

1 of these the carboxyhemoglobin was 31.5 percent. It was concluded by the investigators that carbon monoxide concentrations in the general atmosphere of Detroit do not impair driving ability (10), *but further work is now underway to substantiate or amend these findings.*

Studies undertaken on animals have demonstrated that *guinea pigs exposed to automobile exhaust*, at a concentration several times normal, for 1, 2, and 4 weeks, were especially susceptible to *severe pulmonary disease* (9b). This came to light accidentally following an epidemic which produced pneumonia in the test animals. Significantly higher mortality occurred in the animals exposed to irradiated exhaust, comparable to heavy photochemical smog, than in animals exposed to nonirradiated exhaust or in control animals, which also experienced the epidemic but were exposed only to pure air. This finding parallels the results of another study in which *animals exposed for only 2 hours to pure nitrogen dioxide at levels similar to those occasionally found in community atmospheres were much more susceptible to infection by certain pneumonia organisms* (personal communication, Richard Ehrlich, Armour Research Institute, Chicago). More serious illnesses and more deaths occurred in this group than in the control animals, which were exposed to the same organisms but otherwise breathed only pure air.

Irradiated exhaust, that is, automobile exhaust which has been diluted with air and then exposed either to sunlight or to artificial light with ultraviolet components, is chemically different from exhaust which has not been irradiated. It has been shown that this irradiated gas is chemically similar to the so-called "photochemical smog" so notorious on our west coast. It also causes the same types of damage to vegetation as the "smog" found in California. Constituents include ozone, "oxidants" (oxygen-containing compounds of high reactivity), other hydrocarbons, and oxides of nitrogen.

These ingredients appear to result from complex interactions due to photochemical action on the unburned hydrocarbons and oxides of nitrogen found in exhaust gases. Merely mixing ozone with hydrocarbons, such as gasoline vapors, can simulate this process to some degree. Because these ingredients appear to be more biologically potent, causing damage to plants and eye irritation in people, our recent studies have been focused on them to a large extent.

Physiological experimentation in which measures were made of respiratory function of guinea pigs, including pulmonary resistance, respiratory rate, and minute volume, has shown that the greatest changes occurred in those animals exposed to irradiated exhaust. In general, these changes have occurred when the animals have been exposed to concentrations two or more times the usual ambient levels. However, some physiological changes have occurred in animals at "community" levels, and certain specific pollutants have been observed to produce effects at or near these concentrations. This would appear to indicate that the observed maximum levels present in communities at this time are borderline with respect to causing immediate effects such as changes in pulmonary function and may be highly significant in their long-term effects.

Last year workers at the University of Southern California were able to produce true squamous cancers in the lungs of mice, similar in type to those found in human beings, by exposing the animals first to infection, then to air containing ozonized gasoline. In this experiment, one group of animals was exposed to a virus type of influenza and another was unexposed. Each of these groups was divided after recovery into two further groups, one exposed to purified air and the other to ozonized gasoline. In the animals receiving the infection alone, approximately 8 percent showed squamous changes in the bronchi consistent with healing processes after infection and occasionally demonstrated metaplastic changes. In the animals exposed to ozonized gasoline alone, there were no significant findings. In the uninfected animals exposed to pure air, the findings were negative. A striking 30 percent of the animals which had been infected and subsequently exposed to ozonized gasoline demonstrated the presence of squamous carcinoma. Interestingly enough, the male-female ratio was approximately 3 to 1, similar, in fact, to that found in humans and obviously not associated with smoking habits or occupation (11, 12).

EPIDEMIOLOGIC RESEARCH

Considerable epidemiologic research has also been undertaken with the community used as a laboratory. While increasing effort has been devoted to the chronic effects of normal low levels of community pollutants, the Public Health Service has continued to support research into the extent of previously unreported air pollution disasters.