conducted on the extraction and utilization of mineral substances with a view to conserving resources through the prevention of waste, increasing safety, and on behalf of the Government to investigate mineral fuels.

At the present time, we are committed to research designed to provide feasible, economic methods for abatement of the ever-growing air pollution problems of this country. Although this research is being performed largely in cooperation with the Public Health Service, significant amounts of direct program funds of the Bureau are applied to research programs that originate as a result of efforts to conserve our natural resources. These programs also make a marked contribution towards the pollution abatement program. The two most active areas under investigation cover the control of fumes resulting from combustion of gasoline and diesel fuels in automotive engines and the control of sulfur oxides emissions from the combustion of fossil fuels.

The type of pollutants discharged from motor vehicles differs appreciably from those from industrial installations. Gasoline and diesel fuel are normally very low in sulfur. The exhaust gases are generally high in unburned and partially burned hydrocarbons, oxides of nitrogen, and carbon monoxide. Both automotive and diesel exhaust research is in progress in Bureau laboratories. This research stresses the relationship between types of fuel, combustion system characteristics, and the pollutants emitted. Work is also being done to identify and minimize those constituents of the exhaust that are most active in producing smog.

Just last month, engineers at our Bartlesville, Okla., Petroleum Research Center demonstrated the technical feasibility of equipping an automobile with control devices that will lower the concentration of pollutants emitted well below what the Commerce Department's Report of the Panel on Electrically Powered Vehicles considered as commercially feasible by 1970.

The demonstration involved equipping a 1967 stock model of popular make with devices called exhaust manifold reactors, which were developed by a domestic company interested in the problem of controlling automotive exhaust emissions. Use of the exhaust manifold reactors permits mixing additional air with the exhaust gases, thereby changing their chemical properties.

By applying these devices, the research group at Bartlesville has thus far been able to achieve these results:

(1) Emission of total hydrocarbons from the exhaust of the car has been reduced to less than 70 parts per million (ppm), compared with an average of 900 ppm in the exhausts from cars without pollution controls.

(2) The concentration of reactive hydrocarbons (those that form smog) has been reduced to less than 50 ppm. The Bureau believes that this concentration probably is less than 30 ppm, but further analytical studies are necessary to confirm this finding.

(3) Carbon monoxide has been reduced to less than 0.7 percent of the total exhaust mixture, compared with an estimated 3.5 percent for cars not equipped with pollution controls.

(4) Oxides of nitrogen have been reduced to 400 to 600 ppm, compared with concentrations that range from 1,000 to 2,000 ppm for conventional cars.

The following table compares the pollutant concentration recorded in extended tests of the Bureau's demonstration car with those considered commercially feasible by 1970.

	Bureau of Mines vehicle	Considered commercially feasible by 1970 [1]	1970 California standards
Total hydrocarbons	70 p.p.m	275 or 180 p.p.m	180 p.p.m.
Carbon monoxide	0.7 percent	1.5 or 1 percent	1 percent.
Nitrogen oxides	400 to 600 p.p.m	350 or 600 to 800 p.p.m.	350 p.p.m.

[1] Source: "The Automobile and Air Pollution." Report of the Panel on Electrically Powered Vehicles, U.S. Department of Commerce, October 1967.

It is particularly noteworthy that with its low hydrocarbon and carbon monoxide emissions the Bureau's demonstration car has exceeded both what is considered commercially feasible by 1970 and the standards proposed for California in that year. Only with respect to nitrogen-oxide levels have we missed the lowest mark established, and even there our work has refuted the pessimistic view that nitrogen oxides can be reduced below a certain level only if we are willing to accept higher levels of other contaminants.