# Research Project

## Chemist of choice: Fritz Haber

Fritz Haber was born in the town of Breslau, Germany in early December 1868. His family was one of the oldest families in town, he was the son of Siegfried Haber who was a well know merchant in the town. Fritz studied at St. Elizabeth classical school in the town of his birth where he conducted many chemical experiments from a young age.

From 1886 to 1891 Fritz studied chemistry at the University of Heidelberg under the academic advice of Robert Bunsen who had invented the Bunsen burner and also had help discover the elements cesium and rubidium. He also studied at the University of Berlin from guidance from A.W Hoffmann, and at the Technical School at Charlottenburg under Carl Liebbermann.

Once he completed his studies at the universities he went and worked voluntarily for his father's chemical business as he was interested in chemical technology. He then went on to work at the under the eye off Professor Georg Lunge at the Institute of Technology in Zurich. After all this work he finally decided that he wanted to take up a scientific career and went to work with Ludwig Knorr at Hena for one and a half years to publish with him a joint paper on diacetosuccinic ester yet orthodox methods at the institute under Jena gave Haber little satisfaction. Still uncertain whether to devote himself to chemistry or physics he was offered a job in 1894 at the age of 25 as an assistantship at the Technische Hochschule of Karlsruhe by the Professor of Chemical Technology there who was Hans Bunte. Bunte was especially interested in combustion chemistry also Carl Engler who also worked at the Hochschule introduced Haber to the study of petroleum. Haber's work later on life was immensely influenced by these two colleagues. Finally in 1986 he qualified as a Privatdozent which meant he wanted to become a university professor. He qualified with a thesis on the expirimental studies of the decomposition and combustion of hydrocarbons. Two years later Haber published a book the Grundriss der technischen Elektrochemie auf theoretischer Grundlage ("The Theoretical Basis of Technical Electro chemistry"), which was based on the lectures he gave at Karlsruhe.

In 1911 he succeeded his colleague Engler as Director of the Institute for Physical and Electrochemistry at Berlin Dahlem. He remained here until 1933 when the Nazi race laws nearly forced all his staff and Haber to resign. When he resigned he was invited to come to Cambridge, England by Sir William Pope he remained here for a while but as he had been suffering from heart disease for sometime he feared the English winter and moved to Switzerland.

In the following next 10 years Haber carried out many more other electrochemical researches and experiments. During this time Haber studied the electrolysis of solid salts which laid foundations for Biilmann's quinhydrone electrode for determining the acidity of a liquid. He also looked at the loss of energy from steam engines, turbines and motors driven by fuels and sought for methods to reduce the amount of energy

lost in which he succeeded by finding a solution for the combustion of carbon monoxide and hydrogen. He then turned to the study of the flames and did research on the Bunsen flame that Robert Bunsen had created. His researches revealed that the luminous inner cone of this flame a thermodynamic water-gas equilibrium is established & that, in its outer mantle, there is combustion of water-gas. This led to a chemical method of determining flame temperatures.

When Haber was 37 he published his book on thermodynamics of technical gas recations where we see he recorded a small amount of ammonia produced from $N_2$ and $H_2$ at a temperature of 1000°C with the help of iron as a catalyst. Later he decided to try and create a higher yield of ammonia by synthesizing it he had accomplished in finding a suitable catalyst by circulating nitrogen and hydrogen around the catalyst at 150-200 atmospheres at a temperature of roughly 500° C. This was the beginning of the haber process.

The ammonia produced was initially used to prolong the $1^{st}$ world war as the supplies of nitrates for making explosives. Therefore after modifications of the Haber process lead to the production of ammonium sulphate which is used as a soil fertilizer, it is also used in the production of nitric acid as, the principle used for this process and the subsequent development of the control of catalytic reactions at high pressures and temperatures, led to the synthesis of methyl alcohol by Alwin Mittasch and to the hydrogenation of coal by the method of Bergius and the production of nitric acid. The nitric acid produced could have been used for the production of such explosives such as nitroglycerin, trinitrotoluene (TNT) and cyclotrimethylenetrinitramine (RDX), as well as fertilizers such as ammonium nitrate.

In 1918 Haber was awarded the Nobel Prize for the synthesis of ammonia from its elements. This wasn't the only honor he received during his life he had received many others and was recognized over the globe for what he had discovered.

After a grave illness, Haber died on January 29, 1934, at Basle, on his way from England to convalesce in Switzerland, his spirit broken by his rejection by the Germany he had served so well.

Sources

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