important piece of work to be doing because it is; it is just that we ought to have it generally recognized what the limitations are, both to know what it can accomplish and what it cannot.

Dr. MACFARLAND. Yes.

In my opening sentence I referred to two large air pollution studies in progress at Hazleton Laboratories and I would like now to give a description of the second program. You will be pleased to learn that this can be done rather briefly and without quite so much detail.

By way of background on the second study I will remind you that there have been a few air pollutant visitations sufficiently severe to be labeled "disasters." The London smog of 1952 is the most well known of these disasters and some 4,000 excess deaths were attributed to it. Monitoring stations were in operation during that "killer smog" and levels of sulfur dioxide and suspended particulate were measured. The maximum sulfur dioxide concentration, recorded briefly at one station, was 1.34 parts per million; the peak level of suspended particulate matter was 4.46 milligrams per cubic meter. To the air pollution control officer, the increase in the concentration of both these pollutants over background levels was the salient observation; but, to the toxicologist, the absolute value of the concentrations, vis-a-vis the mortality incidence, appeared anomalous. It is true that those who succumbed were, for the most part, not healthy adult men but, rather a group suffering from preexisting cardiopulmonary insufficiency, or else were very young or very old. But, even allowing for these facts, it is still difficult to see how such toxicologically low levels of sulfur dioxide and suspended particulate matter could elicit such a drastic response as death in 4,000 victims.

Some theories have been advanced which, if true, might explain the observations just cited. One of the more promising ones has to do with what is called a synergistic effect. This is an enhanced response to a mixture of pollutants greater than would be expected from the sum of the responses to each component when acting singly. You can probably anticipate what a review of the literature on synergistic effects among mixtures of common air pollutants is going to reveal. Very few studies have been performed. Those that have are of a short-term, acute nature, employing unrealistically high concentrations of pollutants, and they have been conducted exclusively in small rodents.

In 1966 we suggested to members of the American Petroleum Institute that a study of synergistic effects, in which the deficiencies noted above had been corrected, was worthy of support. In January 1967 the American Petroleum Institute authorized our proposal for a 3½-year program, costing $1.6 million. The details of the design and the battery of test procedures are quite similar to those in use in the power utilities program. Again, the main test species is the primate, although a limited amount of work in rats is also being performed. The main points of difference should be mentioned. The pollutants under examination are the gases sulfur dioxide, carbon monoxide, and nitrogen dioxide, and two particulates, lead chlorobromide and calcium sulfate. Lead chlorobromide is the main lead compound found in the exhaust of automobiles using leaded gasoline as fuel.

Calcium sulfate typifies the ubiquitous "particulate sulfate" found in urban atmospheres. The effects of these five materials acting singly are being determined in several trials, but the bulk of the work will