175 Years of Newcastle Chemistry: From Faraday to Rucaparib

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Heritage Event
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Key Dates\textsuperscript{1} for Chemistry at Newcastle

- Literary and Philosophical Society: 1793
- College of Medicine: 1832
- College of Physical Science: 1871
- Rutherford Technical College: 1892
- Armstrong College: 1904 $\rightarrow$ King’s College: 1937

Until 1963, when Newcastle University was established, chemistry at Newcastle was allied to Durham University (first proposed by Oliver Cromwell in 1657,\textsuperscript{2} eventually founded in 1832)

The earliest Durham University chemists (based in Newcastle) were James Johnston and Thomas Richardson (1816-1867, PhD under J Liebig in Giessen), who both taught medical students\textsuperscript{2}

\textsuperscript{1}W A Campbell, Library resources for the history of science in Newcastle upon Tyne, \textit{Br J Hist Sci}, 1982, \textbf{15}, 281-284; \textsuperscript{2}http://chemistry-alumni.dur.ac.uk/doku.php?id=history
Michael Faraday and Newcastle

Selected publications on chemistry topics:
- Compounds of carbon with chlorine and iodine: 1821/1822
- Action of salts on turmeric paper: 1823
- ‘Bicarburet of hydrogen’ (benzene): 1825
- Conversion of diamond into coke: 1848

Faraday was an elder of the Sandemanian sect of the Church of Scotland and visited Newcastle many times to preach at a branch of the church (Picton Terrace) and to visit relatives.

‘While on such visits Faraday took the opportunity to meet local scientists and to inspect engineering works’

Algernon Freire-Marreco

‘A heaven-born teacher and the terror of all evil-doers’¹

- Assistant to Thomas Richardson
- Educated in Portugal
- Reader in chemistry: 1867
- First professor of chemistry: 1871
- Founder of the Newcastle Chemical Society, the first provincial society in the world: 1868

Investigated a gas explosion on Grey St: ‘a passerby dropped on to the bag (of coal gas) the match with which he had just lit his pipe’¹

President of the Newcastle Chemical Society: read his brilliant address! (Trans Newcastle Chem Soc, 1874-1877, 3, 219-236)

The Newcastle Chemical Society

- 155 registered members of the Society in 1880
- Members from across the UK + Ireland, US and Switzerland
- Annual subscription 10 shillings
- 5 Volumes of Transactions published 1868-1882

Meetings initially focussed on industrial chemistry on Tyneside

Barnard Proctor, a pharmacy teacher and nephew of Faraday, attended the first meeting
Sir Joseph Swan FRS: President of the Society in 1880

At a Newcastle Chemical Society meeting in December 1878 Swan reported his invention of the incandescent light bulb

‘The Chairman (J W Swan) alluded to the difficulty experienced immediately preceding Christmas which led to exhibitions of little novelties’

‘The Chairman then described .... the production of light, by passing a current of electricity through a slender rod of carbon enclosed in an exhausted globe (Trans Newc Chem Soc, 1877-1880, 4, 190)’

Illustrated London News 1879
Peter Phillips Bedson

- Succeeded Freire-Marreco in 1881
- Candidates for the chair presented testimonials from Berthelot, Bunsen, Carius, Dumas, Frankland, Hofmann, Kekulé, Wallach, Williamson, Wöhler and Wurtz
- Kekulé was Bedson’s mentor with whom he had studied in Bonn

For our knowledge of the derivatives of phenylacetic acid we are chiefly indebted to Radziszewski (Ber., 2, 207), who first investigated the conditions under which substitution may take place either in the aromatic nucleus or in the side-chain. My investigation of some of the derivatives of this acid has led to results differing somewhat from those of the above-mentioned chemist. I here propose to give an account of these results, together with some further particulars relative to the bromonitrophenylacetic acids, &c., the study of which I undertook, whilst in Bonn, at the proposal of Professor Kekulé, and

P P Bedson, On some derivatives of phenylacetic acid, Trans Chem Soc, 1880, 37, 94-101
The Bedson Era (1881-1920)

- Bedson’s research at Newcastle was focussed on coal chemistry (he stressed the explosive nature of coal dust)
- Bedson also highlighted the danger of industrial lead poisoning
- Undergraduate numbers grew (from 10 in 1871)
- Women allowed to graduate in 1896
- First 4 honours students graduated in 1915
- Bedson Club founded in 1925

As a man Bedson was small and spare of body, but wiry and energetic, always cheerful, bating an occasional flare-up of temper, which however quickly subsided and left no malice or ill-feeling. He was always Peter, to students and staff alike, and the eternal boy in him was never much below the surface; as an old colleague put it, at one of the last staff dinners he attended, he was the Peter Pan of the College. — J. A. Smythe.

J A Smythe, Obituary of Peter Phillips Bedson, J Chem Soc, 1944, 40-41
Sir Norman Haworth (1883-1950; at Newcastle 1920-1925) was a pioneer of carbohydrate chemistry, awarded the Nobel prize in 1937.

The discovery of the methylglucosides and the interpretation of the phenomena of mutarotation of sugars furnished the strongest reasons for the allocation of an oxide ring structure to the monosaccharides, and this formulation has been universally accepted.

E L Hirst, Obituary of W N Haworth, Adv Carb Chem, 1950, 6, 1-9: ‘the world lost an .... organic chemist who exercised a profound influence on scientific research and education’
George Roger Clemo (1889-1983)

Professor of organic chemistry at Armstrong College, Newcastle upon Tyne, 1925-1954

In the 1930s Clemo was a pioneer in the use of deuterium as a label in organic compounds


Clemo’s house: *Cherryburn* (birthplace of Thomas Bewick)
He claimed to have separated enantiomers of a compound that was chiral solely by the presence of deuterium.

Calcium carbide was treated with D₂O giving [²H₂]acetylene, which was heated at 650 °C over a charcoal or tellurium catalyst to afford [²H₆]benzene.

Resolved by tartaric acid.

During the 19th Century an extract of the plant was commonly used for helping humans get rid of round worms (nematodes); santonin was the first formulated drug (1849: Charles Pfizer, USA).

The terpene santonin was isolated from the wormseed plant (Artemisia santonica) in 1830.

The structure determination of santonin took decades with Clemo eventually proposing the correct arrangement of the atoms.

Joseph J Weiss

Studied with Fritz Haber in Berlin and discovered the Haber-Weiss reaction

Joe Weiss was a pioneer in radiation chemistry and photochemistry, who founded an important school at Newcastle: Graeme Johnson, Peter Jones, George Scholes

The Catalytic Decomposition of Hydrogen Peroxide by Iron Salts*

By Fritz Haber and Joseph Weiss, The Chemical Laboratories, The University, Cambridge

\[ \text{Fe}^{2+} + \text{H}_2\text{O}_2 = \text{Fe}^{3+} + \text{OH}' + \text{OH} \]

The Bedson Building

Opened by Sir Robert Robinson, 10 December 1949; extended in 1959

Bedson Club lectures (1948-49): 5 Nobel prize winners!
Sir James Baddiley FRS

1918-2008  
(Newcastle 1955-1983)

Teichoic Acids and Membrane Function in Bacteria

by
S. HEPTINSTALL  
A. R. ARCHIBALD  
J. BADDILEY

Microbiological Chemistry Research Laboratory,  
School of Chemistry,  
University of Newcastle upon Tyne, NE1 7RU


Selective destruction of teichoic acid reduces the ability of bacterial cell walls to bind Mg2+ ions.
And Many More Including:

Baron (W F K) Wynne-Jones  
(1903-1982)  
Newcastle, 1947-1968; kineticist, worked with H Eyring and J N Brønsted

Richard D Haworth FRS  
(1898-1990)  
Newcastle 1927-1939; best known for Haworth synthesis of phenanthrenes

Neil Hughes  
(d 2001)  
carbohydrate chemist continuing the Haworth tradition

Neil Bartlett FRS (1932-2008)  
Newcastle BSc, PhD; discovered noble gas compounds (1962)

Joyce C Lockhart (1932-)  
Newcastle 1962-1997  
inorganic chemist: macrocycles

Geoff Sykes FRS  
(1934-2007)  
Applications to study chemistry were static or declining in the 1980s so BSc Chemistry with Medicinal Chemistry was initiated by BTG at Newcastle in 1989, alongside honours chemistry.

Research on anticancer drugs had already been commenced by BTG (with Christine Bleasdale) in collaboration with Adrian Harris (Northern Institute for Cancer Research, Newcastle Medical School).

This activity grew rapidly with arrival (1989/1990) of Hilary Calvert, Herbie Newell (NICR) and Roger Griffin (Chemistry).

Academic medicinal chemistry: no country for young men (or women)?

“...harnessing chemistry in the pursuit of drug discovery has deep historical roots in academia.”

B T Golding, Future Med Chem, 2015, 7, 549-551
Poly(ADP-Ribose) Polymerase

Poly(ADP-ribose) polymerase (PARP-1) assists repair of DNA single strand breaks

Newcastle project started in 1990: 13 years to first-in-class clinical trial of a PARP-1 inhibitor

A W White, R J Griffin, B T Golding et al, Synthesis and biological properties of benzimidazole inhibitors of the DNA repair enzyme poly(ADP-ribose)polymerase, J Med Chem, 2000, 43, 4084-4094
PARP-1 Inhibitors in Clinical Trials

- PARP research now embraces the global pharma industry
- More than 30 cancer trials with PARP inhibitors completed and > 50 trials open
- Over 7000 patients exhibiting 8 types of cancer have been treated with a PARP-1 inhibitor (Rucaparib etc)

Rucaparib is being developed by Clovis Oncology (Boulder, Colorado)

‘U.S. FDA granted Breakthrough Therapy designation for rucaparib as monotherapy treatment of advanced ovarian cancer in patients …. with BRCA-mutated tumors …. in April 2015 …. and June 2016’
(from: http://clovisoncology.com/)

The Future

Some current academic staff, postdocs and graduate students working in the School of Chemistry at Newcastle University
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  Julia Robinson

Abby Danecki: School of Chemistry

Rucaparib
Roger Griffin,† Christine Bleasdale, Hilary Calvert, Nicola Curtin, Herbie Newell, Ruth Plummer;
Alex White, Louise Pemberton, Sheila Srinivasan
and many more

R Almassy et al (Agouron Pharmaceuticals)