The International Illumination Congress.

THE International Illumination Congress, which took place on Sept. 1–19, was the first conference of this kind to be held in Great Britain. Something like twenty different countries were represented and the number of names on the official membership list exceeded 500. It may be recalled that the Congress consisted of two distinct sections: the initial period during which members visited in succession London, Glasgow, Edinburgh, Buxton, Sheffield, and Birmingham; and the subsequent stage, on Sept. 13–19, which took place at Cambridge and was devoted to the proceedings of the International Commission on Illumination. During the first period more than a hundred different papers on varied subjects were presented and discussed; at Cambridge, reports from the various national committees surveying progress in different fields or making suggestions for international action were presented, and in some cases effect was given to these suggestions by suitable resolutions.

The programme in London (Sept. 1–3) was mainly social. Such institutions as the National Physical Laboratory, the E.L.M.A. Lighting Service Bureau, the G.E.C. Research Laboratories at Wembley, and the training centre for gas engineers at Watson House were visited. At a luncheon given by the Gas Light and Coke Co. and the leading London electric supply undertakings on Sept. 2, the toast of the Congress was proposed by the Rt. Hon. George Lansbury, M.P., who, on behalf of H.M. Office of Works, had taken a keen interest in the floodlighting arrangements. On the evening of the following day there was also a dinner at the Dorchester Hotel, at which the president (Mr. C. C. Paterson) presided. There were also motor trips round the streets of London by night and a visit to the Croydon aerodrome, where night-flying by artificial light could be witnessed. But the most interesting event of the London programme was undoubtedly the steamboat trip from Westminster to the Port of London, the return journey of which was designed to enable visitors to inspect the floodlighting.

Much has been written regarding the floodlighting, which aroused extraordinary popular interest. It is stated that the crowds on the evening of Sept. 2, the opening day, were the greatest in London since Armistice night. It is impossible to describe this lighting in detail, but there were several features of exceptional interest. The most brilliant illumination (estimated at 20 foot-candles) was attained on Buckingham Palace, which received light from 183 projectors, each rated at 1500 watts; but the treatment of other buildings was artistic and successful, such as the floodlighting, by rose-coloured light, of Somerset House and the pleasing 'local lighting' of Thames House, which enabled its architectural features to be 'picked out' and the roof to be revealed by special strip reflectors. Considerable enterprise was shown in two examples of gas-lighting, the special treatment of Whitehall (bringing the illumination up to Class "A" standard, that is, a minimum of 2 foot-candles, which is attained in no other street in Great Britain) and the floodlighting with gas of St. James's Park. The latter, whilst very effective pictorially, is of considerable technical interest because of the novel gas-lighting projectors designed specially for this scheme. During September there were, however, more than fifty towns throughout the country where floodlighting installations were arranged; Edinburgh Castle may be mentioned as a most noteworthy and effective example of floodlighting.

The party left for Glasgow on Sept. 3. On the following morning, a civic welcome was extended to them by the Lord Provost at the Royal Technical College, where the sessions took place. At Glasgow there were three simultaneous sessions, devoted respectively to lighting developments, photometric precision, and daylight. The papers grouped under lighting developments were mainly descriptive. Miss C. Haslett and Miss Nora E. Millar put in a plea for better domestic lighting. Mr. C. W. Sully emphasised the importance of good lighting to electric supply undertakings, which should set up well-staffed 'lighting service' departments. Sig. C. Clerici reviewed recent progress in illuminating engineering in Italy. Mr. C. A. Atherton presented an informative paper surveying educational methods throughout the world and illustrating (by reproductions of posters, etc.) the effect of national characteristics.

In these three sessions twenty-seven papers were presented, so that one cannot do more than briefly indicate a few salient points. The chief item in Section 2 (Photometric Precision) was a comprehensive survey of photometry by the National Dutch Committee, in which reference was made to the unsatisfactory nature of the various existing photometric standards. There appear to be two alternative possibilities, either a standard based on physical photometry or one based on the use of tungsten lamps of known dimensions. The latter seems the more practical method. Other papers were designed to show the degree of precision possible in laboratory and commercial photometry. Thus R. Koveslígethy and P. Selenyi and also L. Simek (Czechoslovakia) indicated the possibility of confining errors to within 0·25 per cent. A useful contribution by B. P. Dudding and G. T. Winch led to the interesting conclusion that the error in visual photometry consists of two approximately equal portions, arising respectively from imperfect visual judgment and inaccuracies in establishing the standard electrical pressure at which lamps operate. A further inference may be made that, if suitable precautions are taken, laboratory photometry based on the use of photoelectric cells gives greater consistency than is attainable by visual methods. Of special interest was the analysis by A. K. Taylor (G.B.) and by J. Wetzel and A. Gouffé (France) of errors in portable photometers. In the discussion, the importance of accurate control of the current taken by the lamps in such photometers was emphasised; it is regarded as doubtful whether adequate precision can be obtained from customary types of ammeters or voltmeters, and more sensitive methods (based on the use of null-points and bridges, etc.) have been suggested by J. T. MacGregor Morris.

There were no less than ten papers included in the Section on Daylight Illumination, the authors of which were drawn from seven different countries. Of the three British papers, that by P. J. Waldram contained an informative survey of the development of legal aspects of access of natural light, and the corresponding photometric methods that have been evolved in Great Britain. There appears to be good basis for the suggestion that in buildings a minimum daylight factor of at least 0·2 per cent should be adopted. With the normal sky-brightness of 500 lux already approved by the International Commission on Illumination, this factor would correspond to a minimum of 1 foot-candle.

On the evening of Sept. 4 there was a civic reception in the City Chambers by the Lord Provost, followed by a tour of inspection of the lighting of streets in

Glasgow and its environs. The following day was devoted to a pleasant excursion on the Firth of Clyde, and on Sept. 6 the party travelled on to Edinburgh, breaking the journey at Gleneagles. It had been remarked that in Glasgow there was little or no floodlighting, whilst at Edinburgh attention had been concentrated on the illumination of the Castle, which on account of its commanding site is an ideal subject. Although the degree of brightness in this case was less than in some London installations, the effect was very fine, the inequalities in the illumination of the extensive surface of the walls operating as a positive advantage.

At Edinburgh also there was a very full programme of papers, no less than 34 being presented in the four sections dealing with public lighting, diffusing materials, aviation lighting, and physiological problems. The outstanding session, however, was that devoted to public lighting. This was undertaken jointly with the Association of Public Lighting Engineers, the eighth annual conference of which was being held simultaneously. The morning papers were mainly statistical. Contributions reviewing progress in gas and electric street lighting were presented by Sir Francis Goodenough and Mr. W. J. Jeffery. Of considerable scientific interest was the account by Mr. W. S. Stiles ("Mass Experiments in Street Lighting") of impressions of degree of glare, visibility, etc., gathered in Sheffield and Leicester by an appeal to a considerable number of observers.

The afternoon session resolved itself largely into a discussion of the British Standard Specification for Street Lighting, which was ably dealt with by the president (Mr. C. C. Paterson) and others. Modifications in the original specification were explained and the difference between 'methods of grouping' and 'criteria of excellence' illustrated. These papers gave rise to a good 'international' discussion, and the chairman (Dr. N. A. Halbertsma, of Holland) excited general admiration by his interpretations in three languages and his skilful guidance of the discussion. An informative contribution was that of C. Clerici (Italy), who described the lighting of the arterial road from Rome to Ostia, by means of 60 watt fittings 'staggered' at intervals of only 25 ft.—an example of remarkably close spacing. In the section on aviation lighting, the papers by H. N. Green ("The Light Distribution from Navigation Lamps") and the British National Committee ("Ground Lighting Equipment for Aviation") were of special merit. In Section 2, J. W. Ryde and B. C. Cooper were responsible for two papers dealing with the theory of opal glasses. Japan was responsible for three papers in this section. On Sept. 8, visitors left for Buxton, where the next sessions were held.

(To be continued.)

Photographic Analysis of Explosion Flames.*

IN principle the method usually employed for the photographic analysis of explosion flames is the same as that originally designed by Mallard and Le Chatelier fifty years ago. It consists in photographing the movements of the flame along a horizontal glass tube on a sensitised plate or film moving vertically at a suitable known velocity, thus obtaining (*inter alia*) a graph compounded of the two velocities, from which that of the flame at any point can be deduced. Mallard and Le Chatelier employed horizontal tubes of diameter between 1 and 3 centimetres in sections, each 1 metre long, connected in series by means of caoutchouc rings. The whole was focused, by means of a wide aperture lens, on a plate moving vertically with a known uniform velocity of about 1 metre per second.

As the plates used by Mallard and Le Chatelier were not sufficiently sensitive to give satisfactory records with feebly luminous flames, such as those of hydrogen-oxygen explosions, they employed explosive mixtures of carbon disulphide with either oxygen or nitric oxide, the flames of which are much more actinic, believing them to be typical of all explosive 'oxygen' or 'air' mixtures respectively. The behaviour of these mixtures on explosion was found to differ according as they were ignited at or near (*a*) the open, or (*b*) the closed end of a tube. In the former case the flame always proceeded for a certain distance along the tube at a practically uniform slow velocity, which was regarded as the true rate of propagation 'by conduction'. This initial 'uniform movement' was usually succeeded by an 'oscillatory period', the flame swinging backwards and forwards with increasing amplitude, and finally *either* dying out altogether *or* giving rise to 'detonation', according to circumstances. With some 'oxygen'-mixtures the initial period of uniform velocity was short, and appeared to be succeeded abruptly by 'detonation', without passing through any intermediate oscillatory period. When, however, the mixtures were ignited near the *closed* end of the tube, the forward movement of the flame was continuously accelerated until finally 'detonation' was set up. In 'detonation', where the explosion is propagated from layer to layer by 'adiabatic compression', the flame velocities are both uniform and high, usually of the order 2000 to 3000 metres per second.

The experimental method was developed and improved by the late Prof. H. B. Dixon and his collaborators in Manchester during the nineties of last century. They used a highly sensitive film rotating vertically on the periphery of a drum with a constant velocity (which, however, varied between 25 and 50 metres per second in different experiments), the explosion tube being placed at such a distance from the camera that the size of the image was about one-thirtieth of the flame. In this way they analysed the progress of an explosion from its origin up to the final attainment of its maximum force and velocity in 'detonation'. They also discovered (i) the wave of 'retonation', which is thrown back through the still burning or chemically active medium from the point where detonation starts (a phenomenon also independently discovered by Le Chatelier in 1900), (ii) the effects of collisions between two explosion waves, as well as of the passage of 'reflected waves' through the hot products of combustion behind the flame front.

Within recent years the experimental method has been further developed and improved in the laboratories at the Imperial College, South Kensington, chiefly by means of the new high-speed photographic machines designed by Mr. R. P. Fraser, which have so increased its analysing power that it is now possible to photograph and measure movements in explosive flames occurring periodically with frequencies up to 250,000 per second. With a new type of camera embodying the principle of a mirror revolving *in vacuo* at high constant velocity (16,000 r.p.m.) and projecting the image of the explosion flame on to a stationary film, we hope soon further to increase the analysing power four- or five-fold. So that in the near future we hope to be able to photograph and measure periodic flame-movements occurring with frequencies of a million per second.

* Substance of an evening discourse delivered before the British Association on Sept. 24 by Prof. William A. Bone, F.R.S.