

chemists at Colorado State University were posing this problem: Why does nitrate accumulate naturally in the rangelands at such high level? These are the nitre spots of eastern Colorado soils.

At the meetings of the American Association for Advancement of Science a year ago, Dr. Stout of the University of California presented his studies on nitrate in well water. Some well waters run from 10 to 130 parts per million of nitrate. They have been used for drinking water but no adverse effects have been noted. These waters might have adverse effects if given to ruminant animals. The bacterial population in the rumen readily reduces the nitrate to nitrite and it is the nitrite that is poisonous.

There are instances, of course, wherein "blue babies" have been associated with nitrate in well water. Recent evidence indicates that this effect of nitrate does not take place unless there is also bacteriological pollution in the well water. The bulletin provided by the Public Health Service on drinking water quality standards cites many, many cases of "blue babies" afflicted from drinking well water containing nitrate. They have never found a "blue baby" case associated with drinking surface water containing nitrate. This indicates that bacteriologic pollution entering the baby's stomach with water induces the reduction of the nitrate to poisonous nitrite causing methemoglobinemia.

Mr. DADDARIO. That is very interesting, Doctor. I just wonder if there is this accumulation in this way that you indicate to be natural.

Dr. WADLEIGH. Yes.

Mr. DADDARIO. Isn't it incumbent on us, then, to see if we can develop a nitrate fertilizer which we could contain and prevent from being as mobile as it is, and, therefore, not adding to what must be becoming a natural problem.

Dr. WADLEIGH. I think there is an urgent need to develop better fertilization technology since nitrate is so exceedingly soluble. Studies by my staff members indicate that as much as 40 percent of the nitrogen fertilizers applied to the land each year do not enter into beneficial use to the crops. The farmers are spending \$1.5 billion per year for chemical fertilizers. They are applying over 6 million tons of elemental nitrogen. What happens to this 40 percent of the nitrogen fertilizer that does not enter into beneficial use? A small amount goes into land runoff. Some goes into deep percolation. These are minor. Much of our evidence indicates that much nitrogen is lost by chemical reaction in the soil and returned to the atmosphere as gaseous nitrogen. Much nitrogen is sometimes absorbed at excess levels into crop plants.

There have been quite a number of instances in the Middle West, Indiana, Illinois, and Missouri, of cases called "silo disease." When corn or any other forage high in nitrate goes into the silo and starts fermenting, the nitrogen oxides are given off. Silo workers can become very ill. A few have been killed. When high nitrate forage is fed to ruminant animals, they can become very sick. This is sometimes a serious problem when highly nitrogenous forage is used.

As we use higher and higher levels of nitrogen applications on our fields, chemical forms that would not be readily converted to nitrate would be advantageous. The nitrate step is averted. Plants may use nitrogen as ammonium. For example, a sugar beet plant does not grow effectively unless there are 5,000 parts per million of nitrate in its petiole. Ammonium nutrition could avert this buildup.