SCIENTIFIC BOOKS

Ninth Report of the Committee for the Investigation of Atmospheric Pollution. Report on Observations in the year ended March 31, 1923.

ABSTRACTS of the reports of previous years are to be found in SCIENCE, June 2, 1922, April 22, 1921, and November 28, 1919. The present report, both comprehensive and satisfactory, makes it plain that the Advisory Committee on Atmospheric Pollution, appointed in 1912, as a result of agitation by the Coal Smoke Abatement Society, is an effective body accomplishing much good work. Primary purposes have been achieved and scientific measurements of atmospheric impurity obtained. There remain for future investigation the problems of distribution in a vertical direction, the relation of dust to visibility, impurity and health, and acidity of the air.

The present report of 59 quarto pages gives details of the work. Four of its six sections deal with records from instruments developed under the committee's auspices. Two sections deal with certain experimental inquiries. Three methods of examination are in common use:

(1) A standard gauge measuring the total impurities in a month over a measured area. The total is analyzed into insoluble and soluble, tar and other carbonaceous matter and ordinary wind-borne inorganic dust.

(2) An automatic filter which isolates samples of impurities near the edge of a circular disc of filter paper at intervals of two hours or more.

(3) The jet dust counter (Owens). Here a limited volume (50 cubic centimeters) of air is pushed rapidly through a slit and the dust deposited on a cover glass of small cross section, to be examined microscopically.

All these instruments are now manufactured commercially, and whoever wishes to study air purity can purchase and determine for himself.

The amount of impurity as determined by the jet dust counter ranges from 80,000 particles per cubic centimeter during a thick fog to a few hundreds, or even a hundred during clear air. It takes about 10,000 particles per cubic centimeter to make a milligram of dirt per cubic meter.

One of the problems on which some progress has been made is the relation between transparency or visibility, as it is commonly called, and the amount and nature of the impurity. Two methods of measuring transparency, both novel, have been tried. In the first, a uniformly illuminated surface has its optical brightness at different distances measured with an ordinary photometer. In the second, a specially designed photometer is placed in the beam of a searchlight and a comparison made of the illumination of the mirror with that of a black stop placed in front. This is known as the contrast photometer, designed by Mr. L. F. Richardson. By it, changes in the transparency of the atmosphere which are constantly occurring can be readily detected and measured; and as simultaneous observations by filter and by dust counter can be made, one can get a good idea of the efficiency of the dust and other particles in diminishing transparency. We do not, however, know the relation between water droplets which form the bulk of the obstruction of clouds and the hygroscopic dust particles which are so necessary in the formation of clouds.

Regarding the results obtained with the automatic filter, the observations of the past year confirm the concentration of suspended impurities between 10 A. M. and 6 P. M. and comparative purity between midnight and 6 A. M. Of course there are some contradictory results.

The International Union for Geodesy and Geophysics, meeting at Rome in 1922, purchased sixteen jet dust counters; and these were sent to Meteorological Bureaus at Rome, Paris, Stockholm, Japan, Lisbon, Bucharest, Poland, Athens, London, Toronto, Rio de Janeiro, Madrid, Washington, Belgium, Melbourne and Pavia. The London records show that during a smoke fog, 20,000 to 50,000 particles per cubic centimeter were present. There appears to be a tendency for particles to attain a maximum size during heavy smoke fogs, while during the lighter hazes the particles are usually much smaller. Probably the densest fog of the winter in London was on January 17, 1923. The number of particles per cubic centimeter at 11:15 was about 53,000, the diameter varying from 1.5 microns down. There were numerous crystals visible in the record. Incidentally we note that records obtained from tobacco smoke show nothing but transparent yellow oily deposit, free from solid particles.

One other interesting statement is that during a heavy smoke fog in London, one would breathe in 24 hours of such fog 500,000,000,000 particles of suspended matter. Their size is such that if placed in contact these would form a string of about 250 miles in length. "This way of looking at the degree of pollution," says the committee, "gives some idea of the work which must be done by the cilia and cells of the respiratory organs to remove the impurities breathed in."

Space does not permit reproduction of the various illustrations; also the somewhat extended discussion of the origin of the spherical particles (probably of volcanic origin) and of the hygroscopic nuclei.

Mention should be made of the use of the jet counter by Kimball and Hand (*Monthly Weather Review*, March, 1924) in determining the number of dust particles at various levels, in airplanes piloted by Air Service officers from Bolling Field.

The writer of this note has also used an Owens jet dust counter in connection with artificial lightning, through the courtesy of Dr. Peek of the General Electric Company in the high tension laboratory at Pittsfield. Discharges three meters long, with voltage of over one million and amperage of 100,000, were employed. The slides do not, however, show the marked clarification of the air which was expected; but the experiments are not made in free air. Observations before and after real lightning flashes are under way at Blue Hill Observatory.

ALEXANDER MCADIE

SPECIAL ARTICLES

SENSITIVE FLAMES AND APPARENT FLAME PRESSURE[1]

ADJUSTMENT

THE disposition of apparatus is shown in figure 1, where UU' is the interferometer U-gauge, r and s the reentrant and salient pin holes, t the quill tube and F the fine conical gas jet about 1 mm in diameter (salient outward) for the sensitive flame. F is preferably placed vertically. The gas inlet G is at the middle of t so that r, s and F may function as nodes. G is provided with a stop cock to vary the gas pressure. Since this pressure acts at both U and U', it is only the acoustic pressure due to vibration within the quill tube which will influence the gauge, U, U'.

The pin holes r s are rarely quite of the same diameter. Hence the fringes will move for any sudden change of pressure at G, temporarily; but they soon return to zero. The flame F was very sensitive; but no acoustic pressure under any conditions could be observed. There was no effect even when the flame was purposely made turbulent by high gas pressure. This was also the case in a variety of other devices. Thus the sensitive flame phenomenon must be considered to exist outside of the quill tube t F and there is no corresponding vibration within.

TELEPHONIC EXCITATION

On removing t from r s and the gauge and joining it to a telephone excited by a little induction coil with a break of variable pitch, one gets a beautiful exhibition of König's flames at F. In this case a small sharp flame, 2 or 3 cm or less, is of course desirable. However, the attempt to detect the resonances in the quill tube in this way failed.

FLAME PRESSURE

Joining the quill tube t with the shank U only (s,

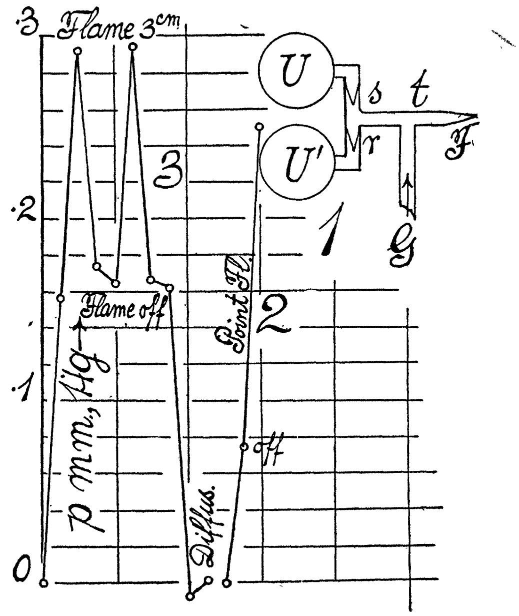

figure 1, may be left in place as it does not function, r, also inactive, may be open to the atmosphere), one observes an increased pressure within t (caet. par.), whenever the flame F is ignited. These pressures are in excess of the normal registry of the gauge so that small flames (from a point like a split pea to 2 or 3 cm) only, are to be used. Figures 2 and 3 give examples of the results. The curve, Fig. 2 (points spaced horizontally to show different conditions), beginning with no pressure (mm of mercury) when the cock is closed, registers about .075 mm with the gas cock just open, owing to the resistance at the jet, and .25 mm after the flame is lit. The point flame, therefore, acts like a stopper, virtually narrowing the jet. Figure 3 gives a more extended series, with a flame 2–3 cm long. Hence the gas pressure at t in the absence of flame is larger, about .16 mm. With the flame lit, the pressure reaches nearly .3 mm. It is not, however, as much larger as in the case of the point flame. When the flame is blown out the intermediate gas pressure is restored, first at a rapid rate, finally very gradually, the progress obviously corresponding to a case of cooling of the mouth of the jet. The phenomenon is remarkably steady and the experiment may be repeated indefinitely, two cases being given in figure 3. When the gas is finally shut off, the fringes dip below zero, which however is regained in the lapse of time. This is optic evidence of the diffusion of hydrocarbon gas into the U-gauge and of the subsequent diffusion outward.

REMARKS

I was at first inclined to believe that an actual pressure increment within the flame locus had been ob-

[1] Advance note from a Report to the Carnegie Institution of Washington, D. C.