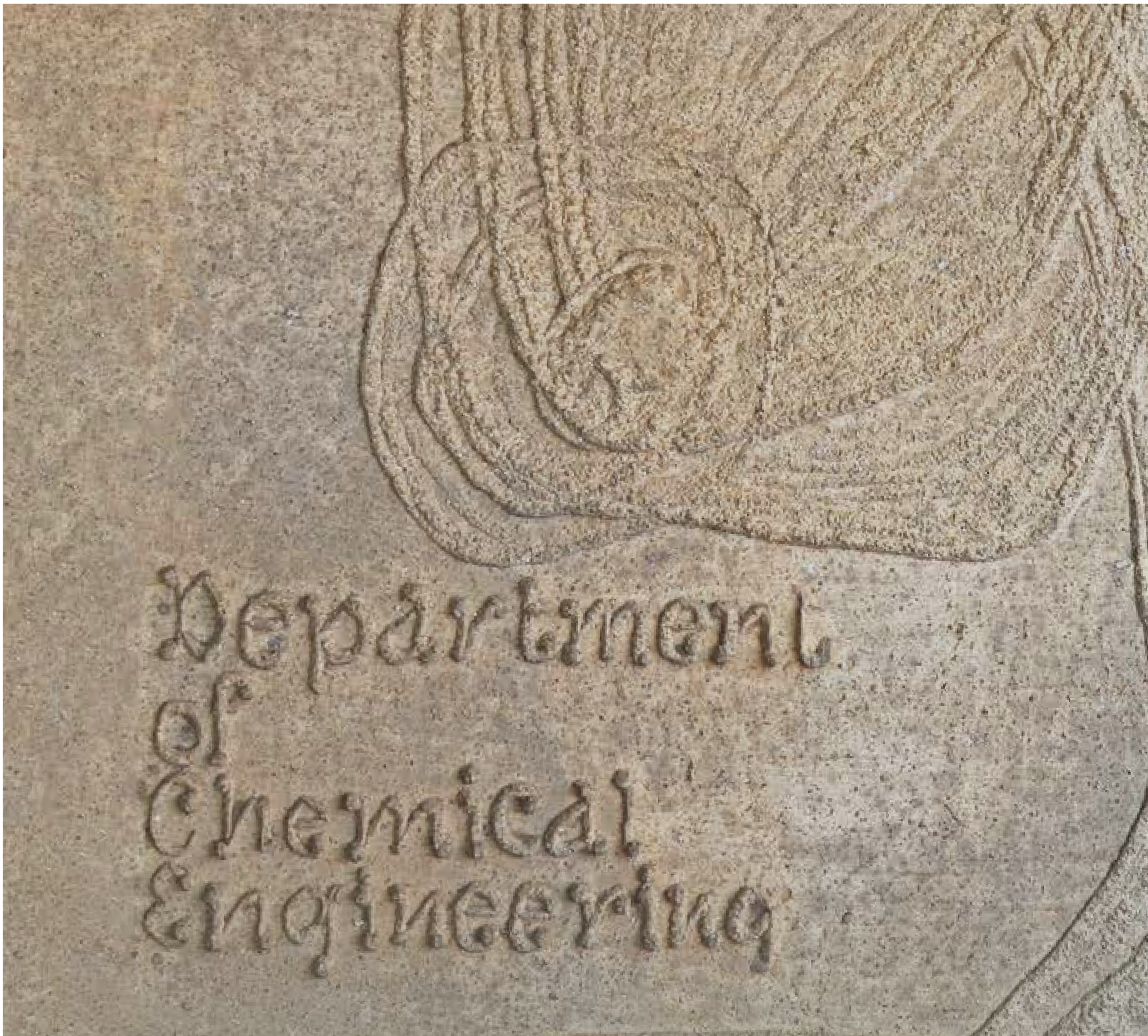
CHE4048F BUSINESS, SOCIETY AND ENVIRONMENT

Provides guidance to students about their future roles as practising professionals. The course covers: benefit indicators, physical risk in the process industries, environmental sustainability, social impacts and license, innovation and entrepreneurship, business planning, capital and operating cost estimation, profitability assessment and engineering ethics.

CHE4049F PROCESS SYNTHESIS AND EQUIPMENT DESIGN

A largely analytical and quantitative course, building on the design philosophy from previous courses. It further develops process synthesis tools (including heuristics) and looks to consideration of multi-objective optimisations, spanning everything from plant level considerations (process control), to wider issues beyond the plant "gate".

The interior (above) and exterior (on facing page) of the Chemical Engineering Building.



Published by the Department of Chemical Engineering,
University of Cape Town, South Africa.
www.uct.ac.za

Design and production by Rothko
www.rothko.co.za

ISBN 978-0-620-90479-7
9 780620 904797