A Legacy of Lancashire

Its Chemists, Biochemists and Industrialists

By Brian Halton

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Cover photograph: Pendle Hill and the Ribble Valley. From Bashall Barn across Clitheroe to Pendle Hill by Charles Rawding; see: http://commons.wikimedia.org/wiki/File:Pendle_Hill_and_the_Ribble_Valley_-_geograph.org.uk_-_72304.jpg

Three Lancastrian Sayings:

Rain before seven, fine before eleven

Rags to riches to rags

Well, if he took his brass wi ’im, it’s melted bi this time

and

Three Proverbs:

Clogs to clogs in three generations

English

Scattering is easier than gathering

Irish

Teachers open the door. You enter by yourself

Chinese

….. and Two from the Electronic Era:

What boots up must come down

Windows will never cease

Lancashire Pit-Brow Women
Engraving from *The Illustrated London News*, 28 May 1887

Esther M. Zimmer Lederberg Memorial Website
(http://www.estherlederberg.com/EImages/Extracurricular/Coal/Terms.html)

A Street in Bury, 1958, Philip Capper
(http://commons.wikimedia.org/wiki/File:Bury,_Lancashire,_England,_1958.jpg)

Preface

Although he probably does not remember it, it was Roy Jackson of Monash University in Melbourne and from Bacup in Lancashire who asked me if I was aware of the number of chemists coming from our mutual county. He then proceeded to rattle off the names of some for me. That was back in late 1988 when I was on leave at Monash, using the late Roger Brown's pyrolysis equipment as we had none in Wellington.

That snippet of information lay dormant in the grey matter for some 25 years, emerging only after I had agreed to write a series on *Unremembered Chemists* (as Peter Hodder, the then editor of *Chemistry in New Zealand* insisted the series be titled - after all if I knew of them then they were not forgotten) and selected the first few subjects. I found that several Lancastrian chemists were appropriate, remembered Roy's comment, and decided to see just how many I could find. This booklet is the culmination of these efforts. Through the good graces of Chris Moody at Nottingham University, many living chemists who have distinguished themselves, but whom I had failed to recognise because it is many years since I left the UK, are now included. It is more than likely that there are others who should be here but are omitted, and to them I apologise.

Apart from Roy and Chris, I am indebted to many of those whose details are included within these pages. Their willingness to provide information not easily available otherwise has made the writing and compiling of this '*Legacy*' so much the easier, and hopefully more interesting and useful. The free provision of images from numerous organisations, institutions and individuals is gratefully acknowledged for it puts the faces to the names.

The pages that follow give the names of the chemists in sequence from William Henry (b. 1774) to the present with a profile of each that provides some indication of the person and the work for which they are recognised. It is not surprising, therefore, that early scientists attract a more detailed account than those still practising the profession and adding to the kudos that they already have gained.

Brian Halton
Wellington
February 2015

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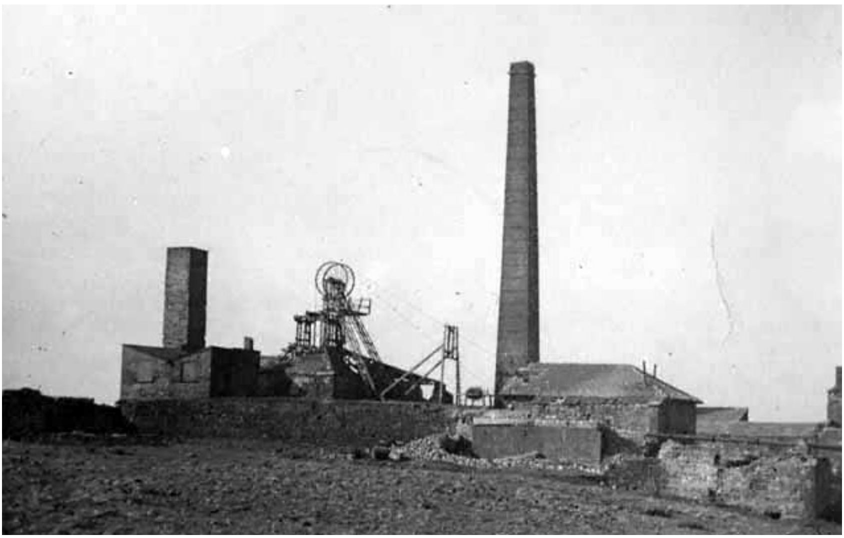

A view of Lol Hoyle Colliery near Shadsworth, 1917
Image provided by Blackburn with Darwen Borough Council
(for use in the Cotton Town digitisation project; see: www.cottontown.org)

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INTRODUCTION

Lancashire is one of the northern counties of England, occupying the south-western corner of that part of England. It has a population of almost 1.5 million Lancastrians. Its history is thought to have begun with its founding in the 12th century. In the Domesday Book some of its lands were treated as part of Yorkshire but once the initial boundaries were established, it bordered Cumberland, Westmorland, Yorkshire and Cheshire.

During the Industrial Revolution the county emerged as a major commercial and industrial region that encompassed some hundred mill towns and collieries. By the 1830s, almost 85% of all cotton manufactured worldwide was processed in Lancashire. The towns of Preston, Bury, Accrington, Blackburn, Bolton, Rochdale, Oldham, Chorley, Darwen, Nelson, Colne, Burnley and Wigan were major cotton mill towns during this time, while Blackpool was the major centre for tourism with most of the inhabitants of the mill towns taking their annual holidays there during the wakes week. Most of the chemists recorded herein come from these towns.

The boundary reforms of 1974 removed Liverpool and Manchester and most of their surrounding suburbs from the county to form what are now parts of the metropolitan counties of Merseyside and Greater Manchester, respectively (see Figure 1). At this time, those parts of Lancashire in the Lake District, including the Furness Peninsula and Cartmel were subsumed into Cumbria with the loss of some 700 square miles. Today, Lancashire borders Cumbria, Greater Manchester, Merseyside, and North and West Yorkshire. Yet the Duchy of Lancaster still exercises the right of the Crown within the historic boundaries of the county. The compilation that follows is set by the traditional pre-1974 county boundaries.

Few events have altered life as we know it more than the industrial revolution. Andrew Boyd of the College of Engineering, University of Houston in his radio presentation on *Industrial Engines of our Time* states[1] that it led to:

"… a fundamental reshaping of the economy that began in the mid to late eighteenth century and continued for about fifty years. New ways of manufacturing textiles, the steam engine, and advances in metal working freed us to make more, and make it faster. But something was missing. That something was science."

Thus, the Industrial Revolution was the transition from hand production methods to the daily use of machines and machine tools, with new chemical manufacturing and iron production processes. There was im-

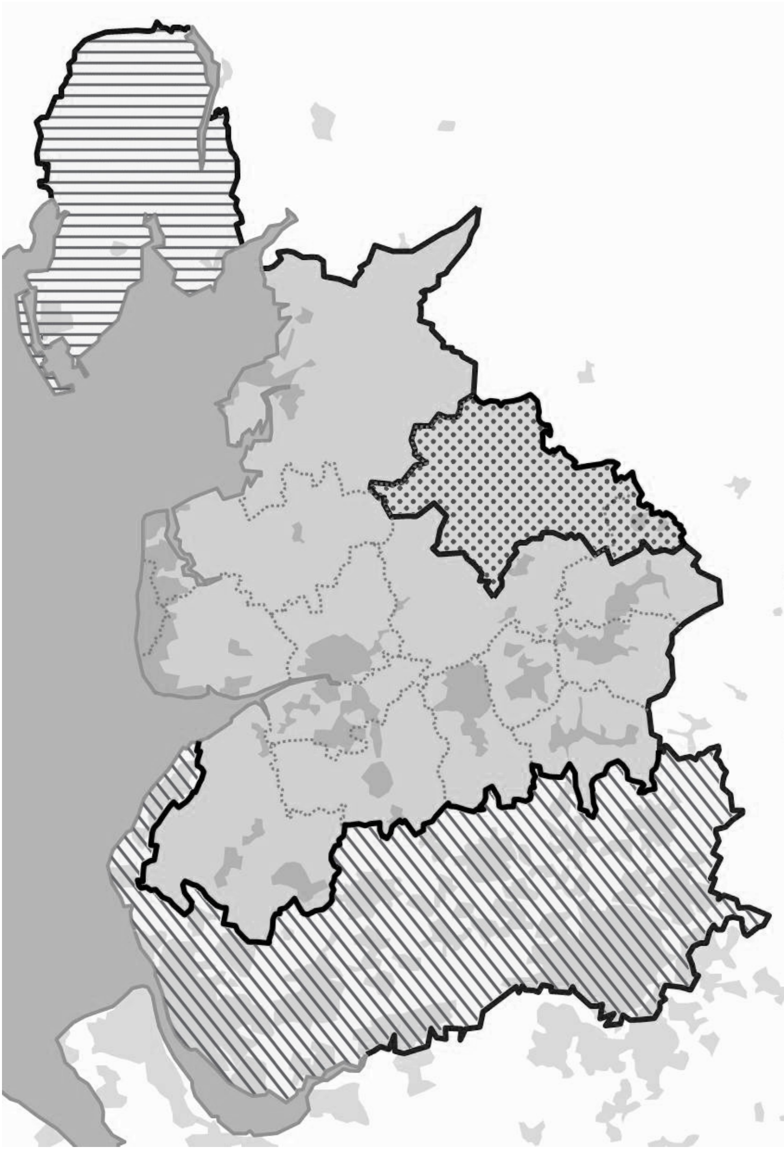

Figure 1. The historical and current boundaries of Lancashire. Horizontal hash: Furness enclave - now part of Cumbria; angled hash: Old Lancashire – now metropolitan counties of Merseyside and Greater Manchester; dotted: former part of the West Riding of Yorkshire now part of Lancashire (modified by Dan Thompson from Dr. Gregg: http://en.wikipedia.org/wiki/Lancashire#mediaviewer/File:Historical_and_current_boundaries_of_Lancashire.png)

proved efficiency of water power, increasing use of steam power, and the development of machines. It took place in the period from about 1760 to sometime between 1820 and 1840. This transition also included change from wood and other bio-fuels to coal.

Textiles were the dominant industry of the Industrial Revolution in terms of employment and financial return from capital invested. It was this industry that was the first to use modern production methods, the ‘revolution’ being triggered in 1764 in the village of Stanhill, on the hill above Oswaldtwistle, with the invention the spinning jenny by James Hargreaves, and patented by him in 1770. In many ways this marked the beginning of the industrial revolution. The involvement of more formalised science to the county came from the apothecaries with William Henry collaborating with John Dalton on work with gases, even assisting the colour blind mathematician and meteorologist in the laboratory which led Dalton to the atomic theory in the early 19th century.

William Sturgeon, born in Whittington near Carnforth invented the electromagnet in 1825, while Lancastrian Sir Richard Owen coined the word *dinosaur* in 1842. Sir J.J. Thomson of Cheetham Hill in Manchester

Spinning Jenny
(http://commons.wikimedia.org/wiki/File:Spinning_jenny.jpg)

discovered the electron in April 1897 and received the Nobel Prize for Physics in 1906. Sir Ernest Marsden of Rishton, prior to emigrating to New Zealand, conducted experiments at the University of Manchester in 1909 with Hans Geiger, whose method of detecting ionizing radiation gave rise to the Geiger counter and demonstrated the existence of the atomic nucleus.

Sir Arthur Harden laid the foundations for the discipline of biochemistry with his carbohydrate metabolism work that led to the 1929 Nobel Prize in Chemistry. Sir Walter Norman Haworth's carbohydrate chemistry gave him that in 1937. In 1941, John Rex Whinfield and James Tennant Dickson at the Calico Printers' Association in Manchester discovered polyethylene terephthalate (PET), the common polyester developed also as Terylene (Dacron). The University of Manchester built the world's first programmable computer in 1948 and purchased the first commercially available computer, also made in Manchester, in February 1951. The world's first transitorised computer was the Manchester Transistor Computer released in November 1953. The Atlas, another Manchester University computer, was developed largely by Tom Kilburn and in 1962 was most the powerful computer in the world.

Blackley in north Manchester boasted industrial enterprise as early as 1785 with the Borelle Dyeworks, established by emigrant French industrialist Louis Borelle. It transferred through The Delauney Dyeworks and The British Dyestuffs Corporation, to become ICI Dyestuffs at Hexagon House when the Procion dyes (dichlorotriazines) were discovered there. The general anaesthetic Halothane (2-bromo-2-chloro-1,1,1-trifluoroethane) was discovered at ICI's Widnes Laboratory by Wallasey's Charles Suckling in 1951 and ICI scientists had other breakthrough discoveries, many coming from the Pharmaceuticals Division set up at Alderley Park in Cheshire in the late 1950s. The 2008 takeover of ICI Pharmaceuticals by AstraZenica is set now to have the facility closed at about the time that this booklet appears.

Lancastrian Richard Laurence Millington Synge was a co-inventor of two-dimensional chromatography for which he received the 1952 Nobel Prize in Chemistry with Archer Martin, while Michael Smith from Blackpool received his in 1993 for his site-directed mutagenesis.

Graphene was discovered at the University of Manchester under Prof Sir Andre Geim and Sir Konstantin Novoselov when they extracted single-atom-thick crystallites from bulk graphite in 2004. Finally, it must be noted that the University of Manchester evolved from Owens College with Lancastrian Sir Edward Frankland its inaugural professor of Chemistry in 1851, and where many early Lancastrian chemists gained their advanced education.

While the profiles of the of Lancastrian Chemists that follow do not show them all to be as productive as the scientists mentioned above, they do serve to illustrate that this small pocket of England has produced a remarkable number of successful and talented chemists. And this from as early as 1774 through to the present day. In large measure these individuals have come from Manchester (15) and what were the old cotton towns that hug the Pennines (28) and noted above. It may seem surprising that few chemists have come from coastal Lancashire from Liverpool north (13), but then the Industrial Revolution had its origin in East Lancashire.

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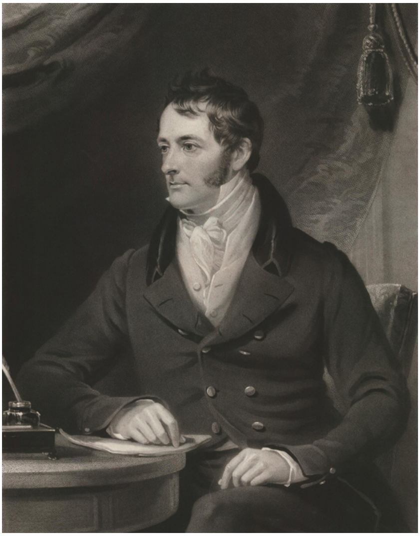
William HENRY, FRS (1774-1836)



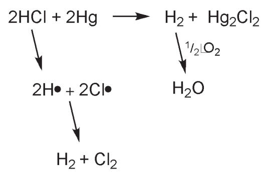
Portrait by James Lonsdale © National Portrait Gallery, London, with permission

William HENRY was born on December 12, 1774 at 19 St. Ann's Square in Manchester. He was the third son of apothecary and surgeon Thomas Mercer and his wife Mary (née, Kinsey).[1-3] William was privately educated by the Rev. Ralph Harrison and entered the Manchester Academy (which his father helped establish) in 1786 when it opened. As a young boy William suffered serious injury when a heavy beam fell on his right side. The consequential acute neurological pain he suffered turned him to study and limited his physical activity. At age 16 he left the academy to become secretary-companion to Thomas Percival, a colleague of his father and the leading physician in Manchester. Percival, who had poor eyesight and suffered violent headaches, employed William to keep him familiar with the developments in medicine and science by reading to him, and then taking dictation. Thus, William Henry became familiar with Percival's correspondence with the noted men of science and literature of the day. While with him, the young Henry began to study medicine and he entered Edinburgh University for a medical degree in the winter of 1795 after spending five years with his mentor.

At that time, Edinburgh was the centre for modern medical education in the UK as Oxford and Cambridge retained the classical medical tradition. While there, Henry attended lectures in chemistry given by Joseph Black, who, though old and frail, was still the Professor of Chemistry.[1] Henry was drawn more to science and was able even to perform his first piece of serious scientific research, and this was read to the Royal Society by his father on June 29, 1797.[2,3] However, after a year of medical school, his father recalled him to Manchester to help run the family businesses. After a short time he was taken into partnership and ran the magnesia factory, the mainstay of the family fortune. The elder brothers, Thomas Jr., and Peter had little appetite for the business and lacked the aptitude to assist, so that William became central to the family affairs.[3] However, by late 1805

William was able to leave the business in the hands of a manager and he returned to Edinburgh to complete his studies. The two years there gave him his only period free from commercial responsibility.

William Henry had a natural talent for experimental study and it was over the ten years following his first return from Edinburgh that he made his major contributions to chemistry, carrying the skills he learned as a manufacturing chemist to the research bench. Apart from magnesia, the other major activity of the Henrys was the production of aerated waters – soda water with or without added flavouring. Thus, William Henry had a life-long interest in gases, their essential properties and their chemical behaviour, and, later, he became actively involved in the gas lighting industry in Great Britain. His interest in gases led him to work with his father on pneumatic medicine - the inhalation of gases to treat disease, and especially consumption - at the Royal Manchester Infirmary and it directed much of his early work. In this, William studied the composition and decomposition of muriatic acid gas (HCl) which, like all acids at that time, was thought to contain oxygen. He came close to solving the problem of its composition in 1800, some ten years ahead of Humphrey Davy. His results appeared in the *Philosophical Transactions* of the Royal Society in 1800. Henry repeatedly exposed HCl to electric discharges and when performed over mercury he saw a volume reduction and the formation of a white solid [now recognised as mercury(I) chloride]. When repeated with HCl in the presence of O_2, a greater volume drop was seen as water is formed from reaction of the liberated hydrogen with the oxygen. In the absence of mercury, chlorine was produced (Scheme 1). When Davy finally showed that muriatic acid was comprised of hydrogen and chlorine only, Henry supported him and provided additional evidence in 1812.[1] Although Henry was unable to come to the correct conclusion regarding HCl until after Davy's paper, it is clear that his results are correct and of significance. However, the work for which he is best known is on the solubility of gases.



Scheme 1. Electric discharge of hydrogen chloride

Henry's studies on gas solubility gave rise to what we now regard as Henry's law. It also led to a friendship and collaboration with the teacher John Dalton, most notably from 1800-1805. He helped the colour-blind Dalton with his experiments and, while Dalton subsequently became world-famous for his theories, his practical abilities were less enduring. Thus, Dalton and Henry shared an interest in the chemistry of gases and liquids. Understandably, William Henry approached his study of them from the viewpoint of an industrialist who manufactured soda water and hoped to use gases in medicine. Dalton, on the other hand, came to chemistry from a meteorological background.

By about 1800 Dalton regarded the atmosphere being comprised of four types of particle – the atoms of oxygen and nitrogen and the compound atoms of water and carbonic acid (carbon dioxide) that were motionless. He could not understand why a puddle of water could diffuse into the atmosphere or why the air did not separate into layers. His discussions with Henry as to what might cause these effects were probably important in the development of his atomic theory. In 1801 Dalton formulated the concept that there was a repulsive force between particles of the same kind in a gas, viz. like repels like, and that this resulted in every particle of water in air getting as far from another as possible so that the whole would be evenly distributed throughout the available space. William Henry, initially opposed to this, converted to acceptance by 1804, saying every gas is a vacuum to every other gas.[1] The change stemmed from his and Dalton's experiments on gas solubility, notable over 1801 and 1802 when both worked on their solubilities in water. Because most previous study had been with carbonic acid (carbon dioxide), Henry chose this as his first target and he reported his results to the Royal Society (London) just before Christmas in 1802 and published them in the *Philosophical Transactions* early in 1803.[1] Dalton read his studies to the Manchester Literary and Philosophical Society some ten months later, on October 23, 1803, and published them in the *Memoirs of the Literary and Philosophical Society of Manchester* in 1805.[1] Henry's conclusion, which appears in an appendix to the original paper, became known as Henry's law and for this he was awarded the Copley Medal in 1808. The law, one of the fundamental gas laws, states:

> *At a constant temperature, the amount of a given gas that dissolves in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid.*

An equivalent is:

> *The solubility of a gas in a liquid is directly proportional to the partial pressure of the gas above the liquid.*

The most common practical illustration of Henry's law is provided by carbonated soft drinks. Before the container of the drink is opened, the gas above the drink is almost pure carbon dioxide at a pressure slightly higher than atmospheric. The drink itself contains dissolved carbon dioxide. When the bottle or can is opened, some of this gas escapes, giving the characteristic hiss or pop. Because the partial pressure of carbon dioxide above the liquid is now lower, some of the dissolved carbon dioxide comes out of solution as bubbles. Obviously, when a glass of the drink is left in the open, the carbon dioxide in solution equilibrates with the carbon dioxide in the air, and the drink goes flat. A more complex example of Henry's law is in the bends that can be suffered by underwater divers.

Henry's physical neurological pain continued to increase through his later life. On the night of Sept 2, 1836, at home in Pendlebury, Manchester, he committed suicide in his private chapel.

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John MERCER, FRS (1791-1866)

John MERCER was born on the February 21, 1791 in the small town of Great Harwood, the second son of a Lancashire cotton spinner who died when John was eleven years old.[1,2] By then, John was in his second year of work as a bobbin winder, subsequently to become a hand weaver. John's mother remarried in 1806, and he became half-brother to William that year. John lived with various relatives over the years but, at 10 years of age, a neighbour and pattern designer at the nearby Oakenshaw Print–Works in Clayton-le-Moors (Mr Blenkinsop) started to teach John to read and write and introduced him to long division in mathematics before he moved away.[2,3] The boy continued his education himself gaining a reputation as 'adept at figures', and as a self-taught musician; he played several instruments and formed a choir and a band.[3] Later, John Lightfoot, the Excise surveyor at the same calico dye works befriended John and taught him higher mathematics with his own sons who were dyers at the works.[4,5] Mercer was a keen learner and soon became even more recognized.

Once, when visiting his mother, he saw his half-brother, William, seated on her knee wearing an orange dress. That vision changed his life forever as he decided that he should become a dyer. As quoted in the book by his nephew Edward Parnell,[3] John Mercer was "*all on fire to learn dyeing*", but he had had no instruction in the subject, no books, nor the means to obtain them. Nonetheless, he found the supplier druggist in Blackburn, and purchased the common materials then in use, e.g. peach wood and Brazil wood (two forms of *Caesalpinia echinata*) that yield the red pigment Brazilin now known as Natural Red 24; alum, the potassium double sulfate of aluminium (correctly $Al_2(SO_4)_3.K_2SO_4.24H_2O$), which when added to water clumps negatively charged colloidal particles together into *flocs*; copperas [iron(II) sulfate, $FeSO_4$ $7H_2O$], which gives the blue-green aquo-iron (II) complex in water, etc.[1]

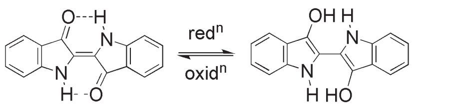
Following experiments with the Blackburn dyes, Mercer became a dyer, forming a business with a partner using remnants from the Great Harwood loom weavers. His successes attracted the attention of the Fort brothers, the owners of the Oakenshaw Print Works and at 18 years of age he took an apprenticeship in their colour-shop. Napoleon's Fontainebleau Decree of 1810 impacted on all English print-works and resulted in Mercer's resignation to weave and dye alone.[1]

It was in 1814 when getting his marriage licence in Blackburn that John obtained a second-hand copy of *The Chemical Pocket Book* or *Memoranda Chemica: arranged in a Compendium of Chemistry* (James Parkinson, 3rd edn., 1803). John Lightfoot had given him a copy of the 1787 *The Table of New Nomenclature* proposed by De Morveau, Lavoisier, Bertholet, and De Fourcroy but it was of little use on its own. When coupled with the Compedium, a new world was opened to Mercer. The short account of 'the sulphide of antimony' led Mercer to a series of experiments that culminated in his 'antimony range' of dyed calicos. He found that the alkaline sulfantimonates (salts of the hypothetical sulfantimonic acid, H_3SbS_4) provided an excellent medium to fix a bright orange antimony sulfide (Sb_2S) on calico – something previously unknown. This led to re-employment at the Oakenshaw works where he devised new styles and colours in the dye industry that, importantly, led to new branches of industrial chemistry, as it was then known.[1-6] His work with chromium compounds is reputed[3,5] to have created the industrial manufacture of bichrome (potassium dichromate). He rediscovered and introduced into England a method of applying lead chromate to cotton cloth in 1823. This yellow dye, then of great importance, was formed by treating the fabric 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 almost every ten years. He also greatly improved the methods of printing indigo by using potassium ferricyanide and potash.

Of almost equal importance was his method of preparing mixed cotton and woollen fabrics that subsequently accepted dye with equal effectiveness. He found that some aluminium *lakes* [the pigment formed when a dye is precipitated with an inert binder (the mordant), usually a metallic salt] from organic dyes were dissolved by ammonium oxalate and this led to the use of aluminous colour-precipitates in steam colour work. Mercer also devised a new and cheaper method of preparing sodium stannate, whose value to the calico dyer provided him with much income.[1]

Of the many improvements made by Mercer, the use of alkaline arsenites, in the *dunging* operation was one of the more important.[3] Superfluous uncombined mordant 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 discoloured the whites, deteriorated the dyeing liquor, so that 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.

His self-taught skills and knowledge led John Mercer to make accurate records of his work to the extent that, from the earliest times, 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, the reduced soluble form of indigo.



6, indigo **7**, indigo white (leuco-indigo)

Calico, when submerged and then removed from a bath of white indigo, quickly shows atmospheric oxidation reverting the white 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]

Throughout his life, Mercer was 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). The traditional method 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 he was able to extract all of the dye. Some 25 years later a French chemist visited the Oakenshaw works to describe his method of cochineal extraction, but he had to concede that, although similar, the Mercer method required fewer steps and was superior.[3]

In 1841, Lyon Playfair was employed as chemist at Thomson's Primrose print-works in Clitheroe (some 12 km from Great Harwood). The two men became friendly, met weekly in a pub in Whalley mid-way between the towns and discussed science and matters of the day affecting print works. Observations made by Mercer in 1843 and discussed at the Whalley meetings, led Playfair subsequently to discover the nitroprussides. 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. Later, with James Thomson and Walter Crum, Playfair, nominated Mercer for election to the Royal Society, which occurred 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 £10,500, 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 the 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 resulting in the process gaining popularity only after 1890 when H.A. Lowe improved it by holding the cotton taut to prevent such shrinkage. The fibres then gained a lustrous appearance and it represents the modern form of mercerising cotton. Although discovered by Mercer in 1844, the fine details of the mercerization process are still not fully understood and are too lengthy to include here; the reader is referred to the recent reviews on the subject.[6-9] The discovery that treating cotton cloth with sodium hydroxide facilitates the dyeing process and imparts a lustre means that it is entirely fitting that the commercial process immortalizes his name.

Finally, at the 1858 British Association meeting in Leeds, 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 book[3] (see below) shows that Mercer had more than a grasp of the octet and the periods (based on O = 8).

$$\begin{aligned} O - Li &= 1 \\ S - L &= 9 - 1 = 8 \\ Se - Na &= 17 - 9 = 8 \\ Te - K &= 25 - 17 = 8 \end{aligned}$$

So with the lithium and magnesium groups:

$$\begin{aligned} Mg - L &= 5 \\ Ca - L &= 13 - 5 = 8 \\ Sr - Na &= 21 - 13 = 8 \\ Ba - K &= 29 - 21 = 8 \end{aligned}$$

Figure 2. Extract from pages 324 and 325 of *The Life and Labours of John Mercer, FRS*; see ref. 3.

The principal partners of the Oakenshaw Print Works retired in 1848 and John Mercer elected to do the same, devoting his time to experimental study. However, after his wife's death in 1859 his enthusiasm waned. He died on 30 November 1866 following complications from falling into the water of a reservoir some two years earlier. 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.[6] Although he patented some of his inventions, he freely gave away many others to the 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 became the equivalent of a Justice of the Peace in 1861, but claims of justice for the community were not infrequently out-weighed by Mercer's feeling of pity and compassion for the offender.[3]

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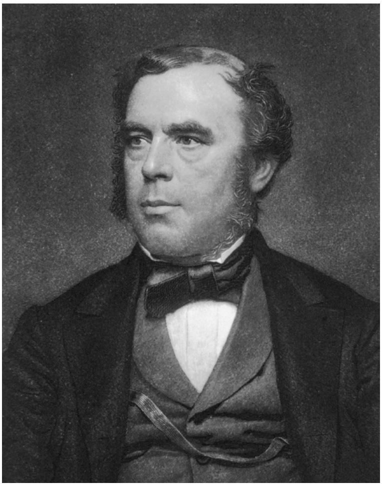
John William DRAPER (1811-1882)



John William DRAPER was born on May 5, 1811 in the parish of St. Helens, Lancashire, the son of Wesleyan clergyman Rev. John C. Draper and Sarah (née Ripley) his wife. Draper senior had a moderate income but his ministry required that the family frequently moved from parish to parish throughout England. The young John was home tutored until 1822 by his father (who had scientific interests) and by private tutors. Only at 11 years of age did he enter school – Woodhouse Grove in Leeds, the Methodist school for the sons of ministers – staying there until 1826 when he once again returned to home instruction. He showed an early interest and ability in science and in 1829 he entered the (then) recently opened University College, London to major in chemistry under its inaugural professor, Edward Turner. There he gained an interest in the chemical effects caused by light, an interest which drove his subsequent career. In 1831, during his undergraduate education, he married Antonia (Ann) Gardner, the daughter of a court physician,[1,2] then later that same year he was awarded a "certificate of honours" in chemistry (the University of London was created only in 1836 as an over-arching examining body that granted its first degrees on in 1839).[1] John's father died unexpectedly in July 1831 and his mother, three sisters, and he and his new wife were persuaded by relatives in Christiansville (now Chase City), Mecklenburg County, Virginia, USA to emigrate into the US and this they did in 1832.[2,3]

After arrival in Christiansville Draper established a laboratory and set to scientific experimentation on capillarity. He published on this and a variety of subjects, supplementing his three London papers with eight more prior to furthering his education at the University of Pennsylvania from 1835. This was funded by his sisters from their *Misses Draper Seminary for Girls*[4] and John studied chemistry and physics under Dr. Robert Harris while taking the university course in medicine. He also had chemistry classes from John K. Mitchell, then Professor of Chemistry at the Franklin Institute in Philadelphia. Draper graduated in medicine in March 1836, taught at Hampden Sydney College in Virginia, but was persuaded by his university mentors to accept appointment at New York University the following year. He became Professor of Chemistry and Botany in 1838 and was a founder of the New York University Medical School, becoming a professor in it from 1840, and its president from 1850 until 1881. He raised his family of four boys and two girls in New York.[1-4]

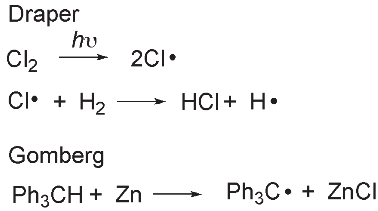
John Draper's scientific work spanned chemistry, physics, medicine, botany and scientific literature. His first independent study that led to definitive results on osmosis, and on the circulation of sap in plants and blood in animals, appeared[5] as a letter to the editor of the *American Journal of Science* in 1834. His first concerning the action of light followed a year later with a study on whether light exerts a magnetic action. His first purely chemical paper was *Chemical Analysis of the Native Chloride of Carbon, a singular mineral* published in the *Journal of the Franklin Institute* (of the State of Pennsylvania) in 1834.[6] The *native chloride of carbon* had been collected on the Isle of Sheppey in the Thames estuary in the summer of 1832. Although most had been given to Turner in London, Draper took ca. 12 grams of the sample to the US. He concluded that the compound contained two atoms of carbon and one of chlorine and that the presence of hydrogen was unlikely. His concluding statement was: *The production of this substance, to judge by its scent at first, and the locality in which it was found, seems to be referable to a marine animal. But through what singular changes must a dead fish pass, before its remains would leave a chloride of carbon, nearly pure?* With the exception of well recognized marine products such as Tyrian purple,[7] though incorrect, this is one of the earliest chemical analyses of a marine species.

In 1836, a practical set of instructions and commentary for carrying out *microscopic chemistry* followed.[8] Here, Draper's premise was that much good chemistry could be carried out using semi-micro techniques (as we would now call them) and he advocated the use of sand and water baths (admittedly in a kitchen frying pan and pan, respectively) for heating purposes, holding a hot tube by its neck with folded paper, and using apothecary phials for small scale distillation and sublimation. Draper's premise was that chemistry should be available to and performed by anyone with an aptitude and skill for it, and his microscopic chemistry fitted well to this.

Draper's research flowered from 1839 to 1856 generating some 45 papers and 5 textbooks, though his writing continued well into the 1870s. His dominant contribution was on "radiant energy", which led to some 28 publications and the first law of photochemistry – the Grotthuss-Draper law. Both he and Theodor von Grotthuss (1785-1822) recognised that for light to produce an effect upon matter it must first be absorbed. Although Grotthuss proposed the law in 1817, he gained more recognition for his electrochemical work and it was Draper who gave substance to the proposal.

Draper approached radiant energy by studying the chemical action of light to determine is effect in photography, on chlorine gas, and on the growth of plants. Most studies of light from 1725 had involved the action on silver salts leading to Scheele distinguishing between radiant heat and light in 1777, and then the concept of "chemical rays" from effects in the violet region of the spectrum by Ritter and Wollaston in the first years of the 19th century.[2] Draper studied the effect of light in changing the colours of metallic salts and applied the photographic process in the solution of physical problems prior to Louis Daguerre's 1839 discovery (the daguerreotype in which a direct positive is made in the camera on an iodine-treated silvered copper plate). Draper improved the process by exposing the plates to bromine fumes finding that a mixture of silver iodide and bromide was much more sensitive to light. This was to the extent that in the same year (1839), he took photographs of the human face and the first daguerreotype portrait in New York. He had the process so perfected[9] by early 1840 that the image he took of his sister Dorothy is one of the oldest surviving human portrait photographs and certainly the first of quality.[4,10] That same year he presented the Lyceum of Natural History of New York with the first photograph of the moon's surface and improved it over the ensuing years to show craters and then (with Morse) opened one of the first portrait studios on the roof of his house on 4th Street in New York in 1840.

The effect of light on chlorine gas provided the first documented example of a photochemical reaction in a laboratory.[11] In 1843 Draper announced to the British Association that chlorine underwent significant change under the influence of sunlight and explained it by the absorption of "chemical rays" that changed the character of the gas so that it united with hydrogen, a property not seen from chlorine or hydrogen kept in the dark. While now easy to accept (Scheme 1), none of this was a part of 1840 thinking – the first persistent radical was the triphenylmethyl in 1900. Draper concluded that solar light comprised a third and new imponderable: the agent that produced chemical change. He gave this the name *tithonicity* from Roman mythology; he thought solar light to be weakened from interaction with matter.



Scheme 1

Draper extended his usage of tithonicity to include *tithonography*, *tithonic effect*, *tithonometer* and *tithonoscope* as *music in an English ear*,[9] and used the decomposition of chlorine and formation of HCl in the design of an actinometer to measure the force of the tithonic rays – his tithonometer. The Draper actinometer was subsequently improved by Bunsen and Roscoe who refined it to allow not only accurate comparative determinations, but reduce the chemical action of light to an absolute measurement.[13]

These spectral investigations led to Draper's understanding of radiant energy. Thus, in 1842 he proposed what is now the first law of photochemistry - the Grotthuss-Draper law.[14] Subsequently he concluded that *every part of the spectrum, visible and invisible, can produce chemical change and can modify the molecular arrangement of bodies*, and that *the rays effective in producing chemical or molecular changes in any special substance are determined solely by the absorptive power of that substance*.[15] His results using a diffraction grating with its surface silvered with tin amalgam, provided a far more intense reflected spectrum than the former transmitted ones and he suggested that the best result would come from ruling the grating on steel or speculum metal (*ca.* 2:1 copper tin alloy capable of high polishing). He also suggested that the regions of the spectrum should be denoted by their wavelengths, saying: *The measures of one author will compare with those of another and the different phenomena of chemical changes occurring through the agency of light become allied at once with a multitude of other optical results*.[16] The grating led to the first photograph of the solar spectrum.

Other work for which Draper is recognised is his definition of what is now the Draper point (798 K), and that, as the temperature of an incandescent body is increased, it emits rays of light of an increasing refrangibility. At that time spectroscopy had evolved to the extent that all glowing solids were known to emit continuous spectra, unlike gases that emitted bands or lines. Draper went beyond, by defining what has become the Draper point, to study the spectral composition of flames concluding that all flames yield the same results. Every prismatic colour was found in them (even bright Fraunhofer lines of different colour) even in those cases where the flame is very faint. The spectrum of cyanogen was, he said, *so beautiful that it is impossible to describe it in words or depict it in colours*. Subsequently, he came to the conclusion that *the occurrence of lines, whether bright or dark, is hence connected with the chemical nature of the substance producing the flame and that if we are ever able to acquire certain knowledge of the physical state of sun and other stars, it will be by an examination of the light they emit.*[17]

Finally, a role taken by Draper few are aware of is that he was the inaugural President of the American Chemical Society.[18] His Presidential Address given in November 1876 in New York City was entitled *Science in America*.[19] The literature he published in later life, gained him fame as an author, from his *History of the intellectual development of Europe* in 1862, *Thoughts on the future civil policy of America* (1865), his noted *History of the American Civil War* published between 1867 and 1870, to his most well-known *History of the conflict between science and religion*[20] that was published in 1874. This last treatise went through more than twenty editions in its first ten years and was translated into most European languages. Because Draper was open and honest about the continuing conflict between science and religion his book was placed on the *Index Expurgatorius* of the Catholic Church. Draper died at his New York home in Hastings on January 4, 1882.

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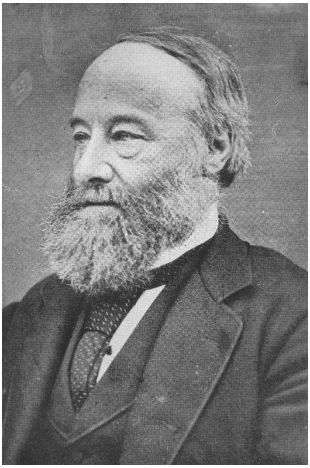
James Prescott JOULE, FRS (1818-1889)



James Prescott JOULE is usually classified as a physicist but his 19th century studies are embodied in chemistry to the extent that his inclusion here is more than justified. The second of five children born to Benjamin Joule, a wealthy brewer, and his wife Alice (née Prescott), James Prescott Joule was born in the house adjoining the Joule Brewery in New Bailey Street, Salford on December 24, 1818. As a child, James was weak and shy, and suffered from a spinal disorder, preferring studies to physical activity. Although the spinal problem later improved, it affected him throughout his life.

James was tutored in the family home *Broomhill* in Pendlebury, near Salford, until 1834 when he was sent with his elder brother Benjamin to study with John Dalton at the Manchester Literary and Philosophical Society. The pair received two years' education in arithmetic and geometry before Dalton retired following a stroke. However, Dalton's influence made a lasting impression as did that of his associate, chemist William Henry.

James was fascinated by electricity, and he and his brother experimented by giving electric shocks to each other and to the family's servants. When their father became ill, James and his brother took over running the brewery. James had no opportunity to attend university. However, his great desire was to continue to study science, so he set up a laboratory in his home and began experimenting before and after work each day.

Thus, to Joule, science was merely a serious hobby. It was when he became interested in replacing the brewery steam engines with electric motors that his scientific career started. He studied the nature of heat, and discovered its relationship to mechanical work. Joule's recognition did not come easily and it was only from acceptance and promulgation by William Thomson (later Lord Kelvin) that his studies were accepted. The principle of energy conservation involved in Joule's work gave rise to the new scientific discipline known as thermodynamics. Although not the first scientist to suggest this principle, Joule was the first to demonstrate its validity and he is correctly recognized as the chief founder of thermodynamics. He showed that *work can be converted into heat with a fixed ratio of one to the other, and that heat can be converted into work*. This led to the Law of

Conservation of Energy and the development of the First Law of Thermodynamics. Joule worked with Thomson for about ten years from 1852 on a number of important experiments that served to substantiate the field of thermodynamics and led to the Joule-Thomson effect. They also developed the absolute scale of temperature. The SI-derived unit of energy, the joule, is named for James Prescott Joule.

Joule was elected Fellow of the Royal Society, in 1850, received a Royal Medal in 1852, the Copley Medal in 1870 and the The Albert Medal of the Royal Society of Arts in 1880.

James married Amelia Grimes in August 1847 and they had a son and daughter. His wife and daughter both died in 1854. From 1872, Joule's health began to deteriorate and he did little subsequent work. He died on October 11, 1889 in Sale, near Manchester.

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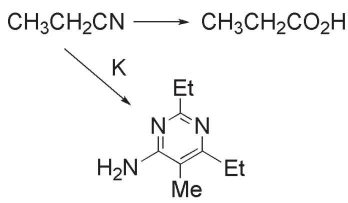
Sir Edward FRANKLAND, FRS (1825-1899)

Edward FRANKLAND was born on January 18, 1825 near the small town of Garstang between Preston and Lancaster.[1-3] Edward was the son of Margaret (Peggy) Frankland who went into service with the wealthy Gorst family in Preston in 1824. She had an affair with the young heir, Edward Chaddock Gorst and, when discovered, the horrified family dispatched the pregnant Peggy with a handsome annuity, providing that the identity of the father was never disclosed; it was revealed only by 20th century historians. Peggy moved to Churchtown, in the Parish of Garstang, where her son Edward was born. Although accorded her family name he was given the first name of his father.[2]

Edward Frankland's childhood has been described as ferocious as he and his mother were outcasts. Nonetheless, she ensured that Edward got an education by using the annuity to meet the costs.[2] By the time he was seven years old he had been to seven schools where, it appears, he was routinely given beatings. It was only in his eighth school that he gained an element of stability as he stayed there until he was twelve.[4] That school in Lancaster was enlightened as the pupils were encouraged to acquire first-hand knowledge of nature and even conduct simple experiments themselves. From twelve to fifteen years of age the young Edward attended the Lancaster Free Grammar School, although this time is recorded[5] as 'entirely unproductive'. By then, his mother had married William Helm, one of the first lodgers at the Lancaster guest house she had established. At 15, Edward's wish was to enter the medical profession and so, on advice from others, stepfather William apprenticed him to the local druggist Stephen Ross.

The apprenticeship with Ross required 70-hour per week of bone-breaking labour, hauling, wrapping and grinding.[2] Frankland has referred to it as *six years' continuous hard labour*,[6] but he gained some useful skills, not least the safe handling of chemicals. Despite the working hours, Edward used his limited free time to borrow books from the Mechanic's Institute, attend the classes and conduct some experiments in the makeshift laboratory that the local doctors had made available there.[5] Edward gained a position at the end of his apprenticeship with Lyon Playfair at the Government Department of Woods and Forests in London. His progress there was such that soon he was appointed Playfair's lecture assistant, took the course he gave and successfully completed the final examination, the only one he ever sat.[5]

Herman Kolbe, another of Playfair's assistants, had come to the belief that organic compounds were comprised of identifiable groups of atoms which he termed *radicals* (then 'radicles'). Frankland became caught up in this and, with Kolbe, showed that the hydrolysis of ethyl cyanide led to propionic acid, thus confirming the hypothesis (Scheme 1). The results were communicated to the Chemical Society in April, 1847. The following month saw the pair go to Marburg where Frankland spent some time in Bunsen's laboratory attempting to prepare the ethyl radical by dropping ethyl cyanide onto potassium metal. In his words, *a very vigorous reaction often accompanied by fire and rapid gas evolution* took place.[7] The gaseous product was not the desired ethane



1, kyanethine
2,6-diethyl-4-methylpyrimidinamine

Scheme 1

but butane, which required the cyanide to be impure and contain some water. A side product named kyanethine was subsequently proved to be a trimer of cyanoethane (Scheme 1).[7]

Frankland left Bunsen after three months, becoming a teacher at Queenswood School in King's Somborne in Hampshire where he found John Tyndall, subsequently the prominent 19th century English physicist, was one of the other teachers. The pair taught one of the first laboratory-based science courses in England, each teaching the other his own subject by rising at 4 am to exchange lessons before schoolwork began.[8] Again, Frankland was drawn to research continuing his quest for the ethyl radical as he knew it. Initially, he tried to remove the oxygen atom from diethyl ether using both potassium amide and potassium metal, but was unsuccessful. He then directed his attention, not to ethyl cyanide again, but to the iodide as HI was known to be decomposed easily by the metal. After an explosion with potassium, he switched to zinc, heating the reagents in a sealed tube. Unfortunately he had no means of measuring or estimating the gaseous product in the sealed tube since his eudiometer had been broken. Frankland left the tubes unopened, resigned his post, and left after a year to return to the Marburg laboratory, this time with Tyndall and the sealed tubes.

Serious research started during the summer of 1848. Frankland studied the action of sodium on fatty acids, obtaining radicals such as 'methyl', in reality, ethane. Opening one of the sealed tubes that he had brought from Hampshire under water in mid-February 1849 led to an evolution of gas that was apparently as spectacular as it was significant – he obtained ethyl (butane)! His researches were successfully submitted for the PhD degree in July 1849. However, during his last weeks with Bunsen, he noticed a liquid product in one of his unopened Queenswood tubes from the July 1948 reaction of ethyl iodide with zinc. This liquid was shown to contain zinc. It was an organic compound and it contained the metal! It was diethyl zinc as we now know it and organometallic chemistry was born with that July 1848 experiment (Scheme 2).

$$2EtI + Zn \longrightarrow Et_2Zn + I_2$$

$$2MeI + Zn \longrightarrow Me_2Zn + I_2$$

$$Me_2Zn + 2H_2O \longrightarrow 2MeH + Zn(OH)_2$$

Scheme 2.

On July 12, 1849 in Bunsen's laboratory Frankland prepared dimethyl zinc by digesting methyl iodide with zinc. After discharging the gasses, he cut off the upper part of the tube so as to test the action of water on the solid residue. On adding water he saw,[9] *a greenish-blue flame several feet long shoot out of the tube, causing great excitement amongst those present and diffusing an abominable odour through the laboratory*.

Frankland returned to England early in 1850 as Professor of Practical Chemistry at Putney College.[10] He remained there for only one year, but it was a year full of research and significant output. He examined the action of light on reactions between metals and alkyl halides on a flat part of the roof of his chemistry laboratory and the increasing daylight of the spring. A range of organometallic compounds involving zinc, tin, mercury, etc., were discovered, firmly establishing the new branch of chemistry. The recorded regularity in the formulae of his compounds led him to recognise that each element had a limit to the number of radicals that could attach; each had a definite combining power. Thus, from his novel yet obscure compounds, Frankland discovered one of the most significant principles of chemistry, namely that known as valency, which he articulated by terming it "combining power". The idea of valency laid the groundwork for Kekule's hypothesis of the structure of benzene and for Gerhardt's theory of types. The results, communicated to the Royal Society as his second paper on organometallic compounds and read at a meeting on May 10, 1852, were published subsequently,[11] securing his place in the documented history of the valency concept.[12]

On January 2, 1851, Frankland was appointed inaugural professor of chemistry at Owens College in Manchester.[13] However, before he left London he married Sophie Fick, whom he had first met while with Bunsen in Marburg in 1847, and started his family in Manchester. It was during his six and a half years there he designed the laboratories, established his own research using a new Mancunian technique of heating under pressure in an iron digester, and became consultant to a range of industries to a scale unprecedented among other universities. This led to Manchester's tradition in applied chemistry. His researches led to the synthesis of the zinc alkyls in large quantity. He was elected to the Fellowship of the Royal Society in 1853 and was awarded its Royal Medal in 1857. College mismanagement led to Frankland's resignation[5,13] and move to London in mid-1857 with his wife and three children.

There he published his *Lecture Notes for Chemical Students*,[14] where the atoms were represented by their letters and joined by bonds (a term introduced in the book); the concepts also of valence were discussed. He extended his organometallic work and, from 1859 with Duppa, he carried out the first published studies on organoboron compounds including the very reactive trialkylborons.[15] Not only were organomercury and -phosphorus compounds reported, but the pair made significant contributions to synthesis of ethers, esters, and dicarboxylic, hydroxy and unsaturated acids that revealed the structure and relationship between the compounds, all coming from the exploitation of their organometallics. To some, Edward

Frankland is regarded as a founder of synthetic organic chemistry.

Despite the foregoing, Frankland's international reputation came more from water analyses. Over the 1859 summer he assisted Hofmann in reporting to the metropolitan board of works on possible means of deodourising sewage. This involvement with water analysis and purification gained momentum after he took over Hofmann's role at the Royal College and that as analyst for the London water supply; he was appointed to the second royal commission on the pollution of rivers in 1868 and given a fully equipped government laboratory. Much valuable scientific information on sewage contamination, industrial effluent and water purification for domestic consumption was gained over a six-year period. He pursued the quest for safe drinking water and campaigned against supplies that failed to meet his standards. While this led to antagonism from many chemists employed by water companies, he became recognized as the world leader in the field. Increasingly, he was asked to analyze water samples and he moved his consultancy to a privately funded laboratory from about 1862 and well into his retirement. Criticism that his analytical work took him away from his role at the Royal College persuaded him into early retirement in 1885 aged 60 years.

Frankland served on the Council of the Royal Society and the office of Vice-President, and then became the 1871-73 President of the Chemical Society. His great concern for the education of chemists, the provision of laboratory programmes and the needs of the profession led him to campaign for professionalism in the discipline. So successful was he that in 1877 the Institute of Chemistry of Great Britain was founded, with a focus on the qualifications and professional status of chemists. Its aim was to ensure that consulting and analytical chemists were properly trained and qualified. It was the first professional organization for scientists to be created. Frankland served as its first President from 1877-1880. In retirement he received the Royal Society's Copley Medal (1894) and a KCB in the Queen Victoria's Diamond Jubilee Honours of 1897 for his water quality work. He died on holiday in Norway on August 9, 1899.

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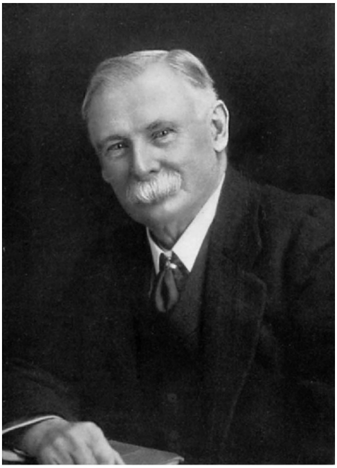
Sir Thomas Edward THORPE, CB, FRS (1845-1925)



Thomas Edward THORPE was born on December 8, 1845 in Goodier Street, Harpurhey, and a suburb of Manchester some five kilometers from the city centre. He was the eldest of eight children to George Thorpe, a cloth and yarn merchant, and his wife Mary (née Wild). Educated at the Manchester diocesan school and employed as a clerk, he entered Owen's College in 1863 where he worked as an assistant to Henry Roscoe, the longstanding professor of chemistry.[1-3]

With Roscoe, Thorpe conducted some notable work on a range of subjects that included the chemical action of light, for which he travelled to Brazil in 1866 and Lisbon in 1867, and on the chemistry of vanadium. He was awarded the college's 1867 Dalton scholarship and left the following year for PhD study with Bunsen in Heidelberg. His work there was on the remarkable liquid alloy of sodium and potassium, the subject of his 1869 PhD thesis. This work has an interesting origin. Roscoe gave Thorpe two bottles containing beautiful crystals of sodium and potassium under mineral oil, respectively. However, in order to save packing space Thorpe placed both samples in one bottle. On arrival in Heidelberg he presented his credentials to Bunsen, unwrapped the jar and passed it to his soon to be mentor. Bunsen *looked hard at the bottle and then his visitor, who then realised that something was wrong*.[4] Bunsen found no crystals but a shining liquid resembling mercury – the sodium-potassium alloy that became the subject of Thorpe's PhD thesis. His time with Bunsen coincided with that of Victor Meyer and the two shared a laboratory and accommodation and became close friends.[2,4] On leaving Heidelberg, Thorpe spent a short time in Kekule's laboratory in Bonn and worked on (and published) ethylbenzoic acid. In 1870, he returned to Manchester and continued his photochemical work with Roscoe prior to accepting appointment as Professor of Chemistry at Anderson's University in Glasgow (now the University of Strathclyde). On September 24, 1870 he married Caroline Emma Watts, the daughter of a prominent Manchester educationalist. His time in Glasgow was a mere four years during which he carried out work on a new oxychloride of chromium, phosphorus chlorides, the constitution of paraffin, and the interaction between carbon tetrachloride and phosphorus pentasulfide, publishing his results in various European journals. In December 1870, Thorpe travelled to Catania, Sicily, to further his photochemical studies by observing a total eclipse of the sun, the results of which he published with Roscoe.[5]

In 1874, Thorpe left Glasgow to become Professor of Chemistry at the Yorkshire College of Science on its establishment in Leeds. He stayed there for eleven years, establishing his discipline, designing the laboratories and continuing his significant research. The college was modelled on Owen's College in Manchester and transformed with it as a constituent of the Victoria University, and then, in 1904, it became the University of Leeds. Thorpe maintained a steady output of scientific research on the relationship between molecular weight and specific gravity of substances. The work led to his election to fellowship of the Royal Society in June 1876 and the award of the inaugural Longstaff Medal of the Chemical Society in 1881. He received a Royal Medal in 1889 for the work on molecular weights and was one of three inaugural members of the International Committee on Atomic Weights in 1902.

For ten years from 1885 he was professor of chemistry in what became the Royal College of Science in South Kensington and later the Imperial College of Science and Technology. His researches there (among others) continued studies on phosphorus compounds that started in Leeds. One notable outcome was the isolation of PF_5 and the recognition of pentavalent phosphorus.[6] Another was the isolation of the supposed trioxide of phosphorous that was a waxy solid of precisely double the composition - P_4O_6. Tutton[4] found that the oxide gave an addition product with sulfur, namely $P_4O_6S_4$, the preparation of which gave "*very lively and dangerous explosions*" on several occasions. Collaborative work with Brunton subsequently led to the discovery that P_4O_6 was the cause of the necrosis of the jaw ('phossy jaw') suffered by workers in the match industry and the eventual replacement of white phosphorus with the much safer red allotrope. As well as his work on chemical investigations, Thorpe took part in a further four eclipse expeditions in the early 1890s.

Thorpe left academic life in 1894 to take up the senior post at what became the Government Laboratory in Somerset House London.[3] This had responsibility for British food and other standards. This work gave Thorpe his significant reputation as an analyst. The lab in Somerset House was housed in improvised attics rooms, where it had been established in 1842. In 1897, Thorpe moved the laboratory to Clement's Inn where the design was of his own making in every detail, and regarded as one of his greatest achievements. With his staff, Thorpe worked on matters of public health, including the detection of arsenic in beer, and the elimination of lead from pottery. It was Thorpe who laid the essential foundations of the laboratory as a Crown entity and the year after he retired it transferred to Treasury control as the Department of the Government Chemist. It undertook the chemical work for all other services of the Crown.

Thorpe's retirement saw him knighted (he had been appointed Companion of the Bath in 1900) and then reappointed to his chair of chemistry at what had become the Imperial College of Science and Technology where he was also the Director of the Chemical Laboratories. During his career Thorpe wrote a number of books, including *A Manual of Inorganic Chemistry* (1873), the five volume *Dictionary of Applied Chemistry* (1890) and a *History of Chemistry* (1909) as well as two on his hobby of yachting. Thorpe held various prestigious appointments including President of the British Association (1921), Vice-President of the Royal Society (1894-1890) and its Foreign Secretary (1899-1903), and President of the Chemical Society 1899–1901. His work on the International Committee on Atomic Weights continued into the early 1920s.

In 1912 Thorpe finally retired and moved to Salcombe in Devon where he lived for a further 12 years although with deteriorating health. He died of a heart attack on February 23, 1925 and was survived by his wife but had no children.

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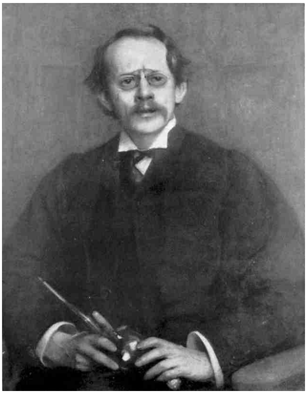
Sir John Joseph THOMSON, OM, FRS (1856-1940)



John Joseph THOMSON was born on December 18, 1856 in Cheetham Hill, a suburb of Manchester some 2 km from the centre and now close to the border with Salford, then on the outskirts of the city. His mother, Emma Swindells, came from a local textile family, while his father, Joseph James Thomson, ran an antiquarian bookshop founded by a great-grandfather. He had a brother, Frederick Vernon, two years his junior. They were of Scottish parentage. JJ (as he was usually known), had his early education in small private schools where he demonstrated great talent and interest in science and was destined to be an engineer by his father. His parents planned to enrol him as an apprentice engineer to Sharp-Stewart & Co., a locomotive manufacturer, but these plans were cut short when his father died in 1873. So, Thomson entered Owens College at the unusually young age of 14. His professor of mathematics recognized his brilliance, and JJ was encouraged to apply for a scholarship at Trinity College in Cambridge, which he entered in 1876. He completed his degree, BA with 1st class honours, in 1880 and obtained his MA in mathematics in 1883. In 1884 he became Cavendish Professor of Physics with whom Ernest Rutherford studied and later succeeded him in the post.[1-3]

On January 22, 1890, JJ married Rose Elisabeth Paget, whose father Sir George Edward Paget, KCB, was Regius Professor of Physic at Cambridge. Rose was one of the first generation of women permitted into advanced university studies and was among the researchers at the Cavendish. She performed some experiments on soap films in 1889 after attending some of Thomson's lectures. They had two children, son George Paget Thomson who became a prominent physicist, himself gaining the 1937 Nobel Prize in physics, and daughter Joan Paget Thomson, who often accompanied her father in his later life travels.[4]

In 1897, Thomson discovered the electron in a series of experiments designed to study the nature of electric discharge in a high-vacuum cathode-ray tube. He was awarded the Nobel Prize in physics in 1906 in recognition of the great merits of his theoretical and experimental investigations on the conduction of electricity by gases. JJ's separation of neon isotopes by their mass with assistant Francis Aston was the first example of mass spectrometry. Thomson was a highly gifted teacher and, apart from his son, seven of his research assistants won Nobel Prizes in physics. Other notable discoveries made by JJ were his 1905 discovery of natural radioactivity in potassium and his 1906 demonstration that hydrogen had only a single electron per atom.

Thomson was elected a Fellow of the Royal Society in 1884 and President from 1915 to 1920. He was knighted in 1908 and appointed to the Order of Merit in 1912. He became Master of Trinity College, Cambridge, in 1918 where he remained until his death on August 30, 1940. He is buried in Westminster Abbey, close to Sir Isaac Newton.

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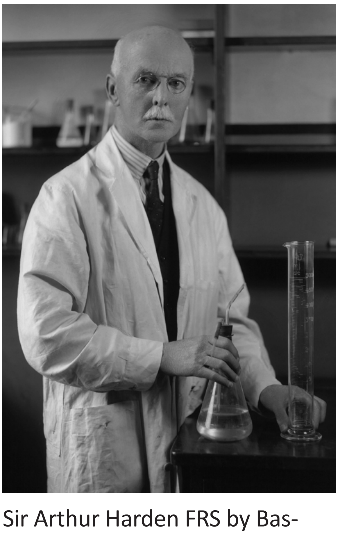
Sir Arthur HARDEN, FRS (1865-1940)

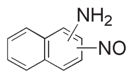


Sir Arthur Harden FRS by Bassano Ltd. (© National Portrait Gallery London, with permission)

Arthur HARDEN was born on October 12, 1865 at Moss Side in Manchester, the only son of Albert Tyas Harden, a Manchester business man, and his wife Eliza MacAlister of Paisley.[1] He is closely connected with John Young (see below) not simply by their place of birth and education, but by their study of sugar fermentation and enzymes that took place at what became the Lister Institute in London. Harden was awarded the 1929 Nobel Prize in Chemistry jointly with German-born Swedish biochemist Hans von Euler of Stockholm University. He remained at the Lister Institute beyond his retirement in 1930 aged 65.

Arthur Harden and his sisters were brought up in a somewhat austere nonconformist atmosphere, akin to the Scottish Presbyterians, renouncing the theatre and regarding Christmas almost as a pagan festival. At the age of 7 he attended a private school run by Dr Ernest Adam in the Manchester suburb of Victoria Park (the Victoria Park School). In 1877, when 11, he moved to Tettenhall College in Wolverhampton where he stayed until he was 16, having remained for an additional term from normal in order to qualify for the London matriculation. Then, in January 1882, he entered Owens College (Victoria University), Manchester, and studied chemistry under Prof. (Sir) Henry Enfield Roscoe, then at the height of his fame as a teacher. He graduated with first class honours in chemistry in 1885 and a year later was awarded the Dalton scholarship of the College.

Harden's first research was on *the action of silicon tetrachloride on aromatic amide compounds* and published in the January issue of the Transactions of the Chemical Society[2] in 1887. From Manchester he proceeded to Erlangen and, under the direction of Otto Fischer, prepared a nitrosonapthylamine (**1**) and investigated its properties. Having been awarded his PhD degree, he returned to Manchester as junior and later senior lecturer and demonstrator under Prof. H.B. Dixon who had succeeded Roscoe. He stayed there until 1897 when he was appointed chemist to the newly founded British Institute of Preventive Medicine, later becoming the Lister Institute in London.



1

Soon after Harden joined the London Institute it was renamed the Jenner Institute (after the pioneer of smallpox vaccine) and then, in 1903, as the Lister Institute in honour of the great surgeon and medical pioneer, Dr Joseph Lister. It became a School of the University of London with Harden a full-time teacher, but when the medical schools in London introduced special teaching for a diploma in public health the Lister Institute classes were discontinued. The 'Chemical' and 'Biochemical' departments at the Lister merged in 1907 to become the Biochemical Department with Harden in charge, a position he held until his retirement in 1930. In 1912, in recognition of his outstanding work on bacterial chemistry and alcoholic fermentation, he was made Professor of Biochemistry in the University of London.

At the Jenner Institute, Harden became interested in biology and began an investigation of the fermentation of sugars by bacteria to find diagnostic means for the differentiation of varieties of *Bacillus coli*. However, he kept a carbon balance sheet based upon the amounts of the various products and discovered several new substances, and was the first to construct a picture of the breakdown process as a whole. He showed that acetic acid and ethanol were formed in equimolecular proportions and that the two terminal alcohol groups were the source of them. In 1905, he published similar observations on the action of *B. lactis aerogenes* where the amount of acetic acid and alcohol formed was not equal. One-third of the fermented glucose could not at first be accounted for, and the deficit was found partly in the form of 3-hydroxybutanone (MeCOCHOHMe) and partly as the reduced form, butane-1,3-diol, compounds not previously known to be products of bacterial action on sugars. The butanone proved to be the substance responsible for the colour reaction of the Voges-Proskauer test used as a diagnostic criterion by bacteriologists. Although there were more papers, Harden's bacterial chemistry did not attract the attention it deserved - bacteriologists did not appreciate what it was about, and chemists found it too removed to be of general interest.

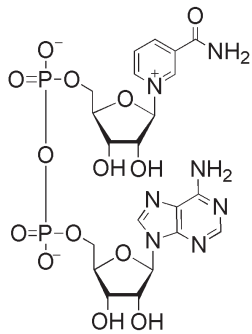
The fermentation of sugar by the cell-free juice expressed from yeast received much of Harden's attention and, with the newly appointed W.J. Young (among others), found that the zymase (the cell-free juice expressed from yeast) would not convert sugar into alcohol unless another substance, a co-ferment that we now know as NAD (nicotinamide adenine dinucleotide, see below), was present. The second was that phosphate was also necessary. This Harden-Young collaboration on the biochemistry of carbohydrates lasted some 10 years. By replacing the traditional gravimetric analysis for CO_2 by a simple volumetric one they were able to make frequent determinations of the CO_2 evolved and study the progress of the reaction at ten-minute intervals for as long as necessary. They found that the phosphate entering into the fermentation reaction was changed into a form no longer capable of precipitation by the magnesia mixture employed, yet a solution of soluble phosphate could not replace the boiled juice. Another factor, for which Harden adopted the term co-ferment, was also present. Both phosphate and co-ferment co-operated together with the zymase of the unboiled juice to produced fermentation. Disappearance of either the ferment or the co-ferment brought the fermentation to an end. Usually it was the co-ferment that was expended first but it disappeared less rapidly in the presence of glucose than in its absence. Addition of phosphate led to the decomposition of an equivalent amount of glucose and a greater total amount of fermentation. The change of the phosphate to a form no longer precipitated by the magnesia mixture was explained when Young isolated the barium salt of a hexose diphosphoric acid. His demonstration of the slow conversion of the hexose diphosphate into hexose and phosphate by yeast juice was another important step.[13] The equations representing the reactions were given as by him as:

$$2C_6H_{12}O_6 + 2Na_2HPO_4 = 2CO_2 + 2CH_3CH_2OH + C_6H_{10}O_4(PO_4Na_2)_2 + 2H_2O \quad \text{(Eq. 1)}$$

and

$$C_6H_{10}O_4(PO_4Na_2)_2 + 2H_2O = C_6H_{12}O_6 + 2Na_2HPO_4 \text{ (Eq. 2)}$$

The co-ferment was regarded as a substance containing a phosphoric group combined with a group of unknown composition by means of which the phosphate was passed to the sugar and a new phosphate group taken up. There followed a period of controversy and for about 25 years the nature of the coenzyme provoked much discussion and research. Harden and Young had correctly described it as a body in which phosphate was combined with some other group that took up and passed on the phosphate group. However, it was only in 1937 that the independent work of Warburg[14] and of Euler[15] successfully established its structure as that of adenine pyridine diphosphonucleotide. named by Warburg and Christian as diphosphopyridine nucleotide. By 1953 the compound had become recognised as DPN and then, from 1961, it was changed to the now accepted nicotinamide adenine nucleotide (NAD, **2**) by the International Union of Biochemistry.[16] The partnership of Harden and Young led to the part played by phosphorylation in carbohydrate breakdown and the necessity for the intervention of both phosphate and coenzyme. Harden went on to become (with Hans von Euler-Chelpin) the 1929 joint winner of the Nobel Prize in Chemistry for their investigations on the fermentation of sugar and fermentative enzymes.



2, NAD

Whilst Harden formally retired on his 65th birthday he continued to go every day to his laboratory carrying on experimental work and correcting proofs until a year or two before his death. He was a founder-member of the Biochemical Society in 1911 and for 25 years from 1912 the editor of The Biochemical Journal. Arthur Harden was elected to the Fellowship of the Royal Society in 1909, awarded its Davy Medal in 1935 and was knighted in 1936. He served on the Council of the Chemical Society and became Vice-President. In 1900, he married Georgina Sydney Bridge of Christchurch, New Zealand. They had no children and she predeceased him in 1928. Arthur Harden died at his home Sunnyholme in Bourne End, Buckinghamshire, on June 14, 1940.

The great achievement of Harden and Young was the discovery that the process of phosphorylation and dephosphorylation forms the basis of carbohydrate metabolism. Their evidence of phosphorylation was indisputable since they isolated two intermediates in which phosphate was bound to the hexose molecule, the 1,6-hexosediphosphate and the 6-hexosemonophosphate. Evidence of the process of dephosphorylation was given when they described the effects of a specific enzyme, a hexose diphosphatase, breaking down the hexose diphosphate with liberation of free phosphoric acid. The foundations of carbohydrate biochemistry were well and truly laid by these workers.

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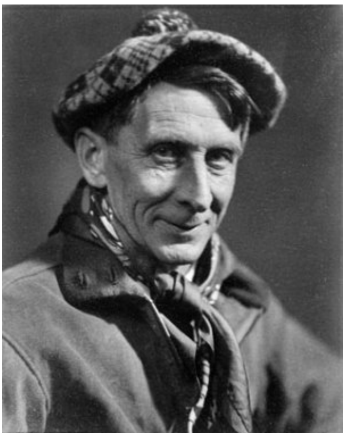
William John YOUNG (1878-1942)


William Young (courtesy University of Melbourne Archives)

William John YOUNG was born on 26 January 1878 in the Manchester suburb of Withington. He was the son of William John Bristow Young, a clerk, and his wife Hannah (née Bury). His education at the local Hulme Grammar School led to his interest in science and on leaving he enrolled in Owens College where he graduated with his BSc in 1898. He began research early in his career and he was awarded the Levinstein and Dalton research exhibitions for 1899-1900 and 1900-1901, respectively; he graduated MSc in 1902. On July 30, 1903 he married Janet Taylor at St Margaret's parish church in Whalley Range, Manchester.[1,2]

After his fruitful collaboration on carbohydrate metabolism with Harden in London (see above), Young applied for and was offered the position of Biochemist at the Australian Institute of Tropical Medicine in Townsville.

His selection was by a committee chaired in London by Dr. C.J. Martin (then Director of the Lister Institute). With his wife and young daughter Sylvia, Martin left London in late 1912 for Queensland.[1-4]

It was only in 1912 and Young's arrival in early 1913 that laboratory science was initiated in Northern Queensland allowing Townsville to become the birthplace of Australian biochemistry. It is said that he and his family had a happy time in Townsville[1-2] where his work alone and with Breinl was mainly concerned with the metabolism of 'Whites' living in the tropics. The most notable outcome was their 1920 paper in the Annals of Tropical Medicine and Parasitology.[5] Young's success at the Institute was such that, by 1920, it had adequately demonstrated that the tropical regions were habitable by a "working white race", as specific conditions such as leptospirosis (or Weil's disease) had been understood. It had served its purpose and was disbanded in 1921 to be subsumed into the newly founded Commonwealth Department of Health.

By then William Young had moved to Melbourne as, in 1920, W.A. Osborne (Professor of Physiology) of the University of Melbourne had secured Young's appointment as lecturer in biochemistry to take charge of the subject. Soon after arriving in Melbourne, William developed an interest in the applied biochemistry of food preservation and transport, and subsequently became the leading Australian expert and innovator in this field.[6] Young was promoted to Associate Professor Biochemistry in 1924.

In 1926 Melbourne University released Young to help the Council for Scientific and Industrial Research (CSIR) (with which he had worked closely) to establish laboratory and field studies into the biochemical problems of the cold storage of food.[7] Despite hopes of a permanent recruitment of Young to the CSIR, William returned to his teaching duties in 1928, but remained a consultant. It was his recommendations that led to the formation of the section of food preservation and transport in 1931. Only in 1938 was William Young appointed the inaugural Professor of Biochemistry at the University of Melbourne, by which time he was the leading Australian expert and innovator in the field of food preservation and transport. He had solved problems associated with the conveyance of chilled meat and the preservation of citrus fruits and some of the methods that came from Young's studies are still used in the marketing of ripening bananas.[8]

The Brisbane abattoir laboratory to study meat chilling had opened in 1932.[9] With the co-operation of Professors Bagster and Goddard of the University of Queensland, Young guided and planned in detail investigations on meat, fish, bananas and citrus, and provided room for the laboratory work to be performed in his Department. He was the first to train food technologists, though they were not known as such then, and he assisted C.P. Callister in his researches to become probably the first Australian DSc in food technology in 1931.[8] Callister developed Vegemite from brewer's yeast and marketed it in Australia in 1923. Young was an active member of the Society of Chemical Industry of Victoria giving lectures and publishing various aspects of his work. He had collaborated with W.A. Osborne whilst at the Townsville Institute[27] and he co-authored the Melbourne-based text *Elementary Practical Biochemistry* with him through the first five of its six editions (W. Ramsey, Melbourne).

Young was an enthusiastic bushwalker and member of the Melbourne Wallaby Club holding the presidency during 1925-26. His contemporaries spoke of him as an indefatigable worker and a charming companion. He was gentle and modest with an uncommon sense of social involvement. He supported his profession, holding the presidency of the Victorian Branch of the Australian Chemical Institute over 1938-39. William John Young died on 14 May 1942 in East Melbourne from a perforated gastric ulcer.

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Edmonson SPENCER (1885-1955)

Edmondson SPENCER was born in 1885 at 30 Lenches (now Lenches Road) in Colne, Lancashire, second son of Joseph and Priscilla Spencer. He was raised there with his elder brother William and his sisters Clara and Minnie. He began his formal education at the Wesleyan Council School in the town, also known as the half timers' school with a fee of 4d per week. On leaving school, Edmondson became an apprentice gardener prior to being a weaver at the Walk Mill that ran some 500 looms. His father was a grocer and a cotton warp dresser (one who assembled the yarns or threads prior to weaving the cloth), but by 1901 he had died and the shop was run by Priscilla who lived there with her four children.

While at the Mill, Edmondson took evening classes in mathematics and science at the Technical School taught by Dr. Wilmore and they directed his career to metallurgy. On completion of these studies he was awarded a 1909 City and Guilds scholarship to attend the Royal College of Science and Royal School of Mines in South Kensington where he graduated with an associateship in metallurgy some four years later. During this time he spent his vacations working back in the Walk Mill. By 1914 he had gained a first class honours degree in metallurgy from London University and became a metallurgist at the Woolwich Arsenal. After two years there, Spencer moved to become Chief Metallurgist at the Gnome and Rhone Aero-engine works, the company that produced some 25,000 engines on both sides of the channel during the First World War. In 1919 after the war, he joined Bird and Co. as consulting chemist and industrial researcher, employed to develop the mineral resources of India by examining oil-bearing earths. He was based in Calcutta and remained there until his retirement. He was awarded a PhD degree from London University (at Liverpool) in 1924. While in India, Edmondson patented a procedure for the production of fine white art paper and was President of the Indian Institute of Chemists during 1933-1934.

Spencer maintained a house in London until 1947 when he purchased a property known as Ashfield in Keighley Road back in Colne, to which he retired. He died on November, 19, 1955 as a patient in Hartley Hospital in the town and left much of his estate to the Hospital, the Providence Independent Chapel and the Colne Council. He is regarded as a noted benefactor to the town and the Trust Fund in connexion with Providence Independent Methodist Chapel is still operative.

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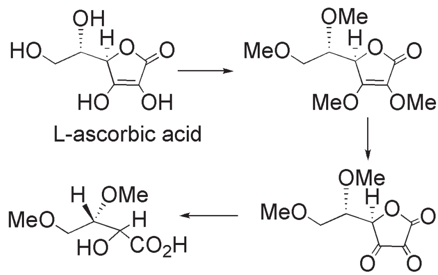
Sir Walter Norman HAWORTH, FRS (1883-1950)

Walter Norman HAWORTH was born on March 19, 1883 at 90 Park Road, Chorley, Lancashire, the second son and fourth child of Thomas and Hannah (née Crook) Haworth. His father, manager of the Rylands linoleum factory, was a distinguished and professional man whom Norman joined at age 14 after attending the local school.[1] The linoleum industry gave him an interest in dyestuffs and led to his lifelong involvement with chemistry . Despite pressures from his family to stay with the business, his chemical interests were so keen that he took lessons from a private tutor in the neighbouring town of Preston and passed the entrance examination for Owens College (Victoria University) in Manchester, entering the institution in 1903 when W.H. Perkin Jr. was head of chemistry. A quiet and hard-working student, Haworth gain a 1st class honours degree in chemistry in 1906 and had the intention of moving to chemical industry after a period of research in the Manchester laboratories.[2] However, he worked with Perkin for three years on the synthesis of terpenes and was awarded a two-year 1851 scholarship. This he took up in Göttingen where he continued studies of the terpenes present in essential oils with Otto Wallach. He gained his PhD degree in just one year and returned to Manchester as a research fellow for the second year of the fellowship, continuing the alicyclic studies. He was awarded the degree of DSc by the University in 1911, the minimum time permitted. That year he was appointed Senior Demonstrator in chemistry at Imperial College London under Sir Edward Thorpe (see above) but moved the following year to a lectureship in chemistry at St. Andrews University in Scotland.

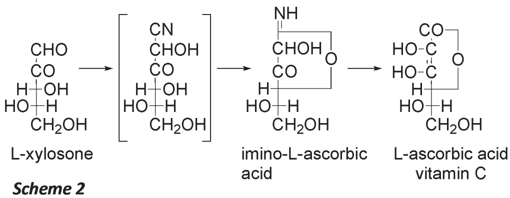
It was over his eight years there that Haworth's interest in terpenes transformed into studies in carbohydrate chemistry, notably from the involvement of Professor James Colquhoun Irvine and the retired Thomas Purdie. His efforts, interrupted by the impositions of the First World War, concentrated on the disaccharides, cellobiose, lactose, maltose, sucrose, and the trisaccharides. 1920 saw Haworth take the chair in chemistry at Armstrong College, Newcastle upon Tyne, then a college of the University of Durham, and in 1925 the Mason chair in chemistry at the University of Birmingham where he remained until his retirement in 1948. At Newcastle he established his carbohydrate research in an already research-active institution and took a good number of students with him to Birmingham. His time there saw the carbohydrate school develop as the leader in the UK.

The carbohydrate work led to the determination of the structures of many simple and complex compounds. His group showed that the carbohydrates were not the open chain compounds Emil Fischer had thought but the (now) traditional hemiacetal pyranoses and furanoses. Haworth then went on to depict the sugars by a perspective formula – the Haworth formulae – and introduced the term 'conformation' into the language of organic chemistry.[3] His extensive studies of the carbohydrates took up all of his research time in Birmingham save for the needs of his department during WWII. From 1932 Haworth invested much time and student effort into determining the structure of vitamin C and synthesising the molecule. The Hungarian, Szent-Györgyi had isolated the molecule from orange juice and the adrenal cortex at Cambridge University in 1927. He found it to be a very reactive $C_6H_8O_6$ compound, named *hexuronic acid*, and thought it to have importance in biological redox chemistry. Later, the compound was shown to be the previously unidentified antiscorbutic (scurvy) factor. The Haworth group showed the compound to be related to L-threose and confirmed the structure through methylation, oxidation and degradation to mono-acid as shown in Scheme 1.



Scheme 1

Total synthesis of the labile molecule was another matter as synthesis of the L-series of sugars was by no means easy. However, persistence paid off as the acid was obtained from D-galoctose in some eight steps that led to L-xylosone, which gave vitamin C by reaction with HCN and then hydrolysis of the imino-L-ascorbic acid thus formed (Scheme 2). It was identical to the natural material. It was for this work and his extensive carbohydrate chemistry that Haworth was awarded the 1937 Nobel Prize for chemistry (jointly with Paul Karrer who had studied carotenoids, flavins and vitamins A and B2). It was from that synthesis that large scale production of the vitamin became possible. Much of the vitamin C work was done in collaboration with E.L. Hirst, another Lancastrian from Preston who had had started his PhD with Howarth in St. Andrews (see p.47). Haworth offered him an appointment in Newcastle and followed it with one in Birmingham in 1927.



Scheme 2

The outbreak of WWII found Haworth recovered from health problems and he took a responsible part in the UK atomic energy project. The years following the war require reorganisation from war time to peace time activity with a significant increase in student population, but in 1948, at the age of 65 years he had to retire. His academic career not only involved his significant carbohydrate research and the more than 300 publications that he provided from his laboratories, but involvement with numerous Councils, committees and Boards. He was President of the Chemical Society over 1944-46, Vice-President of the Royal Society in 1947 and Vice-Principal of The University of Birmingham in 1947-48. He gained numerous awards and Honorary degrees, became a Fellow of the Royal Society in 1928, was awarded its Davy Medal in 1934 and its Royal Medal in 1942; he won the Chemical Society's Longstaff Medal in 1933 and was knighted in 1947.

Haworth undertook numerous lecture tours that included one to Australia and New Zealand, the latter component as the Royal Society representative to the 7th Pacific Congress held in Auckland and Christchurch between February 2 and 23 of 1949. His 100-page book *The Constitution of Sugars* (London: Edward Arnold & Co., Ltd., 1929) became a standard text in the subject.

Norman Haworth married Violet Chilton Dobbie, daughter of Glaswegian chemist Sir James Johnston Dobbie FRS, and they had two sons, James and David. Norman Haworth died on his 67th birthday, March 19, 1950 after spending a few days in the Somerset with his wife visiting their younger son. He suffered a fatal heart attack in the home that he designed and built at Barnt Green on the slopes of the Lickey Hills overlooking the Worcestershire plain. His wife and sons survived him.

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James Riddick PARTINGTON, MBE (1886-1965)

From: http://lifesun.info/what-is-j-r-partington

James Riddick PARTINGTON was born on June 30, 1886 in the small coal mining village of Middle Hulton, south of Bolton. His father was a book-keeper in Bolton and his mother (née Riddick), the daughter of a Scottish tailor. The family moved to Southport while the boy was still young. He was educated at the Victoria Schools of Science and Arts that opened[1] in 1887 (the year of Queen Victoria's jubilee) leaving in 1901 at 15 years of age when his parents returned to Bolton. Back there, he became an assistant to the town's Public Analyst for two years and was then appointed laboratory assistant at the town's Pupil Teachers' Training College. Later he became a clerk in the Bolton Education Office.[2] Following his early Southport studies in mathematics and practical chemistry, the young Partington used the 1901-1905 period for intensive private study in mathematics and languages. In 1906, at age 20, he qualified for entry to the Victoria University of Manchester and gained his first-class honours BSc degree in 1909. Despite being taught by Henry Roscoe and W.H Perkin Jr, organic chemistry never appealed to him. His undergraduate work led to a teaching diploma and a fellowship funded by the Beyer, Peacock and Co. Ltd., the famed English railway locomotive manufacturer, to start his MSc as the first student with the newly appointed physical organic chemist, Arthur Lapworth. Partington was awarded his MSc in 1911 having published some six papers. The work set him to his lifelong study of thermodynamics. That same year he published his first textbook *Higher Mathematics for Chemical Students* while still a graduate student (Methuen, London 1911, pp. 272). It remained a competitor to Mellor's 1902 text *Higher Mathematics for Students of Chemistry and Physics* until 1939.

As an MSc graduate, Partington went to Germany to work with Nernst in Berlin on the specific heats of gases and he found his new mentor inspirational. James was an 1851 Exhibition scholar[3] yet he never completed his doctorate there despite having five papers published in the *Physicalische Zeitschrift*.[2] 1913 saw Partington return to Manchester as a lecturer in Chemistry where one of his first students was Marian Jones, whose MSc thesis work he supervised and whom he married on September 6, 1919 after WWI. At the outbreak of that war Partington joined the army to become a member of the Ministry of Munitions initially working on water purification for troops on the Somme with E.K. Rideal and then, under F.G. Donnan, the production of nitric acid. The war work led to the award of an MBE (Military Division) to the by then Captain Partington. He was awarded a DSc degree by the Victoria University of Manchester in 1918.

The year of his marriage at age 33 saw his appointment to The East London College as its Professor of Chemistry. It had started its existence in 1887 on Mile End Road as a place of entertainment and education for the poor living in the East End of London, transitioned to an educational institution and gained degree-granting status by the University of London in 1915. Partington remained there through its transition to Queen Mary College London in 1934 until his retirement in 1951. His early years were marred by a lack of resources, yet he continued his physical chemical work and established a modest research school. It was through the 1920s and 1930s that Partington made many contributions to the Faraday Society and served on its Council and publications committee from 1919 until 1938, where he also represented the ACS *Journal of Physical Chemistry.* While some have said that Partington's research was uninspiring, it was of an exceptionally high standard and provided many highly accurate physical measurements.

The years of WWII saw Queen Mary College evacuated to Cambridge and Partington spent the war years enjoying the facilities of the Cambridge libraries. His wife elected to remain in London at their family home in Wembley, though whether her two daughters and son Roger (who also became a physical chemist) were there is not recorded. She had become a chemistry schoolteacher and produced a set of cards to assist in the teaching chemical formulae and equations that was manufactured for sale by Baird and Tatlock in London.[4] Tragically, she took her own life in March 1940 leaving her husband a widower for his remaining life.

The main recognition accorded Partington is not so much from his research work as his writings and his role as a chemistry historian. He, like contemporary Joseph Mellor, has set his place in the literature of chemistry. Not only did he write a series of textbooks for students, he provided books on the alkali and the nitrogen industries. While back in London he completed his famous five volume treatise on physical chemistry that ran to some 1.5 million words and, in his later life, his *magnus opus*,[5] *A History of Chemistry* that ran to four volumes despite the second part of the first volume never being published.[6]

On attaining 65 years of age in 1951, James Riddick Partington retired from his chair at Queen Mary College. He had so enjoyed his time in Cambridge that he moved back there to a house in Mill Road where he was looked after by an aged housekeeper. However, when she retired in late 1964 he transferred himself to Northwich, east of Chester in Cheshire to be near his sister.[5] He died on October 9, 1965 at a hospital in the nearby Weaverham.

Partington served on the Council of the Chemical Society, was a member of the Faraday Society and The Society of Chemical Industry, but it was his involvement with chemical history that led to many accolades. He was involved in establishing the Society for the Study of Alchemy and Early Chemistry (subsequently morphing into The Society for History of Alchemy and Chemistry) in 1937 and served as its first president. The organisation established the Partington Prize in 1975.[5] Sadly, no institution accorded Partington an honour for his exceptional chemistry literary work. Nevertheless, in 1965 he was awarded the George Sarton Medal, the most prestigious award of the History of Science Society.

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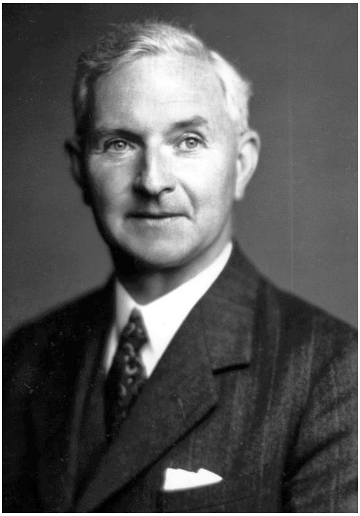
Sir John Edward LENNARD-JONES, FRS (1894-1954)



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John Edward JONES (LENNARD-JONES) was born September 27, 1894 in Leigh, the son of a retail furnisher. He was educated at Leigh Grammar School where he specialised in classics. However, on entering Manchester University in 1912 he registered not for this subject but for mathematics, and he gained BSc (Hons) and MSc degrees, the first at the outbreak of WWI. In 1915 he joined the Royal Flying Corps serving in France only to return to Manchester University as lecturer in mathematics where he gained his DSc degree. A senior 1851 Exhibition Fellowship came his way in 1922 and he moved to Cambridge and Trinity College where he gained his PhD two years later. As quantum mechanics was still an unknown entity, it was Lennard-Jones who introduced the empirical form by which the potential energy (PE) of two molecules separated by a distance *r* could be calculated and this (Eq. I) became known by his name.

$$PE = A/r^n — B/r^m \text{ .... Eq. I}$$

In 1925 he married Kathleen Lennard and added his wife's family name to his own to become Lennard-Jones; they subsequently had two children, John and Mary. That year with his wife, he moved to Bristol as Reader in Mathematical Physics and was elevated to become Professor of Theoretical Physics some eighteen months later. As such, he was the first mathematician to hold a position and then chair in a Department of Physics. There, he continued his studies on interatomic forces in solids and gases. After quantum mechanics was discovered and applied, he took a year at Göttingen when Pauli and Heisenberg were in residence. He introduced the new theories to Bristol on his return and he subsequently had many visiting theoretical physicists. These included Herzberg and Delbrück, the latter involved in the launch of molecular biology research in the late 1930s. Lennard-Jones' major paper was his 1929 *The electronic structure of some diatomic molecules* that provided the first study of molecular orbitals in theoretical chemistry.[2,3]

The reason for including Lennard-Jones among the chemical fraternity from Lancashire becomes obvious when one realises that from his position as Professor of Theoretical Physics in Bristol he moved back to Cambridge to take up the Plummer Chair of Theoretical Chemistry and Professorial Fellow of Corpus Christi College in 1932.[4] This was the first chair of theoretical chemistry created worldwide and as its incumbent, he was responsible for establishing a school of theoretical chemistry in which the concepts of quantum mechanics and interatomic forces were applied to a wide range of physical and organic chemical phenomena. He founded the Cambridge Mathematical Laboratory and was its Director in the immediate post-WWII years. He has been called the *Father of Computational Chemistry* and is responsible for fostering C.A. Coulson as his first graduate student (PhD 1936) and subsequently J.A. Pople (PhD 1951) among his distinguished pupils. There was a series of papers (1935-37) on the behaviour of atoms and molecules on surfaces, another in 1937 on the molecular orbitals applied to polyenes and aromatics and then in 1938 a series (with A.F. Devonshire) on liquids.

During WWII Lennard-Jones became a member of the Scientific Advisory Council of the Ministry of Supply and a number of its committees rising to Chief Superintendent of Armament Research having control over the old Woolwich Department. After the end of the war he became Director of Scientific Research (Defence) for close on a year. His government service utilised the remarkable administrative skills that the man had gathered. Nonetheless, he elected to return to Cambridge, which he did in 1946 after being knighted (KBE, 1946). He was elected Fellow of the Royal Society in 1935, was President of the Faraday Society from 1948 to 1950 and gained the Royal Society Davy Medal in 1953. That year he elected to follow interests in expanding academia by taking up the post of Principal of the University College of North Staffordshire (now Keele University) but his tenure was cut short by his early death; he died on October 1, 1954 in Stoke-on-Trent.

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Sir Edmund Langley HIRST, CBE, FRS (1898-1975)

Edmund Langley HIRST was born July 21, 1898 in Preston, Lancashire, the elder son of the Rev. Sim Hirst, a Baptist minister, and his wife Elizabeth, daughter of a flour merchant and baker of Liverpool. Edmund was given his mother's maiden name as his second name. Because of his father's ministry the family moved frequently and Edmund had a mixed schooling.[1] He attended a kindergarten in Burnley, had lessons privately, and studied at schools in Burnley and Ipswich before the family moved to Scotland so that he could attend his father's *Alma Marter*, Madras College in St. Andrews. He entered it in 1910 and, like his father, became dux of the school in his final year of 1914.

Edmund gained a bursary and Carnegie scholarship that allowed him to attend the local university, the University of St Andrews. He read Latin, Greek and Mathematics that year but was thrust into chemistry in the summer of 1915 when Professor James Irvine and Dr Norman Haworth (see p. 39) needed assistance in the preparation of dulcitol (D-galactitol) and some local anaesthetics, which were unobtainable in Britain. His introduction to organic chemistry involved the preparation of dimethylamine from *N,N*-dimethylaniline – a steep dive into aromatic chemistry that (he claimed) did him no harm.[1] He continued with synthetic work during his second year and was introduced to carbohydrate chemistry by preparing galactose and D-galactitol from lactose. However, his call-up for war service came in 1917. He was demobilised in early 1919 and studied hard to take his undergraduate finals in June that year and gained his BSc and MA degrees. On Haworth's advice he applied for and was awarded a Carnegie Research Scholarship taking his PhD studying the disaccharide cellobiose; he completed the degree in 1921. After Haworth moved to Newcastle in 1920, Hirst was directed by Professor Irvine and subsequently studied cellulose and carbohydrate ring systems beyond his degree years. He accepted a lectureship at Manchester University in 1923 under (Sir) Robert Robinson but moved to re-join Haworth in Newcastle the following year. It was from this time that the extensive collaboration between these two men blossomed (for a summary see: Haworth, p.39 and ref. 1, pp. 140-143). Haworth moved to Birmingham in 1925 but it was only after he was able to bring Hirst to join him in 1927 that his work there really took off, despite having amassed some twelve students and the collaboration of a number of the academic staff. Hirst was appointed as Assistant Director of Research and carried a significant lecture load. He gained a Birmingham DSc in 1929, was promoted to Reader in 1934, the year he was elected FRS. His most spectacular work at this time in association with Haworth was the determination of the constitution of vitamin C (ascorbic acid) and its synthesis, the first laboratory synthesis of a vitamin.[2,3]

Two years later saw his 1936 appointment to the chair of organic chemistry at Bristol University to which he took two of the Birmingham staff to form the nucleus of his own carbohydrate team. The work in Bristol involved plant gums, the epoxypolysaccharide mucilages, and starch. The war years demanded work be done on explosives and Hirst was fully involved in administrative and laboratory duties until the end of 1944. He was then appointed to the Manchester chair vacated by (Lord) Alexander Todd, which he took up in January 1945 taking some of the Bristol team to complete the war effort. However, it was in 1947 that he accepted the second chemistry chair at Edinburgh, the Forbes Chair of Organic Chemistry, which he held until his retirement in 1968. His researches at Edinburgh continued his thrust into complex carbohydrate chemistry and the work has been adequately summarised.[4] It includes (among other studies) determination of the structure of insulin, studies of fructofurano-containing grasses, starches, hemicelluloses, seaweeds and gums. In all, some 300 papers emanated from his studies and they established him nationally and internationally.[5]

Edmund Hirst was awarded a Coronation Medal in 1953, appointed a CBE in 1957 and knighted (KB) in 1964. He chaired the Chemistry Research Board of the UK's DSIR from 1950 to 1955, served twice on the Royal Society Council, was Vice-President and President of the Royal Society of Edinburgh (1958-64), President of the Chemical Society (1956-58) and Vice-President of the Royal Institute of Chemistry from 1967 to 1969.

Hirst's personal life was far from easy. While he married Beda Winifred Ramsay in 1925, she soon displayed the symptoms of mental illness that proved incurable and by 1937 she was permanently hospitalised. These years made his home life in Weoley Hill, Birmingham, difficult and in 1948 the marriage was dissolved. The following year he married Kathleen (Kay) Jennie Harrison for what proved to be a happy and ideal relationship; neither marriage led to children. Edmund Hirst died on October 29, 1975 in Edinburgh.

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Wesley COCKER (1908-2007)

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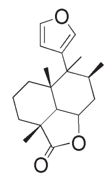
Wesley COCKER was born on January 31, 1908 in the small town of in Oswaldtwistle, some 5 km east-southeast of Blackburn and contiguous with Accrington in the former Lancashire cotton belt. His father was in that trade eventually managing several mills.[1] His Methodist up-bringing was rigorous and he retained his religion throughout his life. Wesley attended the local grammar school in neighbouring Accrington and was encouraged to attend university by his family. However, finances only stretched to the local Manchester University. His interest in chemistry was generated from the good laboratory facilities at school – it doubled as the local Technical College School in the evenings.

As it happened, Manchester in the 1920s had the foremost chemistry department in the country with (Sir) Robert Robinson as professor of organic chemistry to which the young Cocker was attracted. He graduated with his 1st class honours degree in 1928 when Robinson moved to London. Cocker remained in Manchester gaining his MSc and PhD degrees (Buckhardt and Lapworth, respectively). His work with Lapworth involved the addition of hydrogen cyanide to carbonyl compounds and that demanded copious quantities of liquid HCN. Cocker told, many times, how he determined whether the HCN was dry: *pour a little on the palm of the hand and blow on it – any water present would be left on the hand*. Clearly this is not a method for 21st century safety conscious chemists or their OSH directors!

After his PhD, Cocker remained at the university as Lapworth's personal assistant for a year before moving to ICI Dyestuffs in Blackley.[2] There, he found that Robinson's lectures on dyestuffs gave a good background but it was his study of methods to make methyl methacrylate, the precursor of Perspex that occupied much of his time and was his main claim to fame.[1] On working with diazonium salts used in dyestuffs manufacture he found that a precipitate that had been discarded was, in fact, the sought after diazonium intermediate they were seeking.

From ICI Cocker joined with his Lancastrian (Accrington) cousin (Sir) William Cocker who had a small business in Oswaldtwistle. They began to manufacture chemicals including mercaptobenzothiazole for tyre manufacture and resins for the paint trade. Together they made the active ingredient for the famous antiseptic Dettol (4-chloro--3,5-dimethylphenol). The business expanded operations and they built Cocker Chemicals in Nook Lane in the town. William remained managing director of the firm until 1963.[3] It has been recorded that a wonderful stench came from the factory and blew out over the whole of the town when the wind was in the right direction.[3] However, Wesley was not satisfied in an industrial environment and sought an academic appointment. He moved to the University College of South-West England at Exeter in 1937, which awarded London degrees. He worked on amino acid chemistry, married Eleanor Garstang, a fellow Lancastrian, and then accepted appointment at Newcastle in 1939 prior to the beginning of WWII. There he was influenced by Professor George R. Clemo who introduced him to natural products chemistry and work involving the structure of santonin. This interest went with him to Trinity College, Dublin when he took up his professorship at the beginning of 1947.



marrubiin
CAS 465-92-9

The time at Cocker Chemicals served Wesley in good stead as he fought to have the deteriorating old buildings at Trinity replaced over his first years there. He also revolutionised the teaching programme bringing it up to date by the late 1940s standard. His vigorous research programme was initially based around his earlier santonin studies but extended to derivatives and the terpene marrubiin (opposite) a constituent of the horehound plant, which is a member of the Labiate tribe and used in cough remedies. His terpene studies led him to gain funding for the first IR, UV, NMR and mass spectrometers in the Republic of Ireland.

Institute of Chemistry of Ireland 2000; with permission

Wesley Cocker was elected to the fellowship of the Royal Irish Academy shortly after his arrival in Dublin and served on its Council in various roles. He was a staunch member of the local Branch of the Society of Chemical Industry, the Royal Institute of Chemistry, the Chemical Society and the Institute of Chemistry of Ireland, and he had much to do with its resurgence. He died on January 30, 2007 a day before his 90th birthday.

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Richard Laurence Millington SYNGE, FRS (1914-1994)

http://en.wikipedia.org/wiki/Richard_Laurence_Millington_Synge

Richard Laurence Millington SYNGE was born on October 28, 1914 in Liverpool, the son of Lawrence Millington Synge, a Liverpool Stockbroker, and his wife Katherine (née Swan). It seems that the boy was taught by his mother until he was nine years old when he was sent to boarding school in preparation for a 1928 entry to Winchester College. There he studied classics until 1931.[1] However, during this time his biology teacher introduced him to the amino acids by pointing out that proteins were made up of them. His chemistry teacher furthered this by having him prepare glycine. On entering Cambridge University in 1933 he read physics, chemistry, and physiology, gaining his undergraduate degree in 1936, having taken biochemistry in Part Two of his Tripos. From 1936 to 1939 he was a research assistant in the Cambridge biochemical laboratory and it was during this time that his interest in the separation of amino acids was really aroused. He took particular attention of the countercurrent principles in fractional distillation. After working close to Australian Hedley Marston in Cambridge (he had studied wool in relation to soil sulfur deficiency), Synge's interest in amino acids increased and, with a scholarship from the Wool Industries Research Association (WIRA), he worked on the separation of acetyl amino acids gaining his doctorate in 1941. With the degree in hand, Synge moved to the WIRA laboratories in Leeds where he worked with Archer Martin and the pair developed a method to separate the various molecules that compose the complex mixture. The process combined adsorption chromatography and countercurrent solvent extraction and worked by placing the complex molecular mixture on one end of a strip of fine cellulose paper that was then placed in a solution of either alcohol and water or chloroform and water. The liquids flowing through the paper would move the complex substance, and the molecules then separated, depending on their rate of adsorption by the paper and by their affinity for either of the two liquids. A series of spots remained on the paper, each indicating which type of molecule was present. They gave the first demonstration of this new partition chromatography to the Biochemical Society at its meeting at the National Institute for Medical Research, London, on June 7th, 1941.[3,4] The pair shared the 1952 Nobel Prize in Chemistry for this new method of two-dimensional chromatography which became an invaluable research tool used in studying plant photosynthesis and DNA sequencing.

Synge left the Leeds lab in 1943, taking a position in the biochemistry laboratory at the Lister Institute of Preventative Medicine in London in order to work in an area with more relevance to the war effort; he worked almost exclusively with the antibiotic peptides of the gramicidin group. 1948 saw him move to Rowett Research Institute in Aberdeen as the Head of the Department of Protein Chemistry. Due to his mother's influence in his boyhood days he had always been more interested in plants than animals and the opportunity to work in plant biochemistry was of great appeal to him; it also allowed him to tackle a number of more practical agricultural problems. He was responsible for discovering more than 100 novel species despite the reaction of quinone with the amino acids adding complexity. He remained at the Rowett until 1967 and spent the 1958-1959 period at the Ruakura Agricultural Institute in Hamilton, New Zealand, during which time he helped solve the problem of facial eczema in sheep. It was he who identified the spores of the fungus *Sporidesmin bakeri* and subsequently isolated samples. He transferred to the Food Research Institute in Norwich in 1967 and held an honorary professorship of biological sciences at the University of East Anglia from the following year until 1984, keeping his work on the reactions of polyphenols and quinones, and amino acids bound in plants under investigation.

Dr. Synge was made a Fellow of the Royal Society in 1950 and of the Royal Institute of Chemistry in 1952, and became an honorary member of the American Society of Biological Chemists. In 1943 he married Ann Stephen, a niece of Virginia Woolf. They had four daughters and three sons. In his later life Dick Synge developed a number of illnesses which he kept in check by diet and medication. However, it was myelodysplasia that took hold though it was kept in check by regular blood transfusions. However, it was this that led to his death on August 18, 1994 in Norwich.

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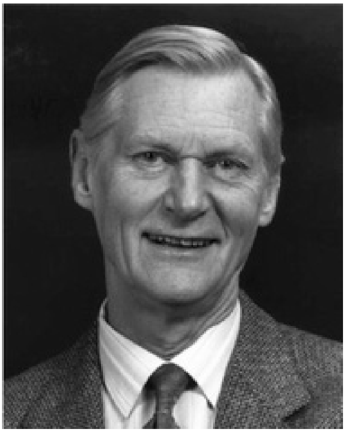
Sir Alan Rushton BATTERSBY, FRS (1925-)



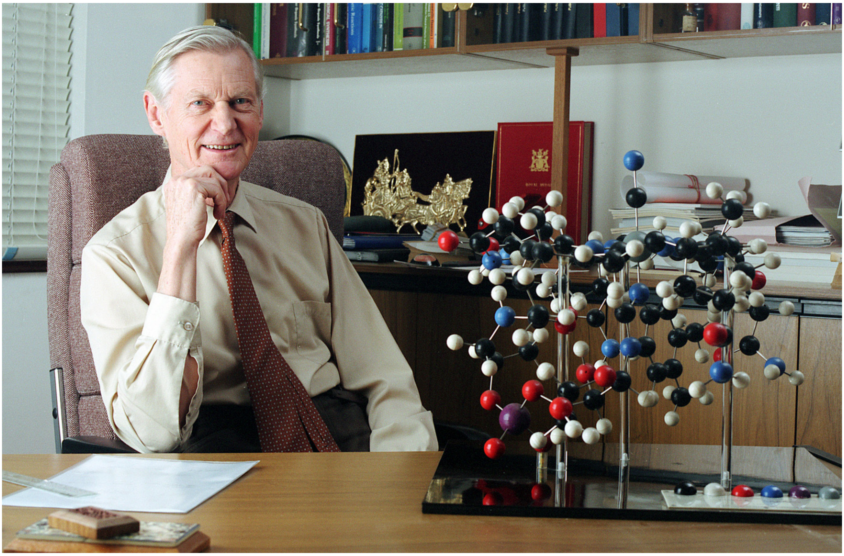
Adapted from *Organic & Biomolecular Chemistry* **2013**, *11*, 6240; with permission of The Royal Society of Chemistry

Alan Rushton BATTERSBY was born on March 4, 1925 in Leigh, now a town in Greater Manchester, to William Battersby and his wife Hilda (née Rushton). He is widowed and has two sons.

He passed the 11+ examination from King Street Primary School and that enabled him to enter Leigh Grammar School. He did well there and was happy, but because it was wartime then, he decided to help by leaving school at the age of 14 or 15 to enter a war factory in Leigh making electric cables. No one in his extended family had ever been to a University! Soon he realised that he had made a mistake as he had qualifications only equivalent to O-level. Three years of home study combined with attending, in the time not at work, what was then Salford Technical College allowed him to gain results in the Higher National Certificate (equivalent to A-level) appropriate for university entry. His family could not afford to pay the cost of his going to university but he passed the examination for a Lancashire Technological Scholarship and was able to enter Manchester University as a chemistry student under the professorial guidance of Alexander Todd. He graduated with 1st Class Honours in 1946 and was awarded a research studentship for work on the structure of emetine (used to treat amoebic dysentery) under H.T. Openshaw. In 1947, Openshaw moved to St. Andrews and Battersby went with him to complete the structural work on emetine and gain his PhD in 1949.

From 1948 to 1953, he was a Lecturer at St Andrews with the 1950-1952 period spent in the USA as a Commonwealth Fund Fellow, the first year with Lyman C. Craig at the Rockefeller Institute for Medical Research. There he worked on the structures of the peptide antibiotics tyrocidine and gramicidin and additionally, devised a method to determine their molecular weight (no mass spectrometers then!). At Rockefeller, he mixed with scientists of the highest calibre (several Nobel Laureates), often not chemists, who were working on very significant problems dealing with the chemistry of living systems. Battersby saw that these areas held huge opportunities for an organic chemist, a decisive moment governing the future direction of his research. It was to be focussed on biosynthesis, the chemistry of enzymes and synthetic work to mimic the chemistry carried out in Nature. In 1954, he moved to Bristol where his biosynthetic work was launched with the problem of morphine biosynthesis. Cyanide, carbonate and acetic acid were becoming available carrying their radioactive ^{14}C forms and these were used to synthesise likely precursor molecules for the ^{14}C-labelled form of morphine. These were injected into the growing poppy plants and later the morphine was isolated from them to check by radioactivity whether the supposed precursor had been converted into morphine. It proved to be a highly successful approach that led to the elucidation of the pathway not only to morphine but to many other alkaloids. Alongside this work, the structures of the highly poisonous calabash curare arrows were determined and a stereospecific synthesis of emetine was carried out.

In 1962, Battersby was invited to take up the second Chair of Organic Chemistry at the University of Liverpool where the biosynthetic work was expanded to many families of alkaloids. Tritium, the radioactive isotope of hydrogen, then became available to add to the armoury not only for biosynthesis but also studies of enzymic stereocontrol. By 1967, the alkaloid work was essentially complete so Battersby moved to study the tetrapyrroles where the pathways to haem and chlorophyll had huge gaps in knowledge. This work was soon transferred to Cambridge University following his invitation to a Chair of Organic Chemistry there in 1969. The research on alkaloids gradually gave way to a full effort on the biosynthesis of uro'gen-III, the parent for haem and chlorophyll. Initially, ^{14}C labelling of putative intermediates was used, but later the two essential enzymes deaminase and cosynthetase were produced in quantity by fermentation to allow a more direct attack. This led to the discovery of hydroxymethylbilane, a key intermediate on the pathway to uro'gen-III and also revealed the roles each enzyme played; many related studies of protoporphyrin-IX were carried out.



Prof Sir Alan Battersby; photo © Doug Young, Cambridge University

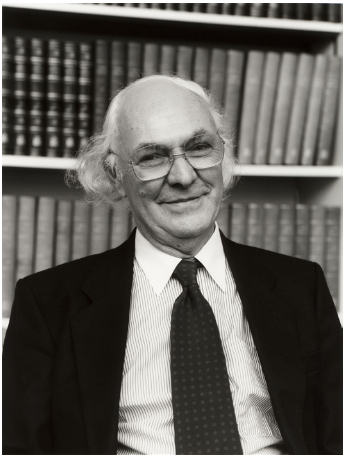
Battersby then took on the problem of how vitamin B12 is biosynthesised by micro-organisms. By that time ^{13}C NMR spectroscopy allowed multiple labelling patterns to be employed. This work uncovered the detailed pathway to the vitamin; a critical feature of all the later studies on B-12 was a marvellous collaboration with a group of French biochemists and geneticists. They produced all the required enzymes, while the synthetic and spectroscopic work was done in Cambridge. All the foregoing research is available in 441 papers in the major journals of Britain, the USA and Germany.

In 1968, Battersby was elected to the 1702 Chair of Chemistry and continued as Professorial Fellow at St. Catherine's College before becoming an Honorary Fellow in 2000. He has been awarded 24 medals and prizes that began with the Royal Society of Chemistry Corday-Morgan medal and prize in 1959, was enriched by the Copley Medal of the Royal Society in 2000 and (currently) ends with the ACS Robert B Woodward Award in 2004. He was elected Fellow of the Royal Society in 1966, holds six honorary doctorates, and has delivered some 30 named international lectures and held at least a dozen visiting professorships. He has held many consultancy positions and been a member and trustee of named Trusts. He was awarded a Royal Medal in 1984 and appointed a Knight Bachelor in 1992.

He loves music, is a keen fly fisherman and is still an enthusiastic hiker in mountains around the world. His 90th birthday is in March 2015 and the

Chemistry Department in Cambridge is holding a suitable celebration for him.

James Derek BIRCHALL, OBE, FRS (1930-1995)



James Birchall (courtesy of The Royal Society)

James Derek BIRCHALL was born on October 7, 1930 in Leigh. He was a most prolific inventor who entered academic life at Keele University only in 1992 as Professor and was awarded an honorary ScD by the University of East Anglia in 1994. He was one of the very few Fellows elected to the Royal Society in the 20th century who did not possess a university degree. Like Alfred Nobel, he received little formal education proving that night school in Wigan can lead to great scientific achievement. After National Service in the late 1940s he became interested in combustion and the way that chemistry could extinguish fire. His first invention was a chemical made by stewing blood that was added to the foam used for fighting fires – it helped the foam survive the flames. Later, after joining ICI in the 1950s, he continued his passionate interest in fires and invented *Monnex*, a dry powder fire extinguisher based on a potassium bicarbonate/urea complex. The unique extinguishing mechanism makes it up to five times more effective on high risk petrochemical installations and was more effective at dousing petrol fires than anything before or since.

By far the greatest part of his scientific career was spent working for ICI, and many of his inventions were commercialised by the company. He was involved in some 25 patents and almost 170 papers (SciFinder®). He was at ICI Winnington in the 1950s and 1960s, and then at Runcorn in the 1970s and 1980s. The Winnington site, built in 1873 by Brunner and Mond, was the base for the former company Brunner, Mond & Co. Ltd and it was here that ICI manufactured sodium carbonate (soda ash) and its various by-products. Although Birchall rose to the top of the scientific ladder in Britain's largest chemical company, he maintained his interest in experiment and in discussion around a blackboard. He was known to tell hilarious stories about the chemical industry. His best-known invention is the woolly ceramic insulation now used in all high-temperature ovens. It was used in the space shuttle, and is found in cars, in pistons and air bags. He was the first to show how this wool could be made by spinning alumina into fibres by a chemical process, giving a superbly insulating blanket which would survive enormous temperatures.

Birchall was the first to realise the importance of dissolved silica in water. Although the mineral only dissolves to about 10 ppm, London water is thick with it, whereas Scottish water has little. The ingenious and controversial idea he put forward was that silica is but one component in the problem with dissolved alumina an all-pervasive and slow-acting poison, which is washed out of rocks by acid rain, killing plants, fish and ultimately humans. Birchall's deceptively simple reasoning was that the two most abundant chemicals on earth, silica and alumina, fight against each other to permit life. With his colleagues, he showed that fish could be poisoned by very small quantities of alumina dissolved in water. However, when silica was added the fish survived. After his appointment to Keele University he devised a popular experiment that proved his concept. He asked for student volunteers to drink beer whose silica content is high and assumed that it would pick up any alumina in the body, and remove it in the urine. Analyses of the students' urine showed an increase in the alumina content.

His death on December 7, 1995 followed unconsciousness after being hit by a London taxi on a pedestrian crossing on November 30. It is especially ironic that his concern for the health of people connected to hospital machinery impacted in his own final days. Birchall knew that kidney patients can suffer severe health problems after dialysis with significant pain in their bones, even to loss of memory and total brain damage. He went on to show, yet again, that this was dependent on the quality of the water used to wash the blood in the dialysis machine – the use of pure water caused the problems to disappear. He even found a north/south divide. Whereas the dirtier London water was problem-free, the cleaner water from the north that carries less silica led to damage.

His contributions to science were recognised by his election to the Fellowship of the Royal Society in 1982. He was appointed OBE in 1990 and awarded the Armourers and Brasiers' Company Prize in recognition of his outstanding work on inorganic materials including the development of strong ceramic fibres and high strength macro-defect-free cement in 1993 and an Hon ScD from the University of East Anglia in 1994. His wife Pauline (née Jones), whom he had married in 1956 and had two sons, predeceased him in 1990. At his death he was engaged to Audrey Greaves.

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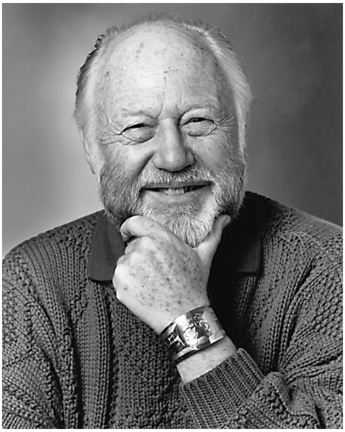
Michael SMITH, CC, OBC, FRS (1932-2000)



Michael Smith (courtesy of MSL)

Michael SMITH was born on April 26, 1932 in Blackpool, son of Rowland Smith, a working-class market gardener, and his wife Mary Agnes (née Armstead).[1-4] The family was not wealthy and it was by way of passing the 11+ examination while attending St. Nicholas Church of England School, and a scholarship, that he entered the local independent Arnold School for Boys. Although his time there was not a happy period, he was inspired by Sidney Law his chemistry teacher and on gaining a State Scholarship he entered Manchester University to study chemistry. He gained his BSc (Hons) in 1953 and PhD in 1956 publishing two papers (1957 and 1958) in the Journal of the Chemical Society with H.B. Henbest.

From Manchester he moved to the University of British Columbia (UBC) in Vancouver to work with Gobind Khorana with a view to developing ways of synthesising molecules that belonged to the biologically important organophosphate groups as the UBC group was developing new techniques of synthesizing nucleotides. When Khorana and his group moved to Wisconsin in 1960 Smith moved with them, but in 1961 he moved back to Vancouver to a position as chemist at the Fisheries Research Board of Canada laboratory, which he held for five years. There he published work on crabs, salmon and marine molluscs, while continuing his studies involving DNA chemistry from independent grant funding external to his fisheries-related work. The fisheries laboratory was located on the UBC campus and he concurrently held the position of associate professor at the Department of

Biochemistry and collaborated with staff there and in medicine. In 1966 he accepted appointment as Professor of Biochemistry (Faculty of Medicine) and he remained there until his death. In 1981 he was one of three co-founders of biotechnology company ZymoGenetics Inc. that was sold to Novo Nordisk in 1988 and is now owned by Bristol-Meyers Squibb. 1996 saw his appointment as the Peter Wall Distinguished Professor of Biotechnology at UBC.[2] Smith was the founding director of the Genome Sequencing Centre (now the Genome Sciences Centre) at the BC Cancer Research Centre in Vancouver.

In the late 1970s, Smith was concentrating exclusively on projects in molecular biology, more specifically on how the genes within the DNA molecule act as reservoirs and transmitters of biological information. In 1978, with a former colleague, he introduced site-directed mutagenesis – the way to make a genetic mutation precisely at any spot in a DNA molecule; it was published in the Journal of Biological Chemistry.[5] Four years later, for the first time, they were able to produce and isolate large quantities of a mutated enzyme in which a pre-determined amino acid had been exchanged for another. This then allowed researchers to introduce specific mutations into genes and, thus, to the proteins that they encode. The original idea stemmed from discussions while Smith was visiting Sanger's laboratory in Cambridge, UK, on his 1976 sabbatical. He realised that making short chains of nucleotides for use in the separation and purification of DNA fragments might also be used to induce mutations to give new qualities or traits in offspring not found in their parents. It took several years to develop and perfect the method but the technique became so well-known and useful that it earned him (with Mullis) the 1993 Nobel Prize in chemistry. By using site-directed mutagenesis, scientists have been able to dissect the structure-function relationships involved in protein plaque formation in the pathophysiology of Alzheimer disease, study the feasibility of gene therapy approaches for cystic fibrosis, sickle-cell disease, and hemophilia, as well as determine the characteristics of protein receptors at neurotransmitter binding sites and design analogs with novel pharmaceutical properties. The viral proteins involved in immunodeficiency disease have been studied and the properties of in-

Smith receiving his 1993 Nobel Prize in chemistry (courtesy of MSL) dustrial enzymes used in food science and technology have been improved using Smith's method.

Michael Smith received numerous awards and honours during his life. These included election as Fellow of the Royal Society of Canada in 1981, Fellow of the Royal Society (1986), the Order of British Columbia (OBC, 1994) and Companion of the Order of Canada (CC, 1995). His biography was published in 2005.[6] In 1987 UBC created the interdisciplinary Biotechnology Laboratory under the leadership of Smith and renamed it The Michael Smith Laboratory (MSL) in 2004.

Smith married Helen Wood Christie on August 6, 1960 and the couple had two sons and a daughter, but separated in 1983. In his later years, Smith lived with his partner Elizabeth Raines in Vancouver.

He died on died on Wednesday October 4, 2000 at Vancouver General Hospital.

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Brian Frederick GRAY (1933-)

Brian Frederick GRAY was born on July 18, 1933 at Ancoats in Manchester, the son of a policeman who rose to become Chief Superintendent of Manchester City. Brian was educated at Burnage High School, then entered Manchester University on a State Scholarship and gained his BSc (Hons I) in chemistry in 1954. He registered for a PhD under Dr. Huw Pritchard, but in those days one had to do an MSc first. This was a mixed experimental/theoretical degree but, given Brian's interest in theoretical chemistry and his knowledge of the subject, he proceeded with Pritchard as his supervisor to his PhD degree and began to explore some of his new ideas. One of these was that the properties of H^- could be calculated from H_2^+ wave functions simply by exchanging M and m, the masses of the proton and electron, respectively, self-evident on inspection of the respective Schrodinger equations (essentially turning the Born-Oppenheimer separation inside out). It was included in his PhD thesis among an assortment of other imaginative topics. However, his external examiner took exception to this and insisted that it and all reference to it be removed from the document, which it was (with scissors!). The PhD degree was awarded (1957) and Gray sailed to the US for postdoctoral time with Linus Pauling at CalTech. There, within weeks, his concepts of turning the Born-Oppenheimer separation inside out was accepted by Pauling and it has been used by others since that time in the treatment of excited states of two-electron atoms.

Gray returned from California to a second postdoctoral in the UK then a lectureship at Salford, but was attracted back to the US. There he gained a position at the Defence Research Corporation (1962-1967) in Santa Barbara where, almost immediately, he needed to submit research proposals for funding. A proposal in combustion kinetics was successful and before long, he wrote his ground-breaking papers on branching chains in combustion processes, which set him on his later career trail.

From 1967 to 1976 Brian Gray was Reader in Mathematical Chemistry at the University of Leeds, where he spent a very happy and productive period in the combustion group led by his friend and mentor Professor Peter Gray (no relation). He left to take up the position of Professor of Chemistry at Macquarie University in Sydney, Australia at the beginning of 1977. He stayed in that position until he was awarded a Foundation Australian Federal Government Fellowship in 1990, which he held in the School of Mathematics and Statistics at the University of Sydney until retirement in 1998 as emeritus professor. He was granted a DSc degree by Manchester University in 1971.

Throughout his career Brian Gray has made enormous and valuable contributions to areas such as quantum chemistry, branching chain reactions, muscle modelling, spontaneous ignition (this both experimentally and theoretically) and general nonlinear analysis of chemical reactions. On retiring and for some time afterwards he remained very busy as an expert witness giving evidence mainly on explosions in the holds of container ships and enjoyed a 'second career' as such, arguing with but generally being kind to barristers struggling with the science!

Brian was elected to fellowship of the Royal Australian Chemical Institute, the Australian Mathematical Society and the Institute of Mathematics and its Applications (UK).

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Anthony LEDWITH, CBE, FRS (1933-2015)

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Anthony LEDWITH was born in Lancashire in 1933 and raised in in Wigan.[1] He took an external London degree at the Wigan Mining and Technical College and was so successful that he transferred to postgraduate work at Liverpool University gaining his PhD in 1957. He was employed at Liverpool as a lecturer in 1958 and moved through the ranks to become the third Campbell Brown Professor of Industrial Chemistry in 1980. He was awarded a DSc in 1970.

He believed that Chemistry should not be compartmented rigidly and his own research reflected this. It covered areas of photochemistry, polymer chemistry and organic chemistry; he was involved in work that ultimately led to the now common superior photochemically-cured dental polymers. He authored in excess of 240 research papers and books, was a visiting professor and invited Lecturer at many institutions external to the UK and served on various government committees.

In 1984 he left the University of Liverpool to become Deputy Director, then Director, of Group Research at Pilkington plc. The research groups he controlled worked in many areas, but the polymer coatings for glass were of particular interest to him. He was a non-executive member of the Boards of several Pilkington companies and Chairman of the Board of Pilkington Energy Efficiency Trust. On retirement from Pilkinton, he returned to higher education, taking on the headship of Chemistry at the University of Sheffield in 1996.

He was President of the Royal Society of Chemistry from 1998 to 2000 whilst simultaneously chairing the UK Engineering and Physical Sciences Research Council. Tony Ledwith was awarded a CBE in 1995 and elected to Fellowship of the Royal Society the same year. He has been awarded Honorary Doctorates by the City University London (1992) and University of East Anglia (2000).

Tony was married with four children. He established a Boys Club in Wigan while a teenager, was an enthusiast for music, and a supporter of the Bolton Wanderers football club. He died on January 5, 2015.[2]

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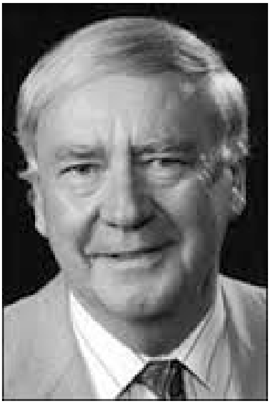
Alan Herbert COWLEY, FRS (1934-)



Alan Herbert COWLEY was born on January 29, 1934 in Blackley, Manchester and gained his BSc(Hons) and MSc degrees in 1955 and 1956 . He stayed on at the University of Manchester to work with Prof. Fred Fairbrother for his PhD that was awarded in 1958. He moved to postdoctoral and instructor experience at the University of Florida from 1958-1960 before a short spell during 1960 to 1961 as a Technical Officer in the Exploratory Group of the ICI Billingham Division in Stockton-on-Tees, England. Between 1962 and 1988 he was at the University of Texas-Austin rising from Assistant Professor to full Professor in 1970 and the George W. Watt Centennial Professor of Chemistry from 1984 to 1988. He then returned to England as the Sir Edward Frankland Professor of Inorganic Chemistry at Imperial College London. This was over the 1988-1989 year as he returned to Austin-Texas in 1989 where he currently holds the Robert A. Welch Chair in Chemistry.

Alan is the author of more than 500 publications on main group and transition metal chemistry, and is the winner of numerous awards. These include the 1980 Royal Society of Chemistry award for main-group element chemistry and its 1986 Centenary medal and lectureship, the Chemical Pioneer Award of the American Institute of Chemists in 1994 and a von Humboldt Prize in 1996. He received the French Government Chevalier dans l'Ordre des Palmes Académiques in 1997 and the 2009 American Chemical Society Award for Distinguished Service in the Advancement of Inorganic Chemistry. He was elected a Fellow of the Royal Society in 1988. Most recently he was given the ACS Distinguished Service Award in the Advancement of Inorganic Chemistry in 2009.

Alan has served on the Council of Gordon Research Conferences, (1984-1987) and was a member of its Board of Trustees for ten years from 1989. He was Vice-Chairperson then Chairperson between 1993 and 1995. He has served as a member of the Editorial Boards of Inorganic Chemistry, Chemical Reviews, Inorganic Syntheses, Polyhedron, Progress in Inorganic Chemistry, Organometallics, and Heteroatom Chemistry. He was a Member of the Air Force Office of Scientific Research Chemical Sciences Review Panel from 1987 to 1990. He has been a scientific advisor to Materia, Inc. and Convergent Venture Partners, L.P. and Convergent Ventures. It is not surprising that the World Innovation Foundation have classified him as a *Chemical Pioneer*.

Alan's distinguished research career has encompassed main group chemistry, organometallic chemistry, catalysis, precursors to electronic materials, polymer chemistry, and environmental chemistry. More specifically, he and his group showed that trimethylsiloxyaluminum dihalides are stable, was first to prepare a compound containing a boron-silicon bond, pursued unusual main group compounds and groups 13 and 15 complexes of low oxidation and coordination numbers. It was the Cowley group that first described arsenic to arsenic, phosphorous and antimony double bonded compounds, a terminal borylene complex, and their work on N-heterocyclic carbenes has led to the nature of the carbene bond being better understood.

Alan married Deborah Elaine Cole in 1975 and has two sons and three daughters. His interests outside of chemistry have included squash, sailing, music and literature.[2]

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William Roy JACKSON, AM (1935-)

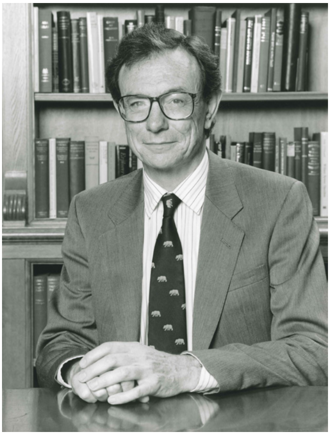
William Roy JACKSON was born in Bacup on February 27, 1935 into a family of railway workers; his father, grandfather and great-grandfather had worked on the northern railways and the family was always known as the Puffer Jacksons. His primary education was at Mount Pleasant Infant School (1939-1942) and Bacup Central Primary School (1942-1945). He was secondary schooled at Bacup and Rawtenstall Grammar. There he was taught and inspired by Milton Ormerod, the chemistry teacher. He left in 1952 with a State Scholarship to attend Manchester University where he gained 1st first class BSc(Hons) degree in 1955. His PhD followed a move to King's College London from which he transferred to a US Ethyl Corporation postdoctoral fellowship at Oxford University with Professors E.R.H Jones and M.C. Whiting. After one year he moved to take up an assistant lectureship at the Queen's University of Belfast, where he stayed until 1972, by which time he had attained readership status. From 1973 he was professor of organic chemistry at Monash University rising to become the Sir John Monash Distinguished Professor in 1995. He was the founding director of Monash's Centre for Green Chemistry. He was awarded a DSc by London University in 1973.

The research work of Professor Jackson falls into four general categories and has involved the development of new catalyst systems based on organometallics for organic molecules with significant biological activity and with good regio- and stereoselectivity. More public awareness has come from his studies with Prof. F.P. Larkins (University of Melbourne) into the structure and reactivity of coal with special emphasis on Victorian brown coals. Currently, Professors Jackson and Chaffee are working with the Sentient Company studying the structure of oil shales from Jordan, Colorado and Queensland, and examining novel methods for extracting oil from them. He has also developed new materials with applications in the areas of pharmaceuticals, controlled release of biologically active compounds, polymer-attached liquid crystals for optoelectronic devices, and new surface coatings. Finally, his work in the green chemistry area has been directed towards new processes which, where possible, use renewable resources in reactions that are environmentally friendly and have a minimum of waste and energy expenditure. He is still active with current work involving recoverable and reusable metal catalysts, new paints from vegetable oils, preparation on non-addictive opioids from Australian poppies and a study of the influence of humic substances (including coal) in agriculture.

Roy's research career has been based mainly around interests in homogeneous metal-catalysed reactions. Many of the catalytic sequences are retarded by free radicals and the development of radical traps, which in themselves do not suppress catalytic activity, is an area of general interest. In addition, this research led to collaborations that involved the synthesis of analogues of known biologically active molecules coupled to an antioxidant moiety. The biological activity of these molecules is being evaluated.

Professor Jackson is now emeritus Sir John Monash Distinguished Professor at Monash and was appointed a member of the Order of Australia in 2013. He received the Australian Government's Centenary of Federation Medal for services to Applied Chemistry in 2003. He was elected to Fellowship of the Australian Academy of Technological Sciences and Engineering in 1990, the Royal Australian Institute of Chemistry (RACI) in 1974 and the Australian Institute of Energy in 1982. Roy has received a number of Awards from them including the Leighton Memorial Medal of the RACI after being President of the Institute in 2002. Roy is married and has three children.

James Johnson TURNER, FRS (1935-)



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James Johnson TURNER was born on December 24, 1935 in Darwen, son of Harry and Evelyn (née Johnson). He attended St. Barnabas primary school and Darwen Grammar prior to his university education at King's College, Cambridge. He gained his BA in 1957 and MA and PhD (with Norman Sheppard) in 1960. He was awarded an ScD in 1984. Following his PhD he held a Harkness Fellowship for his postdoctoral study at Berkeley, California, then returned to Cambridge initially as a demonstrator then lecturer in chemistry in 1963. In 1972 he transferred to Newcastle-upon-Tyne as Professor and Head of Department of Inorganic Chemistry then, in 1979, he moved to Nottingham where he held his chair in inorganic chemistry until 1995 when he became a research professor. In 1998 he was appointed Emeritus Professor. His tenure at Nottingham saw him as Pro-Vice-Chancellor from 1986-1990.

Jim's research has encompassed various aspects of spectroscopy, initially studying NMR during his student days and then photo-intermediates and excited states in organometallic chemistry that he and his group assessed by low temperature techniques and fast time-resolved infrared spectroscopy. Studies of picosecond organometallic processes were followed by infrared band shape analysis.

Jim was awarded a Tilden medal and lectureship by the Royal Society of Chemistry in 1978 and this was followed with the Liversidge Medal in 1991. He was President of Dalton Council from 1994-1996, a member

(1974-1977) then chairman (1979-1982) of the chemistry committee of the Science and Engineering Research Council (SERC) and then a member of the Council from 1982-1986. He served on the University Grants Committee (HEFCE) from 1989-1994. Jim was elected FRS in 1992 and served on the Council for three years from 1997.

Jim married Joanna Gargett and has two daughters and five grandchildren.

Stuart Arthur PENKETT, FRMetS (1939-)

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Stuart Arthur PENKETT was born January 3, 1939 in Eccles, now in the city of Salford, and known for the flaky pastry cakes named after it. Stuart gained his secondary education at Eccles Grammar School and enrolled at the University of Leeds for his tertiary education, being awarded BSc and PhD degrees. Postdoctoral study at the University of Southern California over 1963-65 was followed by three years with the Unilever Laboratories in Welwyn.

In 1968 Stuart transferred to the Atomic Energy Research Establishment at Harwell where he was intimately involved in the research that demonstrated the significance of chemical processes occurring in the atmosphere producing acid rain and ozone. He remained there until 1985 building up a large group of atmospheric chemists who took part in experiments around the world studying the behaviour of ozone and many related gases. He spent a year at the National Center for Atmospheric Research in Boulder, Colorado in 1985 and returned to a National Energy Research readership in atmospheric chemistry based in the Schools of Environmental Sciences and Chemistry at the University of East Anglia. Again, he built up a large group of atmospheric chemists to study the behaviour of ozone and many related gases He was promoted to professor in 1990 and retired with emeritus status in the School of Environmental Sciences in 2004.

His publication '*The importance of atmospheric ozone and hydrogen peroxide in oxidizing sulfur dioxide in cloud and rain water*' is regarded as one of the most significant.[1] It provided a major breakthrough in the understanding of the chemistry of rainwater and of aspects of the sulfur chemistry of the atmosphere that had been studied throughout the 19^{th} and 20^{th} centuries. It clearly showed for the first time that the most efficient oxidation process for sulfur dioxide (SO_2) in cloud droplets was reaction with the strong oxidants ozone and hydrogen peroxide, and that by comparison, reaction with oxygen in the droplets was of little or no importance.

In 1992 Stuart Penkett set up the Weybourne Atmospheric Observatory on funds provided mostly by BP plc. From the early 1990s has come the documentation of changes in ozone and many other gases in the atmosphere over the UK. In 1995, Stuart led the 'Atmospheric Chemistry Studies in the Oceanic Environment' research programme and he has been involved with many groups concerned with global climate change since. He has been an active member of advisory groups associated with the UN Assessment of Stratospheric Ozone, the US National Academy of Sciences, the UK Department of the Environment, the Metrological Office Hadley Centre, the European Union and the EUREKA EUROTRAC project which measures transport and transformation of environmentally-relevant trace constituents in the troposphere over Europe.

Stuart Penkett was awarded the Royal Meteorological Society Gaskell Medal in 1987 and the Elsevier Science Haagen-Smit Award for 2003. He was a Leverhulme emeritus fellow over 2005-06, is a member of Academia Europaea and a foreign member of the Max Planck Society. He is a Fellow of the Royal Meteorological Society. His main research interests are now focused on observations of changing atmospheric composition made at the at Weybourne facility. He remains an international authority on the chemistry of the earth's atmosphere.

Stuart is married to Edith.

Reference

1. Penkett, S.A.; Jones, B.M.R.; Brich, K.A.; Eggleton, A.E.J. *Atmos.Envir.* **1979,** *13*, 123-137.

Brian HALTON, FRSNZ (1941-)

Brian HALTON was born on March 9, 1941 in the small town of Gt. Harwood near Blackburn, the only child of John and Mary Halton. His father had a chequered early career having been the saxophonist in the local Elite Orchestra that toured Ireland during the great depression years but a male nurse at Calderstones Hospital in Whalley during the war. Subsequently he became a shop keeper, sub-postmaster and master grocer. As a child, Brian suffered from bovine tuberculosis and missed two years of schooling before moving to the hamlet of Woodfields, near Stonyhurst College. There he attended St. Joseph's Primary School in Hurst Green, the local village. His secondary education was at St. Joseph's College, Blackpool where his interest in chemistry was enkindled by Bro. Sreenan and then at St. Joseph's Academy Blackheath, London where Bro. Austin inspired him with his encyclopaedic knowledge of the subject. With a State Scholarship he entered Southampton University in 1960, the first member of his extended family to do so. He graduated with a BSc(Hons) in 1963 and PhD in 1966 under the direction of Professor Richard Cookson. The work led to the first isolation and characterisation of two conformational isomers of one molecule, namely cyclotriveratrylenol.

Brian's year of postdoctoral study with Prof. Merle Battiste at the University of Florida resulted in him learning more about organic chemistry than in his years of formal study. His second year there was as Assistant Professor but the entire period was spent working with Battiste on small ring chemistry. In September 1968 he joined the Victoria University of Wellington, NZ, where he rose to become Professor of Chemistry. His research concentrated on highly strained and fused aromatics that led to a raft of unstable cyclopropanated derivatives (the cycloproparenes) that include the most highly strained didehydrobenzenes on the one hand and some exceptionally fluorescent compounds on the other.

Halton was awarded the NZ Association of Scientists Research Medal in 1974, its Shorland Medal in 2002, and the NZ Institute of Chemistry (NZIC) ICI Medal for excellence in chemical research in 1980. He gained a British Council Fellowship in 1974, a Fulbright Research Scholarship in 1981 and a Claude McCarthy Fellowship in 1989. He was elected to Fellowship of the New Zealand Institute of Chemistry in 1977 and of the Royal Society of New Zealand in 1992. Brian has been a stalwart of the NZIC serving as the Wellington chairperson, periods on the Council that included the Presidency in 1986-1987 and New Zealand's representative on the Pacifichem Organizing Committee for 18 years. Apart from recognitions by his University (DSc 1987), Brian has been awarded the sole 21st century Honorary Fellowship of the NZIC (in 2005) and has a Wellington lecture named after him; the inaugural Halton Lecture was given in October 2014 by his former student Professor Martin Banwell of the Australian National University. He retired with emeritus status in 2004 and maintains his office in the School of Chemical and Physical Sciences where he edited *Chemistry in New Zealand* for ten years from 2002. He has written an autobiography, a history of Chemistry at Victoria and edited other biographical works. He continues to write articles involving the history of chemistry.

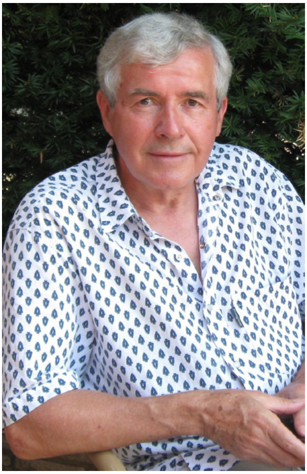
He married Margaret Leach in 1970, has two married sons, one in New Zealand and the other in Germany, and three grandchildren.

Michael John PILLING, CBE (1942-)

Michael John PILLING was born on September 25, 1942 in the small town of Whitworth at the foothills of the Pennines between Bacup and Rochdale. It lies within the borough of Rossendale. Mike attended Bacup and Rawtenstall Grammar School then read natural sciences at Churchill College, Cambridge. There he obtained a BA in natural sciences in 1964 and his PhD in 1967 from study under Dr. A.B. Callear. He continued as a junior research fellow at Churchill College until 1970 during which time he had a year at the (then) National Bureau of Standards at Gaithersburg in Maryland, USA, studying flash photolysis with Dr. W. Braun. In 1970 he was appointed lecturer in chemistry at Oxford University and tutorial fellow in Jesus College. He took the Chair of Physical Chemistry at the University of Leeds in 1989 and was Pro-Vice-Chancellor in the University from 1992–1994.

His research has focused on gas phase reaction kinetics, with applications in atmospheric chemistry and combustion, and has included measurements and modelling of elementary radical reactions. He has received a number of awards, including the Polanyi Medal (1994), the John Jeyes Lectureship (2001) and the Distinguished Guest Lectureship in Environmental Chemistry (2006), all from the Royal Society of Chemistry. He was President of its Faraday Division from 2003–2006, served on the NERC Council from 1995–2000 and was Chair of the Atmospheric Science and Technology Board over the same period. Between 2002 and 2007 he was Director of Composition Research at the National Centre for Atmospheric Science and Chair of the Air Quality Expert Group, a Government advisory body, from 2001–2009. He was awarded an Honorary Doctorate in Natural Science from Eötvös Loránd University, Budapest in 2007 and a CBE in the 2008 Queen's Honours. He retired in 2010 and is now an Emeritus Professor at the University of Leeds.

Edward McDONALD (1943-)



Edward (Ted) McDONALD was born in Ormskirk on Armistice Day, May 8, 1943. His parents were then living in rooms in Maghull, but soon moved into a terraced two-up, two-down with outside toilet and tin bath hanging on the backyard wall, located near Liverpool FC. Both parents had left school at 14, having written their early school lessons on slates, but they gave Ted a sound preparation for school so that by age five he was able to recite the alphabet backwards and carry out addition and subtraction in 'old money' (base 12 and 20!). Anfield Road School provided a strict, but enjoyable, primary education and Ted passed the 11+ examination gaining entrance to Liverpool Collegiate School. While there chemistry came into his life when friend and neighbour Don Carruthers was given a chemistry set for Christmas. Soon the pair had grown out of the innocuous contents, but found small quantities of serious chemicals available fromt specialist supplier Oakes and Eddon. In their home kitchens they burnt magnesium, delighted in the colours of ferrous and cupric solutions, made chemical gardens and, of course, heated potassium nitrate in test tubes and added sulfur and charcoal to spectacular effect. Chemistry lessons at Alsop grammar school started a year ahead of those at Collegiate so Don taught Ted the rudiments of valency to explain and predict the formulae of metal salts.*

At school Ted was very fortunate to have H.L. Heyes as chemistry master. He was so committed to the science that he had texts published on Physical and Organic Chemistry and a wonderful book entitled *Chemistry Experiments for Boys and Girls at Home*. Ted was so inspired by this man's teaching that he and a close friend appealed against their automatic transition after O-level to Classics in the sixth form; they studied Maths, Physics, and Chemistry to A-level. Sixth-form chemistry included carefully sniffing bottles of all the major organic chemicals, and many practical experiments including the preparation of methyl isocyanide (from methylamine and chloroform), which brought the headmaster to the teaching lab to complain about the pervasive stench.

School tradition had the more able boys stay on after A-levels and try for Oxford and Cambridge entrance, normally to read Classics. Ted was one of them and he gained an Exhibition award, not to either of these institutions but to Imperial College. He also won a Liverpool Senior City Scholarship. The modest income from these sources and a government grant allowed him to attend university without financial support from his parents who could ill afford it.

With the entrance examinations completed by Easter, Ted had six months before entering university. He was offered two jobs, but on advice took that in the ICI Analytical Lab in Widnes. He rose early each morning for the 20-mile bus-train-bus journey, his pay of £5 per week just about covering the fares! The real benefit came from learning a wide range of exciting wet-chemical analytical techniques, and becoming proficient at achieving replicate results within a narrow range. Titration, often a key procedure, had sample preparation very varied. It included heating samples with sodium peroxide in a steel 'bomb', or accurately weighing oleum after sealing it into a small glass bulb that would then be crushed under water with a satisfying fizz. The large department provided analytical services for many adjacent pilot plants in ICI's Mond Division, and oleum analyses were needed to optimise conditions for the dehydration of the intermediate in the manufacture of methyl methacrylate.

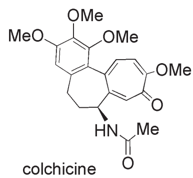
The synthesis of paraquat, the herbicide that revolutionised agriculture by avoiding annual ploughing, gave mixtures of the 2,2-, 2,4-, and 4,4-iso-

* Don, now a US citizen, is still a close friend. When in his 60s he won an ACS award for his industrial research on the use of clay supports to increase the capacity and safety of gas cylinders.

mers. One of Ted's jobs was to analyse these samples by injecting pyridine solutions into a prototype home-built gas chromatograph to determine isomer ratios. No fume cupboard was available and the lab smelt strongly of this unpleasant solvent. At Imperial College, Ted found future Nobel laureates Derek Barton (conformational analysis) and Geoffrey Wilkinson (ferrocene) inspiring teachers. In Year 3 he specialised into Organic, where a review article was written and a research project conducted under Jack Baldwin's supervision. During the summer term of the final year Barton met each organic specialist to discuss career ambitions. He advised Ted not to join Unilever but study for a PhD with Prof A.R. Battersby (see above) at Liverpool. Barton wrote a letter of recommendation that led to a long-reaching and happy outcome.

Summer vacation jobs had variety. Ted's first summer was back at ICI, this time in a process research lab supporting the manufacture of chlorine and caustic soda by electrolysis of brine. In contrast, the second summer was spent selling pop records while working for Brian Epstein in the basement of a family owned NEMS (North End Music Stores) in Whitechapel, Liverpool. There, he met the Beatles and heard their first UK recording pre-release with them in Brian's office (Cynthia Lennon commented that *Love Me Do* was not as good as many of their songs). After graduation and before starting PhD research, Ted returned to ICI but moved across the Mersey to Runcorn Heath to work in the (then) new laboratories of ICIs Corporate Laboratory.

October 1964 saw Ted join Alan Battersby's group in Liverpool. There he worked on the biosynthesis of colchicine. He showed colchicine to be a 1-phenethylisoquinoline alkaloid derived in nature by a route resembling, in part, the biosynthesis of morphine.



colchicine

Directly after PhD examination, Ted took the Cunard QE1 to New York with five other Liverpool PhD chemists off on postdoctorals at various US locations. Ted had been attracted by E.J. Corey's (Harvard) elegant natural product syntheses, especially his analysis of synthetic logic using the strategic disconnection approach. He spent two rewarding years there. Corey had gained access to a powerful computer and recruited Todd Wipke, a chemist with computer-programming skills. The early origins of the LHASA (Logic and Heuristics Applied to Synthetic Analysis) program, the pioneer of today's commercial computer-aided synthesis programs, emerged during this time.

Ted returned to Cambridge (UK) in 1969 joining (with Jim Staunton) Alan Battersby as an academic and assisting the direction of the Battersby research group. Ted spent ten happy and productive years collaborating with Alan and developing his own research with a small independent group. The focus of the joint effort was the biosynthetic origin of cyclic tetrapyrrole pigments, typified by haem, chlorophyll and vitamin B12.

The independent research was aimed at the total synthesis of natural products, e.g. the penta-substutited dihydrophenanthrene, juncusol. The antifungal activity of this compound led to dialogue with crop protection chemists at ICI's Jealott's Hill research station, which Ted joined in 1979. There, his attention was on compounds of value to agriculture and led to the highly successful synthetic pyrethroids cyhalothrin (for eliminating foliar pests), and tefluthrin (a soil treatment to protect maize crops against corn root worm). Both products are significantly safer than their predecessors. While at Jealott's Hill, Ted was also responsible for the theoretical and physical chemistry teams during their ambitious pioneering development of computer-aided molecular modelling, now essential in the design of molecules with specific biological and physical properties.

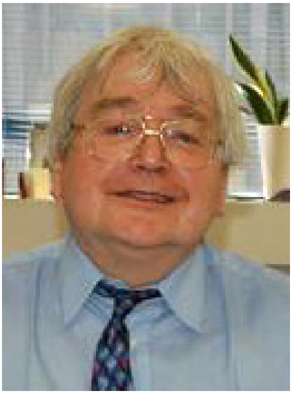
After 10 years, Ted moved to pharmaceutical drug discovery by transferring internally to ICI at Alderley Edge in 1989. There he led the Physical Science Group tasked with introducing protein structural tools to molecular design. Soon, he moved to lead a mainstream drug discovery group with Glaxo, initially at the Ware site and then at the new Stevenage laboratories. The group was responsible for much of Glaxo's chemistry research in the therapeutic areas of cardiovascular, gastrointestinal, respiratory, CNS, and diabetes, with medicines for migraine being the major outcome of that period.

The 1995 merger of Glaxo with Wellcome catalysed further moves as 10,000 jobs were lost worldwide. After a short period at Oxford Glycoscience, Ted moved to Princeton, NJ as a Chemistry Head at Pharmacopeia, a start-up company co-founded by Clark Still of Columbia University. It was set up to develop Still's ingenious method of tagging resin beads to provide vast combinatorial libraries (typically of 50,000), Through his group the four years there added more than eight million compounds to the company collection.

Year 2000 marked a return to the UK and London's Institute of Cancer Research (ICR) where Ted set up a medicinal chemistry unit for the newly created Centre for Cancer Therapeutics. Initially a team of eight synthesis chemists at the Sutton laboratory, his department expanded to 40+ housed in refurbished laboratories. The group, largely funded (competitively) by Cancer Research UK, pursued leads from ICR's high throughput screens against a range of carefully selected protein targets relevant to cancer. By

Ted's retirement in 2008 six candidates had progressed into clinical development in partnership with major pharmaceutical companies; news on outcomes is eagerly awaited.

Charles Richard Arthur CATLOW, FRS (1947-)



Richard CATLOW was born on April 24, 1947 at Simonstone, a small village between Padiham and Whalley, son of Rolf Matzow Catlow (b. 1914, Nelson) and Constance (née Aldred), the third of a family of five. His father was the son of Arthur Catlow and Hjordis (née Matzow) who had moved to England from Norway as what was then something like an au pair. After army service in WWII, his father worked as a local government officer, but was a highly gifted amateur musician. Constance was born in Padiham, also in 1914, and was a committed and highly successful teacher.

Richard attended Clitheroe Royal Grammar School prior to being the first member of the family to go to university when he entered St John's College, Oxford where he gained a BA (Hons 1) in 1970. His research career started with his DPhil studies at Oxford and the UKAEA Harwell Laboratories, from which he gained his degree in 1974 for a thesis on '*Defect Structures in Fluorite Crystals*' studied under Alan Lidiard. He continued research there until 1976 when he accepted a lectureship at University College London (UCL). In 1985, he moved to a joint professorial appointment between the University of Keele and The Daresbury Laboratory where, in addition to his programme of simulation studies of inorganic materials, he also led the development of the diffraction facilities at the Synchrotron Radiation Source. The resulting instruments were used by the UK and international community in wide ranging programmes of new structural science. In the 1990s he was one of the primary investigators with a major grant to provided a general purpose microcrystalline diffractometer at the SRS that also had a major impact on crystallography.

In the 1990s he moved to the Royal Institution (RI) where, in collaboration with John Meurig Thomas, he established a new programme combining simulation with experiment in the study of catalytic materials. The approach proved enormously fruitful in probing catalysts and catalysis at the atomic level and continues to make an important contribution to catalytic science. At the RI, he became strongly involved in public engagement with science. In particular, he ran the institution's *Science Events for Schools* programme for over ten years. During this period he developed a set of science demonstration lectures for primary school children on basic scientific themes (motion, energy, chemistry, electricity and perception) where attendance expanded to over 35,000 children p.a. He initiated a programme of master-classes on computational chemistry given at the weekends to 6th form groups at university campuses around the UK. He also established a highly successful satellite RI schools programme in the NW of England. Since 1990, he has lectured to over 100,000 school students and still lectures to schools audiences.

In 1996, together with Prof. Phuti Ngoepe, he inititiated a collaborative programme, funded by the Royal Society and NRF at the then University of the Nort to establish a sustainable centre for materials modelling within the university. The programme has trained a large number of scientists on this key field, led to substantial scientific output, and much scientific collaboration; it remains very active.

Then, in 1998, he was appointed Director of the Davy Faraday Laboratory of The Royal Institution and in 2002, Head of University College London Chemistry. From 2007, he has been Dean of Mathematical and Physical Sciences at UCL and continues an active and successful research programme in the fields of catalysis and surface science, crystal growth and nano-chemistry.

Catlow has substantial achievements also in knowledge exchange and transfer. Much of his early work concerned the fundamental physics and chemistry of nuclear fuels. His early papers established the basic defect structure of uranium dioxide, the nuclear fuel in most modern reactors, and knowledge vital for predicting properties of the fuel under operating conditions. Thus, his simulation study models provided the physical basis for the high temperature specific heat anomaly of oxide fuels – crucially important in accident scenarios. In addition, he developed the first atomic level mechanistic models for dissolution of fission products in fuel, and of major importance in understanding the evolution of the fuel during operation.

Richard was the lead scientific advisor in a major knowledge transfer initiative involving over 40 companies worldwide in catalytic science with Biosym Technologies Inc. (subsequently Accelrys). The aim was to develop commercial grade software from the academic modelling studies his group and others had developed. It produced the high quality modelling software now used widely in chemicals and materials-based industries.

Throughout his career, Richard has contributed to the scientific community, both in the UK and internationally, with extensive involvement in the work of Research Councils, e.g. the Higher Education Funding Council for England. From 1998 to 2002 he chaired the Research Councils UK High Performance Computing (HPC) Strategy Committee, which helped establish a coherent and long term straegy for UK-HPC. He has served on committees of the Royal Society, the RSC and the editorial board of *Dalton Transactions*. He has particular interest in collaborations within Africa from his long standing collaboration with the South African University of the North/Limpopo, and more recently his involvement with the Royal Society/Leverhulme capacity building programme based at KNUST in Ghana.

Richard Catlow's research programme has been based on the combination of computational and scattering techniques in probing the properties of complex materials. He has played a leading role in developing the field both in the UK and internationally. He can claim to have pioneered the field of computational materials chemistry as recognised in the citation for his FRS election in 2004. The impact of the field has been substantial. His own work, which comprises over 800 publications has received over 25,000 citations. More importantly, the field is now active worldwide: computational techniques are routinely used in key areas of the discipline, including energy materials, catalysis, nano-chemistry and surface chemistry; and their impact continues to grow.

A second major strand of Catlow research has been the development and exploitation of X-ray and neutron scattering facilities in materials science. In particular, his work has exploited the synergy between computation and scattering in catalytic science – a successful approach that is recognised worldwide.

Richard Catlow's achievements have been recognised by awards from the The Royal Society of Chemistry that include the Medal in Solid State Chemistry (1992), the Interdisciplinary Award (1999), the Liversidge Medal (2008), and by the Max Plank Society for which he was the Gerhard Ertl Lecturer in 2014. He was elected to the Third World Academy of Sciences (2006) and Academia Europaea (2013). He is an Honorary Fellow of both the Materials Research Society and the Chemical Society of India, an Honorary Professor of the University of Limpopo and the University of Habana, as well as an Honorary Fellow of St.John's College Oxford.

William CLEGG (1949-)

William (Bill) CLEGG was born on March 8, 1949 in the same Great Harwood as Halton and Mercer (above). He was schooled at Accrington Grammar prior to entering Cambridge University where he gained a BA in natural sciences in 1970 and then proceeded to MA and PhD with Peter Wheatley. Following his completion he held a five-year limited term appointment in Newcastle University that was followed by six-years at Göttingen, Germany with Professor George Sheldrick. He gained his Habilitation there in 1984. This was followed by his return to the University of Newcastle where he has remained since, rising to the rank of Professor of Structural Crystallography in 1992. From 1995 he held a series of joint appointments at Daresbury Laboratory in Cheshire. Bill took early retirement in September 2009, but continues in part-time research, supporting and improving crystallography in Newcastle, developing and exploiting synchrotron radiation for structural studies, and engaging in the training of scientists through PhD supervision. He has organised and taught international courses on crystallography and synchrotron radiation science and has many research papers and three books to his name. He has served on numerous committees and working parties serving the crystallographic, chemical and wider scientific communities nationally and internationally. He was awarded a Cambridge ScD degree in 1989.

His research since formal retirement has included synthetic work in s-block metal coordination and supramolecular chemistry as well as a wide range of structure determinations in collaboration with many other groups. Bill led the project to construct station 9.8 at Daresbury, where his group ran the synchrotron component of the EPSRC-funded National Crystallography Service. He is a major user of beamline I19 for small molecule single crystal diffraction at the Diamond Light Source, the UK's synchrotron, including leading a Newcastle/Durham regional team. Bill is Chairman of the Diamond User Committee and a member of the European Crystallographic Association Council. He was a section editor of *Acta Crystallographica, Section E* from its inception until 2008. He received the 1985 Royal Society of Chemistry Corday-Morgan Medal and is an honorary lifetime member of the British Crystallographic Association.

Bill has a wide range of interests outside of chemistry, notably taking the role of Baptist Chaplain at Newcastle University.

John Adrian PYLE, FRS (1951-)

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John PYLE was born on April 4, 1951 in Eccles, Manchester, the third son of Harold and Agnes (née Rimmer) Pyle. He was educated St Edmund's Primary School in Little Hulton and at De La Salle College, Salford. He gained a BSc in Physics at Durham University and his DPhil in Atmospheric Physics from the University of Oxford in 1976. He is an atmospheric scientist and professor of physical chemistry at the University of Cambridge and Fellow of St Catharine's College. He is the Director of the Cambridge Centre for Atmospheric Science, and since 2007 has held the 1920 Chair of Physical Chemistry in the Chemistry Department. He is also Chief Scientist in the UK's National Centre for Atmospheric Science.

John has expertise in global tropospheric and stratospheric chemical modelling winning the 1985 Eurotrac award of the Remote Sensing Society, the Royal Society of Chemistry's Interdisciplinary Award (1991) and John Jeyes Lectureship (2008), The Korber European Science Award (1999) and the Royal Meteorological Society's Adrian Gill Prize in 2004.

His research involves the use of state-of-the-art numerical models, run on supercomputers, to study the processes controlling the present state of the atmosphere and its evolution. Current studies encompass modeling of the chemistry, dynamics and radiative transfer of the stratosphere by studying the coupling between the chemistry/climate system and land surface processes as important controls on the atmosphere. His group has led the implementation of chemical schemes in the Met Office's Unified Model, used for chemistry/climate studies. The role of surface processes on atmospheric oxidizing capacity and aerosol loading, has built on an existing Met Office/NERC initiative to develop a new community model, UKCA, to study the interaction between climate and atmospheric composition. Here, new chemistry and aerosol schemes are being developed for inclusion in the model. These include ones to describe surface emissions of reactive trace gases and deposition processes. The more gradual decline in northern hemisphere ozone levels, recently partly ascribed to long-term changes in atmospheric flow, and the effect on stratospheric ozone of increasing concentrations of CO_2, CH_4, N_2O and the chlorofluorocarbons are being studied using a number of numerical models.

Inclusion of a detailed chemistry package into the Met Office's climate model allows the study of composition change since the industrial revolution and into the future with calculated changes in surface ozone at the end of this century, under certain assumptions about changing industrial emissions. To carry out the studies, John and his group have also developed lightweight gas chromatography instruments to measure halocarbons after deployment from balloons and high-flying research aircraft.

Professor Pyle was elected FRS in 2004, to Acadamia Europea in 1993 and to a Fellowship of the American Geophysical Union in 2011. He won the 2015 NERC 50th anniversary Impact award with Neil Harris and Cambridge colleagues for work that demonstrates the effect of man-made gases on the ozone layer.

John is married to Elizabeth (née Davies). They have three children, Mark, Joanne and Emma.

Christopher J. MOODY (1951-)

Christopher MOODY was born on December 30, 1951 in Urmston, which is now a part of greater Manchester. He was educated at Manchester Grammar School and then gained his BSc degree from King's College, London. For his PhD he transferred to Liverpool and the late Professor Charles Rees where he investigated the synthesis and reactions of nitrogen-sulfur ylides. He spent a postdoctoral year at the ETH in Zürich working with Albert Eschenmoser on the stereochemistry of 1,4-elimination reactions before taking up a post in industry at Roche. In 1979 he was appointed to a lectureship at Imperial College London, was promoted to a readership in 1989 and moved to the chair of organic chemistry at Loughborough University a year later. In 1996 he was appointed Professor of Organic Chemistry at the University of Exeter and then he moved to Nottingham in 2005 where he is now the Sir Jeese Boot Professor of Chemistry and Head or Organic Chemistry.

Chris has published over 400 papers on work for which he has been recognised with several awards including the Royal Society of Chemistry Hickinbottom Fellowship and Corday Morgan Medal (1986), the Tilden Medal and Lectureship (2000-2001), the Adrien Albert Medal and Lectureship (2001), an EPSRC Senior Research Fellowship (2000-2005), the Royal Society of Chemistry Award for Synthetic Organic Chemistry (2006), the Pedler Lectureship (2008), the Novartis International Lectureship (2010-2011), and the Royal Society of Chemistry Charles Rees award in 2012.

The work of his group is focused on natural product synthesis, chemical synthetic methodology and medicinal chemistry. Several projects are aimed at finding out how to create new, effective anti-cancer therapies inspired by natural products. These include fungal compounds which disrupt cancer-causing pathways, and marine natural products that appear to help the body's immune system reject tumours.

Michael James GREEN (1952-)

Michael James GREEN was born on February 23, 1952 in Radcliffe, some 4 km southwest of Bury, and attended St Paul's Methodist School prior to secondary schooling at Bury Grammar (1963-1970). He transferred to Kings College London for his BSc degree but returned to Lancashire for his PhD at Manchester Institute of Science and Technology working under Dr Tony Tipping and Professor R.N. Hazeldine. It was completed in 1977 with the thesis title of *The Chemistry of Fluorinated Nitroxide Radicals.* Mike then moved to BP, where he worked until 1996. On September 15, 1979 he married Vanessa Lambeth and has two sons.

In his early days with BP Mike was responsible for constructing, commissioning and managing a pilot plant geared to supporting the (then new) BP rhodium-catalysed acetic acid plant in Hull. He continued with catalyst research until 1985 and then had eight years as the Organometallic Team Leader at BP's main research centre at Sunbury. Michael was then promoted to Technical Manager and Research Associate for Homogeneous Catalysis, then he became the Technical Manager of the chemicals laboratory.

For two years from 1996 Mike switched to Courtaulds Coating. He was a Worldwide Director for International Paints where he developed (amongst others) new copper- and silicon-based materials for marine usage.

After a short sojourn with SP Systems, Mike moved to South Africa and made a name for himself working for energy, chemicals and mining company SASOL as manager of homogeneous catalysis and organic synthesis. Work at SASOL involved leading teams responsible for developing new commodity chemical processes, research and technology, and collaborating with South African universities in education and training to PhD level of dozens of students most noticeably from the previously disadvantaged majority. He established international research collaborations with universities around the world. However, in 2009 the University of Newcastle took the (then) bold step of appointing him to a chair in chemistry as Head of the School of Chemistry. It was an appointment indicating the university's intent to work more closely with industry, derive new revenue and create employment opportunities for its students. Mike remained Head of Chemistry and Chairman of the School until his retirement at the end of July 2014.

Mike was a finalist twice in the National Science Foundation's Awards for the person that has made the greatest contribution to the development of science and technology in South Africa. In both instances, quite rightly, he was beaten by people working on cures for AIDS and malaria! Mike Green was the second non-South African to receive an honorary DSc from the University of Johannesburg (2004) when it celebrated 10 years of democracy in South Africa – Margaret Thatcher, UK prime minister and chemist, was the first.

David ALKER (1952-)

David ALKER was born on April 1, 1952 in Chorley and schooled at Wheelton primary school and Chorley Grammar. He gained his tertiary education at the University of Sheffield (BSc 1973, MSc 1974, PhD 1977) with his research under the direction of Professor W. David Ollis. Following two years of postdoctoral study with Sir Derek Barton in Cambridge, Massachusetts, he returned to Sheffield as a lecturer in chemistry, but after three years there he left to join Pfizer as a medicinal chemist. In 2005 he took early retirement from Pfizer in Sandwich after ten years as Discovery Chemistry Recruitment and Academic Liaison Manager with the remit of ensuring that the department could attract and recruit the most talented European chemists. He then formed David Aker Associates where he is an independent consultant, primarily in the area of chemistry recruitment and academic liaison. He has served as an advisor to numerous academic institutions, on various Royal Society of Chemistry committees (currently the Organic Division Council) and the European Federation for Medicinal Chemistry. Dave's work has led to some 28 patents covering the discovery of new potential medicines for the treatment of human disease in the areas of cardiovascular, gastrointestinal and pulmonary medicines, as well as papers in the areas of synthetic or medicinal chemistry.

Keith JONES (1955-)

Keith JONES was born on March 17, 1955 in Manchester, to Eric and Winifred Jones then living in Prestwich. His father was an electrical engineer born and raised in Manchester and his mother was a Salford girl who had worked in a variety of jobs including making radiators for tanks during WWII. Keith's education started at Duke Street primary school in Denton and continued at Harwood Methodist Junior School after the family moved to Bolton in 1964. In 1966, he went to Darwen Grammar School where he came under the influence of outstanding chemistry teacher Ron Heyes. With strong encouragement from Ron, Keith applied to Cambridge to read Natural Sciences, gained admission and graduated in 1976 having specialised in Chemistry.

Keith stayed in Cambridge to carry out research for his PhD (1979) with Professor Sir Alan Battersby (see p.54) on the synthesis of tetrapyrroles, especially isobacteriochlorins. He was appointed to a lectureship at King's College London in 1979 where he stayed for 18 years save for a year carrying out research at Columbia University in New York. Having been promoted to Reader in Organic Chemistry in 1995, he moved to a chair at Kingston University to lead a multidisciplinary research group in biomedical sciences until moving to his current position as Professor of Synthetic Chemistry at the Institute of Cancer Research (ICR), University of London in 2005. He is a leader of the Medicinal Chemistry (Team 3) in the therapeutics unit and Deputy Dean of Biomedical Sciences. He is a Professor in the University of London.

Keith is a medicinal chemist involved in designing, synthesising and optimising small molecules as inhibitors of various proteins and signalling pathways. The real aim of his work is to use the novel synthetic molecules to shed light on aspects of biology with the ultimate aim of inventing new cancer therapeutics. This is for development into clinical trial candidates as potential new medicines. His team is involved in all stages of drug discovery from hit generation through to candidate selection with key skills in the synthesis of small molecules and in understanding their interactions with proteins both *in vitro* and *in vivo*. The group designs, synthesises and develops potential drug molecules to inhibit proteins or signalling pathways relevant in cancer.

Keith Jones is most widely known for his work in the area of heterocyclic synthesis and especially the way in which he and his group developed the use of carbon-centred free radicals in the synthesis of heterocyclic compounds. He has been involved in a number of collaborative projects that have led to compounds possessing potent activity against the parasite that causes bilharzia, *Schistosoma mansoni*, and to compounds that inhibit the sodium/potassium pump that controls hypertension. His major current interest is in discovering small molecules that interfere with protein-protein interactions and in understanding the role and behaviour of such compounds.

Keith has held a number of positions within the Royal Society of Chemistry including secretary and chairman of the Heterocyclic and Synthesis Group as well as Vice-Chair of the Organic Division. He has also chaired the Fine Chemicals Group of the Society of Chemical Industry. He is Chairperson of the Royal Society of Chemistry Research Fund and has been an editorial board member of *Future Medicinal Chemistry* since 1908. Keith was a member of the ICR and Royal Marsden Hospital Cancer Research Units that won the 2012 American Association for Cancer Research Team Science Award. This was in recognition of their tremendous impact in the preclinical discovery and clinical development of innovative cancer therapeutics. The team comprises experts in cancer biology, pharmacology, medicinal chemistry and medical oncology, and has been responsible with academic and industrial partners for the discovery of 16 drug development candidates from 2006. Six of those candidates entered clinical trials.

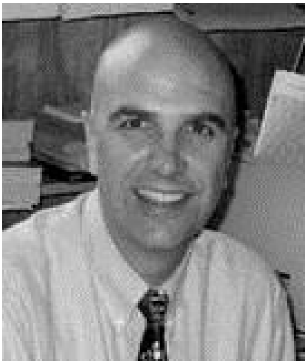
In his spare time, Professor Jones coaches youngsters in cricket and football, enjoys opera and wine, and climbs mountains, mainly in the Lake District and Scotland.

John D. WALLIS (1954-)

John D. WALLIS was born in Audenshaw east of Manchester in 1954, but later on attended school in Sheffield. His family originates from Ashton-under-Lyne. He gained his qualifications from The Queen's College, Oxford. His postdoctoral study was at Exeter University, and then in the Dyson Perrins Laboratory at Oxford University with Sir Jack Baldwin, and at ETH Zurich with Professor Jack Dunitz. This was followed by a period in Ciba-Geigy AG in Basel, Switzerland. He held positions at the University of Kent between 1988 and 1999 before moving to Nottingham Trent University where he is now Professor and Head of Organic Chemistry in the School of Science and Technology. His research interests lie in organic synthesis and X-ray crystallography used in materials chemistry, studies of molecular interactions and bond formation, and aspects of medicinal chemistry. He is also involved in multidisciplinary projects, some industrial.

An organic conductors project concentrates on new substituted derivatives of the organosulfur donor BEDT-TTF [bis(ethylenedithio)tetrathiafulvalene], with applications in molecular electronics. Multi-substituted donors have been prepared, several as a single stereoisomer, and these have laid the foundation for a crystal engineering approach to the design of conducting organic systems, as well as to an investigation of the effect of chirality on electromagnetic properties. His intermolecular interactions project studies reactions between functional groups by measuring the low temperature X-ray structures of molecules in which the groups are forced close to one another, e.g. in *peri*-naphthalenes and triptycenes. Bond formation has been explored by accurate electron density measurements used to probe stages of bond formation between the reacting groups. He is involved in work on anti-cancer agents and GPCR receptors in collaboration with the Queen's Medical Centre, Nottingham. He has further collaborations with the CNRS in Angers, France, with Brock University (Canada), Osaka University (Japan), with the National Crystallography Centre at Southampton University, and with the Physics Department of Warwick University.

Neil BURFORD (1958-)



Neil BURFORD was born in Liverpool on April 29, 1958, son of Richard and Mabel. He grew up in West Derby and attended Blackmoor Park Infants School and Junior School, and then West Derby Comprehensive School. He obtained his BSc degree from the University of Wales in Cardiff, and then moved to Canada in 1979 to begin graduate studies. These were undertaken at the University of Calgary under the supervision of Professor Tristram Chivers and completed with his PhD degree in 1983. After a postdoctoral year at the University of Alberta in Edmonton with Ron Cavell and two years as a Research Associate with Professor Jack Passmore at the University of New Brunswick, Neil joined Dalhousie University as Assistant Professor in 1987. Promotion to Associate Professor in 1991 was followed by Professor in 1995. Neil spent 1996 as an Alexander von Humboldt Fellow with Professor Peter Jutzi at the University of Bielefeld in Germany.

At Dalhousie University, Neil Burford was named as Killam Professor (1998-2003) and the Harry Shirreff Professor of Chemical Research (2000-2011). In 2001 he was nominated and succeeded in the first round of Canada Research Chairs program holding a Tier I Chair from 2001 until 2011. He was named a Killam Fellow of the Canada Council from 2003-2005 and received the Alcan Lecture Award of the Canadian Society for Chemistry in 2006. He received the Faculty of Science Award for Excellence in Teaching at Dalhousie University in 2009. In 2008 and 2014, he was awarded re-invitations by the Alexander von Humboldt Foundation to enable visits to the University of Regensburg to work with Professor Manfred Scheer. Neil served as Chair of the Department at Dalhousie University from January 2008 to July 2011, when he moved to the University of Victoria as Professor and Chair of the Department of Chemistry.

Neil's research challenges traditional understanding, classification and modeling of structure, bonding, and reactivity of the main group elements. His research group aims to discover compounds containing new bonds and new structural arrangements, with the long term expectation for the discovery of new materials. Many of the postdoctoral fellows, graduate students and undergraduate research students who have worked with Neil have gone on to significant independent academic careers. Neil enjoys participating in leadership roles within the discipline of Chemistry. He serves on the Canadian National Committee for IUPAC and has chaired the Committee since 2006. He is currently the Vice-President of the Canadian Society for Chemistry (CSC) and becomes President in 2015. Currently (2014) he is also Chair of the Canadian Council of University Chemistry Chairs. He has served, and serves on, various chemistry journal editorial boards.

Neil has been married to Hélène Francoise since 1980 and they have two sons, Richard John and Matthew Carl.

Susan Elizabeth GIBSON, OBE (1960-)

Susan Elizabeth GIBSON (née Thomas) was born on Nov 3, 1960, in Blackburn and attended the Darwen Vale High School. After studying Natural Sciences in Cambridge and gaining her DPhil from Oxford, she spent a year at the ETH Zürich as a Royal Society Research Fellow. Her independent research career began at the University of Warwick in 1985 and is focussed on transition metal chemistry and its applications in organic synthesis.

Sue moved to Imperial College (IC) in 1990, left in 1998 to become the Daniell Professor of Chemistry at King's College London, but returned to IC in 2002. She then took a three-year period of parental leave over 2010-2013. Her work has won several awards including the first Rosalind Franklin Award of the Royal Society in 2003. Sue served as the President of the Royal Society of Chemistry Organic Division (2007-2010) and chaired the RSC's Awards Committee from 2011 to 2014. She has been a member of numerous panels in the past, including EPSRC Council and the Royal Society's Dorothy Hodgkin Research Fellowship Panel. She has acted as an external examiner for undergraduate chemistry courses in Strathclyde, Durham, Oxford and York. In 2013 she was awarded an OBE for her services to Chemistry and Science Education. In November 2013, Sue assumed the role of Director of the Graduate School at Imperial College.

Sue is married to Vernon and they have two children, Anna and Alex.

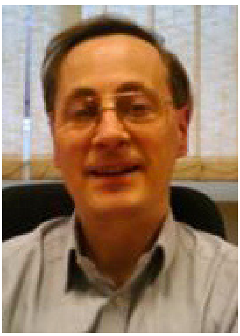
Jonathan M. PERCY (1961-)

Jonathan PERCY was born in Prescot, Lancashire in 1961. He studied Chemistry at Imperial College London (BSc) and the University of Cambridge (PhD with Professor A.J. Kirby FRS). Following academic positions at the Universities of Durham, Keele, Birmingham and Leicester, he moved to his current position as WestCHEM Professor of Synthetic Chemistry at the University of Strathclyde in 2006.

WestCHEM was formed as part of the ScotCHEM initiative to pool Chemistry in Scotland. The School brings together the strengths of the universities of Glasgow and Strathclyde in the West of Scotland, thereby offering a research environment in a large, diverse and expanding chemistry research school.

Jonathan's research is concerned with how organic reactions work, and using the knowledge gained to develop new ways of making important molecules, especially those that are selectively fluorinated. Wherever possible, he uses experiment and theory together to rationalise and predict outcomes. Current reactions of interest include alkene metathesis, organotransition metal-catalysed coupling reactions, especially the Negishi and Suzuki, and Saegusa-Ito cyclisations, directed metalations, and rearrangement, cycloaddition and electrocyclic ring-closure pericyclic reactions. In addition to current methods of synthesis and purification, the key tools used are kinetic methods (NMR, spectrophotometric), simulation techniques (using numerical integration software), and electronic structure calculations.

Michael NORTH (1964-)



Michael NORTH was born on June 28, 1964, in Blackburn and is a Professor of Chemistry at the University of York. He moved there from The University of Newcastle in 2013. His research interests span Green Organic Chemistry. Since some 90% of all commercially available organic chemicals are sourced from crude oil, the demand is unsustainable and provides a major challenge for chemists in the coming decades – renewable, sustainable starting materials are to be sourced. Whilst catalysis is often seen as a green technology, many current catalytic processes rely on metals such as rhodium, iridium and platinum, themselves of limited and decreasing availability. North's interest focuses on a number of aspects of making organic chemistry sustainable. The approach is based on obtaining a thorough understanding of chemical processes by a combination of spectroscopic and mechanistic studies to allow mechanism-led optimisations to be carried out, thereby improving both the chemical effectiveness and the sustainability of a given process.

Timothy J. DONOHOE (1967-)

Photo by Karl Harrison; © Oxford University

Timothy J. DONOHOE was born in Darwen in 1967 and is a Professor of Chemistry at Oxford University. He gained his BSc degree from the University of Bath and his PhD from Oxford. He had two years of postdoctoral experiment with Professor Phil Magnus at the University of Texas before joining Manchester University as a lecturer in chemistry in 1994. He was a Reader there before moving to the University of Oxford in 2001. He was elevated to Professor in 2004 and was Head of Organic Chemistry from 2006-2011. His research interests are in catalysis and synthetic organic chemistry, and the contribution that they can make to the fields of medicine and natural products. His group concentrates on developing new catalytic methodologies for synthetic organic chemistry and asymmetric synthesis, and then employs its chemistry to make biologically important natural products. Tim also co-manages *OxSynC*, which helps to connect Oxford Synthetic Chemistry experts with researchers in other fields. He was awarded the Royal Society of Chemistry Corday-Morgan Medal in 2006, its Synthetic Organic Chemistry Award in 2011, the AstraZeneca, GlaxoSmithKline, Pfizer & Syngenta Prize for Process Chemistry Research in 2012, and most recently, the Charles Rees award by the RSC in 2014. Tim has been appointed as one of the editors of the journal *Tetrahedron Letters* since January 2015.

Steven M. ALLIN (1968-)

Steven M. ALLIN was born on August 18, 1968 in Darwen. He was educated at Darwen Vale High School and St. Marys College, Blackburn. His BSc degree is from Leeds and his PhD from the University of Florida with the late Alan Katritsky. Currently he is Professor of Chemistry at Nottingham Trent University. His research covers several areas including the preparation and reactivity of chiral heterocycles, organic materials chemistry, and the synthesis and development of many classes of bioactive natural products, including antibiotic and anticancer agents. The aim is to develop novel and inventive chemistry, and includes the first successful tandem amino-Cope rearrangement/enamine derivatization procedure, the first asymmetric anionic version of the amino-Cope rearrangement, and the first synthetic applications of that rearrangement. His group has accessed anti-cancer agents, novel anti-malarial agents and many other biologically significant natural products.

Alongside his academic work, Steve is a Founder Director of the 1998 Charnwood Molecular Ltd. that was spun-out from Loughborough University to commercialise the expertise in chemical synthesis and catalysis from his and Phil Page's research groups. The company has laboratory facilities in Loughborough and at BioCity, Nottingham.

Philip Alan GALE (1969-)

Philip GALE was born in Liverpool on September 24, 1969, son of Donald Alan and Mary Isabelle (née Wightwick). He gained his primary education at Woolton County Primary School and then attended the Gateacre Community Comprehensive School from 1981 to 1988 prior to enrolling at Oxford University. He gained his BA(Hons) in Chemistry in 1992 and DPhil in 1995, the latter dominantly concerned with the calix[4]arenes under the direction of Professor Paul Beer. After a Fulbright postdoctoral with Professor Jonathan

Sessler at the University of Texas in Austin, Phil returned to Oxford and was awarded a Royal Society University Research Fellowship. In 1999 he moved to the University of Southampton where he is currently (2014) Head of Chemistry.

Phil's research interests focus on the supramolecular chemistry of anionic species, and in particular the molecular recognition, sensing and lipid bilayer transport of anionic species. Transmembrane anion transporters have potential use in the development of treatments for cystic fibrosis and cancer. He has been an author on some 200 publications including a number of texts on supramolecular chemistry and one on anion receptor chemistry. Phil serves as the Chairperson of the Editorial Board of Royal Society of Chemistry's flagship reviews journal *Chemical Society Reviews*, is the co-editor of the journal *Supramolecular Chemistry*, and is a member of various international editorial advisory boards. In 2012 he was elected chair of the RSC Macrocyclic and Supramolecular Chemistry Group. In addition, he heads the UK's national crystallographic service that is based in the Chemistry Department at Southampton University.

Philip Gale has won a number of research prizes including the Bob Hay Lectureship in 2004 from the RSC's Macrocycles and Supramolecular Chemistry Group and the Royal Society of Chemistry 2005 Corday-Morgan medal and prize. He was awarded an Oxford DSc in 2014.

Steven Philip MARSDEN (1969-)

Steven (Steve) MARSDEN was born on October 7, 1969 in Bury (now Greater Manchester, then Lancashire). His father Brian was an accounts clerk from Prestwich, working with the Salford City Council where he met his wife Anne (née Worthington and from Pendleton). Later Brian moved to Bury Town Council where Steve was their first son. Brian's work in local government and then the NHS took him to Coventry where Steve took his O- and A-levels at King Henry VIII School. Steve's A-level chemistry tutor was fellow Lancastrian, John Humphrey, a graduate of Salford University. He encouraged Steve's (and others) interest in chemistry by letting them perform demonstrations such as large-scale thermite reactions on School open days. Steve took his BSc in chemistry at Imperial College London (the first in his family to enter further education) from 1987 to 1990 where his second-year organic chemistry tutor was another Lancastrian, Chris Moody (see p.82). He stayed at Imperial College for his PhD studies with Professor Steven Ley FRS, working on the total synthesis of rapamycin, before a NATO postdoctoral fellowship at Columbia University in New York in 1993 with Prof. Sam Danishefsky on alkaloidal total synthesis.

In October 1994 Steve commenced his first independent position at Imperial College, before moving to the University of Leeds in 2001, where he is currently Professor of Organic Chemistry and the Head of the School of Chemistry (2013-2018). His younger brother Greg is also an academic at Leeds, where he is Director of the Institute of Transport Studies.

Steve's research interests are in synthetic organic chemistry, with particular emphasis on methods for the synthesis of quaternary asymmetric centres, organomain group chemistry, redox catalysis, and the development of catalytic methods for heterocyclic synthesis. He received the 1998 Meldola Medal and Prize of the Royal Society of Chemistry, and held a Royal Society Industry Fellowship from 2008-2010. He lives in north Leeds with his partner Danielle, their son Ryan and two cats. A lifelong Manchester United fan, Steve retains a season ticket at Old Trafford.

Michael WATKINSON (1970-)

Mike WATKINSON was born in Aughton near Ormskirk, West Lancashire in 1970, son of Bill and Sue. His father was a chemist with Goodlass Wall & Co. before moving into teaching. Mike attended the local St. Michael's Church of England School in the village – then noted for a public footpath running through its playground. He transferred to Mechant Taylors' School in Crosby, Liverpool, for his secondary education. He was inspired to chemistry by his teacher Mr. Kent and Dr. David Nicholls from Liverpool University who was noted for his schools lectures on liquid air.[1] Mike's undergraduate education was at the University of St. Andrews where he graduated in 1991 with a BSc(Hons

1) degree. This was followed by a PhD in Bioinorganic Chemistry at the University of Manchester Institute of Science and Technology in 1994 from supervision by Prof Noel McAuliffe. Mike received the inaugural Laurie Vergnano award from the Royal Society of Chemistry (renamed The Dalton Young Researchers Award in 2008) for this work. A Royal Society-supported postdoctoral fellowship at the Universidad de Santiago de Compostela in Galicia, Spain, was followed by further postdoctoral research at UMIST. He was appointed to a Lectureship in Inorganic Chemistry at Queen Mary and Westfield College in University of London in 1998 (now Queen Mary University of London) where he holds a chair in synthetic chemistry in the School of Biological and Chemical Sciences. He has previously acted as the Head of the Division of Chemistry within SBCS and is now Deputy Dean for Research in the Faculty of Science and Engineering.

Mike's current research interests focus on the custom design and synthesis of novel functional ligand systems (especially those derived from azamacrocyclic ligands) and their metal complexes (particularly manganese). Objectives include the development of novel bleaching catalysts for application in domestic laundry, asymmetric epoxidation catalysts, and preparation of a number of biomimetic complexes. More recently, the group has engaged developing a number of novel sensor agents that include ones for the binding of biological analytes, zinc sensors, and novel hydrogels for the detection of periodontal disease.

Mike is a member of the Zinc UK group of researchers and also a member of the Core Group Management Committee. He is Chairperson of the Chemical Biology working group of the Trans-Domain COST Action Zinc. He is also Secretary and Honorary Treasurer of the Royal Society of Chemistry Macrocyclic and Supramolecular Discussion Group. He is one of QMUL's Governors of Drapers' Academy, which specialises in Science and Maths and is co-sponsored by the Drapers' company.

Reference

1. Nicholls, D.; Hocker, D. *Fun and games with liquid air*, Department of Chemistry, University of Liverpool: RSC [distributor], Cambridge, UK, 1992.

David John PROCTER (1970-)

David John PROCTER was born in the summer of 1970 in Leyland. He obtained his BSc (1992) and PhD degree in Chemistry (1995) under Prof Chris Raynor at the University of Leeds. Work for his PhD was on the asymmetric oxidation of sulfides with novel selenoxide salts. David then spent two years as a postdoctoral with Prof Robert Holton at Florida State University working on the synthesis of analogues of the Taxol. In late 1997, he took up a Lectureship at Glasgow and was promoted to Senior Lecturer in February 2004. In September of that year he moved to a Readership at the University of Manchester where he became Professor in October 2008. His group aims to introduce and exploit new synthetic concepts for the efficient construction of molecules with important biological or physical properties. These include antibacterial agents to address the problem of resistance to antibiotics, anticancer natural products in the search for new treatments, and new semiconductor devices that could revolutionise the electronics industry.

David is current Head of Organic Chemistry at Manchester University and received the 2014 Bader Prize from the Royal Society of Chemistry, the 2014 Liebig Lectureship from the German Chemical Society, and a Leverhulme Trust Research Fellowship over 2013-2014.

Mark MURRIE (1971-)

Mark MURRIE was born in Audenshaw, Manchester in 1971, son of Derek Wynn and Doreen. He was educated at Audenshaw County Primary School and then Stockport Grammar School before attending Nottingham University where he gained a BSc(Hons) in Chemistry in 1992. He moved to Loughborough University for his MSc (1993) and then to Manchester University for a PhD. His research there was in the area of coordination complexes as models for corrosion inhibitors (polynuclear transition metal complexes of benzotriazole) under the supervision of Prof Dave Garner FRS and David Collison, in conjunction with Prof Peter Tasker at Zeneca Specialties in Blackley. This was completed in 1997 after which he took postdoctoral positions with Profs Richard Winpenny at the University of Edinburgh and Hans Güdel at the University of Bern, Switzerland. Mark joined the School of Chemistry at the University of Glasgow where from 2014 he has been a Reader in Chemistry.

Mark's research interests are in the areas of molecular magnetism, high pressure science, the synthesis and characterisation of high nuclearity complexes, and magnetic nanoparticles. His synthetic work spans research areas from the low temperature physics of molecular magnetic materials to medical applications of magnetic nanoparticles in cancer detection and treatment. He was elected a Fellow of the Royal Society of Chemistry in 2012.

Andrew J. WILSON (1977-)

Andrew WILSON was born on January 17, 1977 in Bolton but educated at St Saviours High School in Dundee between 1988 and 1994. He then entered The University of Manchester Institute of Science and Technology (UMIST) graduating BSc (Hons 1) in 1997. His PhD in synthetic chemistry was with Professor David A. Leigh FRS on 'The Controlled Synthesis of Interlocked Architectures', firstly at UMIST then at The University of Warwick, where he graduated in 2001.

He started postdoctoral research at Yale University with Prof Andrew D. Hamilton on the topic of protein surface recognition, then followed it with further postdoctoral research under Profs E. W. (Bert) Meijer and Rint P. Sijbesma at Eindhoven University of Technology in The Netherlands. His topic there was on supramolecular polymers.

In 2004, Andrew took up his first independent academic position as a Research Lecturer at The University of Leeds, where he is now Professor of Organic Chemistry and Deputy Director of the Astbury Centre for structural molecular biology. Andy is also co-director of PPI-Net and a working group leader in an EU-COST action on foldamers.

NON-CHEMIST CHEMICAL INDUSTRIALISTS

Sir Henry TATE (1819-1899)

Sir Henry TATE, 1st Baronet, was the English sugar merchant and philanthropist who established the Tate Gallery in London. He was born on March 11, 1819 in White Coppice, a hamlet near Chorley, the seventh son of the Rev. William Tate, a Unitarian clergyman, and his wife Alice (née Booth). He was schooled in his father's school until aged 13, when he moved to Liverpool to become a grocer's apprentice to his elder brother Caleb, a position he held for some seven years. Then aged 20 and with sufficient capital, he set up his own grocery store at 42 Hamilton Street, Birkenhead. He was so successful that, by 1854, he owned a chain of six shops in Liverpool and Ormskirk in addition to Birkenhead. Some five years later came Tate's first venture into cane refining when he took partnership in the Liverpool sugar refinery of John Wright & Co. Tate's business acumen was such that by 1869 he had gained total control of the Wright Company and was joined in business by his two sons, Alfred and Edwin. He renamed the company as *Henry Tate & Sons*, yet he retained his grocery business for a further two years, selling it only in 1861.

Image: Petr Adam Dohnálek (from Wikipedia Commons)

Sugar refining had its Liverpool origins in the early 1670s, but had changed little when Tate became involved. There were few firms operating and the total amount of refined sugar per week was little more than 400 tons. The refining process produced what was known as the sugarloaf, a tall cone with a rounded top (see opposite) from purifying the imported dark molasses-rich raw sugar. These white sugar loaves had to be broken into smaller pieces using strong pincers for subsequent grocery store sale. Tate recognised that the industry was ripe for change. After learning of sugar cube production by J.J. Langen & Söhne in Germany, he purchased the patent in 1872 from Eugen, the son. Though the inventor, he was more interested in the combustion engine, and sold the process to Tate. This German method of making sugar cubes revolutionised the industry and Tate became the original 'Mr Cube' in 1872. That same year he built a new factory in Liverpool and, having an eye for innovation and technological advances, he adapted the plans to incorporate a new refining technique to increase the yield of white sugar during the construction of the refinery. When the Love Lane refinery became operational in 1872, it produced 400 tons of sugar cubes a week. The production of the sugarloaf soon fell into abeyance and Tate made his considerable fortune opening another refinery in 1877 at Silvertown on the Thames in East London. Sugar is still refined there almost 150 years later. Henry Tate spent the rest of his life resident in London at Streatham, by this time a millionaire, mainly a result of his patenting of a means of cutting sugar into dice-sized cubes.

Tata & Sons sugar packing 1880s; courtesy of Tate and Lyle Sugars

Tate was a modest rather retiring man, well known for his concern with workers' conditions. He built the Tate Institute opposite his Thames Refinery with a bar and a dance hall for his workers' recreation. He donated generously to charity, then, in 1889 donated his collection of 65 contemporary paintings to the government, on the condition that they be displayed in a suitable gallery, toward the construction of which he also donated £80,000. The British Gallery of National Art opened at Millbank on the Thames on

July 21, 1897. He made many donations, often anonymously, and always discreetly, and these included various educational institutions. But it is the *Tate* that he is most recognised for.

Henry Tate married Jane Wignall from Aughton (near Ormskirk) in 1841 and they had eight children, the first a year later. They lived at Park Hill by Streatham Common, South London, from 1877. Jane predeceased Henry by some 18 years. Tate was made a baronet in 1898, the year before his death. He had refused this knighthood more than once but after he had spent £150,000 on the Millbank Gallery build, endowed it with his personal collection, and presented it to the nation, he was told the Royal Family would be offended if he refused again.

He died on December 5, 1899 at Streatham Common. It was only in 1921 that Henry Tate & Sons merge with Abram Lyle & Sons to form Tate & Lyle. In 2001, a blue plaque commemorating Sir Henry was unveiled on the site of his first shop at 42 Hamilton Street, Birkenhead by English Heritage.

References

1. See: http://www.tateandlyle.com/AboutUs/history/Pages/History.aspx (accessed 10 November 2014).

William Hesketh LEVER (Vicount Leverhulme) (1851-1925)

William Hesketh LEVER was born on September 19, 1851 at 16 Wood Street, Bolton. He was the eldest son, but seventh child, born to James Lever and his wife Eliza (née Hesketh), the daughter of a cotton mill manager. At age 6, William was educated at the Misses Aspinwall's Private School, then Kay's Private School, and for three years from 1864 at the Bolton Church Institute by the noted Mr Mason.[1,2] William has been recorded[3] as an unexceptional pupil plodding his way through his studies and, though a keen swimmer, he did not excel at sport either. His home on Wood Street was unlike that in much of Bolton – clean, tidy and an enclave of middle-class sobriety and professionalism.

On leaving school, he began working for his father in the family wholesale grocery business cutting and packing soap bars, for which he was paid £7 per week. He became a junior partner in the company in 1872.[2-5]

Beginning in 1874, Lever's wholesale grocery business began marketing a soap made especially for them called Lever's Pure Honey. Bolton chemist William Hough Watson had invented the new soap using colonial vegetable oil (palm oil) and glycerin, rather than tallow as it gave a free-lathering soap. William, his father and his younger brother (by 2½ years), James Darcy, invested in Watson's soap invention with the early success coming from offering bars of cut, wrapped, and branded soap in his father's grocery business.[2] By the 1880s the soap was in great demand and William decided to make soap. Along with his younger brother, he partnered with William Watson and bought a small soap and cleaning product factory in Warrington for their soap manufacture – Lever Brothers was born, but James never took a major part in running the business. He fell ill in 1895, probably as a result of diabetes, and resigned his directorship two years later. Thanks to William's marketing acumen, the span of three years saw manufacture grow to 250 tons of soap per week with sales of 40,000 tons a year. Within a decade of its launch *Honey* was on sale in 134 countries, rebranded from 1884 as *Sunlight Soap*. By 1888, production was 450 tonnes per week. It was the world's first packaged, branded laundry soap designed for washing clothes and general household use.

http://commons.wikimedia.org/wiki/File:Sunlight-zeep.JPG

William Lever married Elizabeth Ellen Hulme in 1874, the daughter of a Wood Street draper neighbour and one of his classmates from the Misses Aspinwall's school. The couple had a number of children, but only one, also called William, survived.[1] He was born in Thornton Hough in 1888, where the Levers moved that year. Larger business premises were needed and William had purchased 56 acres of land at Bromborough Pool across the Mersey from Liverpool. On the Wirral and between the River Mersey and the railway line at Bebington, it was some 10 kilometres from his home. There he built a new enlarged factory on the marshes and renamed the site *Port Sunlight*.

Soap-making necessitated thinking on a global scale since production required palm oils from the south pacific, citronella from India, cotton from the American south, sesame oil from Africa, and tallow from New Zealand and Australia. In moving his soap business forward, William Lever built Britain’s largest company and in so doing, created the first modern multinational company. His concerns at home were for the welfare of his workers as much as for any personal wealth. He was more than conscious of the poverty he had been a neighbour to in Bolton and espoused the view that company profits should be shared with those who made them – the workers. Thus, William built housing for the workers employed at his factory and developed his village between 1888 and 1914. Named for the Sunlight brand of soap manufactured and located close to the factory, Port Sunlight Village is a model of attractive housing. More than 30 architects were employed to design the structures, and not one building is identical to another. Although 20 houses could occupy an acre, Lever located just seven, thereby creating open spaces for other facilities.[2] By 1909, there were 700 cottages, a concert hall, theatre, library, gymnasium, and an open air swimming pool. Rents were set at 20% of the weekly wage but with conditions. Lever set strict ethical codes and, as the cottage was tied to employment, breaking them could mean losing one’s job; many social activities were compulsory in his village. Despite all of this, conditions, pay, hours, and benefits were all more favourable than normal for industry of the day.

http://commons.wikimedia.org/wiki/File:VIM_washing_powder.jpg and http://commons.wikimedia.org/wiki/File:LifeboySoap.jpg

The concern Lever showed for his workers at home were applied equally to his business developments established in the Belgian Congo. He provided all he promised – two schools, ten hospitals and, by the then standards, a good wage for his 17,000 employees. He checked and approved the design of manager and worker houses for his village(s) akin to those at Port Sunlight. Despite this, many of his African employees were mistreated, often being sent to work by the local Chief who retained their wage to pay his taxes based on the number of his wives. In the early 20th century William Lever was as much a colonist as his counterparts in England. By 1900 *Lifebuoy*, *Lux and Vim* had been added as company brands. Lux Soap Flakes were rebranded Sunlight Flakes in 1900. Subsidiaries had been set up in the US, Switzerland, Canada, Australia, Germany and elsewhere.

The London residence[6] of the Levers was the The Hill at Hampstead. It was bought in 1904 and they lived there until his wife's death in 1913, and them William was there permanently from 1919 until his own death This was on May 7, 1925 and from pneumonia contracted following a trip to Africa. He was 74 years old. His funeral was attended by some 30,000 people and he is buried in the churchyard of Christ Church in Port Sunlight.

William Lever, a lifelong Freemason, was appointed to the Lever Baronetcy of Thornton Manor in 1911, raised to Baron Leverhulme of Bolton-le-Moors in 1917 (for which he added his wife's maiden name to his own), and elevated to Viscount Leverhulme of The Western Isles in 1922. He was MP for Wirral from 1906 to 1910. Of all his philanthropic activities, it was the town of Bolton that received most and it gave Lever the honour of electing him Mayor in November 1918.

References

1. See: http://www.bolton.org.uk/lever.html (accessed 25 August 2014).
2. Macqueen, A. *The King Of Sunlight: How William Lever Cleaned Up The World*, Bantum Press, 2004, pp. 336.
3. See: http://www.wittonweavers.co.uk/?p=2649 (accessed 26 August 2014).
4. See: http://www.history.co.uk/biographies/lord-leverhulme (accessed 27 August 2014).
5. See: http://www.gracesguide.co.uk/William_Hesketh_Lever (accessed 27 August 2014).
6. See: http://www.londonremembers.com/memorials/lord-leverhulme (accessed 29 August 2014).

Appendix: Other Senior Chemists from Lancashire

Alan V Chadwick:

Born in Lancashire, he is professor in physical chemistry at the University of Kent. His research is aimed at understanding the structure of point defects and the mechanisms of diffusion, information important to a wide range of technological processes, including corrosion, catalysis and many materials processing methods. It targets defects and diffusion solids and uses X-ray absorption fine-structure (XAFS) spectroscopy and NMR spectroscopy.

Alison Hulme:

Born in Morcambe in 1968, she gained her university education at Cambridgeand has spent the last 20+ years in Edinburgh. She is a senior lecturer in organic chemistry specializing in natural product synthesis, asymmetric synthetic methodology, chemical biology, tagging and imaging in biological systems, and historical dyestuffs.

Timothy Snape:

Born October 27, 1977 in what is now Aintree University Hospital, he spent much of his early life in and around Ormskirk. He is a senior lecturer in medicinal chemistry in the School of Pharmacy and Biomedical Sciences at the University of Central Lancashire, Preston, having gained his PhD at Liverpool with Prof. Stan Roberts.

Caroline Rigby:

Born July 12, 1978 in Chorley, she is a Senior Chemist, Peakdale Molecular Ltd., Peakdale Science Park, Chapel-en-le-Frith, Peak District, UK.

Matthew I. Gibson:

Born November 22, 1980 in Hazel Grove, Stockport, he is an assistant professor in the Chemistry Department, University of Warwick. There he and his group exploit organic, polymer and carbohydrate chemistry to address global healthcare issues, with particular relevance to regenerative medicine and infectious diseases.

Milestones, Whins Lane Read (images by Robert Wade)

www.flickr.com/photos/rossendalewadey/4822000866/in/photostream/ & .../4821383555/...

The Fellsman in The Ribble Valley (modified from the image by Andrew)

www.flickr.com/photos/arg_flickr/14982066335/

About the Author

Brian Halton is one of the Lancastrians included in this compilation. He was born in Lancashire and educated there and in London prior to entering the University of Southampton in 1963. He gained his BSc(Hons) and PhD degrees (1963 and 1966) prior to postdoctoral experience at the University of Florida where he was appointed Assistant Professor in 1967. He transferred to the Victoria University of Wellington in New Zealand in 1968 and spent his entire career there. Initially a lecturer in chemistry, he rose to become professor. He is now Emeritus Professor of Chemistry.

Brian has served on various international committees and boards, and remains a referee for many prominent international chemistry periodicals. Currently, he is the sole Honorary Fellow of the New Zealand Institute of Chemistry elected in the 21st century. He was the editor of its flagship journal *Chemistry in New Zealand* for some ten years from 2001. In his retirement, he has provided an autobiography that surveys his fifty years as a practising organic chemist and written a history of the Chemistry Department at Victoria over its first 100 years from 1899 from the viewpoint of the chemist rather than a historian. Both of the books are available for complimentary download from the School of Chemical & Physical Sciences website: www.victoria.ac.nz/scps/history.

The present booklet had its origin among a series of article the author wrote for *Chemistry in New Zealand* under the general title of “Some Unremembered Chemists” several of whom were born in Lancashire, Brian’s UK birth county.