

changes. I wonder if you could touch upon the evidence that is there. How can this be understood so that man could with good judgment do what is necessary to overcome the problem?

Dr. COLE. Well, the only reason there is oxygen in the atmosphere is that green plants are continuously putting it there by photosynthesis. These are plants not only on land but also in the oceans where about 70 percent of the oxygen is generated. Photosynthesis stops at night in the dark and on land and high latitudes it practically stops during the winter, so we are dependent for oxygen being produced in other places being brought in.

Now, every year we are burning fossil fuels faster than we did the year before, and all of this is using up oxygen, so we are increasing the rate of use and at the same time we are cutting off plants on land and the Food and Drug Administration estimates that we are putting half a million different types of chemicals into the oceans without any study being made of whether these might be poisonous to the marine plants or not.

If we should by some miscalculation poison all of the marine diatoms, this would cut off 70 percent of our oxygen supply and the oxygen content of the atmosphere would start to decrease unless we agreed to a moratorium on burning fossil fuels.

I have attempted some very rough calculations for this country. The data aren't very good, but I took the 1966 rate of use of fossil fuels in the United States, the coal, petroleum and natural gas, and assumed that it was all completely oxidized, and I compared this with what could be produced in the way of oxygen by the plants in the 48 coterminous States, and to the extent you can trust these rough figures, we are using oxygen 1.6 times as fast as our plants can produce it, so we are absolutely dependent on its being brought in from the Pacific Ocean and Mexico and similar places.

As I say, I am not very happy with these data, but I think we are in the right ballpark with that estimate. We can't go on paving a million acres of land each year and putting it out of productivity without risking eventually some at least local crisis with the oxygen in the atmosphere during winter nights, say, but these widescale atmospheric movements are not even well enough known to let us put down really precise figures on this risk.

Dr. SARGENT. Mr. Daddario, I would like to add another dimension to Dr. Cole's statement. I draw from my article "Adaptive Strategy for Air Pollution," a reprint of which you have. Weather modification from the burning of fossil fuels and the discharge of other wastes into the atmosphere is now well recognized by meteorologists. Information published last year in *Science* by Ludwig and McCormick from the Taft Sanitary Center in Cincinnati indicated that the turbidity of an atmosphere has increased about 77 percent at Davos, Switzerland, where there is a meteorological station of 100 years' duration, located at 1,604 meters above sea level, far away from big cities. An increased turbidity of the atmosphere means that radiant energy coming to us from the sun is being reduced and the photosynthetic process which Dr. Cole talked about depends on the receipt of this solar energy.

With still greater increases in the turbidity of the atmosphere, a point may be reached at which the input of solar energy becomes inadequate to drive the photosynthetic process.