“THE MOLE CONCEPT”

Pilot treatment for PBS-TV series “The World of Chemistry”
by Richard Bellikoff

We open on a supermarket produce section, with customers selecting ripe, luscious fruits and vegetables. The host, in voice-over narration (henceforth referred to as “N,”) points out that few urban dwellers consider where their produce comes from. Cut to vistas of fertile fields, brimming with the produce we've just seen, accompanied by appropriately bucolic music.

Shock cut to famine in Africa: scorched, brittle earth, starving hordes. But in less fortunate countries, N continues, the fertility of farmland can't be taken for granted. Modern chemistry plays a vital role in combatting world famine. Chemical fertilizers can supplement the natural fertility of the soil (We see a truck spreading fertilizer on a field). A key ingredient in making these fertilizers is ammonia (Super: NH_3). It's used as a fertilizer itself, and also as a raw material for manufacturing such fertilizers as ammonium carbonate and ammonium sulfate.

Now we're outside an ammonia plant, with our host on camera. The distinctive smell of ammonia, he says, is familiar to anyone who's ever used a household cleaner. Donning safety equipment, he joins the plant manager on a short tour of the facility. They describe the simple chemical reaction of nitrogen and hydrogen forming ammonia. It's an efficient process, and plant personnel know exactly how much nitrogen and hydrogen they need for the scheduled ammonia output on any given day.

But, the host continues, things weren't always so simple. In the mid-19th century, chemistry was more of an art than a science. The amounts of raw materials necessary to carry out the simplest reactions were unknown, and chemists couldn't even agree on the formulas for many common compounds -- including water! In the course of clearing up these mysteries, a concept called the mole evolved. The mole, the host explains, could be thought of as a sort of chemist's dozen. It's a way of counting a very large number of molecules, and it enables us to calculate the amounts of raw materials we need to make not only ammonia, but also thousands of other industrial chemical products.

We leave the host and see drawings of ancient alchemists. With the idea of the mole, says N, chemistry finally came into its own as a precise, quantitative science. The first major steps toward precision in chemistry were taken by the French chemist Antoine Lavoisier (see stills of him), famous for the accuracy of his experiments. When Lavoisier burned hydrogen in a closed container, water and a vacuum were formed. Measuring the amounts of reagents and products, Lavoisier concluded that one component of the air -- which he called “Oxygen” -- was reacting with the hydrogen to form water, leaving behind a vacuum. Matter, according to Lavoisier, could neither be created nor destroyed, but only transformed into other matter or energy -- a theory known as “The Conservation of Matter,” the foundation of modern chemistry.