



Chemistry

IN NEW ZEALAND

Volume 77, No.2, April 2013

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Cover

Front cover: Calcite from Terlingua District, Brewster County, Texas, USA, viewed under short wave ultraviolet light. See article by Coles, p. 42.

Comment from the President

Welcome to the second issue of *Chemistry in New Zealand* for 2013.

I've recently been looking over the aims* of the NZIC (it seemed like a good thing for a President to be familiar with). Some of them are fairly straightforward – making provisions for the organisation of conferences and lectures, the acceptance of members and the production of the Institute's journal, *Chemistry in New Zealand*.

Some of the aims are drawn with a much broader stroke, for example, aim 2 which states,

“To raise the status and to advance the interests of the profession of chemistry and of those engaged therein”

So what does this mean, and what can we do to accomplish this aim?

Improving the status of chemistry can only be achieved by increased visibility in the wider community. This can be achieved by running and supporting public events, lectures and other chemistry related activities. Of particular importance is exposing young minds to the many positive and exciting aspects of chemistry. Most research seems to show that many children start to lose their natural interest in sciences between the ages of 12 to 15. If we can provide these students with a positive and memorable experience of chemistry we have a good chance of igniting the same passion for chemistry that we have in younger generations.

However, it does not require large events to promote chemistry. Just being willing to take the time to explain what you do as a chemist and why, to a member of the public, can give a lasting and positive impression of chemistry. Engaging with politicians will also raise the profile of chemistry and the scientific community. It is a common complaint amongst scientists and educators at how poorly politicians understand what we do, yet how many have taken the time to visit or write to their local politician?

I would urge all members to be open to opportunities to share your positive experiences and excitement for chemistry with non-chemists over the next few months. Feel



free to let me know how it goes (michael.edmonds@cpit.ac.nz).

The NZIC journal, *Chemistry in New Zealand*, provides members with chemistry news from around the country, as well as articles on various topics of interest. At the February Council meeting, the question was raised as to whether the current format and content of the journal is meeting the needs and interests of members. Consequently, in collaboration with the journal's editor, Peter Hodder, we are now seeking your views about the journal and its current format. If members could email me (michael.edmonds@cpit.ac.nz) with feedback about what they enjoy about the journal, as well as any changes they would consider beneficial, I will collate these comments and discuss them with the editor, the journal's Editorial Board and Council members.

Michael Edmonds
NZIC President

*The aims of NZIC can be found on the Institute's website at <http://nzic.org.nz/aims.html>

New Zealand Institute of Chemistry

supporting chemical sciences

April News

2013 NZIC Conference

The 2013 NZIC conference is to be held in Wellington this year and will be hosted by Victoria University at Rutherford House by the railway station – on the University's downtown campus. The conference will start on Sunday 1 December and conclude on Thursday 5 December. Rutherford House is situated near a variety of transport hubs, accommodation options and more importantly, the city's main attractions, restaurants and hospitality venues. So far, Pieter Dorrestein (University of California, San Diego), Ben Davis (University of Oxford), Tina Overton (University of Hull), Jim Watkins (University of Massachusetts Amherst) and Jeff Tallon (Callaghan Innovation, NZ) have accepted invitations to be plenary speakers at the meeting. The official website for the conference is under construction, but further information can be found at www.nzic.org.nz/conferences.html

Council News

Membership subscriptions

You will have received your subscription notice recently. Council agreed to leave subscriptions unchanged for 2013.

The idea of a **Decade in Advance Membership** has been floated. The concept is that members could pay (say) a 10-year subscription in one payment. No discount is anticipated, but you would be exempt any increases that occur during the term the payment covers. If there is sufficient interest Council will draw up details. Contact the Hon. Gen Sec (rendle@extra.co.nz) if you are interested or have thoughts.

Publications

Council has agreed to discontinue *ChemEd NZ*, the sister publication to *Chemistry in New Zealand*. The main factor in this decision is the loss of funding formerly obtained from

RSC. *ChemEd NZ* was part of the RSC Schools and Colleges package and this has been discontinued.

Membership

New Members 2012-2013 (MNZIC)

Auckland Branch: Dr *Darby G Brooke* University of Auckland, Dr *Brian Hanan*, *Matthew Keesing*, *Craig Lidgard* Mercury Bay Area School, *Colin North* Waiuku College, Dr *Stephen R Parker* IPPC, *Nicola Scholes*, Dr *Zoran Zujovic* University of Auckland.

Waikato Branch: *Hayden Bosgra* Hamilton Christian School, *Brent L Kennedy* Tonkin & Taylor.

Manawatu Branch: *Dave Murdoch* Tamatea High School, *Liam P O'Gorman* Cullinane College.

Wellington Branch: Dr *Lawrence Harris* Callaghan Innovation, Dr *Doreen Mollenhauer* Callaghan Innovation.

Canterbury Branch: Dr *Deborah Crittenden* University of Canterbury, *Martin F Downing* CPIT, *Elena Streltsova* CPIT.

Otago Branch: *Lisa Fortes* South Otago High School, Dr *Bill Hawkins* University of Otago, Prof *Kurt L Krause* University of Otago, *Ian Welsh* Southland Boys' High School.

Student Members

Auckland Branch: *Emily Boyd* University of Auckland, *Charith A Hettiarachchi* University of Auckland, *Ha Zee Kong* University of Auckland, *Jane Leung* University of Auckland, *Michael Pullar* University of Auckland, *Christopher J Wilcox* University of Auckland.

Waikato Branch: *Emma Bagley* University of Waikato, *Daven K Illenberger* University of Waikato, *Sangata Kaufononga* University of Waikato, *Abigail Leonard* University of Waikato, *Jane Spenceley* University of Waikato.

Manawatu Branch: *Nicholas J Francis* Massey University, *Heather Jameson* Massey University, *Iman Kavianinia* Massey University.

Wellington Branch: *Jessie Bird* Victoria University of Wellington, *Cheriselle Braganza* Victoria University of Wellington, *Pauline Calloch* Callaghan Innovation, *Vidhya Damodaran* Victoria University of Wellington, *Amy Foster* Victoria University of Wellington, *Claire Alison Turner* and *Jingjing Wang* of Victoria University of Wellington.

Canterbury Branch: *Junhong Chen* CPIT, *Letitia Gilmour* University of Canterbury, *Rasika Kariyawasam* University of Canterbury, *Gurpreet Kaur* University of Canterbury, *Xiaozheng Ni* CPIT, *Rachel North* University of Canterbury, *Marat Sibaer* University of Canterbury, *Fatemeh Tavakoinia* University of Canterbury, *Andrew Wallace* University of Canterbury.

Otago Branch: *Christophe Dumas* University of Otago, *Matthias Fellner* University of Otago, *Aimee Gommans* University of Otago, *Sean MacKay* University of Otago, *Synove Scott* University of Otago, *Antonia Seidel* University of Otago, *James R Wright* University of Otago.

Deceased

Norman Baird Canterbury Branch, *Harry Gapper* Auckland Branch, *Alan Grout* Auckland Branch, *Louise Russell* and *Alan Turner* both of the Wellington Branch.

Resigned

Auckland Branch: *Jeremy Paul Batchelor*, *Paul Chan*, *Basil John Dempsey*, *Robert (Bill) Dobbie*, Prof *Douglas Keith Russell*, Dr *Bronwen Smith*, *Efrem Tham*, *Robert Thompson*, Dr *Dianne Webster*, *David Wilkins*, *Jason Young*.

Waikato Branch: *Olivia Jordan*, *Nathalie Thomas-Zenden*.

Manawatu Branch: Dr *Lawrence*

Creamer, Margaret Severinsen.

Wellington Branch: *Christopher Blackford*, Dr *Thomas Borrmann*, Dr *Thomas Clarkson*, Dr *Daryl Crimmins*, Dr *Peter Ferguson*, Dr *Robin Ledger*, Dr *Dora Suuring*, *Gordon Wyatt*.

Canterbury Branch: *Lisa Graham*, *Peter Hentschel*, Dr *Margaret Leonard*, Dr *John Love*, *Ronald Roy*, *Tanya Schiefer*, *Graeme Tinkler*, *Kelvin Walst*.

Otago Branch: *John Bailey*, *Richard John Hazle*, *Ryan E Hill*, *George Morris*, Dr *Clifton Rickard*.

Overseas Branch: Dr *Anthony Greenaway*.

Prizes

The deadline for nominations for NZIC Prizes is 30 June. Prizes available for 2013 are: The Easterfield Medal, The Maurice Wilkins Centre Prize for Chemical Excellence, The Prize for Applied and Industrial Chemistry, The ABA Books Denis Hogan Prize for Contribution to Chemical Education. Details are on the NZIC web site www.nzic.org.nz

BRANCH NEWS

AUCKLAND

School of Chemical Sciences, University of Auckland

Distinguished Professor *Margaret Brimble* made an incredible triple act of winning the Rutherford Medal, the country's highest science and technology honour, the MacDiarmid medal for outstanding research with significant human benefits and the Hector Medal for outstanding chemical research. These awards reflect Margaret's huge impact on New Zealand's science scene. On top of this, Professor *David Williams* won the Pickering Medal, the award for outstanding achievement in applied science and technology. Also, Associate Professor *Cather Simpson* received a University "Sustained Excellence in Teaching" award. Work from our glassblowers, *Mike Wadsworth* and *Alastair Mead*, was on display as a part of the Electric Glass exhibition at the TSB Bank Wallace Arts Centre. Finally, Professor *Penny Broth-ers* was appointed Associate Editor

for *Chemical Communications* and Distinguished Professor *Margaret Brimble* was appointed Associate Editor for *Organic and Biomolecular Chemistry (OBC)*, published by the Royal Society of Chemistry.

PhD student *Jin Akagi* received the Best Student Paper Award at the MOEMS-MEMS SPIE Photonics Conference 2013 in San Francisco, USA. The 2012 Baldwin's Prize winners were *James Wood*, *Han Sol Choi* and *Cheyenne Muller*.

The School had many visitors who gave excellent talks. First, Professor *Gary B. Schuster* from the Georgia Technical Institute presented two seminars *Oxidative damage to DNA* and *Modular self-assembly of DNA encoded nanostructures* to the School. Professor *Wee Han Ang* from the National University of Singapore gave a lecture *Tuning the activity of platinum (IV) complexes as anticancer prodrugs*. Professor *Siva Unampathy* of the Indian Institute of Science, Bangalore, presented his seminar *Laser spectroscopy from physics to biology and medicine*. Also, *Mark Gilligan* of Blacktrace Ltd presented *Microfluidics and commercial success! Compatible or not?* Finally, *Shane Telfer* of Massey University gave his seminar *Creating nothing out of something: Thermo-labile groups in metal-organic frameworks (MOFs)*.

The New Zealand Institute for Advanced Study (NZIAS), Massey University Auckland

Anastasia Borschevsky received the Helmholtz-Institute Mainz Visiting Researcher Grant (Institute Mainz Internationales Gastwissenschaftlerprogramm). The purpose of the grant was to allow her to spend a month as a visiting scientist at the GSI Helmholtz Centre in Darmstadt, Germany, and to attend the ENSAR-ECOS Workshop on Future of Superheavy Element Strategy (FUSHE2012), in Weilrod, and the Physics Prospects at FLAIR - The Facility for Low-Energy Antiproton and Ion Research Workshop, in Darmstadt, Germany. She gave talks at the Heavy Ion Accelerator Symposium (HIAS2012), in Canberra, Australia (*Chemical properties of the superheavy ele-*

ments: Theory and experiment) and at the 48th Symposium on Theoretical Chemistry (STC2012), in Karlsruhe, Germany (*Benchmark calculations of atomic properties of element 120*).

Elke Pahl took part in the Conference on Mathematical Methods in Science and Engineering (CMMSE) in Murcia, Spain and gave an invited talk on *Simulation of mercury melting: A hard nut to crack*. She also gave a talk about *Quantum physics* at a conference for gifted teenagers, NZAGC, in Auckland, as well as a talk about *Melting of nanoclusters* at the University of Heidelberg, Germany.

Peter Schwerdtfeger became Distinguished Professor at Massey University, and has been elected into the International Academy of Quantum Molecular Sciences (IAQMS). The Academy is composed of persons chosen amongst the scientists of all countries who have distinguished themselves by the value of their scientific work, their role as pioneer or leader of a school and have most contributed to the advancement of quantum molecular sciences. The Academy currently has 107 members and its headquarter is in Menton (France). Peter is the first New Zealand scientist to receive this honour. He also received the CMMSE prize given to computational researchers for important contributions in the developments of numerical methods for physics, chemistry, engineering and economics. At the TACC (Theory and Applications of Computational Chemistry) 2012 conference in Pavia (Italy), Peter gave an invited keynote lecture on *The relativistic pseudopotential approximation*. He also gave an invited lecture at the REHE (Relativistic effects in heavy elements) 2012 conference on *The variation of fundamental constants in space-time*.

Lukas Wirz, a PhD student in Peter's group, received the inaugural Sir Neil Waters Scholarship.

Jane Allison gave seminars at Massey University, Palmerston North (in May 2012); Victoria University of Wellington, (in July 2012) entitled *Shake, rattle and roll: using simulations to explore how proteins move*; University of Auckland (in Novem-

ber 2012); University of Natural Resources and Life Sciences, Vienna, Austria, and King's College London, UK, entitled *And yet it moves: combining experiment and simulation to describe how proteins really (mis)behave*; and ETH Zürich, Switzerland entitled *Modelling an evolutionary arms race*.

CANTERBURY

University of Canterbury

Paul Kruger and **Emily Parker** have both been promoted to Professor, **Greg Russell** has been promoted within the Associate Professor scale, **Jan Wikaira** has been promoted to Senior Lecturer above the Bar, and **Sarah Masters** has been promoted to Senior Lecturer.

Laura Revell, who completed her PhD on the chemical sensitivity of stratospheric ozone to N₂O and CH₄ in 2012 has been awarded an ETH Fellowship which she took up in March. Laura will be working for two years in Professor **Thomas Peter's** group at the Institute for Atmospheric and Climate Science at ETH Zurich on "impacts of air pollution and climate change on tropospheric ozone".

PhD student **Andrew Gross** (supervised by **Alison Downard**) successfully defended his thesis on 10 December. In January Andrew took up a short-term post doc position at the University of Bath working with Professor **Frank Marken** on technology development for a rapid point-of-care clinical sensor.

The following science prizes were awarded for 2012: **Chloe Thompson** – NZIC Prize for top ranked 200-level student in Chemistry; **Chris Burn** – CE Fenwick Prize for top ranked 400-level student in Chemistry; **Sarah Faulkner** – Haydon Prize for top ranked 300-level student in Chemistry; **Stewart Alexander** – Jack Ferguson Prize for 300-level student for best performance in labs; **Sebastian Reichau** and **Lauren Raffensperger** – Ralph Earle Prize 2012 for Best 2nd year Review Seminar.

National Industry leader, Dr **Peter Surman**, the global research and development manager from Douglas Pharmaceuticals, will teach third and

fourth year University of Canterbury students as well as teaching in the chemistry PhD programme. Dr Surman will visit the chemistry department in May 2013 for a concentrated series of lectures, seminars and workshops. Dr Surman's visit is part of the Futureintech VIP initiative supported by the Institute of Professional Engineers of NZ and funded by New Zealand Trade and Enterprise to promote careers in technology, science and engineering. Douglas Pharmaceuticals is a New Zealand success story and one of the fastest growing pharmaceutical development and manufacturing companies in Oceania.

MANAWATU

The Manawatu branch hosted a student information evening in March following the success of a similar event last year. Events for this year include a technician's information evening, and an industry tour, the timing of which is yet to be confirmed. In February, Nobel prize-winner **Roald Hoffmann** gave a public talk at the Palmerston North Central Library.

Massey University, Institute of Fundamental Sciences

Damian Jones was awarded a Summer Scholarship in Nanoscience and worked with **Mark Waterland** on setting up a fibre optic collection system for Raman microscopy. Mark Waterland was awarded a capital equipment grant from Massey University for a Raman microscopy system that will be home-built and capable of collecting low frequency signals. **Haidée Dykstra** was awarded a Massey University Doctoral Scholarship and will be doing her PhD studies in the Waterland group on Raman spectroscopy of graphene nanoribbons.

Heather Jameson was also awarded a Massey University Doctoral Scholarship, and has begun a PhD working on Metal-Organic Frameworks (MOFs) with **Shane Telfer**.

Veronica Brown, a graduate of Victoria University, has joined the Synthodics group as a research technician. **Krishanthi Jayasundera** has also joined the Synthodics group as a Postdoctoral Fellow.

A group from IFS attended the AMN6

conference in Auckland. **Ashley Way** and **Mark Waterland** presented their recent work on resonance Raman intensity analysis of solvent reorganization in room temperature ionic liquids. **Islah-u-Din** presented a talk on results from his PhD studies on the characterisation and properties of organic-inorganic hybrid materials. **Paul Plieger** presented work on supramolecular anion cages. **Shane Telfer** gave a plenary talk on Metal-Organic Frameworks (MOFs) and some of their applications, as well as recent work by his group.

Recent talks at Massey University have included that by **Osman Doluca**, who recently completed his PhD under the supervision of **Vyacheslav Filichev** and **Geoff Jameson**. He spoke of his work on Twisted Intercalating Nucleic Acids (TINA) in guanosine-rich oligonucleotides. **Sharali Malik** of the Karlsruhe Institute of Technology (KIT) in Germany spoke about carbon nanotubes and graphene. In addition, Prof. **Gary Schuster** from the Georgia Institute of Technology talked about modular self-assembly of DNA encoded nanostructures.

OTAGO

University of Otago, Department of Chemistry

Rob Smith retired from the Department of Chemistry in December 2012. To celebrate Rob's contribution to the Department and the University over 40 years, a special reception was held at the Council Chambers in the Clocktower building. Present at the gathering was Rob's long-time collaborator **Mike Murphy** (Cambridge) who was in turn presented with a cer-



Rob Smith (left) presents Mike Murphy with his Honorary Fellowship of the RSNZ

tificate for his Honorary Fellowship of the Royal Society of New Zealand.

Also in December, the Department welcomed **Rob Middag** as a new lecturer in oceanography. After completing MSc (marine biology) and PhD (biogeochemical oceanography) degrees at the University of Groningen, Rob spent two years as a postdoctoral fellow at the University of California Santa Cruz before his move to Dunedin. His main research focus is the cycles of trace elements in the oceans and the strong links with biological processes. Rob has looked at the interaction between the aluminium and the silicon cycle (most likely due to incorporation of aluminium in the siliceous diatom frustules) and found indications of manganese depletion and possible manganese limitation of phytoplankton growth in the Southern Ocean.

Nobel Laureates Roald Hoffmann (Chemistry, 1981) and Bill Phillips (Physics, 1997) both visited the University of Otago in mid-February 2013. Postgraduate students and postdoctoral researchers had a question-and-answer session over lunch with Roald Hoffmann in the Department, covering a range of topics including the links between chemistry and poetry. Later in the day, he presented a scientific public lecture *All the ways to have a bond*.

In late February **Anil Jalaludin** who has been a PhD student, whose project was partly supervised by **Jim McQuillan**, successfully defended her thesis on the interactions of bacteria and bioactive molecules at solid/solution interfaces. She has returned to a biotechnology lecturing position at the Kuantan Campus of the International Islamic University of Malaysia.

Matthew Cowan, **Scott Cameron** and **Humphrey Feltham**, from Brookers Bunch, all graduated with PhDs on Saturday 15 December. Matthew had returned from his postdoc in Colorado, and Scott from his research scientist position in the Carbohydrate team at IRL (now Callaghan Innovation) to do so; it was great to see them and hear about their new jobs. Humphrey is now a senior member of **Sally Brooker**'s team, on a MacDiarmid-

funded postdoctoral research fellowship.

PhD student **Reece Miller** recently visited Cameron Keper's group at the University of Sydney. **Anton Wiebe**, a master's student from Mainz University, completed a five-month visiting research project in Brookers Bunch and has returned to Germany. **Rajni Wilson** submitted her PhD thesis within three years of starting and is currently on a well-earned break with her family in India, but returns shortly to take up a publishing bursary. In February this year, Sally (invited lecture) and Sebastien Dhers (poster) presented their research at the AMN6 conference in Auckland. After also presenting a lecture at AMN6, Annie Powell, and her husband Ali Malik, visited Otago, on the third year of Annie's Julius von Haast fellowship with Sally Brooker. Ali presented a department seminar on *Graphenes*,

nanotubes and fullerenes before returning to Germany. New to Brookers Bunch in 2013 are Honours students **Zoe Buxton** and **Stuart Malthus** and MSc student **Alexis Baltrop**, plus a brief reappearance by former Brookers Bunch member **Nick White**, who recently graduated DPhil from Oxford and will soon take up a Killam postdoctoral fellowship at UBC, Vancouver, with Mark MacLachlan. The group recently received two pieces of excellent news from another former Brookers Bunch graduate, **Jon Kitchen**: he and **Kelly Kilpin** will marry on 2 March before Jon starts a tenure track lectureship at Southampton University in April 2013. Other exciting news is the delivery and installation of the Department's new dual source Agilent diffractometer with Cryostream in late January, which has transformed the range of crystallographic capabilities (in particular with regard to crystal size/quality



Left to right: Soon to be Drs Scott Cameron, Matthew Cowan and Humphrey Feltham, with Prof Sally Brooker (PhD supervisor), on their PhD graduation day.



Roald Hoffmann (centre right) with some of the students and postdocs who attended the discussion with the Nobel Laureate.

and temperature control) as well as capacity in the Department.

Keith Gordon was an invited speaker to SciX (originally called FACSS, the Federation of Analytical Chemistry and Chemical Spectroscopy) in Kansas City in October 2012. His paper entitled *Understanding the electronic structure of thiophene systems and donor acceptor copolymers using spectroscopic and computational chemistry* was part of a symposium organised by the Spectroscopical Society of Japan (SPSJ) who are new members of the FACSS consortium. Keith also spoke as an invited speaker at SPEC 2012 - Shedding New Light on Disease, which was held in Chiang Mai. There he presented some interesting work by **Sara Fraser** on using Raman spectroscopy to quantify gallstone composition sourced from New Zealand patients.

Geoffrey Smith, who graduated with an MSc in December, has started a PhD with Keith Gordon and **Steve Holroyd** (Fonterra) looking at dairy-based products. In January, the group contributed to the week-long MacDiarmid Institute NanoCamp coordinated by **Nigel Lucas**. **Michael Fraser**, **Holly van der Salm**, **Sara Fraser** and **Anastasia Elliott** helped in the Raman and solar cell experiments.

In February the Gordon group attended the AMN6 conference in Auckland. Michael Fraser, **Alvie Lo** and **Holly van der Salm** presented posters, while **Anastasia Elliott** spoke at the Molecular Materials session on triazole complexes, a joint project with **James Crowley**. Keith Gordon spoke, as an invited speaker, in the Wednesday plenary session following Nobel Laureate **Roald Hoffmann** and **Peter Schwerdtfeger**.

Jen Howden from Oamaru has just started work in the Plant & Food Research Unit, in the Chemistry Department. Jen is an Endeavour Teaching Fellow, funded by the Royal Society of NZ, on study leave from Waitaki Girls' High School. She is working with **Elaine Burgess** and **Nigel Perry** on bioactive triterpene concentrations in heritage apples used for cider making. Jen will be in the Plant Extract Research Unit until the end of July.

WAIKATO

The Waikato Branch committee for 2013 is as follows: Chairperson, Michael Mucalo; Treasurer, Michael Mucalo; Secretary, Wendy Jackson; Council Delegate, Jo Lane; Chemistry Education Group Representative, Jo Lane; Student Representative, Maria Revell; Student Liaison Representative, Bill Henderson; Branch Editor, Michèle Prinsep; Committee Members, Megan Grainger, Alan Langdon, John McDonald-Wharry, Yuan Wang, Shelley Wilson.

University of Waikato

Megan Grainger has been awarded a Fulbright Travel Award to present her master's research at the University of Montana. Megan will do this whilst in Montana on a Claude McCarthy Fellowship to finish her PhD studies. Megan's research involved the discrimination and categorisation of automotive glass by laser ablation. Her database of samples consisted of glass from around the world and showed that the glass can be categorised by country of origin.

Bill Henderson is currently on study leave based at Durham University and is enjoying the snow in the U.K. **Michèle Prinsep** recently returned from study leave which was largely spent in New Zealand but also involved trips to the U.K. where she was an invited speaker at the Marine Alliance for Science and Technology Scotland (MASTS) conference in Edinburgh. While on leave she also delivered a series of lectures to postgraduate students at Nanyang Technological University.

Jonathan Puddick has successfully defended his PhD thesis on oligopeptides from aquatic cyanobacteria and is now working as a technical consultant at the Cawthron Institute in Nelson. **Toshie Asamizu** has submitted her PhD thesis on main group element hydrides and has returned to Japan. **Jess MacAskill** has completed her master's research on quantifying toxins in karaka nuts, and **Ashwin Nair** completed his BSc(Hons) project on metallocyclic chemistry of ruthenium.

A number of students were working in the Chemistry Department over the

summer on various projects. **Nikki Graziotti** was working for biologist **Nick Ling** on quantitation of rotenone by HPLC. Working with **Merilyn Manley-Harris** were **Daniel Bernstein** on isolation of a bioactive from a fermentation broth, **Alicia Lloyd** on extractives from biochar and **Chris Lockley** on a solid state NMR spectroscopic investigation of adsorption by biochars. **Tobias Wehr-Candler** worked with **Graham Saunders** on fluoroarylphosphine complexes, **Megan Wyllie** worked with **Michael Mucalo** on creating ceramic replicas from nature's ornate architecture and **Alex McLachlan** worked with **Adam Hartland** on characterisation of organohalogens in cave waters using HPLC.

Retirement of Associate Professor Chris Hendy

Chris Hendy retired from the Chemistry Department at the end of December 2012 after forty years of service. A PhD graduate of Victoria University, he arrived in 1972 after a period of working for the Department of Science and Industrial Research (DSIR) and a postdoctoral fellowship at Columbia University. At Waikato, Chris was instrumental in the successful development of geochemistry and environmental science teaching.



Chris and Vivienne Hendy

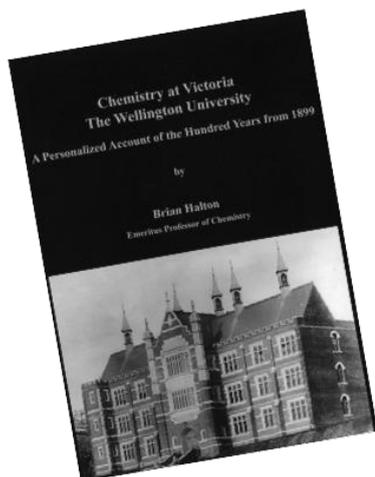
Chris inspired many students to enrol in his courses and continue on to further study through his enjoyable undergraduate field trips. He believed that field work is the key to understanding the environment, as many of the great photos from his field trips attest. Chris was involved in many research areas including paleoclimatic and oceanographic studies, the geochemistry of natural waters and glaciological studies in New Zealand, Antarctica and South America. He was also part of the Waitomo Caves

Research Advisory Committee, a director of the Antarctic Research Unit and an enthusiastic member of the New Zealand Geochemical group. Chris and his wife Vivienne were always very generous in their willingness to open up their lovely home and garden to both staff and students alike and many enjoyable times were had there. Chris would frequently bring in beautiful flowers from the garden to brighten the Chemistry office or produce to share with the department. We wish Chris all the best with his retirement.

WELLINGTON

The first meeting of 2013 in mid-February featured *Wes* and *Sheila Borden* (University of North Texas) who provided an approach to *Chemistry Publishing, Today and Tomorrow*. Given by Sheila with *Wes* inserting comment and answers, they gave an overview of the American Chemical Society publishing operation with *JACS* as the illustrative example. She took the audience through the submission, assessment and review processes, followed this with a comparison of today with the RSC system of 1985 and, finally, provided some speculation on future publishing models. The Q & A session that followed was wide-ranging and ran far longer than usual!

In March Prof *Brian Halton* gave a summary of *Chemistry at Victoria - The Wellington University*. His commentary outlined the inauguration of the College in 1899, covered the tenure of the early professors Easterfield, Robertson and Slater, and outlined the facilities and equipment in



The cover of Brian Halton's book

the various buildings that were occupied until the turn of the 21st century, all illustrated with numerous photographs. An electronic edition of the now published book is freely available for download from: www.victoria.ac.nz/scps/about/attachments/chemistry-at-victoria.pdf

Callaghan Innovation

On Feb 1, Industrial Research Limited (IRL) was renamed 'Callaghan Innovation Research Limited'. All of the formed research groups have become business units of Callaghan Innovation Research Limited and, despite some staff losses, business is as usual. All contracts and arrangements with clients made under Industrial Research Limited will be honoured. During February and March there was a team-by-team SET (Science, Engineering and Technology) alignment process to determine the best way to deliver the capability within Callaghan Innovation in the future.

Sir Paul Callaghan, after whom the organisation is named, was the respected NZ scientist who believed that science was not only about great ideas, but about getting value from those ideas through innovation and commercialisation. The website of the new organisation is: www.callaghaninnovation.govt.nz

Malaghan Institute

Dr *Bridget Stocker* was one of three top researchers to be awarded the prestigious Sir Charles Hercus Research Fellowship from the Health Research Council. The award, worth \$500,000 over four years, will be used to investigate ways to 'switch-off' tumour-promoting immune cells.

Anna Win-Mason, a PhD graduate of Victoria, has taken up a postdoctoral research position in the group of Dr Steve Withers at UBC, Vancouver. She is working on the development of glycosidase inhibitors for the treatment of diabetes. Another PhD graduate of the Stocker-Timmer group, Dr *Ashna Khan*, has recently been offered a position in the carbohydrate chemistry group at Callaghan Innovation Ltd.

Victoria University – SCPS

Dr *Brendan Burkett* (Institute for

Chemical and Engineering Sciences, Singapore), a former SCPS staff member, revisited the School during the December graduation week (his wife, *Misty*, graduated PhD in linguistics), caught up with former colleagues and friends, and gave a seminar entitled *Going Green for Marine*. *Brendan* described some of the industrial work he has been doing aimed at providing new and friendly antifouling additives for marine coatings.

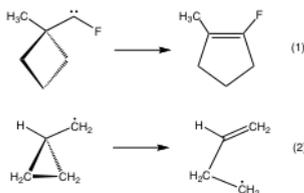
The week of Jan 14 saw Victoria host the 7th Australasian Organometallic Conference (OZOM-7) under the guidance of Prof *John Spencer*. This was the first time that the meeting had been held outside Australia. The OZOM conferences are designed to give young scientists the opportunity to present their work, so, apart from a number of keynote lectures by leading international organometallic chemists, the presentations were by students and postdoctoral fellows. Support by the Australian chemists was very good with over 90 delegates in total. The conference opened on Sunday evening with a plenary lecture by Dr *Christian Hartinger*, newly appointed at the University of Auckland, on the emerging topic of bio-organometallic chemistry and its application in the development on new pharmaceuticals. The other keynote speakers were Profs *Martin Albrecht* (UC, Dublin), *Mike Hill* (Bath), and *Rhett Kempe* (Bayreuth) who not only gave inspirational talks but also engaged with the younger scientists during the session breaks. The organizing committee included Drs *Martyn Coles* and *Matthias Lein*, with excellent support from local staff and students who managed the scientific and poster sessions, and ensured that the coffee breaks were properly catered. The Victoria University chemistry postgraduates were also excellent hosts for the many visiting students, although it might have been better if they had steered them away from the karaoke bar on Cuba Street! The meeting was very well supported by other SCPS chemistry students, notably *Emma Aitken*, who provided delicious baked treats for coffee each morning, and *Claire Turner*, who organized the concluding barbeque, in support of their Ox-fam appeal, which receive a hand-

some donation as a consequence.

January 25 saw Prof **Gary B. Schuster** (Georgia Institute of Technology, USA) visit the School to meet with staff and deliver his seminar *Modular Self-Assembly of DNA Encoded Nanostructures*. He pointed out that in addition to its role as the “information polymer” of life, DNA recently has been recognised as a useful scaffold for the preparation of nanometre-scale objects with unique and useful properties. He told us that his group has recently exploited the self-recognising and self-assembly properties of DNA to construct nanometre scale arrays of conducting polymers. A series of DNA oligomers containing 2,5-bis(2-thienyl)pyrrole monomers linked covalently to N4 of alternating cytosines can be placed between leading and trailing 12 nucleobase recognition sequences. These DNA modules were encoded so that the recognition sequences uniquely associate through Watson-Crick assembly to form closed-cycle or linear arrays of aligned monomers. The cyclic and linear arrays that result exhibit chemical and optical properties that are typical of conducting thiophene-like polymers with red-end absorption beyond 1250 nm. These DNA-scaffolded conducting polymers can be used as active elements to construct molecular scale devices.

In mid-February, a visit to the School by Prof **Weston T. Borden** (University of North Texas) was hosted by Prof Halton who arranged for him to meet and discuss research issues with a number of the staff. His noon lecture was entitled *Calculations on tunneling by carbon tell experimentalists where to look and what to look for*. Wes reminded us those organic rearrangements, which have energy barriers that are both low and narrow, are able to show carbon tunnelling, with such reactions occurring at appreciable rates, even at remarkably low (8 K) temperatures. In order to make experimentally testable predictions about the rates of such reactions and

about the effects of isotopes on the rates, Wes described the small-curvature tunnelling (SCT) calculations that his group has been performing. By using dominantly the carbene ring expansion in Eq. 1 and the ring opening of cyclopropylcarbinyl radical in Eq. 2, he showed that carbon tunnelling is much facilitated by narrow barrier widths and low absolute temperatures. His explanation of things theoretical to the experimentalists was a tour de force.



Two of Prof. **Ken Mackenzie's** PhD students, **Joanne Rogers** and **Mahroo Poorsichani**, attended the February AMN-6 conference in Auckland where Mahroo presented a poster entitled *Incorporation of photoactive Cu₂O in a metakaolinite inorganic polymer*. The group has also hosted Iranian visiting researcher Dr Amirabbas Nourbakhsh for the past six months; he has been working on advanced ceramics, including new materials for drug delivery. Another visiting researcher who joined Prof. MacKenzie's group in February was Ms. **Naprarath Waijarean**, a PhD student from King Mongkut University in Bangkok. During her period with the group, she carried out part of her degree research on the development of inorganic polymers from water treatment waste to remove toxic metals from industrial wastewaters.

Early March saw the inaugural *Ferrier Lecture* delivered at Victoria University by Prof **Vern L. Schramm** (Albert Einstein College of Medicine, New York). The lecture has been established to honour Emeritus Professor Robert (Robin) J. Ferrier, regarded as one of New Zealand's eminent chemists and a leader in the field of carbohydrate chemistry. The inaugu-



Emeritus Professor Robin Ferrier

ral lecture was been made possible by generous support of the Victoria University Foundation, Dr Peppi Prasit (one of Robin's most successful PhD students from 1981), Callaghan Innovation, Victoria University, and the NZIC. Schramm's lecture was entitled *Enzymatic transition states and drug design*, and showed his work using the transition state theory which proposes that chemically stable mimics of individual enzymatic transition states are the most powerful inhibitors known. His approach has the potential to create *transition state analogues* as powerful inhibitors of enzymes by using experimental isotope effects and computational methods to establish the nature of enzymatic transition states and to design transition state analogues. Using the powerful approach of transition state analysis and chemical synthesis, transition state analogues have been obtained for specific targets in leukaemia, gout, cancers, malaria and in antibiotic-resistant bacteria. Some of the transition state analogues developed by the team bind to the target enzymes by as much as 97,000,000 times tighter than the substrate.

Giancarlo Barassi, a former PhD student of Prof **Jim Johnston**, successfully defended his PhD research in mid-December 2012, while **Mark Bartlett** successfully completed his PhD in late February. His work was with Dr. **Joanne Harvey**, and he is now a postdoctoral with Prof. John Hartwig at UC-Berkeley.

Fluorescent minerals: a hobbyist's perspective (with a bit of chemistry...)

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This article outlines the basic physical processes leading to fluorescence, with an emphasis on understanding why certain rocks glow different colours when illuminated by ultraviolet light. This is followed by a series of synopses describing some of the more well known fluorescent minerals, what causes them to fluoresce, and famous locations where they can be found. A rigorous explanation of fluorescence or a full historic account of the mining of specific deposits is beyond the scope of this article; rather, it is the author's intention to introduce the reader to the beauty that lies hidden in some otherwise 'ordinary' looking rocks and crystals.

Definitions and Background

Most people are familiar with the terms 'luminescence' and 'fluorescence', particularly, for example, when applied to different types of lighting. From a scientific perspective, however, these words have clearly defined meanings. The Oxford English Dictionary defines luminescence as "Light, or a glow, emitted by a luminescent (cool) object or surface",¹ distinguishing it from *incandescence* which is the emission of light from a hot body as a result of its temperature. Using a simple energy-level diagram this corresponds to a two-stage process: (i) the absorption of energy causes the promotion of an electron within a substance or molecule from the ground state to higher energy (excited) state, followed by (ii) the electron returning to the stable ground state with the loss of energy in the form of light (Fig. 1). Luminescence is further divided into different classes according to the origin of the energy that promotes the electrons. For example, when the energy is derived from a chemical reaction the result is *chemiluminescence*, whereas *electroluminescence* is a result of passing an electric current through a substance.

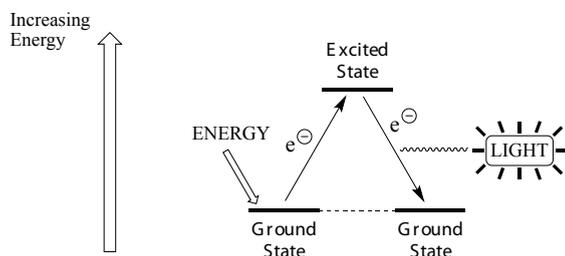


Fig. 1. Simplified energy-level diagram explaining luminescence.

Fluorescence is a type of photoluminescence, corresponding to luminescence in which the energy that promotes the electron comes from the absorption of photons, and the emission of light is caused by singlet-singlet electronic relaxation.² To understand this phenomenon we need to re-examine our simple energy-level diagram, in particular the nature of the ground- and excited states (Fig. 2). Rather than existing as a single, well-defined energy

level, each of these states, in fact, consists of different energies, termed vibrational states. When an electron is promoted to the excited state upon absorption of a photon (a), it typically ends up in a high-energy vibrational state, (b). Rather than lose energy and return directly to the ground state, it is more common for the molecule to transfer energy in the form of rotational, vibrational or translational energy, known as non-radiative decay (c). As a result, when the electron returns to the ground state, the energy of the transition (d) is less than the energy of the absorption. Given the inverse relationship between wavelength (λ) and energy, this corresponds to an increase in the wavelength. Thus, if a substance absorbs light in the ultraviolet region of the electromagnetic spectrum ($\lambda = \sim 10 - 400$ nm), it can emit light in the visible region of the spectrum ($\lambda = \sim 400 - 700$ nm).

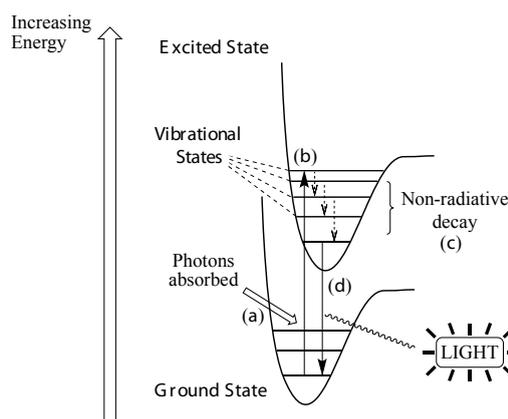


Fig. 2. Energy-level diagram explaining fluorescence.

To observe and fully appreciate fluorescent minerals, a light source that emits radiation in the ultraviolet region of the electromagnetic spectrum is required. A UV-lamp allows the observer to see the colours of the minerals in the visible region. There are two different types of UV-light commonly used for this purpose: longwave (LW or UV-A) which gives out light in the region 315 – 400 nm, and shortwave (SW or UV-C) which gives out light in the region 160 – 280 nm. Different minerals respond to different UV-sources depending on their chemical composition. For example, certain rocks will only respond to shortwave radiation, while others will fluoresce different colours depending on the type of UV-light used.

Fluorescent Minerals

There are more than 3600 mineral species that have been identified and scientifically classified, of which more than 500 are known to visibly fluoresce in some specimens. Certain minerals such as scheelite or autunite are inherently (or intrinsically) fluorescent, meaning that all samples of that mineral will exhibit a characteristic fluo-

rescence. This derives from the chemical composition of the mineral and will be constant for all samples of that mineral. Indeed, this characteristic can be used to identify the presence of the mineral, and has been used during prospecting for certain minerals and ore deposits. In contrast, some minerals are only fluorescent when certain impurities, known as *activators*, are present. In this case the mineral in its pure form may be unresponsive to UV-light. It also means that, depending on the type of activators present (often linked to the geological environment in which the rocks formed), different responses are possible. For example, a pure crystal of calcite (CaCO_3) is not fluorescent. However, many samples of calcite will fluoresce owing to small quantities of other metal ions (e.g., Mn^{2+} , Hg^{2+}) being incorporated into the lattice, which results in a range of colours.³ The following sections describe selected groups of minerals in more detail, focusing on their fluorescent properties.

Scheelite-Powellite Series, $\text{CaWO}_4 - \text{CaMoO}_4$

Scheelite, named after Karl Wilhelm Scheele (1742-1786), a Swedish chemist, is an example of an inherently fluorescent mineral. The molecular formula is CaWO_4 (calcium tungstate) and the crystal structure consists of Ca^{2+} cations and tetrahedral $(\text{WO}_4)^{2-}$ anions distributed throughout the lattice. The crystal morphology is typically dipyramidal, with variation in colour from orange (typical for scheelite from China) to blue (typical for scheelite from Romania). It is, however, most commonly found in its 'massive' form (i.e., as a non-crystalline rock). Regardless of the physical appearance of scheelite, all samples have a characteristic intense blue-white fluorescence when stimulated by short-wave UV-radiation (Fig. 3).

The fluorescence in scheelite is caused by transitions of electrons within the tetrahedral tungstate anion.⁴ Considering the formal oxidation state and electron count of tungsten in $(\text{WO}_4)^{2-}$, it is present in the +6 oxidation state, corresponding to a d^0 electron count. The fluorescence is therefore derived from a ligand to metal charge transfer (LMCT) involving the lone-pairs of electrons in the $2p$ orbitals of the oxygen atoms and the empty $5d$ orbitals of tungsten. A similar process is responsible for the intense purple colour of the permanganate anion (MnO_4^-).

Scheelite forms a solid-solution series with the molybdenum analogue, powellite CaMoO_4 , named after the American geologist and explorer John Wesley Powell (1834-1902). Whilst the pure end-member of the series corresponds to CaWO_4 , it is capable of incorporating variable amounts of powellite. This is readily identifiable under ultraviolet illumination, as powellite is also an intrinsically fluorescent mineral, although in this instance the colour observed is an intense yellow colour. Interestingly although the solid solution of the mineral series is considered to be continuous from one end member to the other, it only takes the presence of a few % of molybdenum before the fluorescent colour of the scheelite changes from blue to yellow.⁵

During the 19th and 20th centuries, several small privately owned mines were in operation in New Zealand for the recovery of scheelite, the most important locations being at Palmerston, Dunedin (Macraes Mine),⁶ and Glenorchy, Otago.⁷ The latter location is of particular historical interest, as it is known that scheelite was being mined at Mount Judah Mine as early as the 1880s. The demand for tungsten waxed and waned in accordance with its use for making armaments during the First and Second World

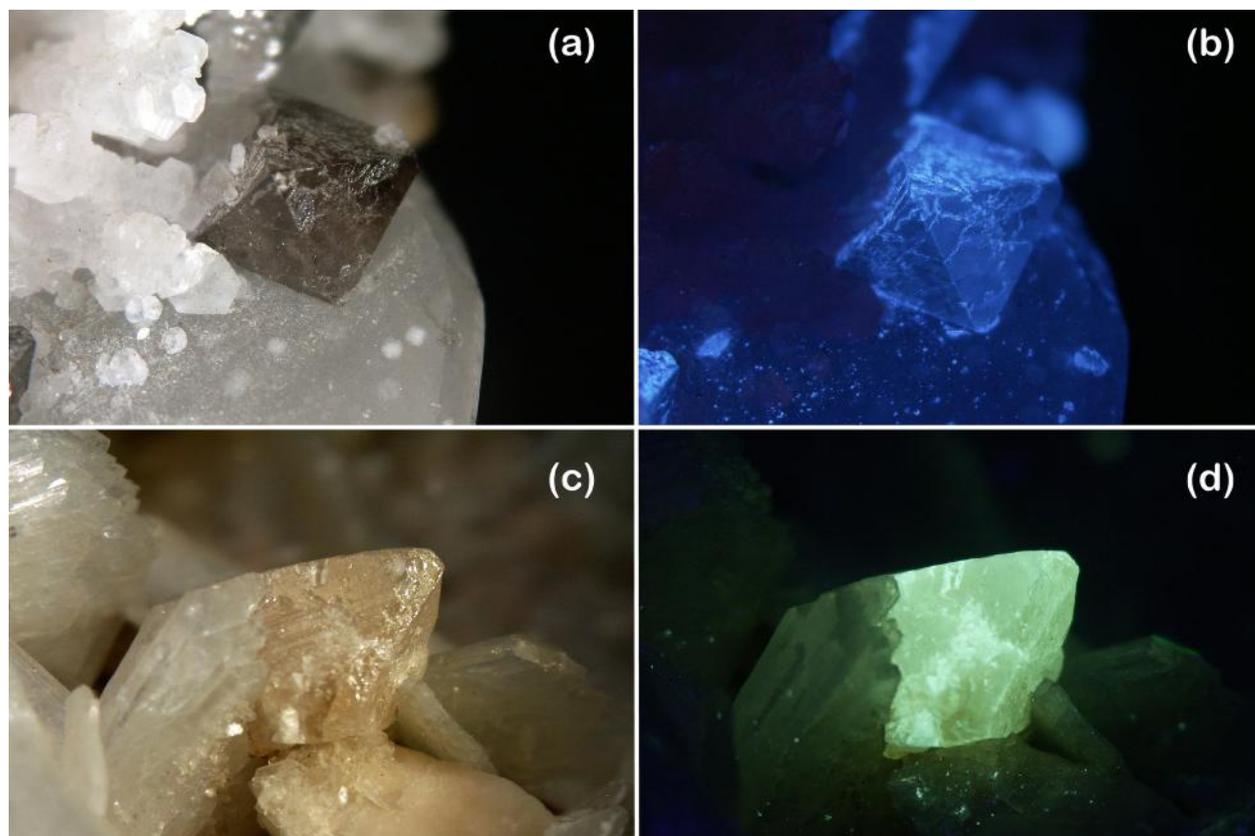


Fig. 3. Scheelite [CaWO_4] from Yizhang County, Chenzhou Prefecture, Hunan Province, China (a) under ambient light; (b) under SWUV-light. Powellite [CaMoO_4] from Aurangabad District, Maharashtra, India (c) under ambient light; (d) under SWUV-light.

Wars and the Korean War. Given the difficult terrain, as well as the high altitudes and erratic occurrence of the scheelite at Glenorchy, it is not currently economical to mine the deposit.

Uranium-containing Minerals

Over 150 minerals contain uranium as a constituent element in their formula, with the most abundant ore being the oxide uraninite, UO_2 . In its massive and possibly impure form this mineral is commonly known as pitchblende. This mineral has historic significance, as research into the radioactivity of this mineral, along with chalcocite (a synonym of torbernite, $\text{Cu}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 12\text{H}_2\text{O}$) led Marie and Pierre Curie to discover the elements polonium and radium. Despite the fact that many uranium-containing minerals fluoresce, uraninite itself does not.

The uranium in naturally occurring minerals is almost exclusively present as the uranyl ion, $(\text{UO}_2)^{2+}$, in combination with other metal cations and inorganic anions. For example, saléeite = $\text{Mg}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 10\text{H}_2\text{O}$, uranocircite = $\text{Ba}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 12\text{H}_2\text{O}$, zeunerite = $\text{Cu}(\text{UO}_2)(\text{AsO}_4)_2 \cdot 10\text{--}16\text{H}_2\text{O}$ and curite = $\text{Pb}_3(\text{UO}_2)_8\text{O}_8(\text{OH})_6 \cdot 2\text{H}_2\text{O}$. The uranyl dication is a very stable molecular unit with *trans*-oxygen atoms (O–U–O angle 170–180°) that form multiple bonds with the metal centre (U–O distance 1.6–1.8 Å). The uranyl dication is the most common activator in uranium-containing minerals and hence, despite the many combinations of cations and anions that are present in uranium minerals and the many different colours of the minerals themselves under ambient lighting conditions, the fluorescent colour is almost always green / yellow.

Examples of fluorescent uranium minerals that commonly appear in collections include autunite (hydrated calcium uranyl phosphate, $\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 11\text{H}_2\text{O}$), named for the type locality (where the original material for the formal definition of the mineral was located) at Saint-Symphorien-de-Marmagne, Autun District, Saône-et-Loire, Burgundy, France. It forms tabular crystals that can vary in colour from yellow to greenish black, and has a strong yellow-green fluorescence under both SW- and LW-UV-light (Fig. 4). Autunite is not stable and rapidly forms meta-autunite, $\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 6\text{--}8\text{H}_2\text{O}$, through partial dehydration. The colour of this mineral tends to be more yellow (less greenish) and unless precautions have been made to prevent dehydration, corresponds to most specimens in worldwide collections; it retains the same fluorescent properties as the hydrated form.

Most people are aware of the gold rushes that took place in New Zealand during the 19th and 20th centuries, but the 'uranium-rush' that took place in the 1940s and 1950s is less well known. Demand for uranium for use in nuclear weapons by the British and American armed forces prompted the first uranium survey in New Zealand, led by Ernest Marsden who at the time was head of the Department of Scientific and Industrial Research (DSIR). A government ship, the *New Golden Hind*, was chartered to survey the granitic rocks of Fiordland for possible uranium sources. Over two years the rocks and beaches of more than 1,500 km of coast were examined, but no significant concentrations of uranium were found.

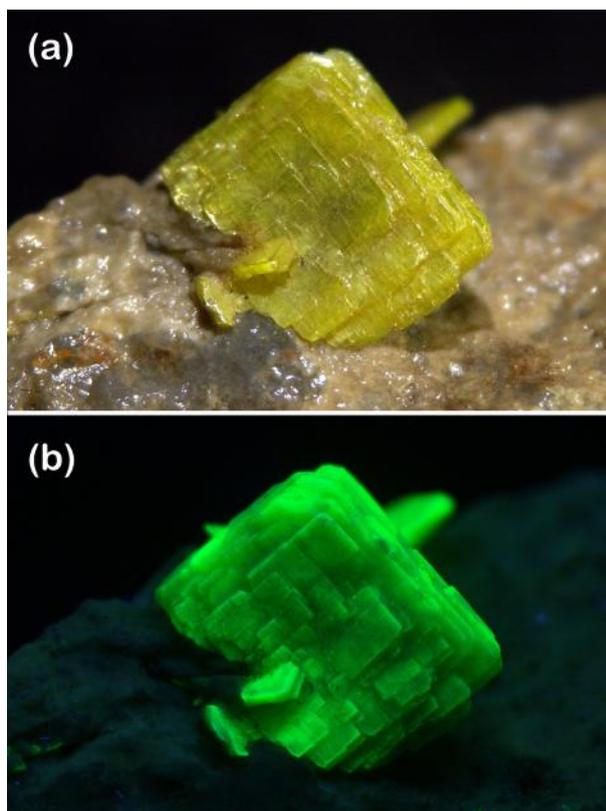


Fig. 4. Meta-autunite [$\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 6\text{--}8\text{H}_2\text{O}$] from Bear Creek Claim, (near Mount Spokane), Washington, USA under LWUV-light.

Interestingly, during the examination of the black-sand concentrates from the gold dredges on Gillespies Beach, near Franz Josef, a new mineral was discovered. Huttonite, named after Prof. C. Osborne Hutton of Stanford University,⁸ is a very rare thorium silicate with chemical formula ThSiO_4 .⁹ Despite containing no uranium, the mineral is described as having a dull white fluorescence with a pink tinge under both SW- and LWUV light.

By the mid-1950s the government had enlisted the help of the general public in the search for uranium-containing rocks, publishing a booklet entitled *Prospecting for Radioactive Minerals in New Zealand*.¹⁰ This led in 1955 to the discovery of uranium-containing rocks near Hawks Crag in Buller Gorge¹¹ by two prospectors, Frederick Cassin and Charles Jacobson, who believed they had discovered the second most concentrated uranium deposit in the world.¹² Unfortunately, further analysis revealed that Cassin and Jacobson's samples were anomalously high in uranium oxide, with other samples from the same location containing between 1% and 25% of the initial values. Despite further investments and government support (Cassin and Jacobson received £100 in 1956 and a further £400 in 1958 for their discovery) the concentration of uranium oxides was just too low in the deposit they found to be financially viable.

Fluorite (where it all began?)

Fluorite (also known as fluorspar) is an extremely widespread mineral with over 6200 locations recorded worldwide, including in the South Island of New Zealand (Hawks Crag, Buller River; Falls Creek; Richmond; and Thompson Hills, Nelson).¹³ It has a simple chemical for-

mula, CaF_2 , and is synonymous with the term 'fluorescent'. A popular misconception is that the mineral is named for its fluorescent properties, whereas the reverse is true. In 1852 whilst examining the ability of certain samples of fluorite to change "invisible light beyond the violet end of the visible spectrum" (i.e., UV-light) into blue light, George Stokes wrote in the *Philosophical Transactions of the Royal Society of London*, "I am almost inclined to coin a word and call the appearance *fluorescence*, from fluor-spar, as the analogous term *opalescence* is derived from the name of a mineral" (viz., opal).¹⁴ The name fluorite actually derives from the Latin *fluere* meaning 'to flow' and relates to the mineral's application as a flux in the steel industry.

Fluorite is a structurally diverse mineral with a range of crystal morphologies that include cubic, octahedral, dodecahedral, hexaoctahedral and tetrahexaoctahedral. Fluorite also occurs in a wide range of colours including green, yellow, purple, blue, pink, brown and colourless. Not all samples of fluorite exhibit fluorescent properties (i.e., it is not an intrinsically fluorescent mineral) and pure samples of CaF_2 do not respond to UV-light. The major cause of fluorescence is the presence of activators. Because it is possible to incorporate a range of atoms, ions and other inclusions, the fluorescent response from fluorite is as varied as its colour in ambient light, and can range from bluish white to green to violet.

The most common colour for the fluorescence in fluorite is violet or blue, attributed to the presence of small amounts of lanthanide ions replacing Ca^{2+} in the crystal lattice. In particular, divalent europium (Eu^{2+}) forms a stable cation with the same charge as calcium, owing to the inherent stability associated with half-filled *f*-orbitals (electron configuration $\text{Eu}^{2+} = [\text{Xe}] 4f^7$). In this case the Eu^{2+} can be a direct replacement for the Ca^{2+} in the crystal lattice. The north-east of England is associated with strongly blue/violet fluorescing fluorite that typically forms well-defined (often twinned) cubic crystals that vary in colour from green to violet to yellow. The fluorescent response is the same no matter what the colour of the crystals, with an intense blue colour observed on exposure to longwave UV-light. The only mine that is currently in operation for the extraction of minerals for sale to collectors (rather than as an economic commodity) in the UK is the Rogerley Mine found in Frosterley, Weardale, County Durham.¹⁵ The fluorite from this location is so responsive to UV-light that it will exhibit 'daylight fluorescence', meaning that a noticeable colour change is present when specimens are viewed in sunlight, without the need for a UV-lamp.

Another interesting class of activator that can be incorporated into fluorite is broadly defined as 'organic hydrocarbons' or 'bituminous matter'. The fluorescent response in this case is typically white/yellow, with differences that depend on the chemical composition of the activator. Good localities for fluorite with this property are Ohio, USA (Fig 5)¹⁶ and Derbyshire in the UK.

Calcite

Another mineral that commonly displays fluorescence owing to the incorporation of activators is calcite, CaCO_3 ,

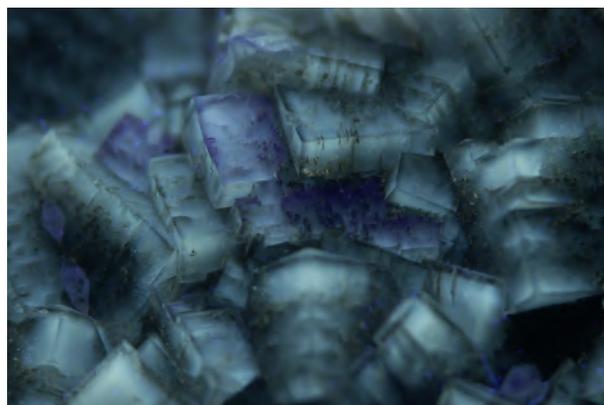


Fig. 5. Fluorite [CaF_2] with hydrocarbon inclusions from Clay Center, Ottawa County, Ohio, USA under LWUV-light.

As for fluorite, a range of atoms and ions can be included in the crystal lattice, leading to fluorescence in many different colours. The most common metallic activator that elicits a large fluorescent response is divalent manganese (Mn^{2+}), giving a strong red colour that is brightest at a manganese concentration of about 1%. In this case the manganese is replacing the calcium in the crystal lattice. Other activators (in no particular order) that may replace ions in calcite or may be present as inclusions are Pb^{2+} , Hg^{2+} , Ba^{2+} , Sr^{2+} , lanthanide ions and organic impurities. Combinations of these activators may also influence the response, with some ions enabling energy transfer within the crystal lattice, enhancing or otherwise changing the response, and others acting as a quenching agent to effectively 'turn off' an otherwise strong fluorescent response.

One particular location that has afforded calcite with an unusual property is the Terlingua District, Brewster County, Texas USA. Calcite obtained from the mercury mines in this area displays a bright blue fluorescence under SWUV-light, and bright pink fluorescence under LWUV-light (Fig. 6). The causes of this complex response are not clear and are still the subject of debate. Lead, manganese and some of the lanthanides have been detected, and original thoughts were that the pink colour was caused by a combination of the orange response typical for Mn^{2+} , tinged by a contribution from the blue fluorescence. However, recent analysis by laser-induced time-resolved luminescence spectroscopy has suggested that much of the fluorescence can be attributed to the presence of crystal defects that are caused by exposure to radioactivity.¹⁷

The Fluorescent Mineral Capital of the World

Certain worldwide locations have become famous for their fluorescent minerals and the most well known is undoubtedly the Franklin / Sterling Hill area in Ogdensburg, New Jersey, USA. This area has been mined for iron and zinc since the 1730s (when it was originally thought to be a copper deposit) and over 340 mineral species have been identified from the area. Remarkably, over 80 of the mineral species fluoresce to some degree or other giving a range of colours in many brilliant combinations (Table 1). The most common fluorescent rocks are calcite (fluorescent red) and willemite, Zn_2SiO_4 , (fluorescent green), which frequently occur together in what is referred to as

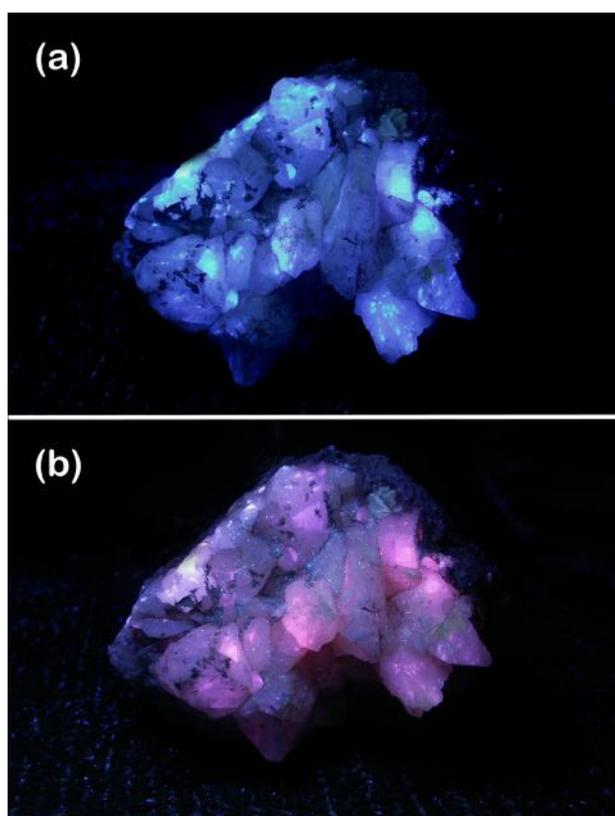


Fig. 6. Calcite [CaCO_3] from Terlingua District, Brewster County, Texas USA, (a) under SWUV-light, (b) under LWUV-light.

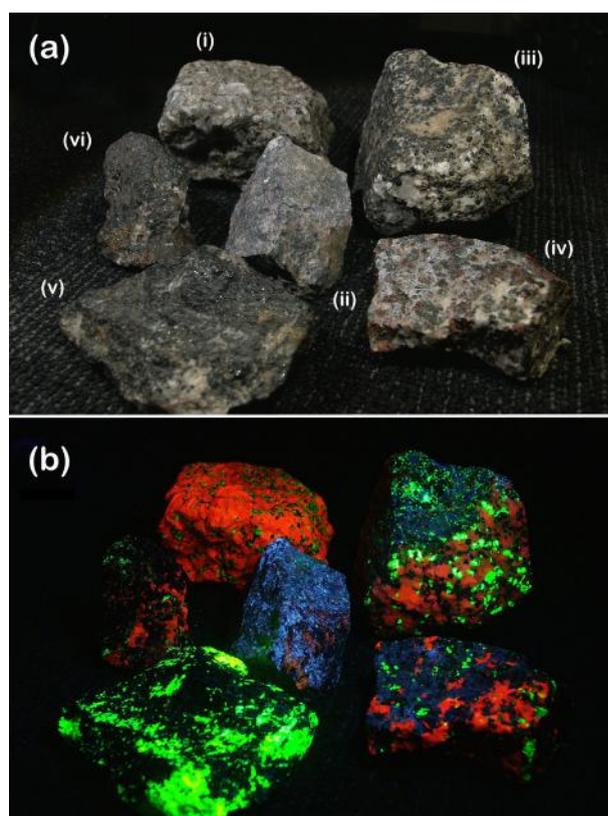


Fig. 7. A selection of fluorescent rocks from the Franklin area of New Jersey, USA (a) under ambient light; (b) under SWUV-light. (i) 'Christmas Rock' calcite (fl. red) and willemite (fl. green); (ii) margarosonite (fl. blue); (iii) calcite (fl. red), willemite (fl. green), and hardystonite (fl. violet); (iv) calcite (fl. red), willemite (fl. green), and hydrozincite (fl. blue-white); (v) willemite (fl. green) and esperite (fl. yellow); (vi) calcite (fl. red), willemite (fl. green), and clinohedrite (fl. orange).

Table 1. A selection of fluorescent minerals from Franklin/Sterling Hill, Ogdensburg, New Jersey, USA

Mineral	Chemical Formula	Fluorescent Response		Main Activator	Other Activators
		SWUV	LWUV		
Calcite	CaCO_3	Red	-	Mn^{2+}	-
Willemite	Zn_2SiO_4	Green	-	Mn^{2+}	-
Esperite	$\text{PbCa}_3\text{Zn}_4(\text{SiO}_4)_4$	Yellow	-	Mn^{2+}	Ce^{3+} , Sm^{3+} , Dy^{3+}
Hardystonite	$\text{Ca}_2\text{ZnSi}_2\text{O}_7$	Violet/Blue	-	Mn^{2+}	Pb^{2+} , Ce^{3+} , Dy^{3+} , Tm^{3+}
Clinohedrite	$\text{CaZnSiO}_4 \cdot \text{H}_2\text{O}$	Orange	-	Mn^{2+}	-
Wollastonite-1A	CaSiO_3	-	Orange/Yellow	Mn^{2+}	Cr^{3+} , Fe^{3+}
Sphalerite	$(\text{Zn},\text{Fe})\text{S}$	Pink/Violet	Orange	Mn^{2+}	Cu^+
Hydrozincite	$\text{Zn}_5(\text{CO}_3)_2(\text{OH})_6$	Bluish-white	-	Pb^{2+}	-
Margarosonite	$\text{Pb}(\text{Ca},\text{Mn}^{2+})_2\text{Si}_3\text{O}_9$	Bluish-white	-	?	?

'Christmas Rock' (Fig. 7). Interestingly the activator in both cases is Mn^{2+} , replacing Ca^{2+} in calcite and Zn^{2+} in willemite. Other 'common' fluorescent minerals from this area are listed in Table 1, along with the activators and other trace elements that may contribute to the observed fluorescence.

Conclusion

Collecting fluorescent rocks constitutes an interesting hobby that can lead to some stunningly beautiful mineral displays. Whilst it is most gratifying self-collecting these

specimens, many samples are available for purchase from sources on the Internet (e.g., <http://www.ebay.com/sch/Fluorescent-Minerals-/3223/i.html>). Readers should note that to observe the fluorescence, a source of UV-light is required. It is easy to obtain a source of LWUV light in the form of 'black-light' bulbs, used for parties and fluorescent art displays. However, SWUV lights are more expensive and are generally only available from specialist scientific sources. The readers should note that exposure to UV-light is harmful to the eyes and long-term exposure to the skin should be avoided. It is strongly advisable to

wear protective goggles and gloves when handling UV-illumination. All UV-photos in the article were taken by the author and are of samples that are currently in his collection; the specimens were illuminated by a 4W SWUV-light (254 nm) or a 4W LWUV-light (366 nm).

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Grants and Awards

Rutherford Discovery Fellowships

The Rutherford Discovery Fellowships support the development of future research leaders and assist with the retention and repatriation of New Zealand's talented researchers.

The Fellowship will provide support for ten early- to mid-career researchers each year (defined as being between three and eight years post-PhD).

The recipients will be supported for a five-year term with competitive funding of up to \$160,000 a year.

The aim is to develop excellent researchers in New Zealand. The on-line web portal closes 5pm on 10 April 2013.

See: www.royalsociety.org.nz/programmes/funds/rutherford-discovery/

2013 Marsden Fund

The key dates for 2013 are as follows:

- 8 - 20 April 2013: Assessment panel meetings
- 2 May 2013: Marsden Fund Council meeting
- 8 May 2013: Invitations for Full Proposals

Bayer Primary School Science Fund

The Fund is sponsored by Bayer and administered by the Royal Society of New Zealand.

The aim is to give primary schools the opportunity to apply for funding required for teaching and enhancing both environmental science and 'nature of science' activities.

A primary school can request a maximum of \$2,000 to help fund activities. A school that has been successful in being funded may only apply for funding once every three years.

The application form must be completed and received by 3.00pm on Friday 26 April 2013.

See: www.royalsociety.org.nz/programmes/funds/bayer-primary-school-science-fund/

Talented Secondary School Students Travel Award

This award provides financial support for secondary school students who have been selected on a national basis to attend international science and technology events. This fund aims to assist talented school students to represent New Zealand.

Only individual school students who have been selected through a national selection process may apply for the award, which is to help cover their direct costs of travel.

Applicants must be New Zealand citizens or permanent residents. They must have been selected by an organisation to represent New Zealand at an internationally recognised science or technology event and be in Years 9-13. The panel reviews applications approximately every 8 - 12 weeks for example: January, April, June, August and October.

See: www.royalsociety.org.nz/programmes/funds/secondary-school-travel/apply/

2013 New Zealand-Taiwan Nanotechnology Research Student Travel Programme

The Ministry of Business, Innovation, and Employment (MBIE) is pleased to offer a travel grant programme for New Zealand students (PhD or MSc) to conduct co-operative study in the field of nanotechnology with research groups in Taiwanese universities and research institutes.

The Research Student Travel Programme aims to help students further their own knowledge, while contributing to the advancement of research linkages at a department level, between Taiwan and New Zealand.

Up to four fellowships will be awarded in the 2013 round to support collaborations of up to 90 days. Detailed information can be found in the programme guidelines.

Applications are now open. Applications close on at 5.00pm on 23 April 2013.

See: www.royalsociety.org.nz/programmes/funds/international-relationships/taiwan/

Primo Levi's periodic system

Peter Hodder

School of Chemical and Physical Sciences, Victoria University of Wellington, and HodderBalog Social and Scientific Research, Wellington (email: peterh@hodderbalog.co.nz)

In November 2012, I was invited by the Italian programme at Victoria University of Wellington to contribute to a study day organised to mark the 25th anniversary of the death of Primo Levi. As a survivor of a year's internment in Auschwitz, Primo Levi is particularly well known for his works related to the Holocaust (Fig. 1),¹ and these and his philosophy featured prominently at the study day. To complement this, the organiser of the study day was keen for me to focus on Primo Levi's life as a practising chemist.



Fig. 1. Upper: Primo Levi (13 July, 1919 – 11 April, 1987). Lower left: Cover of *Survival in Auschwitz: If This is a Man*. Lower right: Cover of Primo Levi's book *If Not Now, When?*; this was the title of the Primo Levi study day at Victoria University on 8 November 2012.

For a chemist, *The Periodic Table - Il Sistema Periodico* is perhaps the most interesting of Primo Levi's books. This work comprises 21 stories, named after 21 of the chemical elements, and linked to Primo Levi's life in general, to his time as a chemistry student, and to his work in a variety of chemistry laboratories as an employee, as a prisoner in Auschwitz, and as a consultant. Table 1 gives the essentials of the chapters related to three themes: Primo Levi's life history, the chemistry in which he was involved, and stories which although fictional still contain references to chemistry.²

Why did he choose the particular elements he did? For the first chapter, the answer is easy. Argon is an 'inert gas', not generally reactive with any other element: somewhat withdrawn from others, you could say. And this is the essence of Levi's family background in Piedmont, Italy: Jewish in origin – not rejected by the community, but not particularly welcomed either. Most of the other chapters are perhaps less metaphorical, but more directly linked to chemical themes, and – with the exception of vanadium – in the chronological order of his life, and follow his career transition from chemist to writer.

The description of chemists' research or laboratory work is rarely written in prose that is as engaging as Primo Levi's. Accordingly, I was pleased to find at least one undergraduate programme that has attempted to use one of Primo Levi's selected elements as the basis of a class exercise.³ Given that explosions are generally appealing to chemistry students, the authors of the exercise selected Primo Levi's chapter on potassium as a required reading, and wrote about it thus:

"Levi describes an accident in a laboratory in which he was involved as an undergraduate student. Levi had to distil benzene in the presence of sodium;⁴ however, since he was unable to find this metal in his laboratory, he decided to replace the sodium with potassium. After the distillation, Levi took the flask to the sink to wash it. As the water entered the flask, an explosion occurred, and a fire started in the laboratory. Levi was able to extinguish the fire without any serious consequences. He then tried to find an explanation for the incident."

The authors then asked the students to consider aspects of the chemistry involved, by answering the two questions: "Why did the author [Levi] suppose that he could use potassium instead of sodium? How do you think he got that idea?" ... and "Do you think it is part of a chemist's work to make 'innovations' like that, namely to introduce changes in established procedures, like changing potassium for sodium?"

I told my audience of Humanities scholars that the answer to the first question is because sodium and potassium have some similar chemical properties – which chemists have discovered over time, and which accounts for their location on the periodic table of the elements. Perhaps cheekily, I said that the answer to the second question is "No" if you're a teacher, and "Yes" if you're a researcher!

The chapters on hydrogen and potassium in *Il Sistema Periodico* both feature explosions. The chapter on nickel deals with Primo Levi's work in a mine, that on phosphorus deals with his first romance – and chemistry; in the chapter on cerium, he steals and sells this so-called rare

Table 1. Themes of chapters in *Il Sistema Periodico*

Chapter number	Chemical element	Symbol	Essential content of chapter	Theme*		
				Life	Chemistry	Fiction
1	Argon	Ar	Family origins	●		
2	Hydrogen	H	Friendship – chemical explosions	●	●	
3	Zinc	Zn	Notions of purity	●	●	
4	Iron	Fe	Friendship	●	○	
5	Potassium	K	Chemistry		●	
6	Nickel	Ni	First employment – mining		●	
7	Lead	Pb	Follows from Ni; first science fiction			●
8	Mercury	Hg	“Alchemy, allegory and erupting volcanoes”		●	●
9	Phosphorus	P	Science fiction?/ despair in work/first love	●	●	
10	Gold	Au	Capture, deportation, loss of freedom	●	○	
11	Cerium	Ce	Survival/ theft of cerium	●	○	
12	Chromium	Cr	‘Rebirth’ /commercial paint	●	●	
13	Sulfur	S	Fiction		○	●
14	Titanium	Ti	Fairy tale			●
15	Arsenic	As	Offence and redemption – philosophy	●	●	
16	Nitrogen	N	Chemistry consulting	●	●	
17	Tin	Sn	Business partnership/chemistry	●	●	
18	Uranium	U	Back in paint factory – life/chemistry	●	●	
19	Silver	Ag	Reminiscences, some chemistry	●	○	
20	Vanadium	V	Recall capture – life	●	○	
21	Carbon	C	End of chemistry start of writing		●	

*Some chapters cover more than one theme. In such cases, the major themes are shown as closed circles (●), the lesser themes are shown as open circles (○)

earth element in order to survive Auschwitz. The much later chapter on vanadium revisits the prison laboratory in which he worked at Auschwitz as he discovers that his supervisor from that time is a client of the varnish factory in which he later works. The chapters on chromium and silver have been described as industrial detective stories in which chemical problems are solved, while the chapters on arsenic, nitrogen and tin are about his adventures as a free-lance consultant.⁵ In that regard, I particularly liked Primo Levi’s description of the consulting role:

“To be a consultant is the ideal work, the sort from which you derive prestige and money without dirtying your hands, or breaking your backbone, or running the risk of being roasted or poisoned: all you have to do is take off your smock, put on your tie, listen in attentive silence to the problem, and then you’ll feel like the Delphic oracle. You must weigh your reply very carefully and formulate it in convoluted, vague language so that the customer considers you an oracle, worthy of his faith, and the rates set by the Chemists’ Society.”⁶

Levi’s turn to chemistry-as-fiction is evident in his stories relating to lead, mercury, sulphur, and titanium. In these the chemical behaviour of these elements is subservient to the stories Primo Levi weaves.

The elements selected by Levi for his chapters are scattered throughout the periodic table (Fig. 2). Properties (such as ionisation energies or electronegativities) of the elements in chapter order do not show an obvious periodicity (Fig. 3, Fig. 4), unlike the plot of ionisation energy versus atomic number of *all* the elements, for example, that shows rough periodicities defined by maxima at the inert gases and minima at the alkali metals. However, if the themes of the chapters are used to define a ‘Levi index’, by assigning a numerical value of ‘1’ to ‘Life’, ‘2’ to ‘Chemistry’, ‘3’ to ‘Fiction’, and allowing for combinations (i.e., Life + Chemistry = 1.5; Chemistry + Fiction = 2.5) a rough periodicity does emerge (Fig. 5).

A more robust determination of the ‘Levi index’, perhaps by a textual analysis of the amount of ‘life’, ‘chemistry’ and ‘fiction’ in each chapter,⁷ might improve matters, but the diagram at least shows that Levi’s choice of elements constitutes a “periodic system”. However, Levi’s 21 elements do not constitute the Periodic Table in the sense that chemists know it, and so perhaps the book should have been entitled *A periodic system*, or *Levi’s periodic table*. Interestingly, the title of the book in Italian *Il Sistema Periodico* translates to the English *The Periodic System*, while the English *The Periodic Table* trans-

Periodic Table of the Elements

Fig. 2. Distribution of chemical elements that are the names of the chapters in *Il Sistema Periodico*.

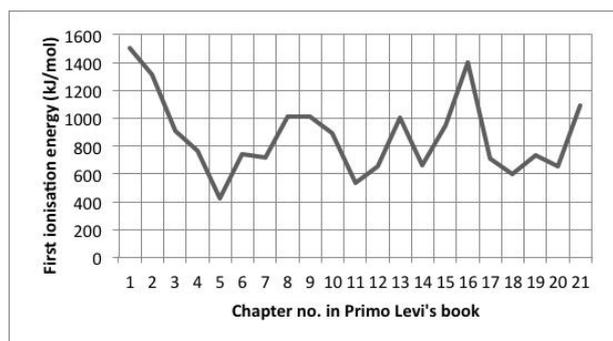


Fig. 3. Variation of chapter themes in *Il Sistema Periodico* and ionisation energy with the atomic numbers of the elements after which the chapters are named.

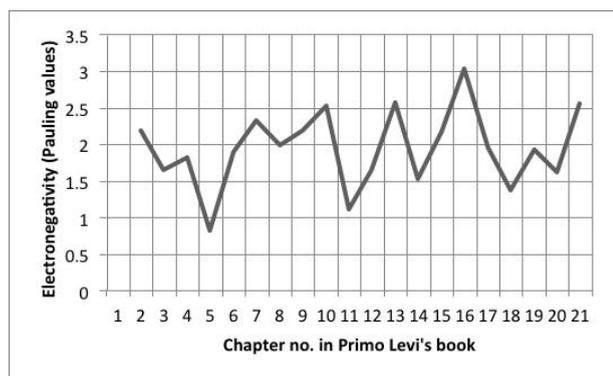


Fig. 4. Variation of chapter themes in *Il Sistema Periodico* and electronegativity with the atomic numbers of the elements after which the chapters are named.

lates to the Italian *La Tavola Periodica*. For this reason, and probably unbeknown to the artist who designed the cover of one edition of Primo Levi's *The Periodic Table*, an illustration that shows a table but not specifically the chemist's Periodic Table (Fig. 6) seems rather more appropriate. From this idea and from Fig. 5 a 'Levi table' can be constructed, as shown in Fig. 7.

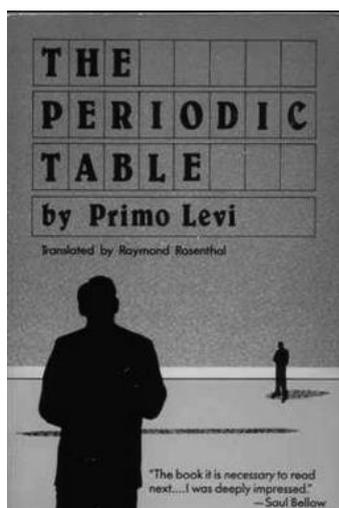


Fig. 6. A version of the cover of Primo Levi's book *The Periodic Table*, which features a symbolic periodic table.

F	Pb	S	Ti				
F+C	Hg						
C	K	Ni	C				
C+L	H	Zn	P	Cr	As	N	Sn
L	Ar	Fe	Au	Ce	Ag	V	

Chapter order, by theme

Fig. 7. A 'Levi periodic table'.

While as a chemist, I can identify with Primo Levi's *Periodic Table*, the scientist-manager in me also found pleasure in Levi's fictional play *The Sixth Day* (Fig. 8),⁸ to which I referred in closing my presentation.

The Sixth Day essentially chronicles the deliberations of a committee in the final stages of developing a Man. Before the meeting starts the chairman praises the progress so far:

Levi index	3	F						•						•	•							
	F+C								•													
	2	C				•	•														•	
	C+L			•	•						•			•			•	•	•	•		
1	L	•			•					•	•									•	•	
Chapter		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Element		Ar	H	Zn	Fe	K	Ni	Pb	Hg	P	Au	Ce	Cr	S	Ti	As	N	Sn	U	Ag	V	C

Fig. 5. Variation of chapter themes, including partial themes, in *Il Sistema Periodico* by chapter number.

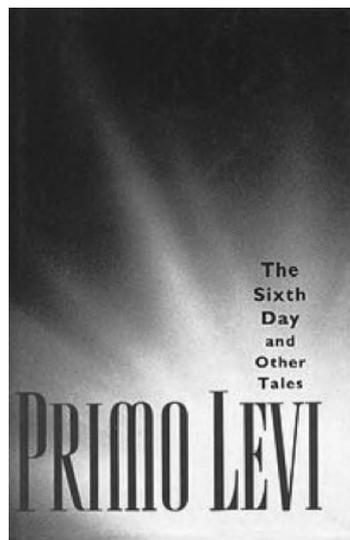


Fig. 8. Cover of *The Sixth Day*.

“The elegant and practical solution of the problem of oxygen regeneration has been particularly practical [acknowledging the thermodynamic advisor], the successful procedures submitted and realised by the advisor for chemistry, for the closure of the nitrogen cycle, and in another no less important field, the perfecting of the wing-flapping frequency, movement of which I’m glad to convey to the advisor on mechanics, the high praise of management, together with the request to pass it on to the bird foreman and the insect foreman who have assisted him.”

The rest of the play comprises interchanges between the fusty committee members which include an anatomy advisor, a minister of waterways, and a psychological

advisor (as well as those specialists mentioned earlier). The meeting is suddenly interrupted to be told that management has already decided what Man will be like, at which the chairman laments: “They didn’t wait for us... Once again they’ve decided to prove to us that we’re not necessary, that they can manage by themselves, they do not need anatomists, nor psychologists...” He could have added “nor even chemists”. There is nothing more the specialists can do: apart from the Secretary’s administrative tasks; the chairman intones: “everyone else is relieved of any and all their commitments. Take heart gentlemen, the meeting is adjourned”.

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Some Unremembered Chemists

A series of articles that explores the lives and work of selected chemists who have made a significant contribution to the advancement of the discipline, the profession and well-being of mankind, yet who are little remembered.

John Mercer FRS, FCS, MPhS

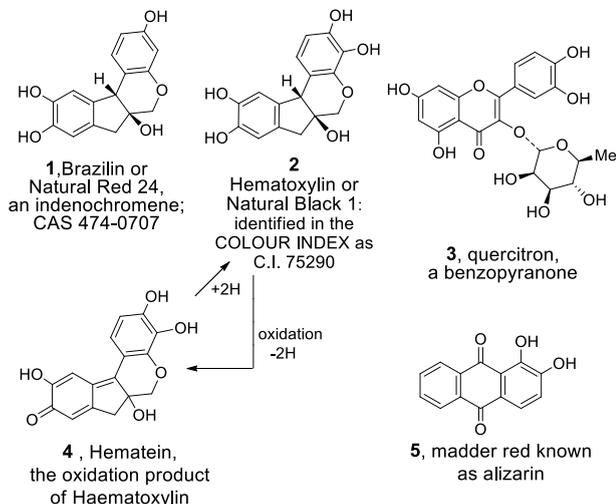
Part II. The industrialist, the chemist and the man

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Part I: *This Journal*, 2013, 77, 26–28.

In the first part of this article, the rise of John Mercer as a self-taught dyer in the town of Great Harwood, Lancashire, England, was described from his birth¹ in 1791 until he was re-employed at the nearby Clayton-le-Moors “Oakenshaw Print Works” in 1818 as an experimental chemist in the colour-shop^{1–5}. Mercer had experimented from as early as 1807 with, amongst others, the compounds depicted in Scheme 1. He advanced the use of dyes and the art of dyeing quite significantly. At this time all dyestuffs were supplied in crude state, with nothing available from synthetic preparation.⁶ It was, therefore, important to purify the dyes to avoid overspill (the dye spreading beyond the desired part) in the dyeing process, and chemists were employed at the various dye works for this and to improve the process.



Scheme 1

From the time of his employment (previously, he had been an apprentice, but that was terminated in 1810 as a result of Napoleon’s Fontainebleau Decree), Mercer’s skill and energy provided many inventions of new styles and new colours in the dye industry and, importantly, they led to new branches of *industrial chemistry*, as it was then known.^{3,4} It was his “antimony range” of dyes that led to his (re)employment, and this he developed further to give browns of differing hues on calico² with copper(II) and lead(II) compounds.⁶ His work with chromium compounds is reputed^{3,4} to have created the industrial manufacture of bichrome (potassium dichromate, $K_2Cr_2O_7$). At the time of his initial experiments with it, the cost was

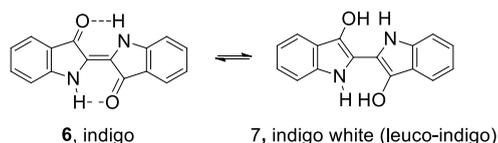
ten shillings and sixpence an ounce but by 1885, after his studies and with industrial manufacture becoming more common, its cost was less than sixpence per pound. He rediscovered and introduced into England a method of applying lead chromate ($PbCrO_4$) to cotton cloth in 1823. This yellow dye was then of great importance and formed within the fabric by treating it with lead acetate and then potassium chromate. That same year he introduced manganese bronze (a mixture of manganese oxides whose hue depends upon the degree of oxidation) formed from manganese salts, a dyestuff that went in and out of fashion in a cyclic manner almost every ten years. He also greatly improved the methods of printing indigo by using potassium ferricyanide [$K_3Fe(CN)_6$] and potash.

Of almost equal importance was his method of preparing mixed cotton and woollen fabrics that would subsequently accept dye with equal effectiveness. He found that some aluminium *lakes* [a lake is a pigment formed by precipitating a dye with an inert binder (the mordant), usually a metallic salt] from organic dyes were dissolved by ammonium oxalate [$(NH_4)_2C_2O_4$], and this led to the use of aluminous colour-precipitates in steam colour work. He also devised a new and cheaper method of preparing sodium stannate (Na_2SnO_3), a compound that was valuable to the calico dyer that provided him with much monetary gain.

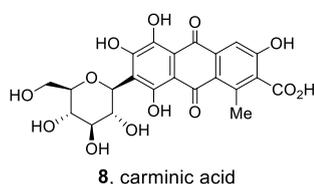
Of the numerous improvements made by Mercer, the use of alkaline arsenites, e.g., Na_3AsO_4 , in the *dunging* operation was one of the more important.³ Superfluous uncombined mordant that remained on the cloth from the first stages of the dyeing process, and any remaining thickening agent with which the mordant was printed in, had to be removed after *ageing* and prior to attaching the dye. Unless adequately removed, the mordant dissolved in the dye-bath and caused discolouration of the whites, a deterioration of the dyeing liquor, and the dye spread beyond the defined pattern. Traditionally, the removal was accomplished by passing the cloth through hot water in which cows’ dung had been dissolved – hence the name. Mercer’s discoveries led to far superior substitutes, the principal ones of which were sodium silicate and arsenate.

Once established, John Mercer was sought after by chemical manufacturers and dyers, and he is reputed to have given his services freely. His self-taught skills and knowledge had, from the earliest times, led him to make accurate records of his work to the extent that solution

strengths and chemical quantities were recorded in (the then new) equivalents. He is regarded as one of the earliest workers in volumetric analysis. In 1827, he was able to value bleaching powder and bichrome using standard solutions. He speculated on the nature of white indigo **7**, the reduced soluble form of the indigo, **6**. When calico is submerged in a bath of white indigo and then removed, the white indigo quickly reacts with atmospheric oxygen and reverts to the insoluble, intensely colored indigo in the fabric. His views on what happened here were contrary to the accepted ideas but, subsequently, the redox process as we know it was proved correct.³



From the time of his first experiments early in the nineteenth century, Mercer had been concerned with avoiding waste. In about 1825, he introduced a new way of recovering the colouring matter of cochineal (the aluminium salt of carminic acid, **8**). The traditional method of the time, involved digesting in hot water, but Mercer found that some 25% of the dye was left in the dregs. At ten shillings per pound of weight this was an unnecessary waste. By adding a neutral alkaline oxalate to the water he found that 100% of the dye was extracted. Some 25 years later a French chemist visited the Oakenshaw works³ to describe his method of cochineal extraction, but he had to concede that, although similar, the Mercer method required fewer steps and was superior.



In 1841, Lyon Playfair (the noted chemist who had been James Thompson's private assistant and then a PhD graduate of Liebig in Giessen) was employed as a chemist at Thompson's Primrose print-works in Clitheroe (a town some 12 km from Great Harwood). He recognized Mercer's abilities and the two men became friendly. They began to meet weekly in a pub in Whalley, a village midway between the towns, to discuss science and matters of the day affecting the print works. These meetings attracted as many as ten like-minded individuals and it was at one of these gatherings that Mercer advanced his theory of catalysis, which he illustrated with many examples.³ Subsequently, he read this theory to the 1842 Manchester meeting of the British Association for the Advancement of Science. Playfair extended these concepts and they were finally settled by Kekulé. Playfair's influence had Mercer extend his knowledge and by the time that he formally retired he was regularly using the *Bereichte* and other journals of the era.

Further observations made by Mercer in 1843, and discussed at these Whalley meetings, led Playfair subsequently to discover the nitroprussides, e.g., $\text{Na}_2\text{Fe}(\text{CN})_5\text{NO}$. Playfair was so enamoured with the work of John Mercer

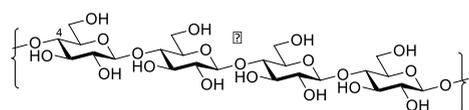
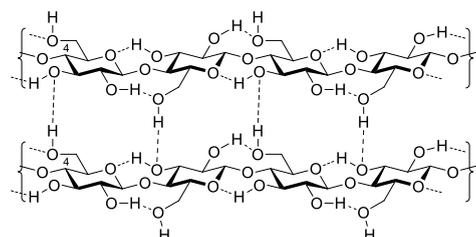
that he persuaded him to become a foundation member (in chemical manufacture) of *The Chemical Society* in 1842 (FCS). Later, a group of noted chemists of the day, James Thompson, Walter Crum and Lyon Playfair, on dining at the home of Professor Thomas Graham, concluded that Mercer should be nominated for election to the Royal Society. In a final letter to Mercer, Playfair stated that it "would be a great tribute to a man who has acquired knowledge of science without the aid of academies, and under every disadvantage" and it was this persuasion that had Mercer accede.³ He was elected a Fellow of *The Royal Society* (FRS) in 1852.

It was Mercer's discoveries of 1844 that gained him the fame and kudos he deserved, and a considerable fortune. He provided a formulation for red ink, which gave him the sum of £10,100, and then his experiments in treating cotton with sodium hydroxide, sulfuric acid and zinc chloride led to the *mercerization* process, which he patented in 1850. There appear to be few records of the red ink formulation, although his experiments were carried out in partnership with Robert Hargreaves at his Broad Oak factory, near Accrington. In contrast, the mercerization process is well known. What Mercer found was that any one of sodium hydroxide, sulfuric acid or zinc chloride caused individual cotton fibres to become thicker and shorter, giving the cloth much greater strength. It also became semi-transparent and better able to absorb dye. In his original process, the overall size of the fabric shrank, with the result that the process became popular only after H. A. Lowe improved it in 1890; the cotton was held during treatment to prevent it shrinking. The fibres then gained a lustrous appearance. This represents the modern form of the process with mercerized cotton (Fig. 1) now the norm.

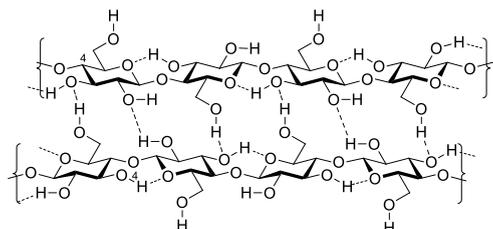


Fig. 1. Spools of mercerized cotton thread (from en.wikipedia.org/wiki/File:SpoolsOfThread and en.wikipedia.org/wiki/File:Mercerised_cotton_thread_of_800px-Spool_of_white.jpg).

Although discovered by Mercer in 1844, the fine details of the mercerization process are still not fully understood. Cellulose consists of a polymeric chain of D-glucose molecules depicted by structure **9** (Scheme 2). In the polymer, the alternate rings are rotated 180° with respect to one another and the chain is strengthened by H-bonding, as shown in **10**. The discourse by Speakman⁷ provides the essentials of what is known about the process of mercerization. Thus, the change in lustre of cotton fibres on treatment with concentrated NaOH is due to a change in the shape of the fibres. On the cotton plant the fibres are attached to the cotton seeds in a closed cotton pod. The fibres are straight with a circular cross-section and have a central cavity filled with a dilute aqueous solution of various salts and other small molecules, akin to thick-

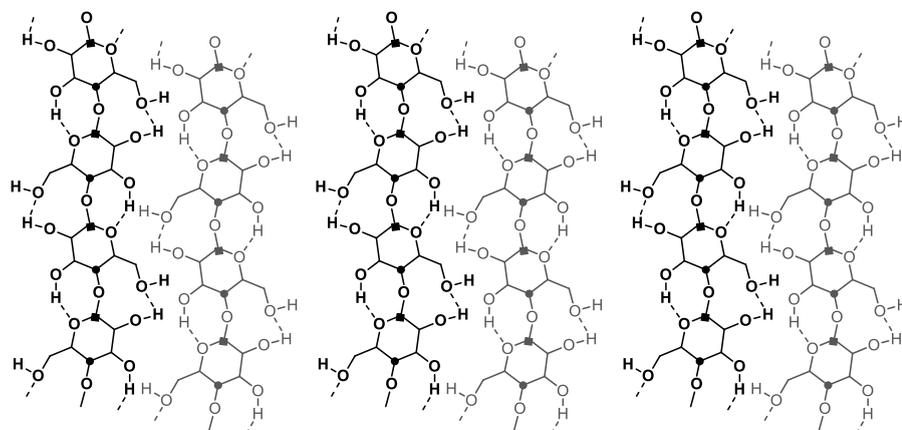
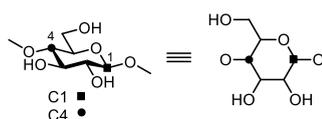
9, Cellulose: β -linked poly-D-glucose

10, crystallized region of cellulose, showing H-bonding in the aligned parallel chains of the less thermodynamically favoured sheet of non-mercerized cotton

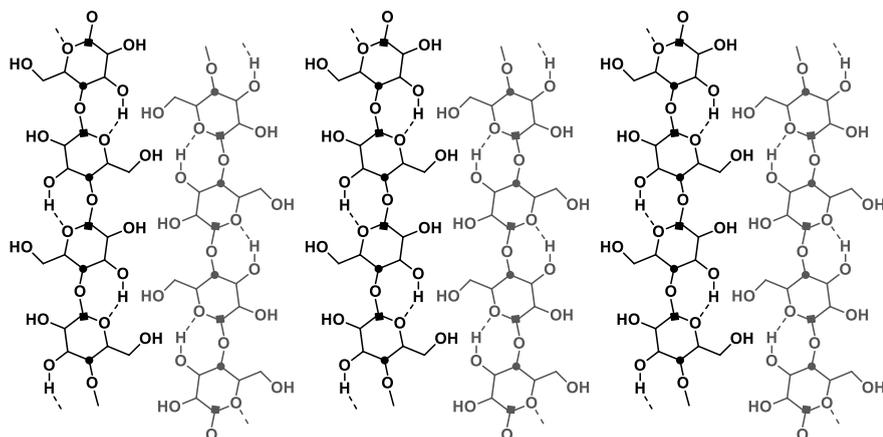


11, crystallized region of cellulose showing H-bonding in the parallel chains and their opposite orientation in the thermodynamically favoured sheet of mercerized cotton,

Scheme 2.



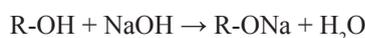
Scheme 3. Two parallel sheets of cellulose - unmercerized.



Scheme 4. Two antiparallel sheets of cellulose - mercerized.

walled tubes. When the fibre reaches its final length, the pod opens, the fibres dry in the sun, flatten and twist and acquire a tortured shape. Electron microscopy and X-ray diffraction experiments have shown that the cell walls of the cotton fibres contain microfibrils, each composed of about 1000 fully extended cellulose molecules. Each of these molecules consists of some 6000 glucose residues. Along the microfibril, ordered regions that are crystalline alternate with shorter non-crystalline ones. Untreated cotton is some 60% crystalline and has all the cellulose chains running parallel to one another and is stabilized by H-bonding, as shown by **10** in Scheme 2. The chains are arranged in sheets as depicted in Scheme 3 for three cellulose molecules in two separate sheets (not to scale). The bonds shown in bold depict one sheet and the plain bonds the other. There is no H-bonding between sheets and the cotton is in its less thermodynamically stable form.

During mercerization, NaOH enters the central core of the fibril and breaks the H-bonding network and the fibres swell:



The chains can move one with respect to the other. However, when the NaOH is washed out of the cloth the sodium salts revert to their normal hydroxyl nature and the

H-bonding network is re-established giving new microfibrils. The sheets are disrupted during the NaOH treatment and the regenerated microfibrils are formed in such a way as to generate the thermodynamically more stable form. The cellulose chains now run in opposite, antiparallel, directions depicted by **11** in Scheme 2 and the new sheet format of Scheme 4. Since the sheets do not align one with the other, the independent sheets carrying **9** do not lie in the same direction, and it appears that the antiparallel arrangement comes from new H-bonding between cellulose molecules of different sheets when the NaOH is removed. No single chain rotates through 180°.

An alternative explanation involves the stacking of the fibrils during the crystallization process. Here neighbouring parts of the molecule run in opposite directions in the zigzag plates and are antiparallel allowing for the reorganization.⁸ Furthermore, stirring the polymer molecule during crystallization causes a portion of the long molecules to become extended, while the

remainder crystallize to give plates at intervals along the rods. These rods are disc-shaped and give rise to a partly crystalline structure with wheel-like plates along its axis – such a structure is termed a synthetic polymer shish-kebab (a β -*cylindrite structure*). Mercerized cellulose has been shown to have such shish-kebab components by electron microscopy.⁸ The chains in the kebab parts of the cellulose shish-kebab molecule are folded in just the same way as from an unstirred solution and are, therefore, likely to be antiparallel; the chains in the shish (extended) part of the molecule are assumed also to be antiparallel. Although many fine details still remain to be established as illustrated by a recent review,⁹ Mercer's discovery of treating cotton cloth with sodium hydroxide to facilitate the dyeing process and imparting lustre means that it is entirely fitting that the commercial process immortalizes his name.

Mercer's immersion in colour led him to produce some of the earliest recorded colour photographs. In a letter to Lyon Playfair written in May 1857, he states that he had been experimenting for 2-3 years making photographic experiments, not as an artist but as a chemist. However, the earliest record of him observing the effects of sunlight on material dates back to the 1820s. His studies and 'amusements' led to him discovering a new way of measuring the power of solar rays and to the blue-print concepts. From 1854 he began producing colours on paper and cloth using the impact of light on various chemicals and obtained pictures "in a variety of pleasing tints".³ His studies led to him exhibiting a number of the photographs at the 1858 British Association meeting in Leeds. A professional photographer of the day said that he had never seen anything on paper as beautiful as the Prussian blue in softness and gradation that Mercer had obtained.³ His specimens attracted much attention in Vienna and the photographic society there sought the process from him.

At the 1858 meeting of the British Association, Mercer described the reducing action of light on complex salts of iron to give a blue colour, the depth of which depended upon the light intensity, a discovery of his that dated to 1828. This 'blue-printing' proved of immeasurable value to the drawing offices. He intended to use blue-printing to measure the intensity of sunlight, an idea that was adopted by several metrological stations.

At the same meeting of the British Association, John Mercer advanced the concept of simple mathematical relations between the atomic weights of the elements. Unfortunately, this was generally ignored. Mendeleev's Period Table of 1869 and the subsequent periodic system followed,¹⁰ yet the extract from Parnell's book³ (Fig. 2) shows that Mercer had a grasp of the octet and the periods (based on O = 8)

So with the lithium and magnesium groups:

$\begin{array}{l} \text{O} - \text{Li} = 1 \\ \text{S} - \text{L} = 9 - 1 = 8 \\ \text{Se} - \text{Na} = 17 - 9 = 8 \\ \text{Te} - \text{K} = 25 - 17 = 8 \end{array}$	$\begin{array}{l} \text{Mg} - \text{L} = 5 \\ \text{Ca} - \text{L} = 13 - 5 = 8 \\ \text{Sr} - \text{Na} = 21 - 13 = 8 \\ \text{Ba} - \text{K} = 29 - 21 = 8 \end{array}$
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Fig. 2. Extract from pages 324 and 325 of *The Life and Labours of John Mercer*, F.R.S – ref. 3.

The principal partners of the Oakenshaw Print Works retired in 1848 and John Mercer elected to do the same, devoting himself more to experimental study. However, after his wife's death in 1859 his enthusiasm waned. He died on 30 November 1866 following complication from falling into the water of a reservoir (under construction) some two years earlier. It appears that he was an unselfish person with a furtive mind given to flights of scientific fancy with his friends. He was an experimentalist *par excellence* and had remarkable insight into chemistry. It has been said that had he devoted himself entirely to research, he would have been among the most distinguished chemists of the day.⁵ Although he patented some of his inventions, he freely gave away many others to great advantage and considerable profit of the recipients. He became an honorary member of the Manchester Philosophical Society in 1849 and of the Glasgow Philosophical Society (MPhS) in 1860. He accepted a role equivalent to Justice of the Peace in 1861, but Parnell says that "the claims of justice to the community were not infrequently outweighed by his feeling of pity and compassion for the "offender". It is clear that John Mercer was an upstanding and outstanding member of the community.

Acknowledgements

I am grateful to Dr Mattie Timmer for improving the structures depicted in Schemes 2-4.

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Change to Data Protection Laws

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Before agricultural or veterinary products are used and sold in New Zealand they must be granted approval by the regulatory authorities. They are the Ministry for Primary Industry (MPI) and the Environmental Protection Authority (EPA).

If it is a new active ingredient or there is a significant change from an existing product, the approval process can involve significant costs in obtaining data to prove there is minimal risk to public health and the environment and that the products are effective.

If the product is the same as an existing product that is registered (i.e., it is a generic product), it is possible to cross reference the data which supported the registration for the original innovative product, rather than obtain new data. This can be a very significant shortcut which will save on costs and time to bring a generic product to market. In fact, many generic products would not be on the market were it not for this shortcut. While it is possible for a generic manufacturer to generate the data themselves to support a registration application, in practice this does not happen owing to the prohibitive cost and time involved. However, this cross referencing of data can only be done once the data for the original product become publically available.

Part of the law governing the registration of new products is that the government agency will keep data confidential for a certain period of time after the first registration. This is generally known as the "data protection period". This gives the innovative product registrant, i.e., the company that generated the data, a head start on the market. The investment in time and money to create the data package is often considerable. Data protection can be thought of as a reward for making this investment.

This data protection period can be considered a form of intellectual property protection, which if handled strategically can complement patent protection. As New Zealand is a small market, patent applications are not always filed in New Zealand. In these cases one of the main intellectual property options is data protection. However, many believe the data protection provisions are not comprehensive enough to encourage the registering of new products in New Zealand, particularly in cases where there is no patent protection.

Government review of data protection periods

The Government recently indicated that it intends to make some amendments to the data protection provisions in the Agricultural Compounds and Veterinary Medicines Act (the law that governs the registration of products). Officials are working on the necessary amendments, with a view to the changes taking effect from late 2013. How-

ever, the timing for bringing changes of law through parliament is often slower than anticipated.

As part of the announcement of the changes that would be made there was also a note of what will not be changing, notably the data protection period for new active chemical ingredients that have not been previously registered in New Zealand. The review found that the current five year period of protection was appropriate. To put this in context; Australia gives eight years, Europe eight and the United States ten, with provisions for extending this time where further data are provided for various reasons. However the Government believes five years strikes the appropriate balance between encouraging the introduction of new products into New Zealand and the time before generic products can enter the market. In comparison other countries this data protection period is relatively generic manufacturer friendly.

New uses

In order to encourage the registration of additional uses for products, it will be possible to seek an extension of the five-year period of protection by one year for each additional use that is registered within three years of initial product registration, up to a maximum of three extra years. This would give a potential maximum of eight years of protection for the original data.

This change is being introduced because the Government review found that a number of important New Zealand horticultural crops and commercially farmed animals are considered "minor" commercial crops or species internationally, so products are not registered for use on them. The change is intended to encourage the registration of these additional "minor" uses in the New Zealand market. Examples of some of the agricultural uses which are relatively major in New Zealand in comparison to other countries are related to apples, kiwifruit, deer, goats and ostriches.

It has been pointed out this approach could encourage daisy-chaining of applications for new uses, rather than including all uses in the first application for registration. It is therefore possible that this provision could actually delay products becoming available for multiple uses.

New uses and reformulations of non-innovative compounds

Currently there is no data protection provided for new uses or reformulations of products that contain active ingredients that have been previously registered in New Zealand. The review found that the lack of data protection in this area may be inhibiting the registration and development of uses and products for the New Zealand market. As a result, a three-year period of data protection will be

introduced for new uses and reformulations. This is intended to provide an incentive to register additional uses and reformulations of existing products in the New Zealand market.

How large a change will need to be made in order to trigger data protection for a new use will need to be clarified.

We are sure that the above issues in relation to the extension of data protection provisions will be addressed in the upcoming legislation. The extension provisions are a welcome addition to the data protection available in New Zealand and should encourage registration of new products in New Zealand.

If you have any queries regarding intellectual property related matters (including patents, trademarks, copyright or licensing), please contact:

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Katherine Hebditch and Tim Stirrup of Baldwins Intellectual Property in Auckland specialise in chemistry and biotechnology patents. Katherine obtained her PhD in organic chemistry from the University of Manchester in the UK in 2004. She is currently working towards registration as a patent attorney. Tim obtained his PhD in molecular biology from the University of Southampton in the UK in 2007. He is also working towards registration as a patent attorney.



Dates of Note

Hoh Hao Li was the Chinese-American biochemist and experimental endocrinologist who, with his co-workers, isolated in pure form six of the eight hormones known to be secreted by the anterior pituitary gland. He was born on May 21, 100 years ago. **Max (Karl Ernst Ludwig) Planck**, the noted German theoretical physicist, was born on April 23, 1858. This was the day in 1853 that **Auguste Laurent**, the French chemist who developed organic chemistry as a distinct science, died. April 24 marks the 125th anniversary of the founding of the Eastman Kodak company by inventor George Eastman, while the following day marks 60 years since the *Nature* publication of the structure of DNA in a one-page article by **James D. Watson** and **Francis Crick**. **Josiah Willard Gibbs**, the American mathematical physicist and chemist known for his contributions to vector analysis and as one of the founders of physical chemistry, died on April 28, 1903. This same date marked the birth in 1753 of **Franz Karl Achard**, the German chemist who invented a process for the large-scale extraction of table sugar (sucrose) from beets. In 1801, Achard opened the first sugar-beet factory, in Silesia (now Poland). **Harold C. Urey**, the American awarded the Nobel Prize for Chemistry in 1934 for his discovery of deuterium, was born on April 29, 1893. **Georg Brandt**, the Swedish chemist who was the first to discover a metal unknown in ancient times (isolated and named cobalt in 1730), and **Albert Hofmann**, the Swiss pharmacologist

who discovered LSD (lysergic acid diethylamide), both died on April 29, but in 1768 and 2008, respectively.

On May 1 in 1683, a patent was awarded in England for the extraction of salt from sea water. May 5 sees the 50th anniversary of the world's first human liver transplant (1963); it was performed by Dr. **Thomas E. Starl** in Denver. **Henry Edward Armstrong**, the English organic chemist whose major research in substitution reactions of naphthalene was important to the synthetic-dye industry, was born on May 6, 1848. That was also the day, 60 years ago, that the first heart-lung machine was used to successfully complete the first open-heart surgery; Dr. **John Heysham Gibbon's** machine was the forerunner of those now in common use. **Nevil Vincent Sidgwick**, the English chemist who contributed to the understanding of chemical bonding, especially in coordination compounds, was born on May 8, 1873, whilst **Victor Mordechai Goldschmidt**, the German mineralogist who made important studies of crystallography died on this day in 1933. **Joseph Louis Gay-Lussac** died on May 9, 1850. **Rudolf Schoenheimer**, the German-American biochemist whose technique of "tagging" molecules with radioactive isotopes made it possible to trace the paths of organic substances through animals and plants and revolutionized metabolic studies, was born on May 10, 1898. **Justus von Liebig** was born on May 12, 1803. The name *Vaseline* was registered

as a trademark for the petroleum jelly developed by an English-born chemist **Robert Augustus Chesebrough** on May 14, 1878. **Frank Hornby**, the English inventor and manufacturer who patented the Meccano construction set in 1901, was born on May 15, 150 years ago.

Nicolas-Louis Vauquelin, the French chemist who discovered the elements chromium (in 1797) and beryllium (in 1798), was born on May 16, 250 years ago. **Hans Berger**, the psychiatrist who recorded the first human electroencephalogram (EEG), was born on 21 May, 1873. **Hans Goldschmidt**, the German chemist who invented the thermite (alumino-thermic) process adopted worldwide for welding railroad and streetcar rails, and which is still in use for on-site welding, died on May 25, 1923. **Ascanio Sobrero** was the Italian chemist who discovered nitroglycerin by adding glycerine slowly to a mixture of nitric and sulphuric acids in 1847; he died on May 26, 125 years ago (1888). When Sobrero discovered the explosive power of even a single drop in a test tube, he named the new compound pyroglycerin. Sobrero was horrified by the destructive potential of his discovery, and made no effort to develop that power himself, though it became known as nitroglycerin, or blasting oil. Two decades later, Nobel combined nitroglycerine with diatomaceous earth, making it safer to handle, but just as useful for blasting rock for construction and mining. Nobel made a fortune as the inventor and manufacturer of dynamite. **Wolfgang Ostwald**, the German chemist who devoted his life to being a teacher, researcher, editor, and one of the founders of colloid chemistry, was born on May 27, 1883. **Ernst Ruska**, the German electrical engineer who invented the electron microscope died this same day 25 years ago. **Morris William Travers**, while working with Sir **William Ramsay**, discovered the element krypton on May 30, 1898, in London.

Edwin Gerhard Krebs, the American biochemist and winner (with Fischer) of the 1992 Nobel Prize for Physiology or Medicine for discovering reversible protein phosphorylation, was born on June 6, 1918. **Ronald G.W. Norrish** was the British chemist who shared the 1967 Nobel Prize for Chemistry (with fellow Englishman Sir George Porter and the German Manfred Eigen) for their studies of very fast chemical reactions. Between 1949 and 1965 he collaborated with his former pupil Porter in the development of flash photolysis and kinetic spectroscopy for the investigation of very fast reactions. Norrish also made a significant contribution to chemistry when he corrected Draper's law. In the mid-19th century John Draper proposed that the amount of photochemical change is proportional to the intensity of the light multiplied by the time for which it acts. Norrish showed that the rate was, in fact, proportional to the square root of the light intensity. Norrish died on June

8, 35 years ago (1978). **Kurt Alder**, the German organic chemist who was the co-recipient (with Otto Paul Hermann Diels) of the 1950 Nobel Prize for Chemistry for the development of the Diels-Alder reaction (1928), or diene synthesis, died on June 20, 55 years ago. On June 25, 1903, **Marie Curie** went before the examination committee to successfully complete her PhD. On June 25, 1783, **Antoine Lavoisier** announced to the French Academy of Sciences that water was the product formed by the combination of hydrogen and oxygen, a discovery made earlier by Henry Cavendish in 1766. **Peter Waage**, the Norwegian chemist who published the law of mass action (with his brother-in-law **Cato Guldberg**) in 1864, was born on June 29, 1833.

Buckminster Fuller, the architect who developed the geodesic dome and after whom the C₆₀ molecule fullerene is named, died 30 years ago on July 1. **Samuel Hahnemann**, the founder of homeopathy, died on July 2, 1843. **Axel Hugo Teodor Theorell**, the Swedish biochemist who won the 1955 Nobel Prize for Physiology for his discoveries concerning the nature and mode of action of oxidation enzymes, was born on July 6, 1903. On July 7, 1668, **Isaac Newton** received his MA from Trinity College, Cambridge. On July 10, 1908, **Kamerlingh Onnes** liquified helium for the first time. **Elias James Corey**, the American organic chemist who won the 1990 Nobel Prize for Chemistry for his development of the theory and methodology of organic synthesis, has his 85th birthday on July 12. **Saul Dushman**, the Russian-American physical chemist who was a world leader in vacuum science and technology, and author of several standard scientific textbooks on the subject, was also born on July 12, but in 1883. **Paul Walden** was the Latvian chemist who, while teaching at Riga, discovered the Walden inversion; he was born on July 14, 150 years ago. **Hartmut Michel**, the German biochemist who (with Deisenhofer and Huber) was awarded the Nobel Prize for Chemistry in 1988 for the determination of the three-dimensional structure of the proteins essential for photosynthesis, is 65 years old on July 18. **Pierre-Louis Dulong**, the chemist and physicist who helped formulate the Dulong-Petit law of specific heats in 1819, died on July 18, 1838. **Curtis Marbut**, the US geologist who is regarded as a co-founder of modern soil science, was born on July 19, 1863. **Rudolph A. Marcus**, the Canadian-born American chemist and 1992 recipient of the Nobel Prize for Chemistry for his work on the theory of electron-transfer reactions in chemical systems (the Marcus theory), has his 90th birthday on July 21.

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Science in the News

Use of helium gas in party balloons: are we wasting a valuable resource?

Helium is the second lightest and second most abundant element in the universe and is found in some natural gas deposits during gas and oil drilling. It has the lowest boiling point of any element (4.2 K). Liquid helium is used as a coolant in cryogenics where it cools the superconducting magnets, and its commercial applications include its use for the operation of MRI scanners and the Large Hadron Collider. In addition, it is utilised in the industrial sector as a pressuring and purge gas and as a protective environment for arc welding.

Helium, however, has a more frivolous and what some would consider wasteful use. It makes brightly coloured party balloons fly high into the air or allows them to bob along your living room ceiling and if inhaled, helium can make your voice sound very high and squeaky. But should we be wasting helium like this?

Once helium is released into the atmosphere it cannot be recovered. Considering that there is only a limited amount of Helium available, as it is rare and finite, there are arguments for conserving it and perhaps banning its use in balloons.

Dr. Peter Wothers, a researcher at Cambridge University, used the Royal Society's Christmas Lecture in 2012 to argue his case for banning the use of the gas in Christmas party balloons. He worries that because helium is non-renewable and unable to be synthesised that we should be ensuring it is only used for its industrial applications. In his lecture he warned "The scarcity of helium is a really serious issue. I can imagine that in 50 years time our children will be saying 'I can't believe they used such a precious material to fill balloons'."

New Zealand National Science Challenge panel announced

Members of the public were given an opportunity to have their say in the development of future science challenges in New Zealand via the website www.thegreatnzscienceproject.co.nz at the end of last year. Submissions to the website closed on 28 January 2013. Following from this, a National Science Challenge Panel has been formed.

This panel, chaired by the Prime Minister's chief science adviser Sir Peter Gluckman and comprising eleven researchers and young scientists, has been set up to look at the important science challenges which will face New Zealand in the future. The panel members include:

Professor William Denny (Auckland Cancer Society Research Centre)

Dr Ian Ferguson Departmental (Science Adviser for the Ministry for Primary Industries/Chief Scientist of Plant and Food Research)

Professor Peter Hunter (Professor of Engineering Science and Director of the Bioengineering Institute at the University of Auckland)

Professor Mary O'Kane (NSW Chief Scientist and Engineer, Australia)

Professor Jacqueline Rowarth (Professor of Agribusiness at the University of Waikato)

Professor Richie Poulton (Director of the Dunedin Multi-disciplinary Health and Development Research Unit, University of Otago);

Charles Royal (Member of MBIE Science Board)

Professor David Penman (Consultant, previously Assistant Pro Vice Chancellor Research, Lincoln University);

Elf Eldridge (PhD student at the MacDiarmid Institute)

Rachael Wiltshire (2012 Dux of Samuel Marsden Collegiate, Wellington and a 2012 Royal Society of New Zealand science prize winner).

The Government has budgeted \$60 million funding from last year for new investment into the National Science Challenges.

Traces of dicyandiamide (DCD) found in New Zealand milk

Laboratory tests, performed in New Zealand in September last year by dairy company Fonterra, found that 10 out of 100 samples taken of whole milk powder, skim milk powder and buttermilk powder made with milk from the North and South Islands contained 'very low levels' of DCD.

According to The Ministry for Primary Industries, previous tests performed in 2010 showed no indications of DCD, and DCD was not found to be present in any dairy products made in November of last year.

The Ministry said, "Testing completed so far has not shown any DCD residues to be present in protein products, butter, cheese or anhydrous milk fat." In addition they stated, "Research shows no food safety risk or human or animal health concerns with DCD use."

As a precaution, the fertilizer companies have suspended the sale of DCD, which is used to reduce the leaching of nitrogen into waterways and to reduce greenhouse gas emissions. DCD has been commercially used since 2004 and a year before its release, Landcare Research assessed the potential environmental and human health affects of spraying DCD onto pasture. No risks were found as a result of these studies.

Currently, there is no internationally set standard for DCD residues in food. DCD is water-soluble and is said to wash rapidly into soil with rain. This means it is subsequently out of reach of consumption by animals.

The Ministry for Primary Industries says it will take up to five years for it to investigate the issues which will allow the subsequent setting of a maximum allowable residue level.

The Local Government Association, representing water quality regulators however warns, "The withdrawal of nitrogen inhibitors from fertiliser is a major concern for both New Zealand's agriculture-based economy and for our environment."

Conference Calendar

New Zealand Climate Change Conference 2013

4 – 5 June, Palmerston North

The conference will cover the latest research in climate change physical science, adaptation, mitigation and cross-cutting issues. Bringing together researchers from across New Zealand and overseas, this two-day conference will showcase the latest climate change research thinking and outputs.

Conference attendees are invited to submit abstracts and deliver presentations (or posters) on recently completed or in-train research under the following themes:

- the physical science
- impacts adaptation and vulnerability
- mitigation
- integration and cross-cutting issues

Conference registration and abstract submission will open soon. Whilst the conference will primarily appeal to New Zealand's climate change research community, it will also appeal to industry, government, NGOs, and members of the public interested in the latest climate change research.

Please visit the dedicated conference website for further information: www.nzcccconference.org or contact Richard Nottage (NZCCC) r.nottage@nzclimatechangecentre.org (04 386 0327).

Challenges in Organic Materials and Supramolecular Chemistry

18 – 21 June 2013, Kyoto, Japan

Challenges in Organic Materials and Supramolecular Chemistry will be the first event in the International Symposia on Advancing the Chemical Sciences (ISACS) series in 2013. This meeting builds upon the success of ISACS 6 on Organic Materials and Supramolecular Chemistry by bringing together leading scientists from across the world to share scientific developments. Themes include:

- self-assembly and self-assembled materials
- imaging and sensing
- medicinal and chemical biology aspects of supramolecular chemistry
- organic materials
- porous materials

See: www.rsc.org/ConferencesAndEvents/ISACS/ISACS10/index.asp

8-ISMSC 2013, 8th International Symposium on Macrocyclic and Supramolecular Chemistry

7 – 11 July 2013, Arlington, Virginia, USA

This conference showcases advances in supramolecular chemistry, materials science and nanoscience.

See: www.indiana.edu/~ismsc8/

Challenges in Chemical Renewable Energy

3 – 6 September 2013, Cambridge, UK

Challenges in Chemical Renewable Energy will be the third event in the International Symposia on Advancing the Chemical Sciences (ISACS) series in 2013. This meeting brings together leading scientists from across the world to share scientific developments in renewable energy generation and storage.

The conference will bring together exceptional researchers, all leading names in their field, for an outstanding plenary programme, complemented by contributed talks, together with extensive poster sessions that will provide many networking opportunities.

Themes: photovoltaics, solar fuels, new battery materials, fuel cells and molecular catalysis.

See: www.rsc.org/ConferencesAndEvents/ISACS/ISACS12/

2013 NZIC Conference

1 – 5 December 2013, Victoria University of Wellington

Confirmed speakers: Pieter Dorrestein (University of California, San Diego), Ben Davis (University of Oxford), Tina Overton (University of Hull), Jim Watkins (University of Massachusetts Amherst) and Jeff Tallon (Callaghan Innovation). The official conference website is under construction, but further information can be found at www.nzic.org.nz/conferences.html

IC'13 – RACI Inorganic Chemistry Divisional Conference

8 – 12 December 2013, Brisbane, Australia

IC'13 embraces all aspects of inorganic chemistry including bioinorganic, organometallic, main group and materials chemistry.

The confirmed IC'13 Plenary Speakers include:

- Professor Michael Graetzel (EPFL, Lausanne, Switzerland)
- Professor Chuan He (Chicago, USA)
- Professor Annie Powell (Karlsruhe, Germany)
- Professor Phil Power (UC, Davis, USA)
- Professor Dongyuan Zhao (Fudan, China)

See: www.scmb.uq.edu.au/ic13