The papers on illumination engineering practice were the first of their kind which had been given before the Commission. In these, the authors, Messrs. Lieb, Merrill, and Powell (U.S.A.), gave an account of some of the features of the organised campaign which is being carried on in America to promote the widespread practical application of the principles of good lighting. Dr. Lieb urged that the work of the Commission should not be restricted merely to the theoretical aspects of illumination, but should be extended to include the practical aspects of illumination engineering so that it would be of benefit both to manufacturers and the general public. Mr. Merrill described the method of conducting good lighting demonstrations, while Mr. Powell described various types of propaganda work, and surveyed a large field of investigatory work in practical illumination engineering.

The fifth technical meeting dealt with factory and school lighting and with automobile headlights. Mr. L. B. Marks (U.S.A.) presented the report of the international sub-committee on lighting in factories and schools as a basis of international agreement. Recommendations of the minimum illumination in various circumstances, of the maximum brightness of light sources, of exit and emergency lighting, and of the colour and finish of school interiors, were made. There was general agreement that at present standard minimum values of illumination for working conditions should not have any legal force, and that whatever regulations are made should be based solely on considerations of the health and safety of employees. Mr. Gaster (Great Britain) presented a paper on some further developments in industrial lighting in England, and M. Bordoni (Italy) on some phenomena of glare. Dr. Sharp (U.S.A.), chairman of the international sub-committee on automobile headlights, presented a report in which the proposals made by each of the various countries were reviewed, while papers dealing with the photometry of automobile headlights were presented by Messrs. Bossu and Cellerier (France).

After the technical meetings were over a plenary meeting of the Commission re-elected Dr. E. P. Hyde to the office of president for the next three years. Mr. C. C. Paterson was also re-elected to the office of honorary secretary and treasurer, and Messrs. Edgcumbe (Great Britain), Rouland (France), and Semenza (Italy) as vice-presidents, while Mr. Walsh of the National Physical Laboratory, to whose ability and efforts the technical success of the meeting was so largely due, will continue his work as general secretary for the next three years. It was provisionally decided that the next meeting should take place in the United States of America in 1927.

The meetings were held in the Palais Eynard, which was kindly placed at the disposal of the Commission by the City of Geneva. The delegates were entertained at a motor excursion and a dinner at Bellerive on the evening of Tuesday, July 22, by the president and members of the Geneva City Council; and at a dinner at the Hotel des Bergues by the Swiss National Committee on Wednesday, July 23. On July 24 the Swiss National Committee were the guests of the foreign delegates at a dinner held at the Parc des Eaux Vives.

The Swiss National Committee, particularly the president, M. Filliol, and the secretary, M. Largiardèr, were responsible for the excellent arrangements made for the meeting, while M. Thomas, the director of the International Labour Office, very kindly placed a secretarial staff and interpreters at the disposal of the Commission. H. B.

The Automatic Measurement of Atmospheric Pollution.[1]

By Dr. J. S. OWENS.

THE suspended impurity in the air can be measured by two methods, the automatic recorder or filter, and the jet dust counter method. The former was designed primarily for measurement of smoke pollution, and depends upon filtration of the air through white filter paper, the resulting discoloured spot being compared with a calibrated scale of shades. In the dust counter method the results are independent of the colour of the particles, a count of their number as well as an examination of their size, shape, and nature being made microscopically. Curves showing the numerical value of the suspended impurity for different cities and its variation from hour to hour can be plotted from the average figures for a large number of days. The cities selected for this purpose were London, Rochdale, Blackburn, Glasgow, and Stoke-on-Trent.

The London curves of impurity for Westminster, Savoy Hill, and Kew Observatory indicate that the impurity is lowest between midnight and 6 A.M., after which it rises rapidly to a maximum between 9 and 10 A.M., falling again steadily until about 4 in the afternoon, when there is a tendency to rise slightly to a second but lower maximum. At about 10 P.M. the impurity falls away until about midnight. The Sunday curves are similar, but the maximum in the forenoon is not reached until about an hour later. The rise of impurity between 6 and 7 A.M. is attributed to the lighting of fires, the smoke from which is emitted in greatest quantity soon after lighting.

In plotting the curves referred to, it was found advisable to divide the days into two groups:

(*a*) Days in which there was much smoke haze at some time, as indicated by the automatic recorder showing a shade number equal to or above 4—equivalent to 1·28 mg. per cubic metre. These were referred to as "Z" days.

(*b*) Days of little smoke haze when the maximum did not reach Shade 4.

As the existence of thick smoke haze over a city on certain days is due rather to failure of the natural processes by which normal smoke is removed as produced, than to abnormal smoke production on those days, this division is an attempt to separate ordinary days from those in which the ventilation fails, usually during anti-cyclones with light or indefinite winds and inversion of the lapse rate.

The distribution of impurity for Rochdale and Glasgow is very similar to that in London. The records from Blackburn exhibit certain peculiarities. These were prepared from an average of 269 days for the year 1923–24, 136 being winter—72 of which ranked as "Z" days, that is, days of much smoke haze.

The hourly distribution in Blackburn has certain important peculiarities; for example, a rapid rise of impurity commences in the morning in the summer about 4 A.M., and reaches its maximum on week-days and Saturdays at 7 A.M., while on Sundays the maximum is not reached until 10 A.M. Again, in the week-day and Saturday curves there is a second maximum between 10 and 12 in the forenoon, higher than the first, and separated from it by a 4-hour interval.

It is inferred from this that there are two main sources of smoke, making their maxima at different

[1] Substance of a paper read before Section A (Mathematics and Physics) at the Toronto meeting of the British Association.

times. The Sunday curves show no evidence of a double maximum in the forenoon. It is therefore inferred that the first maximum is due to industrial and the second to domestic smoke. In support of this is the fact that in winter the second maximum is higher than the first for week-days, while in summer the first is higher than the second. The relation

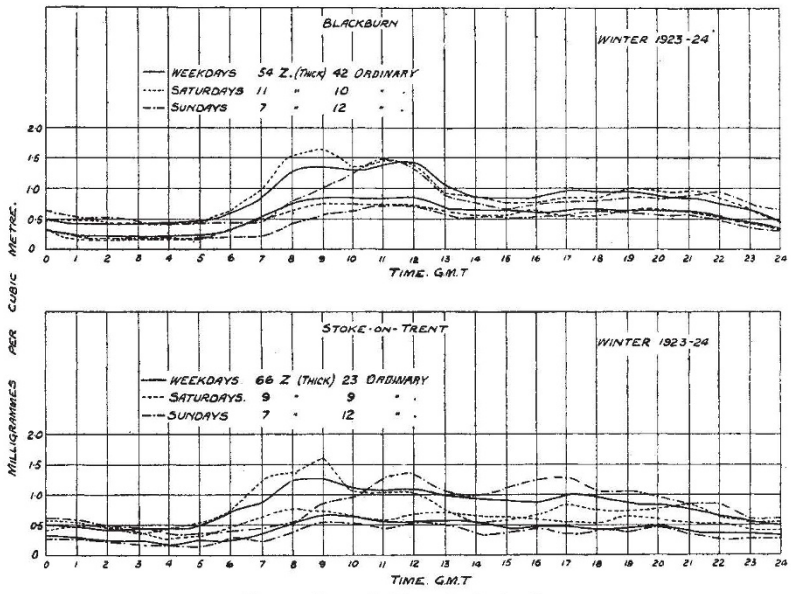

FIG. 1.—Suspended impurity in the air.

between the total smoke emitted on Sundays and on week-days is as 2000 to 3077, based on the curves for ordinary winter days—not ranking as "Z" days. If the Sunday smoke be assumed to be domestic, and the week-day smoke domestic plus factory, the ratio of factory to domestic smoke becomes 1 : 1·85.

Stoke-on-Trent exhibits even more peculiarities than Blackburn. Stoke is a pottery city containing about 2500 ovens. Records are available for a total of 222 days, including 126 winter days —82 of which ranked as "Z." Thus of the winter days recorded 65 per cent. had thick smoke haze, that is, on two out of every three days.

Fig. 1 shows that a definite rise began about 4 A.M. on week-days and 5 A.M. on Sundays. On summer week-days and Saturdays the maximum is reached between 7 and 8 A.M., while in the winter on week-days and Saturdays the maximum is between 8 and 9 A.M., and on Sundays about mid-day. In both summer and winter the impurity is maintained at a high level during the whole afternoon, but with remarkable oscillations, not shown in the records of the other cities mentioned. The minimum impurity is found at about 3 A.M.

The amount of suspended impurity in Stoke on ordinary winter Sundays is not much less than on week-days, the ratio being as 2022 to 2398. Here there are evidently conditions which make it impossible to apply the method already used for ascertaining the relation of factory to domestic smoke. In all the Stoke records for summer and winter, the Saturday maximum in the forenoon is the highest. This can be traced to the custom of lighting pottery ovens on Friday night or Saturday morning.

The incidence of atmospheric impurities on different days of the week has also been examined for six different cities, from which it appears that there is a general tendency to a minimum of smoke haze towards the end of the week, and a maximum about the beginning.

Since the records of the automatic instrument upon which the above conclusions were based depend upon the discoloration of a filter paper by the trapped impurity, experiments were made in which the results obtained with the dust counter method referred to were compared with those by the automatic recorder. In the latter, which was intended for recording city smoke, the impurity is assumed to be black, whereas the dust counter is independent of colour.

In the latter, fully described elsewhere,[2] the action depends upon the projection of a narrow ribbon-shaped jet of air against a microscope cover glass at such a velocity that a marked fall of pressure occurs with adiabatic expansion and cooling of the jet and consequent condensation of water, supplied from a damping chamber, upon the dust particles and the cover glass where the jet impinges. This results in the dust particles being projected against the cover glass by virtue of their greater density, and their increase of mass due to the condensed water. They adhere to the glass as the water evaporates, leaving a linear trace of dust, which can be examined microscopically and counted.

Simultaneous observations were taken with both instruments, and the results plotted in Fig. 2. From this curve it is evident that there is a reasonably constant relation between the number of

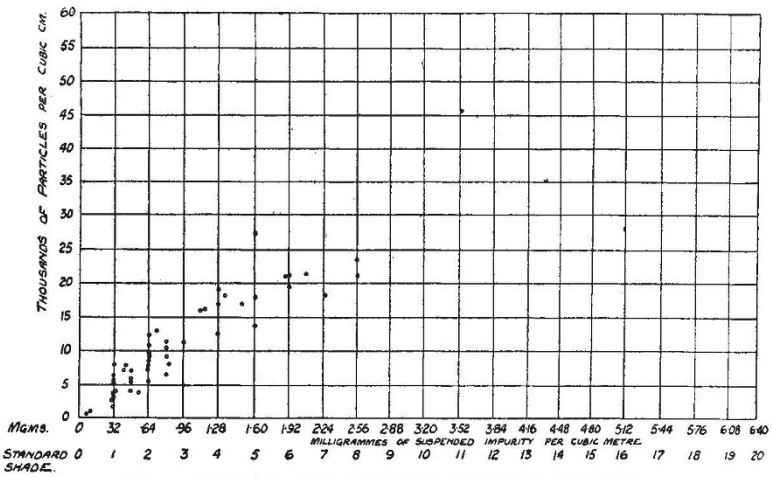

FIG. 2.—Comparison of automatic filter and jet dust counter records.

particles per cubic centimetre, and the weight of impurity in milligrammes per cubic metre as given by the automatic recorder.

This indicates a tendency towards uniformity in size of the particles at different times, but there is also a definite departure from such uniformity during thick smoke haze when the average size increases, doubtless due to insufficient time for separation by

[2] Proc. Roy. Soc. A, vol. 101, 1922.

settlement. The maximum diameter of smoke particles in the absence of thick smoke haze is about 1½ microns, while during thick smoke haze the maximum reaches about 3 microns. Fig. 2 shows that the relation in London between number and weight of particles is usually such that 10,000 particles per c.c. corresponds to 1 mg. per cubic metre. It is not suggested that this relation holds good for all types of dust, but it shows that the automatic recorder gives trustworthy comparative results for city air, where the colour of the suspended particles is usually black.

Horticultural Research.

THE growing recognition of the importance of research work in connexion with the fruit industry is emphasised by the Annual Report issued by the National Fruit and Cider Institute at Long Ashton, Bristol. The year 1923 was the first since the outbreak of the War in which the work could be conducted under relatively settled and stable conditions, and it was marked by steady progress as regards both advisory and research work. The direct and practical bearing of the research work upon the current problems of fruit growers is very noticeable, and though many of the results are still preliminary or tentative, they open up suggestive lines for future progress.

The manurial experiments on fruit trees in pot cultures have been continued to study the effect upon growth of the omission of the various essential elements in turn. Leaf scorch affected many of the plants, but an increase in the amount of potash entirely prevented the development of scorch, while a reduction of nitrogen retarded it and reduced its amount. An examination of the root systems of various fruit trees shows that under many systems of planting there must be considerable overlapping of roots, introducing a serious element of competition which probably acts as a severe check to growth in many cases. This research is being continued in connexion with the danger of planting up orchards of large trees with soft fruit, if the latter is left too long on the ground. In connexion with the damage wrought by the apple blossom weevil it is pointed out that isolated efforts of control are unlikely to be efficacious, but that co-operative action is essential for success. Direct control methods must be associated with hygienic conditions in the fruit plantation, and a scheme of procedure is outlined, embracing a sequence of scraping, spraying, and banding the trunks, followed by the collection of capped blossoms in May. Other pathological investigations deal with egg-killing washes, the effect of sulphur on black currant mite, "red plant" in strawberries and its correlation with "cauliflower disease," purple leaf blotch of strawberry, and the infrequent disease of pear leaf blister.

A most interesting investigation is that of cold process fruit preserves. Under ordinary methods of preparation, jams, jellies, and fruit juices are subject to prolonged high temperature, to the detriment of their flavour, colour, and aroma. With the "cold" method the consistency of the product must be such that micro-organisms do not develop, a condition that can be secured by increasing the sugar content to 62-65 per cent., or less if the acidity of the fruit is high. Jellies and fruit juices give very satisfactory results, but more difficulty is experienced with the jams. Large-scale trials are being made to determine whether these methods are suitable for development under commercial conditions.

Another aspect of the work is shown by experiments on the "buffing" of willows, a process whereby, after prolonged boiling in water, a mineral-brown colour is imparted to the wood of willow rods. Freshly cut willow rods can only be peeled for a short time in the spring, owing to the rapid production of new wood which interferes with satisfactory peeling. "Buffed" rods can be peeled throughout the year, and the introduction of the process has been of great importance to the growers and to the basket industry. Improved methods are being sought and possibilities of industrial application worked out.

The chief lines of work at the Fruit and Cider Institute have been touched on above, but various other researches are being carried out, some of which may lead to more extended inquiries in the future, and others are of importance in their relation to the main investigations.

Problems of Human Nutrition.

THE investigation of human nutrition dealt with in the report before us [1] was undertaken in the autumn of 1922 during a period of depression for those engaged in the coal mining industry. Details regarding the actual food consumption were obtained from 140 families distributed in five different counties. The general result of the inquiry shows that though the average consumption of food in Derbyshire was sufficient for a healthy life when judged by accepted standards, the average diets in Northumberland, Lancashire, Stirlingshire, and in particular Durham, were not so satisfactory. In the latter county the weight of the miners' children was slightly below the county average, though it seems probable that factors other than a deficient diet may have been partly responsible for this. The Committee is cautious in drawing conclusions, since the number of families investigated was not large, and it was recognised that the method adopted of reducing each family to the equivalent of "average men" for the purpose of assessing the nutritional value of the family diet is not free from objection.

The Committee has assumed that the average daily food requirement of a miner is equivalent to some 3400 calories. This figure has, however, not been ascertained by direct observation, but is inferred from a consideration of the numerous data already available on the energy output of man under different conditions of rest and work. Prof. K. N. Moss, in an investigation of the effects of high underground temperatures on the miner, has recently given details of the actual food consumption of a selected number of miners in different districts who had a high reputation for steadiness and industry. These figures show an average daily energy intake of well over 4000 calories, a value much in excess of that assumed by the Committee. Moss's selected subjects were clearly well above the general average, but if we regard the Committee's estimate as approximately true for this general average, it is apparent that there may be very great differences of energy expenditure between different individuals employed in the same industry. It is not alone the actual work done in the mine that matters, for much energy may be expended by the miner in walking to and from his work and in recreation in his spare time: as regards the last two items there is the possibility of great individual and local variations.

It is evident that further investigation is required regarding the actual energy output under everyday conditions not only of miners, but also of workmen in

[1] Medical Research Council. Reports of the Committee upon Quantitative Problems in Human Nutrition: Report on the Nutrition of Miners and their Families. Pp. 59. (London: H.M. Stationery Office, 1924.) 1s. 3d. net.