WHAT'S IT LIKE IN THE CITY?
(Relative to rural = 1 in each case)

City	Atmospheric element
10	Dust particles
5	Sulfur dioxide
10	Carbon dioxide
25	Carbon monoxide
0.8	Total sunshine
0.7	Ultraviolet (winter)
0.95	Ultraviolet (summer)
[illegible]	Cloudiness
[illegible]	Fog-winter
[illegible]	Fog-summer

Fig. 4. The few substances shown in this table as being overly abundant in city air do not nearly exhaust the list. Absent are hydrocarbons by the hundreds—some of them potent carcinogens in laboratory animals—and the highly toxic gas nitrogen dioxide. Since these two react with each other under the stimulus of solar ultraviolet radiation—to produce photochemical smog with its characteristic haze, eye irritation, and damage to sensitive plants—it is perhaps fortunate that pollutants help cut down on solar ultraviolet reaching street levels in the city. Of course some air bacteria that might be killed by such uv are not, but one must be grateful for small favors when living in the urbs.

atomic powered instead of fossil-fuel-powered generating stations, or, farther in the future perhaps, cars operated by batteries or fuel-cells instead of internal combustion engines, or electrified mass transportation. The art of pollution-control is not so much primitive in technical means as deficient in social ones. Whether anybody *has to do* anything about the pollutants that their products or processes emit—and how well they must do it—depends in part on progress made farther back along the "ideal" pollution control chain. Here the first step—setting air-quality criteria—is the most crucial. It is also the most complex.

Though all the needed data are not in, most people would agree, I think, with Vernon MacKenzie, head of PHS' Division of Air Pollution, when he says that "we must . . . get on with the job of developing air-quality criteria and standards against a background of technical and scientific knowledge which is not now and probably never will be perfect." Engineers can recognize the validity of this approach; as professionals they live with it.

There's a worm or two in the apple

Nevertheless, in view of large gaps in existing knowledge about the chemistry of normal and polluted atmospheres, there are understandable differences in outlook between industrial and public health people over which substances'—and which industrys'—emissions should be controlled. Many industrial people, including the most enlightened ones, remain somewhat loathe to pursue very much control-orientated research in the absence of definitive legal standards based on equally definitive criteria. Indeed, the automobile industry claims it wants such criteria precisely so it will know where it stands over the longer haul. It points to its experiences of recent years in California, the State that has led the country—perhaps the world as well—in pollution-control activities. California has more cars and a more poorly ventilated climate, in the Los Angeles area anyway, than any State in the Union. It also is richly endowed with sunshine. So it's not surprising that it leads the country in its concern about the auto component of its air pollution problem.

Auto exhausts emit two main contaminants: hydrocarbons and nitrogen oxides. The hydrocarbons come mostly from fuel that is not completely oxidized to carbon dioxide and water during engine operating cycles. The hydrocarbons are diverse in kind—compounds originally in the fuel as well as new compounds that are formed during the high-temperature combustion process. Nobody has identified all of the compounds, but there were about 200 of them at last count. Nitrogen oxides, particularly nitric oxide (NO) with lesser amounts of NO_2, result from the high-temperature dissociation of molecular nitrogen and oxygen from the intake air used to burn the fuel. The liberated atomic nitrogen and oxygen then combine to yield the oxides. These reactions are reversible at high temperatures, but they are prevented from reversing—the two oxides are literally "frozen in"—as combustion temperatures drop rapidly from peak values during expansion of the gases in both auto engine cylinders and power-station exhaust stacks.

Of these two groups of contaminants California has so far established emission standards only for the hydrocarbons, chiefly because it was originally thought that the nitrogen oxides in auto (and other) exhausts would be far more difficult, and maybe unwise to eliminate. It was also felt originally that reducing the concentration of either one of the starting reactants would help reduce the build-up of troublesome final photochemical reaction products in the air.

Over the years, as California re-inventoried the dimensions of its pollution problems in finer detail, changes were made in automobile and other emission limits. The average uncontrolled automobile exhaust emits about 700 ppm hydrocarbons. Current California standards, set by the State Department of Health and approved by the legislature, limit this to 275 ppm and include an additional restriction