HISTORICAL CHEMISTRY

Fixing the Nitrogen Problem

Historical Perspective

Each year, the chemical industry synthesizes tons of nitrogenous fertilizers, increasing agricultural production around the globe. But prior to 1915, humans had to rely solely on natural resources for fertilizer, and the dwindling supply of these materials caused widespread fear of world starvation. A crisis was averted, however, through the discovery of an answer to the "nitrogen problem," a term used at the time to describe the shortage of useful nitrogen despite its abundance in the atmosphere.

The Malthusian Threat

In 1798, Thomas Malthus published his famous "Essay on Population," a report predicting that the world's food supplies could not keep up with the growing human population and that famine, death, and misery were inevitable.

Malthus's warning seemed to be echoed in the 1840s by the great Irish potato famine. In fact, the rest of Europe likely would have suffered serious food shortages as well had crop yields per acre not been increased through the use of fertilizers containing nitrogen.

Few living things can utilize the gas that forms 78% of the atmosphere; they need nitrogen that has been combined with other elements, or "fixed," to survive.

But soil often lacks sufficient amounts of the organisms that fix nitrogen for plants, so fertilizers containing usable nitrogen compounds are added. In 1898, two-thirds of the world's supply of these compounds came from Chile, where beds of sodium nitrate, or Chile saltpeter, were abundant. But, as the chemist William Crookes emphasized in his speech to the British Association that year, these reserves

Nitrogen gas

Animals

Plants

Ammonia

Decomposition

Nitrogen-fixing bacteria on plant roots
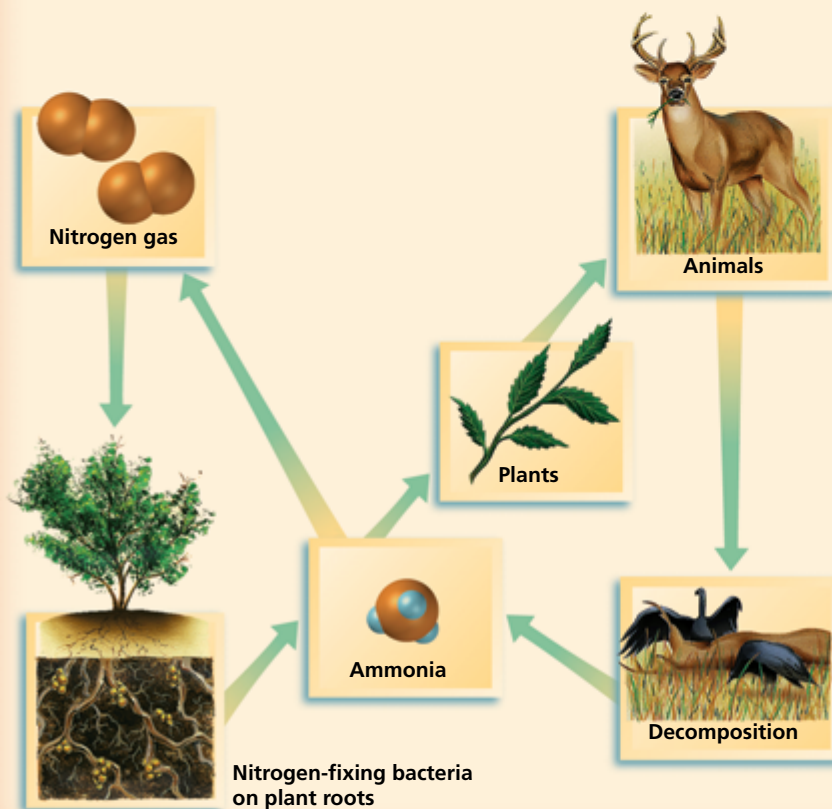
◄ *Nitrogen is released when living things die and also from animal wastes and plant material. Some bacteria are able to break the bond holding the nitrogen molecule together, freeing the nitrogen atoms to combine with hydrogen to form ammonia. Plants can absorb the nitrogen in this form from the soil. Animals then benefit from the nitrogen by eating the plants.*