

Stirred and shaken!

CHEMISTRY NOBELS In the International Year of Chemistry, **C Sivaram** charts the Nobel prize winning achievements in the field, from work on synthesis of sugars to vitamin chemistry.

This year is the International Year of Chemistry. Major achievements in chemistry are recognised every year by way of the Nobel Prize. The very first Nobel Prize in Chemistry awarded in 1901 went to Dutch chemist Jacobus Vant Hoff mainly for formulating laws of osmotic pressure in solutions.

The 1902 prize went to Emil Fischer for work on sugar chemistry leading to synthesis of sugars and purines. He was a student of Adolf Von Bayer, who himself got the prize in 1905 for synthesis of organic dyes, including that of the indigo dye. This proved disastrous for the Indian indigo plant export, which was earlier the only source for the dye. Two other Fischers also got the chemistry Nobel. One was Hans Fischer, who got it in 1930 for the constitution of chlorophyll, use of substituted porphyrins leading to eventual synthesis of haemin.

In 1973, Ernst Otto Fischer shared the prize with Geoffrey Wilkinson for their independent work on organometallic 'sandwich' compounds and revolutionising transition metal chemistry with compound like Ferrocene and those compounding rhenium and hydrogen or chromium with benzene among others. Earlier in 1912, Grignard and Paul Sabattier shared the prize for work on organometallic compounds (Grignard reagents etc.) This was the first shared chemistry prize. The first eleven prizes, including the 1911 one to Madame Curie (for isolation of radium and polonium) were given to individual chemists. The next shared prize in chemistry was in 1929, when Sir Arthur Harden shared with Von Euler for work on alcoholic fermentation of sugars. In 1935, Curie's daughter, Irene shared the chemistry prize with her husband, Frederic, for work on artificial radioactivity, involving transmutation of aluminium to phosphorus. Only one other woman chemist has got the Nobel, i.e., Dorothy Hodgkin in 1964 for seminal work in unraveling the structure of complex molecules like, insulin and Vitamin E, through X-ray crystallography.

In 1903, Svante Arrhenius became the first Swedish to get the Nobel for his work on electrolytic theory of dissociation. He was influential in the rejection of the great Russian chemist (and founder of the periodic table) Mendeleev for the 1906 prize.

Discovery of inert gases

In 1904, British chemist Sir William Ramsay won the prize for discovery of inert gases in the atmosphere, like Argon, Neon, Helium, Xenon, etc. In 1906, Moissan got the prize for the discovery of Fluorine. Ernest Rutherford got the Chemistry prize in 1908 (all the more ironic as Buchner got it in 1907 for cell fermentation). Rutherford's assistant Frederic Soddy won it in 1921.

Other scientists also regarded as prominent physicists who got the Nobel in chemistry include Irving Langmuir (1932 for his work on surface chemistry, he coined the terms covalence and electrovalence in his work on gas conductivity), Peter Debye in 1936 (for screening in electrolytes) and William Giauque in 1949 for cooling to very low temperatures (sub-Kelvin) by adiabatic demagnetisation technique. Work on surface chemistry (this time for chemical reactions on surfaces) was again recognized with a Nobel to Gerhard Ertl in 2007. The other individual chemistry prize (after 2000) was given in 2006, to Roger Kornberg for his work on how DNA is converted to RNA. His father, Arthur Kornberg had shared the 1959 Medicine prize for work on biological synthesis of RNA and DNA.

Twice lucky

Only Frederick Sanger has got the Nobel Prize twice in chemistry, first in 1958 for his work on structure of proteins (including insulin) and then again in 1980, this time jointly with Paul Berg and Walter Gilbert for determination of nucleotide sequence in viruses. Linus Pauling, the only person to get two individual Nobel prizes, got the chemistry prize in 1954 for his work on chemical valence bonding and in 1962 the Peace prize. While Crick, Watson and Wilking got the medicine prize in 1962 for



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the DNA double helix model, Perutz and Kendrew got the chemistry prize the same year for their work on globular proteins, thus making it an all-British affair!

The only Russian to get the chemistry prize was Nikolai Semenov, who shared it in 1956 with Sir Cyril Hinshelwood for chemical chain reaction kinetics. After K Fukui shared the chemistry prize in 1981, with Hoffmann for chemical reaction energetic, several Japanese have shared the Nobel chemistry prize starting from year 2000, when Hideki Shirakawa shared the prize with Alan McDiarmid and Alan Heeger for developing electrically conducting polymers. The 2001 and 2002 prizes also had Japanese sharing the prize, i.e., Ryogi Noyori for chiral catalysis and Koichi Tanaka for mass spectrometric analysis of bio-molecules, respectively. The 2010 chemistry prize was given by E Negishi and A Suzuki sharing the prize with Richard Hock for palladium catalysed cross couplings in organic synthesis of complex compounds. The 2008 prize also had a Japanese Osamu Shimomura sharing the prize with Chafie and Tsien for development of the green fluorescent protein (GFP) as a bioscience tag.

In 2009, the only Indian recipient of the chemistry prize, Venkatraman Ramakrishnan, shared it with Ada Yonath and Thomas A Steitz for work on ribosomes and protein synthesis. In 1999, Ahmed Hasan Zewail of Egypt, won the prize for work on femtosecond chemical reactions. Earlier in 1967, Eigen, Norrish and Porter also got the prize for studies of fast chemical reactions.

Thermodynamics as applied to chemistry got Onsager the prize in 1968 (for reciprocal reactions) and Ilya Prigogine in 1977 for non-equilibrium thermodynamics. Otto Hahn won the prize in 1944 for the all important nuclear fission of uranium, and Seaborg and McMillan for transuranium elements in 1951. George Hevsey (isotope tagging, 1943), Willard Libby (Carbon-14 dating, 1960) were the other winners.

Fritz Haber won the prize in 1918 (Haber process) and Bergius and Bosch in 1931 (liquefaction of coal). Harold Urey won the Nobel for heavy Hydrogen discovery in 1934, Zsigmondy (1925) and Svedberg (1926) for colloidal chemistry. Millikan's student, Richard Mulliken won it in 1966 for orbital models. The study of organic synthesis also got many prizes, including Woodward (1965) and Natta and Ziegler (1963).

Polymer chemistry resulted in Flory getting the prize (1974) and Hermann Staudinger in 1953. Artturi Virtanen of Finland (1945) got the prize for agricultural biochemistry and Robert Robinson (1947) for plant products like alkaloid.

Luis Leloir in 1970, for biochemical metabolism (Leloir road), G Herzberg (1971), atomic spectroscopy, Theodore Richards (1914) and Francis Aston (1923) for atomic mass spectroscopy, Melvin Calvin (1961) for analysis, Paul Karrer and Walter Haworth (1937) and Richard Kuhn (1938) for vitamin chemistry, are other notable winners.