

Geoffrey Wilkinson

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For the original article, see the website <http://www.matthey.com>.

Sir Geoffrey Wilkinson was born in Todmorden, Yorkshire. He was one of the greatest international inorganic chemists, making noted contributions in transition metal chemistry, homogeneous catalysis, organometallic chemistry, and coordination chemistry. In 1973, when he shared the Nobel Prize with E.O. Fischer, the award was made for the discovery of ferrocene and similar "sandwich compounds", work he did jointly with R.B. Woodward, while Wilkinson was an Assistant Professor at Harvard from 1951 until 1955.

Wilkinson, the first of three children of Henry and Ruth (Crowther) Wilkinson spent his childhood in Todmorden. His parents, as was usual at the time, left school at age 12 to enter the working world; Henry as a house painter and decorator, Ruth as a weaver. Todmorden was a "cotton town", and at that time had a population about twice as large as today's of 13,000 – a victim of the introduction and popularity of synthetic fabrics. His interest in chemistry arose early, partly because an uncle managed a factory in Todmorden which produced Glauber's salt and Epsom salt. On Saturday mornings he was allowed to tinker in the small factory laboratory. His parents were determined that their children should receive a better education than they did. Thus he won a County fellowship in 1931 to attend Todmorden Secondary School (later "High School"), and because of his excellent progress, a Royal Scholarship to attend Imperial College of Science and Technology at London University.

At Imperial College he studied both chemistry and geology. In 1941 he graduated with a B.Sc. degree, first class honors, and continued his studies toward a Ph.D. under H.V.A. Briscoe, the only Professor of Inorganic Chemistry in Britain. His thesis was on: "Some Physicochemical Observations on Hydrolysis in the Homogeneous Vapour Phase", a title to disguise the fact that the compound studied was phosgene.

In 1942 he was selected by the Joint Recruiting Board as a scientific officer at the Atomic Energy Project in Canada. He worked at the University of Montreal, and later at Chalk River, Ont. on nuclear fission. Many other celebrated scientists also worked there: John Cockroft (also from his old school in Todmorden), Bertrand Goldschmidt, Charles Coryell (later at M.I.T.), Alfred Maddocks (later at Cambridge University), Jules Guéron, and Pierre Auger, and also two scientists who were later convicted for being spies for the Soviet Union: Alan Nunn May and Bruno Pontecorvo.

Shortly after the war Wilkinson joined the staff at the Lawrence Livermore Laboratory, working with Glenn T. Seaborg on the production of neutron-deficient isotopes of the transition elements and lanthanides. Seaborg has stated that Wilkinson had made more

artificial isotopes than anyone has ever made, a total of 89. Here he also started amassing his vast knowledge of descriptive inorganic chemistry: At the time the separation and isolation of isotopes had to be done by chemical means, requiring an intimate knowledge of the chemical behavior of target elements and others from which they were to be separated. One of the nuclear transmutations he accomplished was that of platinum into gold. The report of this resulted in a headline in the San Francisco Chronicle: "Scientist discovers gold mine in the cyclotron."

In 1950-51 he received a faculty appointment at M.I.T. to conduct research in coordination chemistry, then, in 1951 he was appointed Assistant Professor of Chemistry at Harvard University where he did the research on ferrocene and other cyclopentadienyl compounds.

The recognition by Wilkinson and Woodward of the unique "sandwich structure" of ferrocene (bis-(cyclopentadienyl)iron, Cp_2Fe) was a crucial point in his career, which started the emphasis on organo-transition metal chemistry, still an active field today. Twenty years later Wilkinson wrote a personal account of this discovery. From 1952-1953 he extended this work to bis(cyclopentadienyl) complexes of ruthenium, rhodium, iridium, and others. He used the new technique of nuclear magnetic resonance (NMR) to show that covalent metal hydrides (in this case Cp_2ReH) gave high-field ^1H NMR shifts.

In 1955 Wilkinson was appointed to Briscoe's old chair at Imperial College, still the only chair in inorganic chemistry in Britain. He was one of the youngest professors Imperial College ever had. Here at Imperial he did most of the work on platinum group chemistry. This interest was probably sparked by the recognition that these metals had many oxidation states, resulting in a rich body of chemistry.

His interest in platinum metals chemistry led to an early association with the Johnson Matthey Company, the prime marketer of platinum metals. He had a consulting relationship and received the supply of platinum metals needed for his research program on "loan" basis, i.e. Johnson Matthey received back the spent materials for recycling.

Wilkinson turned his interest to the catalytic activity of platinum metal compounds. The work of one of his students, Fred Jardine isolated the compound $\text{RhCl}(\text{PPh}_3)_3$, known as "Wilkinson's catalyst". This catalyst is very effective for the hydrogenation of alkenes and alkynes and of hydroformylated hex-1-yne to n-heptaldehyde and 2-methyl hexaldehyde. $\text{RhCl}(\text{PPh}_3)_3$ was a chance discovery, it was the product obtained when it was attempted to make $\text{Rh}(\text{Cl}_3\text{PPh}_3)$, and was discovered to be a very powerful catalyst. $\text{RhCl}(\text{PPh}_3)_3$ can be made readily by reacting $\text{RhCl}_3 \cdot n\text{H}_2\text{O}$ in ethanol with excess triphenylphosphine.

Wilkinson later showed that though $\text{RhCl}(\text{PPh}_3)_3$ was a very effective hydrogenation catalyst, it was not a hydroformylation catalyst. The agent responsible for hydroformylation catalysis was $\text{RhH}(\text{CO})(\text{PPh}_3)_3$. Most of the butyraldehyde used for the synthesis of bis(2-ethyl-hexyl)phthalate, a plasticizer for PVC, uses $\text{RhH}(\text{CO})(\text{PPh}_3)_3$ as the catalyst. It is likely that Wilkinson's work on catalysis was an important factor in

his being chosen for the 1973 Nobel Prize in chemistry, although the "sandwich" compounds were noted in the citation. In subsequent years Wilkinson and his students worked in Rhodium, Ruthenium, Osmium, Iridium, Platinum and Palladium chemistry.

Wilkinson the Man

Wilkinson was the academic supervisor for the two authors of the Platinum Metals Review article on which this piece is based. In their joint obituary of Wilkinson they wrote: "The spirit in his research group was more like that of an urgent gold rush in the West than the scholarly and disciplined calm expected in academia." He worked hard, six or even seven days a week, from early morning to late evening., and he expected his students to do the same. However, he was not a slave driver and was not put off by eccentric behavior. He freely used expletives when thwarted or stirred and had a great sense of fun. He was able to inculcate others with his enthusiasm. He would wander from one to the other in his lab in the late afternoon and inquire "What's new" and make suggestions for altering conditions if a reaction did not work as hoped for. He had no great sympathy for theoretical chemistry and would quote examples when theoretical predictions were proved wrong by subsequent findings.

He was in a hurry to publish results, sometimes resulting in errors. So, at one time, he announced the product of the reaction between thiophene and iron pentacarbonyl as thiopheneiron tricarbonyl, when it was later shown that there was no sulfur in the product, and that it was the unexpected butadieneiron tricarbonyl, a fact which Wilkinson accepted without being greatly disturbed.

Wilkinson was a staunch fighter for the recognition of the importance of chemistry by government in Britain, communicating his views bluntly to prime ministers, ministers of education, vice chancellors and others who held the purse-strings of research funds, people he would refer to as "the apparatchiks."

Geoffrey Wilkinson had a lasting influence on his former students, and on chemistry and the Northeastern Section can be proud that a small, but decisive part of his career was spent in our midst.

