Bureau of Mines responsibilities for the conservation and efficient utilization of fossil fuels places this agency in a unique position to take a responsible part in the overall Federal program on air pollution abatement. Therefore, our staff, in cooperation with the Public Health Service, is making every effort to find a feasible solution to the control of pollutants at the source of their production. We believe that a total systems approach to the problem is required if the problems of air pollution are to be solved without severe economic and social effects on the Nation as a whole.

Most air pollution ordinances that have been adopted or are being considered by cities, counties, states, etc., contain provisions limiting the sulfur content of fuels burned in stationary heating and power plants. This type of limitation is the only currently feasible method of effecting substantial and immediate reduction of emissions of sulfur oxides to the atmosphere.

Nevertheless, widespread adoption of such provisions would have a significant impact on the availability and cost of low-sulfur fuels. For example, over 90 percent of coal containing 1 percent or less sulfur is produced in the Appalachian area, which contains about 8 percent of total reserves of such coal. Furthermore, these low-sulfur coals are, (a) in great demand by metallurgical plants, both in the U.S. and in foreign countries, (b) priced substantially higher at the mine than high-sulfur coals, and (c) produced somewhat farther from the areas considering their use for air-pollution control purposes than are the higher-sulfur coals currently being used.

Accordingly, the Bureau recently embarked on a special cooperative project to determine the location, quality and availability of low-sulfur coals for energy production.

The combustion of fossil fuels in powerplants and for space heating is a principal source of air pollutants, particularly sulfur and nitrogen oxides. The Bureau of Mines is engaged in research that we believe will lead to practical and economically feasible methods for: (1) desulfurization of fuels and (2) the removal of sulfur oxides from stack gases before being released to the atmosphere and the subsequent recovery of the sulfur resulting from the combustion of these fuels, thus reducing the critical shortage of sulfur that now exists on a world-wide basis. It is estimated that more than 23 million tons of sulfur dioxide are discharged into the atmosphere annually from the combustion of fuels for heat and power purposes and from industrial operations such as the metallurgical processing of sulfide ores.

One of the most promising methods for the recovery of sulfur from stack gases is the alkalized alumina process, which the Bureau invented and then developed in conjunction with the U.S. Public Health Service.

The process consists of four steps:

1. *Absorption.*—Alkalized alumina is contacted by the flue gas to remove sulfur oxide.
2. *Regeneration.*—The alkalized alumina containing the sulfur oxide is treated with a reducing gas to convert the sulfated alumina to its original state for recycling in the process. Simultaneously, the sulfur oxide is converted to hydrogen sulfide.
3. *Production of reducing gas.*—A gas generator is required to supply the gas essential to step two above. The reducing gas may be derived from either coal or natural gas or heavy hydrocarbons.
4. *Sulfur production.*—Hydrogen sulfide is converted to elemental sulfur.

Steps one and two are novel to the alkalized alumina process; steps three and four are borrowed from other existing commercial-scale operations.

Operated on the basis of 90 percent removal of sulfur oxide from stack gases obtained from the combustion of 3 percent sulfur coal, the process should produce one ton per day of byproduct sulfur for each 4.3 megawatts of power generated.

Research on the alkalized alumina process has proceeded through laboratory bench-scale experiments using simulated flue gases, to a small scale pilot plant study. This now has been followed by operations in an intermediate sized pilot plant capable of handling 55,000 cubic feet of stack gases per hour. Completely instrumented for automatic control, this latest unit is designed for operation over extended periods on a 7-day a week, 24-hour a day schedule.

On the basis of results obtained to date, the process appears promising, both technically and economically. Latest estimates, however, indicate that the system will not be ready for industrial application before late 1970 or early 1971 *at the present level of effort.* Normally, it would be recommended that any further development await the outcome of the present pilot plant research program. However, because of the urgency of the situation and since this process is the most promis-