Volume 11 **Number 028**

Fritz Haber and the Double-Edged Sword of Synthetic Nitrogen I

Lead: By 1900 world population was beginning to outstrip agricultural capacity. Farmers could not grow enough to feed the people. Then Fritz Haber solved the nitrogen problem.

Intro.: *A Moment in Time* with Dan Roberts.

Content: The three main nutrients required for successfully growing plants are potassium, phosphorus, and nitrogen. Good top soil contains them in sufficient amounts to grow crops, but after long use, soil becomes

depleted of these ingredients and must be renewed. Potassium and phosphorus are economically available in sufficient quantities to be put back easily, but nitrogen is not. Nitrogen is in the air. It is a gas that is a large part of the atmosphere. Getting it into the soil for plant synthesis is very difficult. Traditional farmers added plant clippings and animal waste, rotated crops or planted legumes such as beans or lintels, so-called green manure, to restore the soil and increase yields. Traditional agriculture could not keep up with an exploding world population. Farmers were losing the battle.

In 1899 Carl Bosch, a chemist at

BASF, the giant German chemical company, began to synthesize ammonia, a key to the production of nitrogen-rich chemical fertilizer. It was the work of his colleague Fritz Haber, a professor of physical chemistry at The Technical Institute of Karlsruhe, however, who solved the nitrogen problem. He developed a catalytic process which, under immense heat and pressure, combines gaseous nitrogen and hydrogen to create ammonia. By the end of the twentieth century, Fritz Haber's breakthrough had made possible the inexpensive manufacture of chemical fertilizers, which by the end of the 20th century were being put into the soil at a world-wide rate exceeding 175 million tons per year. Next: the

two-edged sword of synthetic nitrogen. Research assistance by Shirley Patron and Jed Kennedy.

At the University of Richmond, this is Dan Roberts.

Resources

Cole. J.A. and S.J.Ferguson. *The Nitrogen and Sulphur Cycles*. New York, NY: Cambridge University Press, 1988.

"Fritz Haber's Legacy" *The Economist* (US) V 313 Nov 1989. P 104.

Goran, Morris. *The Story of Fritz Haber*. Norman, OK: University of Oklahoma Press, 1967.

Gorman, Moran. "The Present Day Significance of Fritz Haber" *American Scientist.* July 1947. 35 (3):400-403

Keifer, Davis. "Capturing Nitrogen Out of the Air." *Chemistry Chronicles.* 27 Oct. 2002.

Smil, Vaclav. *Fritz Haber, Carl Bosch, and the Transformation*. London, UK: The MIT Press, 2000.

Smil, Vaclav. "Global Population and the Nitrogen Cycle," *Scientific American* (July, 1997): 76-81.

Travis, Tony. "The Haber-Bosch Process: Exemplar of the 20th Century Industry." *Chemist and Industry.* (Aug.2 1993): 1-13.

Yarnell, Amanda. "Nitrogenase Keep Surprising." *Chemical and Engineering News*. 27 October 2002.

Copyright by Dan Roberts Enterprises, Inc.