mines, however, scientists are still working on probabilities. The one thing they are sure of is that the mechanism is far more complex than is generally believed.

The trouble starts with the oxidation of pyrite in the presence of air and water. Pyrite—chemically, iron disulfide—is a mineral commonly found imbedded in coal seams and associated rock strata. When it oxidizes, many reaction products can be formed; however, the primary product is ferrous sulfate which dissolves in water, thereby cleansing the pyrite to expose fresh surface for oxidation.

Acid mine drainage probably results from the interplay of all known processes of pyrite decomposition and oxidation-chemical, electrochemical, and bacterial. Chemical oxidation apparently triggers the acid-formation mechanism, but there are accompanying or subsequent complications. Pyrite conducts electricity and exhibits characteristics in water solutions that suggest an electrochemical reaction, which reduces pyrite to iron and generate sulfur gas and soluble forms of sulfur. Bacterial oxidation has also been inferred from the consistent presence of pyrite-oxidizing bacteria in acid waters in mines, and streams. A BCR sponsored study at West Virginia University dating back to 1944 led to identification of the probable—and important—role of bacteria in acid mine water formation.

The chemical complexity of the oxidation process and of the resulting alkaline or acid mine drainage discharges are described in a more detailed supplementary statement I shall present for the record.

Also described in the supplementary statement are the three major pyrite oxidation theories: chemical oxidation, bacterial oxidation, and electrochemical oxidation.

In addition to iron, other major elements show up in mine drainage waters, including calcium, sodium, aluminum, manganese, and magnesium. Aluminum and manganese are dissolved from strata in contact with acid mine water. Ground water, the commonest vehicle of mine drainage, usually contains calcium and magnesium from the dissolving of bed limestone, dolomite, and magnesites.

Precipitates from mine drainage are the showy parts of the problem—obvious even to the casual observer who has no fix on the acid content of a stream. Mine water containing ferrous iron may remain clear in a low-pH solution, but dilution with alkaline water, aeration and/or bacterial action can set up a chain of reactions converting ferrous to ferric iron and forming the yellow-to-red precipitates that cause "red water."

The notorious "yellowboy"—the yellowish-brown sludge seen in underground mines and on streambeds—results from the oxidation of ferrous to ferric compounds that are insoluble in increasingly alkaline waters. The composition of the precipitate is as varied as the source material—in its idealized form yellowboy is ferric hydroxide.

PREVENTION PREFERRED: BUT NOT PROBLEM FREE

The task of controlling and preventing stream pollution from mine discharges can best be described as one involving a host of variable conditions of nature, each of which must be more fully understood. The demonstration projects that would be authorized in the bill be-