

ATMOSPHERIC POLLUTION IN LOS ANGELES

by M. Neiburger

In the investigation into the cause of air pollution in Los Angeles, it is emphasized that the conditions which are called "smog" there are quite different from those of London and other large metropolitan areas in higher latitudes where smoke from the burning of coal combines with condensation of water vapour at high humidities to produce the traditional type of smog. In addition to the reduction of visibility which is the principle manifestation of the usual type of smog, air pollution in Los Angeles is characterized by severe irritation to the eyes and mucous membranes and damage to vegetation.

That the difficulty in Los Angeles was not due to the burning of coal was obvious, for coal had not been used there for half a century; the principle sources of heat and energy were petroleum and natural gas. Not just in Los Angeles, but throughout the United States petroleum and natural gas have been increasingly important as an energy source. In the future it may be expected that in all areas of population concentration the Los Angeles type of smog will replace the London type.

Initially it was thought that sulphur dioxide was the substance responsible for the eye irritation through its being oxidized and combined with water vapour to produce sulphuric acid. Sulphur dioxide is given off in the refining of petroleum as well as in the burning of fuel oil. Industries were required to control the production of sulphur dioxide, and as a result the amount in the atmosphere was reduced by half. Nevertheless eye irritation and damage to vegetation continued to be reported and for a time the source remained a mystery.

It was Professor A. J. Haagen-Smid of the California Institute of Technology who recognized that the characteristic odor of Los Angeles smog was similar to that which occurs in the laboratory when certain hydro-carbons are oxidized by ozones. Professor Haagen-Smid was able to show that the oxidation of hydro-carbons in laboratory flasks could produce all of the smog manifestations: eye irritation, plant damage, and reduction to visibility. Since ozone normally is not present to any extent near the earth's surface there was still a missing link in the explanation of the occurrence of Los Angeles smog. This explanation was provided when Dr. Haagen-Smid showed that the irradiation of hydro-carbons in the presence of nitrogen dioxide gives rise to ozone and to all of the smog manifestations. Since nitrogen dioxide results whenever there is combustion at high temperatures this completed the explanation.

At first it was thought that oil refineries were the main contributor to hydro-carbons in the atmosphere, and they were required to control all losses during the refining and storage of petrol. Subsequently it was found that automobile engines give off unburned or partially burned hydro-carbons totalling at least as much as had been coming from the refineries. So far the losses from automobiles have not been controlled.

An investigation was made into meteorological conditions associated with air pollution in Los Angeles. An inversion is present just a short distance above the surface continuously throughout the warm season and frequently also in the winter months. This inversion is not a local one, but is part of the general trade wind inversion which extends westward from the coast, where it is found at about 400 metres on the average with a temperature increase through it of 10-12°C, to the Hawaiian Islands, where it is at about 2000 metres with temperature of 2°. This inversion limits the upward diffusion of pollution to the layer below its base, about 400 metres on the average but frequently much less. The horizontal transport of the pollution is also limited, due to the fact that the wind is light, and consists of a moderate sea breeze during the day, followed by a light land breeze at night. Air trajectories show that the air moves back and forth with the land and sea breeze more than once before it is finally carried away. Thus it has a long stay over sources of pollution before finally leaving the Los Angeles Basin.

A computation of the injection of pollution into the air as it moved along a typical trajectory across the pattern of motor traffic density showed that the amount which would be accumulated in the air in this fashion is consistent with the amount found by measurement. The accuracy of the trajectories, which were computed from wind stations at about 50 locations over the basin, was tested by use of fluorescent material as a tracer. Statistical studies of the computed trajectories

reaching various air sampling stations showed that there were many cases when refineries could not be the source of the hydrocarbons and the smog manifestations, but that automobile traffic could be responsible.

The state of California has passed a law which requires that all automobiles will have to be equipped with devices which will prevent the emission of hydrocarbons into the atmosphere. These devices doubtless will have an effect in reducing the amount of hydrocarbons ejected into the atmosphere. However, unless there is some testing procedure to ensure that the device on all vehicles is in good operating condition the effect will be counteracted by the constant increase in the total number of motor vehicles. For this reason Professor Neiburger was not optimistic about the elimination of the smog problem in Los Angeles in the near future.

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SNOWDRIFT IN ANTARCTICA

by U. Radok

Dr. Radok of Meteorology Department, University of Melbourne, first described an extensive series of drift measurements made at Wilkes in 1959 by R. Dingle and interpreted its results in terms of steady-state diffusion.

Good agreement was shown between the observations and the theory according to which the drift density must decrease with height according to a power law, with exponent depending on the particle fall velocity and the vertical wind shear. A further deduction made and confirmed was that the drift density at any level should be an exponential function of the negative reciprocal wind velocity at that level. This claim was queried in the discussion following the talk, and later exchanges led to the agreed conclusion that such a relation holds strictly only if the surface drift density is independent of wind velocity (as seems to be the case for the Wilkes data).

The speaker next applied the results of the Wilkes' work to drift observations reported from other parts of Antarctica and showed that agreement was as good as could be hoped for, in view of the different methods used by different expeditions. The same data showed that a small but distinct change in particle fall velocity with height represents a steady trend, rather than a discontinuity at a height between 25 and 50 cm above the surface, as had been suggested by the Wilkes data.

In conclusion mention was made of an extensive new drift program to be carried out at Byrd Station next year, when it is hoped also to compare the main types of traps which have been used to measure snow drift in Antarctica.

30 November 1961

RESEARCH IN OZONE AND OTHER PHENOMENA

by A. B. Pittock

Mr. Pittock of Physics Department, University of Melbourne, gave some brief comments on the proceedings of the International Symposium on Atmospheric Ozone and General Circulation which he attended in Switzerland in August, and also of the Radiation Symposium held in Vienna the following week. The status of the various ozonesonde developments was discussed. The Paetzold and Vassy optical sondes were regarded as reliable although not ideal for routine synoptic determinations of the vertical distribution of ozone. The Brewer electro-chemical sonde, which is being adopted by the British Meteorological Office for synoptic work, was favourably reported, while Regener's chemi-luminescent sonde was described as promising but not yet satisfactory. Considerable discussion over multiple scattering corrections in the umkehr method and the possible effect and