The Last 25 Years of Chemistry in Otago and Southland

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Chemistry in Otago and Southland involves on one hand the large scale industrial chemical processes of aluminium smelting at Tiwai, milk processing at Edendale, gold extraction at the Macraes mine and fertilizer manufacture at Awarua and Dunedin. On the other hand, fundamental chemical research and the teaching of chemistry is dominated by the activities of the Chemistry Department at Otago University (OU) and the science departments of the polytechnics and high schools in the area.

Otago University

OU Chemistry moved in to a new undergraduate laboratory building in 1971 and a new research/administration building in 1972. It has remained there since, although internal refurbishment to laboratories and office space has occurred in both buildings over the years, particularly to meet new occupational safety and health requirements and to optimize space utilization among university departments. The past 25 years has seen major changes to both departmental management and the funding regime. There has been a positive move to a committee management structure. A period of tight budgets in the late 80s was relieved when chemistry became one of the first departments in the university to be given budget flexibility and control within defined parameters. By 1996, this flexibility had provided for ten new academic staff appointments and support for their research. The period 1995 onwards saw an emphasis on quality teaching and research. The past decade has seen this quality research being recognised in the award of many Marsden and FRST grants, individual prizes for excellence, and a high ranking in the national PBRF exercise. External research funding now plays a pivotal role in the financial health of the Department and has led to a big increase in the number of research fellows and assistants appointed.

Research

Physical Chemistry

The Department had a long tradition in undertaking what might now be considered as classical physical chemistry beginning in the 1950s with Hugh Parton (electrochemistry) and Max Pankhurst (aqueous solution chemistry). This tradition was continued by Arch Matheson (1969-1990) and Bob Smith (1965-1991) undertaking classical electrochemical analysis of aqueous solutions, and Dave Fenby (1967-1996) examining aspects of the thermodynamics of the mixing of organic liquids. Research in zeolite and surface chemistry was initiated by Chris Pope (1961-1997), and William Ducker (1994-1997) introduced the technique of atomic force microscopy to study surfactant behavior. Kate McGrath (1997-2003) extended surface chemistry research by studying aspects of biomineralisation. Such biophysical research continues with Guy Jameson (2006-) who is studying physicochemical aspects of metal-containing enzymes and, most recently, Carla Meledandri (2009-) researching the design and synthesis of nanoscale materials for combined bioanalysis and targeted drug delivery. Extensive research into the kinetic behavior of aqueous inorganic systems, particularly cobalt coordination and porphyrin compounds, was undertaken by Dave Buckingham (1978-1995) and his scientific officer Charles Clark (1978-2000).

Keith Gordon (1993-) focuses on understanding the properties of conducting polymers, nanostructured electromaterials, dairy products and pharmaceuticals using spectroscopy and computational chemistry. Keith was

University of Otago Chemistry Building

NZIC President in 2006 and is a founding Principal Investigator in the Wellington based MacDiarmid Institute. Henrik Kjaergaard (1996- 2009) introduced acoustic spectroscopy to the Department and developed theoretical calculations to study fundamental aspects of molecular vibrations in small molecules of interest in atmospheric chemistry. Jim McQuillan (1975-) began his research on UV-vis and IR spectroelectrochemistry but, more recently, has developed internal reflection IR spectroscopy to study adsorption reactions on metal oxide particles and adhesion of biomolecules. He is the current President of IUPAC Division I - Physical and Biophysical Chemistry.

Organic Chemistry

Organic chemistry in 1985 was ably lead by Peter Grant (1962-1991) with assistance from Ross Grimmett (1967-1996), Rob Smith (1971-) and Rex Weavers (1975-2011). Primary research activities involved natural products and synthetic transformation of readily available NZ materials (Grant, Weavers) together with synthetic organic and organometallic chemistry (Smith) and heterocyclic reactivity (Grimmett). In addition, Ross Grimmett produced a series of well-cited comprehensive reviews in azole chemistry. The Department was well equipped for this work – particularly with NMR spectrometers. The following decade saw appointment of Dave Larsen (1990-) and Chris Hunter (1989-1990; he subsequently returned to the UK and developed a high profile career at Sheffield) and emphasis on natural products chemistry was diluted somewhat with wider research scaffolds such as carbohydrates and other bioactives examined. The move towards more biologically oriented study was enhanced by the appointment of Eng Tan (1992-) and Alan Hayman (1992-) with research interests in enzyme reactions and bio-organic chemistry, respectively.

From about 1995 onwards the organic research moved more towards biology and medicine, with many staff becoming involved in projects with colleagues in biological and biomedical departments. Facilities were maintained at useful levels and, while routine NMR had always been well resourced and supported, the changed emphasis required more HPLC equipment and better mass spectroscopic facilities than in the previous years.

In 1991, a joint venture was initiated between Chemistry and MAF Technology (now the Plant & Food Research CRI) and a plant extracts research unit (PERU) was created. Its objective was to discover and develop biologically-active natural products from NZ native plants and introduced crops. This successful entity is housed within the Department and is led by Nigel Perry (1996-) and employs four permanent researchers. Linkages with biological researchers in OU, nationally and internationally are strong, and some 120 multidisciplinary papers and reviews have been published and three patents filed to date.

In the twenty year period from 1985, over 180 publications were authored by organic chemists from Otago University. However, the last five years has seen more changes to the organic chemistry profile with Rob Smith commencing a staged retirement and Rex Weavers' departure this year. Recent new staff members with interests in chemical synthesis are James Crowley (2008-) and Nigel Lucas (2008-) and they are expected to take organic chemistry in new and exciting directions in the future. Organic chemistry originated from efforts to understand the natural biological processes at the molecular level, while its future at OU seems secure with continuing research in this area along with the synthesis of new biomolecules and materials being actively pursued.

Inorganic Chemistry

Inorganic chemistry has for many years been intertwined with physical chemistry as the application of physical methods strongly supported the synthetic research programme. An early staff appointment was that of Melville Carr (1959-1996) with specialist research interests in geothermal reactions, NZ clays such as montmorillonite, the properties of coal and the gasification of coal to manufacture liquid fuels. In 1985, the organometallic chemistry of Brian Robinson (1967-2010) and Jim Simpson (1969-), and the transition metal studies of Lyall Hanton (1981-) and Bob Cunninghame (1970-1995) were complemented by Dave Buckingham's (1978-1995) and Charles Clark's (1978-2000) appointments and the cobalt(III) mechanistic work has been continued by Allan Blackman (1991-). Electrochemistry, EPR, photochemistry, and single crystal structure determinations were essential techniques for the Robinson/Simpson research on electroactive clusters and then aryl ring ferrocenyl fluorophores. In recent years, this work was reinforced by the theoretical calculations of Henrik Kjaergaard (1996-2009).

The fluorophore work spawned studies in polymer clays and, ultimately, the foray into polymer gels by Lyall Hanton and Steve Moratti (2006-). Lyall Hanton's interest in arsenic ligands moved to nitrogen- and sulfur-based systems and into metallosupramolecular chemistry thanks to the brief appointment of Chris Hunter in 1989. Macrocyclic chemistry became a successful research area when Sally Brooker joined the staff in 1991. David McMorran's appointment as a senior teaching fellow in 2003 contributed to the metallo-supramolecular interests. Again, coordination chemistry has retained a strong physical bias through Sally Brooker's interest in magnetic materials and Allan Blackman and Keith Gordon's work on photoactive metal complexes. In 2008 appointments of James Crowley and Nigel Lucas were made, with both having strong organic/inorganic research interests. James' research is centred on metallo-supramolecular systems and molecular machines, while Nigel has interests in the organometallic chemistry of graphene systems.

Environmental and Analytical Chemistry

Research into Environmental Chemistry and the associated teaching courses at OU grew out of analytical chemistry courses developed in the 1970.by microanalyst Arthur Campbell (1948-1987). Keith Hunter (1980-) joined the department as a lecturer in Analytical Chemistry and he initiated aspects of trace metal research in marine chemistry with the establishment of clean room facilities and associated instrumentation. He also worked successfully with marine biologists to establish an interdisciplinary postgraduate teaching and research programme in marine

science that included use of expanded facilities at the university's Marine Biological Laboratory at Portobello on the Otago Peninsula.

In 1990, Barrie Peake (1972-) moved his research interests from spectroscopic studies of free radicals and joined Keith Hunter, assisting him in the teaching of new courses in aquatic chemistry, marine chemistry and marine pollution. He has also established research on aspects of trace metals in aquatic environments, natural aquatic photochemistry and dissolved organic matter and, most recently, is investigating the environmental fate of pharmaceutical compounds. Russell Frew (1996-) has established research on the application of natural isotopes in the environment as well as a commercial isotope-measurement laboratory (see below).

The Department and the National Institute of Water & Atmospheric Research (NIWA) established a joint National Centre of Excellence for chemical and physical oceanography in 1996. Phillip Boyd (1996-) and Kim Currie (1996-), assisted by a number of postgraduate postdoctoral students, have developed significant research activities in the areas of climate change that include iron-limitation of marine productivity, and long term trends in oceanic CO_2 chemistry.

Kim Hageman (2006-) has developed research involving organic pollutants, particularly airborne material in remote environments, using GC-MS. The Community Trust of Otago Centre for Trace Element Analysis was established in 2005 with Claudine Stirling as the Scientific Director. This centre is involved in inductively-coupled plasma mass spectrometry measurements of ultra-low levels of a range of trace metals using both quadrupole and multi-collector instrumentation. Sylvia Sander joined the Department in 2001 as a research fellow and has developed research in trace metal techniques in aquatic environments.

Applied Chemistry and Chemical Process Technology

Research and teaching of applied chemistry began in the early 1940s and was continued during the review period with the appointment of Don Brasch (1967–1996), Derek Whyman (1970-1990) and Vivian Alexander (1971-1989) with respective research interests in carbohydrate and pulp and paper chemistry, plasma chemistry, and automatic control theory.

With the then impending retirement of Don Brasch, a chemical engineer Paul Addison (1994-2004) was appointed with research interests in the commercial extraction of chitin from shellfish and he was assisted by Graham Caygill (1994-1999). In the late 1990s a decision was made to reduce the applied chemistry component of at least the Chemistry Honours courses and instead, just offer papers in the new Bachelor of Applied Science degree in conjunction with other subjects such as applied microbiology, biochemistry and food science. By 2004, there was only one remaining applied chemistry staff member, Paul Addison; and his departure that year marked the end of our teaching and research in this area.

Teaching Activities in Chemistry at OU

Lectures

The Chemistry Department has always prided itself on the quality of its undergraduate and graduate teaching. At first year, a large proportion of the students are required to study chemistry as a prerequisite for highly competitive entry to Medical School. So the introductory chemistry syllabus has always been guided largely by the needs of the Medical School and those of associated departments such as physiology, structural biology, biochemistry, microbiology, pharmacology, human nutrition, dentistry, pharmacy and physiotherapy, many of whom also require their students to pass a first year chemistry course.

Up until 1996, first year Chemistry consisted of a single course (Intermediate CHEM 112) of two papers covering lectures and a weekly laboratory extending over the academic year. In 1995, the Medical School reduced its entry requirements for chemistry and this also corresponded with the widespread introduction of a two-semester in place of the three-term academic year. Accordingly, in 1996, CHEM 112 was divided to provide single semester papers (CHEM 111: Molecular Reactivity required for entry to Medical School; CHEM 111 Molecular Architecture to cater for other non-health related disciplines). Students majoring in Chemistry were strongly encouraged to take both these papers. The CHEM 112 content was further rearranged in 2003 to give the present CHEM 191 Chemical Basis of Biology and Human Health paper.

Until 1988, second and third year chemistry teaching consisted of three full-year papers with the classical titles of Advanced 1 (or 2) Physical Chemistry, Organic Chemistry and Inorganic Chemistry, and a half paper at second year in Analytical Chemistry. In 1989, the programme was rearranged into a number of smaller, one semester with more specific titles such as Chemical Reactivity, Chemical Synthesis, Coordination Compounds, Electrochemistry and Surface Reactions, *etc*., along with the introduction of new papers such as Biological Chemistry and Environmental Chemistry to reflect the changing interests of the students and trends in chemical research within the Department. This wide selection of papers continues in various forms although, beginning in 1999, the titles of many of the papers reverted back to the more classical Physical Chemistry, Organic Chemistry, and Inorganic and Main Group Chemistry, *etc*. New 3rd-year chemistry papers introduced in 2010 include Instrumental Methods of Analysis (CHEM 306) and Marine Biogeochemistry (CHEM 365). A new programme in Forensic Science is also being developed across the university with a 2nd-year Analytical and Forensic Science paper (FORS 202) that has a significant Chemistry component to it.

Postgraduate teaching has always involved a series of lectures to the 4th year Chemistry Honours, first year MSc and the Postgraduate Diploma in Science (PGDipSci) students. As with undergraduate chemistry, the postgraduate offerings were originally grouped under the traditional chemistry subject areas. However, since the early 1990s, staff have been given much more freedom, with each lecturer able to give a 10 lecture module of their choice but

typically related to their research interests. The modules are collected together and examined in blocks at the end of Semester 2.

Up until the mid-1980s, assessment of the chemistry lecture courses was based entirely on end-of-year, closed book written examinations. However, with the increasing student demand for more internal assessment, a significant component of the assessment of undergraduate chemistry papers is now derived from student performance in laboratory and assignment work during the semester. The style of teaching Chemistry has also changed significantly over the last 25 years. Up until 1985 it was very much based on *chalk and blackboard* illustrated with 35 mm slides but, with advances in computer technology, the use of overlays, overhead projectors, white boards and, most recently, PowerPoint presentations are common. Ready student access to spreadsheet software and electronic databases and periodicals has also led to an expectation by teaching staff of more sophisticated calculations, data analysis and interpretation by the student.

Chemistry Outreach Activities

As in most NZ universities, the Department has had an increasing involvement with science teachers and students of all ages in local schools since the early 1990s. These activities were started by Barbara Duncan (1990-2003) and developed further by David McMorran (2004-) and David Warren (2006-). The current focus is the delivery of *hands on* chemistry activities for schools across Otago and Southland, as well as developing a support network for teachers in the region. Activities are delivered by a team of PhD and senior undergraduate chemistry students, who at the same time develop a range of skills that enhance their potential to be future ambassadors for chemistry. These activities include teaching chemistry lessons in intermediate and primary schools, providing access to university laboratories and resources for NCEA students who are carrying out internal achievement standards, the development of teaching resources for local school teachers, the development and delivery of experiments for the new OU Advanced Sciences Academy and the delivery of lessons to high school students as part of Marae-based Wananga on the North Island East Coast and Invercargill.

Other notable activities have included a *Chemistry for Christchurch* fund-raising magic show in February to an audience of *ca.* 800 people that was organised and delivered by outreach students, the Otago regional chemistry quiz which has run since 2004 and attracts up to 200 participants, and the Healthy Harbour Watchers programme (also established in 2004) by a local science teacher in conjunction with the departmental staff (see *Chemistry in New Zealand* **2010**, *74,* 141-145).

Alan Blackman regularly contributes articles on topical aspects of chemistry to the Otago Daily Times and he has been doing so since 2001.

Long-standing Chemistry Support Staff

There have been many non-academic Departmental staff with us over part or the whole review period and who have played an invaluable role assisting in all aspects of research and teaching. Able research assistance has been provided by John McAdam (1992-) (Inorganic), Abdul Rahman Manas (2002-) (Organic), Malcolm Reid (1996-) the research laboratory manager for marine chemistry research, and technical help from Pauline Bandeen (1990-) (Organic). Mervyn Thomas (1974-) has ably maintained the NMR facilities, assisted by Ian Stewart (2004-) who has also managed the X-ray diffraction, HPLC and LC-MS instrumentation. John Wells (1981-) has assisted many research staff and students as the glassblower, while Garth Tyrell (1971-) and his fellow technicians have designed, constructed and helped maintain much of the mechanical research equipment in the department. Steven Gray (1975-2006), Jimmy Kerr (1982-2006), Nigel Alefosio (2005-), and Sean Bray (2006-) have all managed the departmental store efficiently. Cathy Bennett (1985-) has been the departmental administration manager during this review period.

Commercial Activities within the Department

Special mention must be made of the role of staff assisting in the running of the Campbell Microanalytical Centre based in the Department. They have undertaken mainly elemental analysis of miniscule amounts of compounds submitted by clients from throughout NZ and overseas. This work was undertaken under the direction of Prof. Arthur Campbell until he retired in 1987 and then Marianne Dick (1982-2009) and Bob McAllister (1976-).

In 1997, OU acquired the analytical facilities of the private Dunedin Company Zentech, and established a small commercial environmental and analytical chemical consulting company (Chem Search) within Chemistry. This group led by John Watson (1997-2008) and assisted by David Barr (1997-) and Dianne Campbell (2001-) undertook a wide range of analyses, mainly of environmental samples for external organizations such as the Macraes gold mine operation, several Central Otago wineries and the Ministry of Fisheries. They also assisted researchers in related aspects of their work until the Chem Search operation was closed at the end of 2008.

In 2004, Russell Frew established fully commercial facilities within the university under the name Isotrace NZ Ltd. This is for accurate measurement of stable isotopes and isotopic ratios such as $^{2}H/^{1}H$, $^{13}C/^{12}C$, $^{18}O/^{16}O$, and $^{34}S/^{32}S$. In 2008, the company was incorporated into the Department as a research unit that continues to provide commercial services, but its main role now is to support research activities across the university that involve isotopic measurements. The unit is currently managed by Robert van Hale (2008-) and assisted by Dianne Campbell.

Influence of Advances in Computer Technology

The advent of microprocessors and associated microcomputers in the later 1970s has had a profound effect on all aspects of research, teaching and administration. Up until 1985, there was only one central mainframe computer in the university and the Chemistry staff used this mainly for refining X-ray crystallographic data collected with the assistance of Ward Robinson and his group in Canterbury, and for simulation of EPR spectra (Peake). Once micro-

processors became routinely available in the early 1980s, Peake interfaced them to a range of analytical instruments as a research exercise and, subsequently, they progressively became integral to every aspect of chemical instrumentation.

As the computational speed and memory capacity of stand-alone microcomputers evolved, students taught before 1985 to program the single central mainframe computer using punched cards, were progressively introduced to programming in languages such as BASIC, Pascal, C++ and MatLab on departmental microcomputers with keyboard and visual display screen. The advent of commercial word processing and spreadsheets packages such as the Microsoft Office suite of programs has made such facilities essential tools in any chemistry department. By the mid-1990s, research and teaching presentations evolved to computer projection of graphical and textual material prepared using graphical packages such as Microsoft PowerPoint.

The appointment of Keith Gordon (1993-) and Henrik Kjaergaard (1996-2009) as physical chemists saw the development and use of increasingly sophisticated computer programs to undertake molecular orbital calculations for research purposes. Our own X-ray diffractometer facilities, acquired in 2006, have also led to extensive in-house crystallographic data analysis. In keeping with the global community, chemistry communication via the World Wide Web is fundamental to our operation. The Department is fortunate in having its own computer support personnel, Richard Coulbeck (1982-1995), the late Andrew McCallum (1992-2001), Simon Money (2001-2006) and Matt Rooney (2006) to maintain and develop its computer facilities.

Chemistry Teaching at the Otago Polytechnic (Dunedin) and the Southern Institute of Technology (Invercargill)

The Science Department at Otago Polytechnic taught chemistry until 2003. Its staff, John Waddick and the late Tony Herd, provided courses for the NZ Certificate in Science and, after 1997, the National Diploma in Science (Level 6). The OU Chemistry Department used this course for technician training but after 2004 the viability of the three year national diploma declined and resulted in the Otago Polytechnic management closing the entire programme at the end of 2006.

Chemistry has been taught at the Southern Institute of Technology only as part of a paper in Years 1 and 2 of the Bachelor of Nursing in the School of Nursing, and as part of the Environmental Science paper in Years 1 and 2 of the Bachelor of Environmental Management programme in the School of Social and Environmental Studies.

Industrial Chemistry

Although chemical-based industries in Otago-Southland are relatively small in number compared to some other areas of New Zealand, they all make a significant and unique contribution to NZ's overall manufactured output.

In 1971, New Zealand Aluminium Smelters Limited (NZAS) commenced production of the world's highest purity (99.98%) grade aluminium at NZ's only aluminium smelter at Tiwai Point, near Bluff. Current annual output is *ca.* 360,000 tonnes of which over 90 % is exported to Japan. The electrolytic Hall-Heroult process is used to reduce alumina (Al_2O_3), sourced as bauxite from Australia and dissolved in a bath of molten sodium aluminium fluoride (Na_3AlF_6) at 960 °C. The smelter has an extensive on-site and off-site monitoring programme to assess the effects of discharges to land, air and water mainly arising from the gases such as hydrofluoric acid emitted in free and particle-bound forms during the electrolytic reduction. NZAS has well equipped (NZS/ISO/IEC 17025:2005) quality accredited laboratories for the analysis of raw and process materials, environmental samples and cast aluminium. Analytical techniques include the routine use of modern X-ray diffraction, X-ray fluorescence and optical emission spectrometers to assess product quality and fluoride ion specific electrochemistry to ascertain fluoride impact upon environmental samples.

Milk processing at Edendale in Central Southland has a long history beginning in 1881, but it has significantly expanded since 1985 with the spectacular growth in dairying in Southland. Fonterra took over Southland Dairy Cooperative Ltd. in 2001; prior to this, in 1998, the Co-op had merged with Alpine Dairy Products. Fonterra has since increased annual production at Edendale, particularly of milk powder from none in 1985 to 250,000 tonnes in 2010 (estimated value ~ $NZ 2 billion). This is made up of whole and skim milk powder, buttermilk powder and milk protein concentrate powder. Other milk products currently manufactured at the plant include cheese, anhydrous milk fat and mineral casein. Organic chemistry plays a significant part in the production of many milk products, *e.g.* manipulation of pH to separate proteins. Some chemical analyses are undertaken in factory laboratories utilising near infrared technology, as well as titrations for determining product composition and quality. Comprehensive chemical testing of finished products is now carried out at centralised Fonterra laboratories. On-site testing of the potable water supply (for residual chlorine) and pH, and environmental monitoring of the chemical oxygen demand arising from waste water treatment is made.

Superphosphate is one of the most important fertilisers used in NZ due to its cost and nutrient content. Some 160,000–250,000 tonnes per year are manufactured in Southland at the Ballance Agri-Nutrients plant at Awarua (between Invercargill and Bluff). The manufacturing process involves reacting sulfuric acid with phosphate rock, which converts the insoluble unavailable phosphate in the rock into a water-soluble and plant available form. Various additives such as serpentine rock, potash, sulfur and trace elements such as molybdenum, cobalt, copper, selenium and boron can be mixed or blended with superphosphate to make it a versatile fertiliser for NZ farmers. These manufacturing processes involve a large number of chemical reactions that are monitored by laboratory staff on a daily, sometimes-hourly, basis to ensure the super-

phosphate meets Fertmark registered levels. In the early 1990s, the laboratory at Awarua was restructured owing to cost, and staffing was reduced from fourteen to four. Core manufacturing analysis is completed in-house but specialist and sales-related testing is outsourced. Environmental outputs from the plant are subject to Resource Management consents and on-going Regional Council monitoring of discharges. This is additional to monitoring carried out by the on-site laboratory staff.

OceanaGold (NZ) Ltd. has been involved since 1990 in the mining of quartz rock and extraction of gold at Macraes Flat in the East Otago Region. Production has increased from about 75,000 oz of gold in 1990 to 260,000 oz in 2010, grossing $NZ 423 million. The extraction process involves crushing and grinding the ore followed by a flotation process to make a gold concentrate. The concentrate is then subject to pressure oxidation followed by leaching and desorption, then electrowinning to produce gold of about 88-92% purity. The cyanide used during the processing is neutralized prior to the by-product tailings being deposited in the Tailings Dams. The company conducts extensive environmental monitoring that includes chemical analysis of surface and ground water, waste rock geochemistry, and dust and other airborne emission analyses.

Other Otago-Southland industries that use chemical processes in their production include the Dunedin companies: Ravensdown Fertiliser Cooperative Ltd., Cadbury Confectionery Ltd., Cerebos Gregg's Ltd. (manufacturer of coffee, deserts and condiments), and Speight's and a number of smaller boutique breweries scattered around the two provinces.

NZIC Branch Activities

This Branch has its origins in the Otago Chemical Society which was formed in 1929 as a local section of the Institute of Chemistry of Great Britain and Ireland. This society, along with others elsewhere in NZ, was wound up and replaced in 1935 as the component Branches of the New Zealand Institute of Chemistry. The past 25 years has seen the Otago Branch maintain a small but steady membership and meeting schedule. There are relatively few chemists employed in chemistry-related industry in the Dunedin and greater Otago/Southland area, meaning that Branch membership has consisted mainly of academic staff and research students from OU Chemistry with some interest from the Biochemistry, Pharmacy, Pharmacology, Physiology and the Food Science Departments, as well as the Invermay Agriculture Centre in Mosgiel. A notable exception was Stan Winter from the Southland Co-Op Fertiliser Ltd. in Awarua who participated in Branch activities in the 1980s including being Branch Chairman in 1989 and NZIC President in 1991.

NZIC conferences have been organized by the Branch in Dunedin in 1985, 1997 and 2008 and members have made regular contributions in various ways to the NZIC journal. Organized site visits have been to the NZ Aluminium smelter in Bluff, the dairy processing facility at Edendale, the Ravensdown Fertiliser works in Dunedin, as well as to several local breweries and some Southland lignite mines. Over this time, Branch meetings typically have involved talks from academic chemists on the staff or visiting appropriate departments at OU, and national NZIC touring lecturers. In recent years, student participation has been fostered through quiz and poster evenings (supplemented by free alcohol and food!) and the provision of financial support for student attendance at conferences in NZ and overseas.

The Future

The present large-scale chemical processing industries in the area such as the aluminium smelter at Tiwai, gold mining at Macraes, milk processing at Edendale and fertiliser manufacture at Awarua and in Dunedin are likely to continue and even expand their operations in the foreseeable future. There is potential for new large scale chemical industry involved in the conversion of the extensive lignite deposits in Southland into more usable forms of energy such as briquettes and liquid fuel. Similarly, Holcim Cement is currently investigating establishing a large cement manufacturing facility at Weston, inland of Oamaru. There is also potential for more involvement of chemistry in any expansion of the Central Otago wine industry that has come to the fore in the past 25 years, and in any petrochemical industry that might be established should economic amounts of petroleum be discovered from exploration about to be undertaken off shore from Otago. Although a few new OU chemistry graduates and Polytechnic science graduates have been employed by these industries during the review period, if the various developments come to fruition, opportunity will exist for increased contact and/or the involvement of chemists in these industries.

Other future chemical activities in the area will continue to be centred on the chemistry and associated departments of OU. The current areas of research being undertaken by the academic staff of OU promise to lead to significant new knowledge as well as providing excellent training for research students. OU on its various campuses has a long established international reputation for excellence in the both teaching and research, particularly in biological and health disciplines. We envisage that new exciting areas of co-operative chemical research will include smart drug design and delivery, synthesis of new materials, and food science research, and that they will have significant biological and medical as well as chemical importance. The present marine chemistry research group at OU also has a significant international reputation for its research into the oceanic effects of increased atmospheric CO_2 levels and resulting global climate change. It is envisaged that this research will continue to develop in conjunction with the present NIWA Joint Centre of Excellence in Chemical and Physical Oceanography

Chemistry in Otago is in good heart!

Acknowledgement

I acknowledge the help of my long-standing colleagues Jim McQuillan, Brian Robinson and Rob Smith in helping me recollect these past events in the OU Chemistry Department, the contributions of other Departmental staff, and the help of senior management in various chemical-based industries in Otago-Southland.