most of the ill effects associated with high oxidant levels that characterize photochemical smog can be eliminated, without any need for controls on nitrogen oxides for the time being. Others, Haagen-Smit among them, want both ingredients controlled. Still others feel most uneasy about nitrogen oxides. They feel the consensus on the hydrocarbon control approach may be too naive, in that it equates the eye irritation symptoms exclusively with the end products of irradiation. These products reach peak concentrations in experimental chambers after some 4½ hours of irradiation. But Walter Hamming and colleagues of the Los Angeles County Air Pollution Control District have shown that there is an earlier peak of eye irritation observed in many irradiation chamber studies. It is equal in severity to the later one but it occurs only about 1½ hours after irradiation has begun, and not only in simulation studies but in downtown Los Angeles after sunrise as well. This is long before oxidants such as ozone or PAN have reached any appreciable concentration. Indeed, this early irritation peak seems to coincide most closely with maximum NO_2. Thus, Hamming and his coworkers feel that controlling nitrogen oxide emissions equals or exceeds hydrocarbon control in importance in alleviating Los Angeles' most obvious problem.

There's another interesting angle to all this. Hamming points out that the severity of eye irritation produced seems to relate to the intensity of sunlight involved. It turns out that for conditions in Los Angeles region partial control of hydrocarbons alone could possibly lead to more severe and extended periods of eye irritation. Since the early peaking NO_2 wouldn't have enough hydrocarbons available to be used up in zipping on down the photochemical reaction pike it might hang around longer and reach higher daily averages. In any case, Hamming feels that reducing nitric oxide emissions in any degree can only reduce the severity of eye irritations whereas hydrocarbons would have to be limited much more drastically than is currently envisioned to achieve equally effective relief.

This tempest over tearing eyes in Los Angeles may have deadlier ramifications.

The need for controlling NO and NO_2

Obviously, differences in opinion over needed control measures depend on the symptoms that concern one. The control waters have all too often been muddied by imprecise definitions here. Precise definitions are needed, and soon, before going too far with control attempts limited to single, more easily controlled components of complex reaction mixtures. NO_2 itself for instance is acutely toxic at about 100 ppm. The limiting concentration that industrial hygienists allow for it and other oxides of nitrogen in workroom air is 5

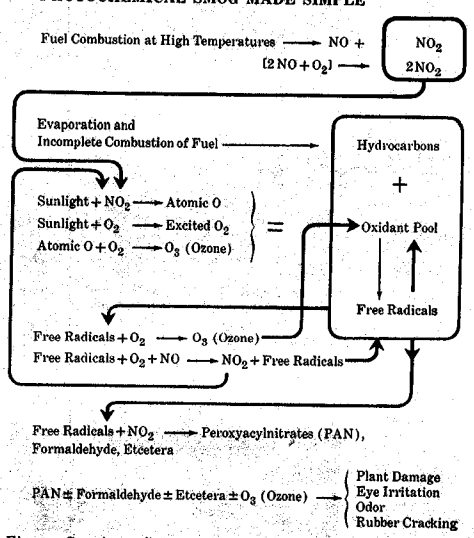

Fig. 8. Starting substances for smog are nitrogen oxides and hydrocarbons. The critical first step leading to group of oxidizing substances is photodissociation of NO_2; this yields atomic O that joins molecular oxygen to produce ozone. Oxidants attack hydrocarbons and produce reactive free radicals of several kinds which are also capable of attacking hydrocarbons and participating in other reactions as indicated. As discussed in story, eye irritation may relate more to NO_2 content than to final reaction products shown.

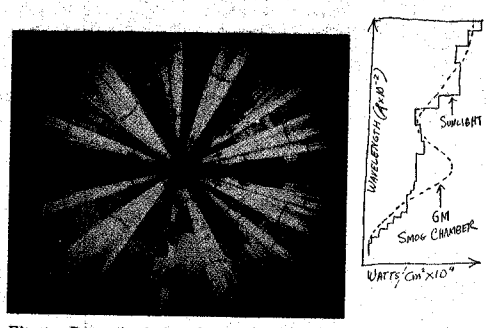

Fig. 9. Smog simulation chamber used by General Motors uses banks of fluorescent lamps enclosed within chamber to simulate sunlight. Spectral matching curves are sketched in the margin. Irradiation is carried out on dilute mixtures of hydrocarbons and nitrogen oxides.