The 1973 Nobel Prize for Chemistry

Prof. E. O. Fischer

Prof. G. Wilkinson

All coordination chemists have been sincerely delighted that the Nobel Prize in Chemistry 1973 has been awarded to two pioneers in the field of organometallic compounds. Many chemists are grateful to the Nobel Prize Committee that the prize was awarded for important contributions to basic chemistry.

Prof. E. O. Fischer was born on November 10, 1918, in Munich. He was a student of Prof. W. Hieber at the Technische Universität München. Working with Prof. Hieber, he became aquainted with the methods and problems of organometallic chemistry and he received his Ph. D. degree in 1952. The title of his thesis was "CO reactions of nickel(II) and cobalt(II) salts in the presence of dithionite and sulfoxylate". Immediately after finishing his Ph.D., E. O. Fischer entered into the new field of metal cyclopentadienyl complexes when, in 1952, he recognized the sandwich structure of ferrocene, the structure of which was independently elucidated by G. Wilkinson. The development of "The Metal Compounds of Cyclopentadiene and Indene" was the subject of his habilitation thesis (1954). Since 1952—the year which is generally recognized as the starting point for the renaissance in organometallic chemistry—E. O. Fischer and his coworkers have obtained many fundamental results, which always opened new routes into the field of metal compounds. One of the milestones in this period was the preparation and characterisation of dibenzene chromium by the so-called reducing Friedel–Crafts synthesis (1955). It was also shown experimentally that the phenylchromium compounds first reported by Hein in 1919, are actually π-arene complexes. In a series of brilliant publications E. O. Fischer and his group extended the chemistry of π-complexes with unsaturated carbocycles. Important contributions were also made to the chemistry of π-olefine metal compounds. Although E. O. Fischer has never cared too much for the industrial application of coordination compounds, his studies have certainly layed foundations for homogeneously catalyzed processes. They have undoubtedly led to a better understanding of the bonding between a metal and organic ligands. The discovery of the metal carbene complexes (1964) which are now being studied by many organometallic research groups all over the world and the development of their chemistry is another high light from the Munich laboratory. Similarly the recently reported metal carbine derivatives are fascinating new results from his laboratory.

Since 1964 E. O. Fischer holds a chair of Inorganic Chemistry at the Technische Universität München where he succeeded Prof. W. Hieber. He is a member of the Bayerische Akademie der Wissenschaften and of the Deutsche Akademie der Naturforscher Leopoldina. In 1957 he received the Chemistry award of the Akademie der Wissenschaften zu Göttingen, in 1959 the Alfred-Stock award of the Gesellschaft Deutscher Chemiker, and in 1972 a honorary Ph.D. degree from the University of Munich. Up to now more than 100 graduate students have been working with him, some of whom have successfully chosen the academic career, and 350 papers have appeared from his laboratory. Prof. Fischer's dedication to chemistry is only surpassed by his dedication to be a citizen of Munich, since this gives him the opportunity to visit the opera and the Bavarian Alps.

W. Beck

Professor Wilkinson was educated at Todmorden Grammar School and Imperial College. His research career began in 1943 when he joined the UK-US-Canadian atomic energy project in Montreal and at Chalk River. His initial studies were on the thermal neutron capture cross sections for uranium and, later, on the distribution of the fission products from U^{235} and U^{233}. This work led to the development, independently of the American work, of the fission yield curve. An important factor in this work and, indeed, in all of his subsequent research, was the application of considerable practical skill—the fruits of the Harwood-Theobald tradition at Imperial College.

The isotope work was continued during 1946–50 in Seaborg's laboratory at the Radiation Laboratory of the University of California at Berkeley. By the end of this period Professor Wilkinson had, it is claimed, isolated more new isotopes than any other chemist. But in 1950 his research career changed direction completely and he took the first step on a course which was to lead to his Nobel award.

Even during his undergraduate days at Imperial College he had been interested in the literature reports on metal carbonyls and, particularly, in the unusual compound butadieneirontricarbonyl. His Research Associateship at MIT in 1950–51 gave him the chance to start experimental work in this area, and this research was continued when he moved to Harvard the following year.

In 1948 a research group at British Oxygen, led by the late S. A. Miller, was investigating amine synthesis by passing olefins and nitrogen over Haber catalyst. The use of dicyclopentadiene led to the accidental formation of a compound of stoichiometry $C_{10}H_{10}Fe$. Independent work in 1951 by Kealy and Pauson also led to the formation of this organoiron compound (ferrocene) from an attempt to prepare fulvalene ($C_{10}H_8$) by reacting the Grignard reagent C_5H_5MgBr with ferric chloride.

Wilkinson, Woodward and their colleagues at Harvard, and also Fischer and Pfab at Munich, recognised that the structure proposed by Kealy and Pauson was unlikely and, after further work, they postulated a novel structure. It was proposed that the iron atom sits between two parallel C_5H_5 rings, and the apposite term "sandwich" compound was coined to describe this unusual bonding.

After the publication of a joint note with Woodward in 1952 proposing the "sandwich" structure, Professor Wilkinson carried out the synthesis of a wide range of compounds of this type, involving most of the transition metals. In so doing he opened up a large new area of chemistry, bridging the formal sections of inorganic and organic chemistry. It was rapidly found that one of the rings could be replaced by other ligands—carbon monoxide, alkyl groups, halide ions, etc. The attractive possibilities offered by such unusual systems soon caught the attention of industrial research laboratories and university chemistry departments alike. It is in recognition of his pioneering work in this important field that Professor Wilkinson receives his Nobel award, together with Professor E. O. Fischer.

In 1955, whilst in Copenhagen, Professor Wilkinson synthesised the first transition metal hydride complex involving a hydrogen atom directly bonded to a metal atom. He has retained an interest in metal hydrides and has been a pioneer of their uses as catalysts.

When he was appointed to the Chair of Inorganic Chemistry at Imperial College in 1956 he carried forward the above lines of research and developed new interests, for example, in metal nitrosyls and in the curious blue solutions formed by dissolving alkali metals in ethers. The use of nuclear magnetic resonance in inorganic chemistry was largely developed by Professor Wilkinson and his colleagues at Imperial College.

More recent work has concentrated on the synthesis of transition metal complexes with useful catalytic properties. One noteworthy example is "Wilkinson's catalyst" $(PPh_3)_3RhCl$, an efficient catalyst for homogenous hydrogenations. Its specificity has been of great use in hydrogenation of, for example, steroids.

Professor Wilkinson was elected to Fellowship of the Royal Society in 1965 and the same year received the American Chemical Society Award in Inorganic Chemistry. He was made a Foreign Member of the Royal Danish Academy of Science and Arts in 1968 and a Foreign Member of the American Academy of Arts and Sciences in 1970. In 1968 he was awarded the Lavoisier Medal of the Société Chimique de France, and he received the First Transition Metal Chemistry Award from the Chemical Society in 1972.

D. M. L. Goodgame