MINISTRY OF TRANSPORT

DEPARTMENTAL COMMITTEE ON STREET LIGHTING

INTERIM REPORT

September, 1935

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COMPOSITION OF THE COMMITTEE.

Major F. C. Cook, D.S.O., M.C., M.Inst.C.E., F.S.I. (Chief Engineer, Roads Department, Ministry of Transport) (*Chairman*).

Mr. J. F. Colquhoun (Public Lighting Engineer, Sheffield).

Mr. C. A. Masterman, M.A., F.I.C. (Chief Technical Officer, Gas Light and Coke Company).

Major W. H. Morgan, D.S.O., M.Inst.C.E. (County Engineer, Middlesex).

Mr. C. C. Paterson, O.B.E., M.Inst.C.E., M.I.E.E. (Chairman of the Illumination Research Committee, Department of Scientific and Industrial Research; Director of the Research Laboratories, General Electric Company).

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Dr. J. W. T. Walsh, M.A., M.I.E.E. (National Physical Laboratory).

Secretary: Dr. H. F. Gillbe, B.Sc., A.I.C. (Ministry of Transport).

Statement of Expenditure.

The estimated cost of the preparation of this Report is £44 0*s.* 0*d.*, of which £26 8*s.* 9*d.* represents the cost of printing and publication. In addition, an expenditure of £1,166 8*s.* 4*d.* has been incurred to date in the provision and operation of the experimental installation to which reference is made in Section 5 of the Report.

MINISTRY OF TRANSPORT

DEPARTMENTAL COMMITTEE ON STREET LIGHTING

INTERIM REPORT

To the Minister of Transport.

SIR,

We, the undersigned, were appointed by you in June, 1934, "to examine and report what steps could be taken for securing more efficient and uniform street lighting with particular reference to the convenience and safety of traffic and with due regard to the requirements of residential and shopping areas, and to make recommendations."

(1) INTRODUCTION.

1. We have been informed that there is some uncertainty on the part of lighting authorities regarding the advisability of entering into new contracts or initiating or extending lighting schemes pending the issue of the Committee's recommendations. Whilst we are not in a position to make our final recommendations we have thought it desirable to issue an Interim Report, the primary purpose of which is to obviate any tendency to delay on the part of lighting authorities in the provision or improvement of lighting installations and to direct attention to certain conclusions at which we have arrived, the knowledge of which we are advised would be generally helpful.

2. The functions of street lighting may conveniently be discussed under four headings :—

(*a*) the convenience and safety of road users;
(*b*) police purposes;
(*c*) the convenience of residents;
(*d*) special purposes in shopping areas and important urban centres.

In this Report we refer, in the main, to the first of these considerations as applied to traffic routes, although we fully recognise the importance of the other three and will deal with them in a later report. We consider that the convenience and safety of traffic should be the primary factors in determining the character of the lighting of traffic routes—a term which we use frequently and which, for the purpose of this Report, may be defined as including all those roads which form the main approaches to or traverse important centres of population, or pass through detached built-up areas, and on which there is appreciable pedestrian traffic.

3. Since our appointment we have held nineteen meetings and have made a number of inspections of lighting installations. We have obtained a considerable volume of information regarding various aspects of street lighting from those organisations most closely concerned with the question. The undermentioned have been good enough to submit memoranda for our consideration and in the majority of cases we have had the advantage of receiving oral evidence from their representatives; the order is that in which evidence was given or memoranda received.

The Illuminating Engineering Society.
The Association of Public Lighting Engineers.
The Automobile Association.
The Joint Gas Lighting Committee, representing :—
- The Institution of Gas Engineers.
- The National Gas Council of Great Britain and Ireland.
- The British Commercial Gas Association.
- The Society of British Gas Industries.

The British Electrical Development Association (Inc.).
The Incorporated Association of Electric Power Companies.
The Incorporated Municipal Electrical Association.
The National Illumination Committee of Great Britain.
The British Electrical and Allied Manufacturers Association.
The Electric Lamp Manufacturers Association of Great Britain, Ltd.
The Institution of Municipal and County Engineers.
The Royal Automobile Club.
The Pedestrians' Association.
The Metropolitan Boroughs Standing Joint Committee.
The Chief Constables' Association.
The National " Safety First " Association (Inc.).
The Commercial Motor Users Association (Inc.).
The Commissioner of Police of the Metropolis.
The Cyclists' Touring Club.

4. Detailed consideration of all the matters within our terms of reference will necessitate further investigation, but on certain points we are able to express definite opinions based on the evidence given to us and on our own observations. In a subsequent report we propose to refer to the evidence in detail and to make such further recommendations as we shall then be in a position to formulate.

(2) Administration.

5. We recognise that although our terms of reference are wide, we were appointed to deal primarily with the technical aspects of the subject. We feel, however, that full advantage cannot be obtained from the recommendations which we put forward on technical grounds unless regard is had to administration and finance, by reason both of the lack of co-ordination between the numerous

authorities upon whom the responsibility for street lighting rests and their varying financial resources. We recognise that proposals which necessitate changes in either of these directions cannot properly be dealt with until the authorities concerned have had an opportunity of expressing their views and full consideration has been given to all the issues which are involved. We have, however, thought it desirable to direct attention to these factors so far as they concern the efficiency of street lighting in its technical aspects and to make suggestions which are based on the evidence given to us.

6. In England and Wales power to light roads was given to Parish Councils by the Lighting and Watching Act, 1833, in conjunction with the Local Government Act, 1894; to Urban Authorities by Section 161 of the Public Health Act, 1875; and to Rural Authorities (if the Minister of Health makes an Order for the purpose) by Section 276 of the same Act. These powers were not given to County Councils, and wherever the powers conferred by Section 161 have become operative the provisions of the Lighting and Watching Act, 1833, are superseded. Under Section 23 of the Road Traffic Act, 1934, a County Council may, if it considers that any county road or part thereof should be lighted or that the lighting should be improved, exercise lighting powers notwithstanding the provisions of the 1833 and 1875 Acts. It is not yet possible to form an opinion regarding the usefulness of this Section, since it came into force only on the 31st October, 1934, and no material advantage could be taken of its provisions until the beginning of the financial year 1935-36. It should be noted that all these powers are permissive, and that (except in the case of the Metropolitan authorities, which are obliged by Section 130 of the Metropolis Management Act, 1855, to light the streets within their districts) there is no obligation on local authorities in England and Wales to provide street lighting save where, owing to an obstruction or other circumstance, a road may be or may become unsafe to road users.

7. The position in Scotland is somewhat different; Section 99 of the Burgh Police (Scotland) Act, 1892, begins "The Commissioners shall make provision for lighting in a suitable manner all the streets within the burgh which in their judgment should be lighted at the public expense . . . ." In burghs to which this Act does not apply, a similar definite obligation to provide street lighting exists; thus with regard to Edinburgh, Section 198 of the Schedule to the Edinburgh Corporation Order Confirmation Act, 1933, provides that "The Corporation shall to such an extent and in such way or manner as they shall deem necessary or proper in the circumstances, make or cause to be made provision for lighting and shall light in a suitable manner streets and other places within the City which in their judgment should be lighted at the public expense . . ."; whilst the City of Glasgow Police Act, 1866,

requires that "The Board shall make provision for lighting in a suitable manner the portions of the turnpike roads within the City and the public and private streets and courts . . . ." In the county areas under Section 44 of the Local Government (Scotland) Act, 1894 (as adapted by the Local Government (Scotland) Act, 1929, and by Statutory Rule and Order, 1930, No. 1026/S.58 made under Section 76 thereof) it is lawful for a district council, or for any two or more district councils, or for not fewer than ten district council electors, to make a requisition to the County Council calling upon them to form such district or districts into a special district for the purpose of lighting, and for the adoption for that purpose of any one or more of the provisions of Sections 99-105 inclusive of the Burgh Police (Scotland) Act, 1892. On the formation of a special district and the adoption of these provisions, or any of them, such provisions apply within the special district with the necessary adaptation. The County Council is the lighting authority in a district so formed. Further, Section 41 (8) of the Road Traffic Act, 1934, provides that "A County Council shall have the like powers with regard to the lighting of any road in the landward area of the county (i.e. in the county excluding burghs) not included in a special district, as they have with regard to roads so included . . . ." We have not been able to obtain definite evidence that differences in the law as between Scotland and England have in fact resulted in a higher standard of lighting, or in more uniform lighting, in Scotland, than obtains in areas where the powers are purely permissive; this may, in part at least, be attributed to the lack of any generally recognised standards.

8. Several witnesses have urged, as the considered view of the organisations they represent, that the lighting of public roads should be regarded as of equal importance to their efficient maintenance and that this is a responsibility which should be imposed by statute upon local authorities. It has also been urged that there should be grouping of adjacent authorities, or alternatively that lighting powers should be confined wholly to larger units, e.g. County Councils and County Borough Councils, and arguments can be advanced for the adoption of some such course. Thus, it was given in evidence that on 31·8 miles (lying wholly within one County) of a heavily trafficked Class I road, of which 21·6 miles are in built-up areas, there are in use nineteen different lighting systems, ranging from British Standard Specification Class E to Class H, controlled by twenty-four different lighting authorities, whilst in some of the built-up areas no lighting whatsoever is provided. It has been estimated by witnesses that if this length of road were lighted to a standard adequate for the type of traffic which it carries (this aspect is dealt with later in the Report) and the provision of the lighting were to remain the responsibility of the authorities of the various districts which the road traverses, the cost to the smaller authorities would necessitate

a rate approaching 10s. in the £, i.e. for lighting the comparatively short sections of the road with which these authorities are concerned, and on which the traffic is of little direct value to the district. If, on the other hand, the County Council were the lighting authority, the witnesses have estimated that the whole length of road could be adequately lighted for a county rate of approximately 0·65d. Another case brought to our notice concerns 13 miles of a modern arterial road in the environs of London, in which there are 27 varying standards of lighting, ranging from reasonable adequacy to none at all. Yet another case concerns a route popularly used as an exit from central London. Five authorities control the lighting of four miles of the route; the lamp standards vary in height from about 10 ft. to 22 ft. and the distance between the lamps from 15 yards to 130 yards; in some sections the posts are confined to one side of the road and in others a staggered arrangement has been adopted, whilst the standard of lighting is described as varying from " excellent " to " bad."

9. It is our opinion that there must be reasonable uniformity in the lighting of those portions of a traffic route upon which a system of lighting is regarded as necessary, and that frequent or abrupt variations in the type and standard of lighting and in the arrangement of the light sources are embarrassing and fatiguing to drivers and may therefore be inimical to road safety. We do not mean to imply, however, that variations in the type of illuminant, or slight changes in mounting height or spacing, are disadvantageous, provided the general standard is satisfactory.

10. From the evidence placed before us we are satisfied that the present system of administration does not provide for the attainment of uniform and effective lighting on traffic routes, although some improvement has been effected by the extension of the areas of certain authorities as a result of the Local Government Act, 1929. It has been suggested in evidence that there might be advantages in the grouping of adjacent authorities for lighting purposes, or in the setting up of Joint Advisory Committees on the lines of the Standing Joint Committee of Metropolitan Boroughs; but we do not consider that marked good would result from the operations of advisory bodies of this character on a subject in which cost is such an important factor, unless reinforced by the power of the purse.

11. This brings us to consider the suggestion put forward by several representative bodies that the cost of street lighting should be met in some degree from national funds. It was urged in evidence that the adequate lighting of the more heavily trafficked routes, in particular, is essential in the interest of the safety and convenience of all classes of road users, and not only of local residents, and that the cost should therefore be considered, in part at least, as a national charge, as in the case of grants made from

the Road Fund towards the cost of road construction and maintenance. If this view is accepted it follows that the Government Department charged with the responsibility for the issue of grants must be empowered to specify an appropriate standard of lighting on roads to which grants should apply and to take such steps as may be requisite to ensure that such standard is achieved and maintained.

12. Consideration of the evidence referred to in the preceding paragraphs (which we appreciate raises questions which may be regarded as outside our terms of reference) leads us to the opinion that consideration should be given to the responsibility for the lighting of classified roads (and such other roads as may be agreed) being confined to large administrative units, with such exceptions as may be provided for, as in the case of road maintenance under Section 32 of the Local Government Act, 1929. We also feel bound to draw attention to the suggestion that grants should be provided from national funds (to an extent to be determined) towards the cost of lighting so much of the system of classified roads (as adopted by the Ministry of Transport) upon which public lighting may be regarded as necessary and such other roads as the responsible Government department may agree to include for the purpose.

13. We are of opinion, however, that the cost of providing lighting in excess of an appropriate standard should be borne wholly by the local authority. Such a standard is not easy to define, but the question is dealt with later in this Report. It may be mentioned that the total annual cost of providing and maintaining such lighting is estimated at from £300 to £400 per mile, which is approximately 75 per cent. of the average cost to County Councils of the maintenance of Class I roads throughout the country.

14. On the assumption that all classified roads in County Boroughs and 20 per cent. of classified roads in Counties (which is a generous estimate) are lighted to the appropriate standard the annual cost would be approximately £3½ millions. We have no ready means of ascertaining the present expenditure on the lighting of roads of this character, but it must be a very material proportion of the sum we have mentioned.

15. Pending any alteration of the present administrative system we recommend that authorities contemplating the installation of lighting on roads within their areas, or the improvement of existing installations, should consult with adjoining authorities with the object of securing agreement with regard to the amount of lighting and the height and placing of the light sources along routes which are of common interest.

(3) The Technical Aspect.

16. It is impossible to determine with accuracy, from the available statistical information, the extent to which bad lighting is the immediate cause of road accidents in this country. We were

told by representatives of motoring organisations that whilst regarding efficient street lighting as directly contributory to road safety, they were unable to point to any but occasional accidents due to bad lighting conditions, and a memorandum submitted to us on behalf of the Commissioner of Police of the Metropolis confirms this view so far as London is concerned.

17. Our own observations lead us to the opinion that the "pools of darkness" resulting from uneven distribution of light on the road surface, more especially in the case of inadequately lighted roads, render it difficult for the motorist to judge distances and for other road users to estimate the speed of approaching vehicles, and that marked variation of lighting in any one thoroughfare may also cause uncertainty in the mind of the motorist regarding the necessity for using his headlights. On the whole we agree with the opinion which has been advanced by more than one witness that street lighting which may be described as patchy may be worse from the point of view of public safety than no lighting at all.

18. In endeavouring to lay down a standard of lighting for roads of this class we are faced immediately with the problem of how such a standard may best be defined. From the evidence placed before us we recognise that it must take time to arrive at a standard and to formulate a satisfactory code of lighting applicable even to a well defined type of traffic route, since there is none which at the moment we would care to recommend for general adoption as sufficiently defining all requirements.

19. We are aware of the important work which has been carried out by the British Standards Institution during the past eight years and of the current and proposed revised street lighting specifications which the Institution has prepared. Many opinions have been expressed in evidence regarding the British Standard Specification. It has been urged that in its current form it represents the greatest measure of agreed views between the various specialists in street lighting in this country, and that when interpreted by a competent lighting engineer it is capable of serving as a basis for satisfactory lighting installations. On the other hand, it has been stated that in concentrating upon minimum horizontal illumination, i.e., upon the intensity of light falling upon the road, the specification tends to divert attention from the effect which that light produces from the point of view of the road user, and for traffic routes, this after all is the ultimate factor which has to be considered. The specification attempts to serve two objects, first in defining various classes of installation in terms of horizontal illumination, mounting height, and spacing/height ratio, and secondly in determining how such installations can be tested in practice and adequate maintenance ensured. The specification also contains clauses in general terms referring to such factors as glare and stating that tenders for new specifications should be accompanied by distribution curves, etc. Our attention has been drawn

to the existence of other codes in other countries, but we are not satisfied that these present any advantages compared with the British Standard Specification. Although the latter appears to be the most complete quantitative reference which exists, not every installation designed within its provisions for a certain class is equally satisfactory. This difficulty is, we believe, receiving the active attention of those responsible for the specification. It would, therefore, be undesirable for us to accept the specification in all its details as the means for defining the special lighting requirements of traffic routes. More especially, the considerations outlined in Paragraph 20 are not taken account of in the present British Standard Specification.

20. With certain exceptions it appears to be generally accepted that objects on the carriageway are, in the majority of cases, seen by the driver of a motor vehicle by silhouette against a relatively bright background, provided headlights are not in use. This background may consist of the road surface, footway, fence, buildings, or any combination of these features. If this view is correct, one of the objects of a street lighting installation should be the production of a sufficiently bright background against which the objects likely to be encountered may be readily observed. We find that there is some conflict of technical opinion on this subject; on the one hand as to whether, to the driver of a fast moving vehicle, uniformity or non-uniformity of road surface brightness is the more conducive to visibility when coupled with the effects of glare, and on the other as to whether any quantitative expression can be given to the brightness factor, bearing in mind its dependence upon such extraneous circumstances as the condition of road surfaces, weather, colour of object, etc. We have therefore arranged for the erection of an experimental lighting installation whereby this and other important factors may be studied, in the first instance on a straight flat length of road. Subsequently it will probably be found necessary to carry out confirmatory trials under the more frequently occurring conditions of bends, gradients, road junctions and the like. A brief account of the installation is given later in this Report (Paragraphs 32 and 33).

21. The majority of the witnesses stated that in their opinion the minimum standard of lighting to be aimed at for the class of roads to which we have referred in Paragraph 2 is that which will enable drivers to proceed with safety at 30 miles per hour without the use of headlights, and in the absence of any more satisfactory criterion the large majority expressed the view that an effective installation is one which they associated with a generously planned Class F of the British Standard Specification. Pending further investigation we recommend that on traffic routes the lighting units should be of at least the number and power of those required for this standard.

22. The manner in which the available light is distributed must be governed by circumstances. If the road is in open country or is bordered by trees little advantage is obtained by directing light beyond the edge of the carriageway and/or footway, and the light can more usefully be directed on to the road itself. In built-up or partly built-up areas it may be necessary to direct part of the light on to the fences or lower parts of the fronts of the buildings, and in certain cases to provide additional light flux for this purpose. An important factor to be observed in this connection is the nature of the background against which objects on the carriageway require to be rendered visible to the drivers of vehicles, and in designing and erecting installations every effort should be made to ensure that the available light is employed in such a manner as to produce the maximum contrast between the brightness of the object to be viewed and the background against which it is seen, subject to the absence of glare from the light sources. Special care should be taken to ensure that the kerbs and footways, where they are provided, are adequately lighted.

23. Considerations of cost have caused installations to be designed with increasingly powerful light sources, spaced at greater distances apart. To avoid glare these light sources require to be mounted high. The opinion generally expressed in evidence was that the most satisfactory result is obtained by suspending the sources over the traffic lanes, that is about 6 ft. beyond the kerb line, and we endorse this view. This method of positioning, involving the use of overhung arms or suspension wires, necessitates in any case a mounting height (i.e. distance between the light source and road surface) of not less than 18 ft. to allow clearance between lamps and vehicles. Witnesses have suggested, and our own studies have confirmed the view, that a mounting height of the order of 25 ft. is desirable for the production of a satisfactory installation and for the avoidance of glare. Furthermore, we are informed that for overhung sources the capital and maintenance charges do not seriously increase if the mounting height is raised from about 18 ft. to 25 ft. We therefore recommend for general adoption a mounting height of 25 ft., with 6 ft. overhang, except in special circumstances, such as where the road is bordered by trees, when for kerb lighting the height may necessarily have to be reduced, or central suspension adopted.

24. Where financial conditions permit there is an advantage in close spacing, especially on winding roads, and for normal purposes even on straight roads we consider that the spacing should not generally exceed 150 ft. It has been pointed out to us, and indeed it will be readily appreciated, that uniform spacing of the posts may not give the most satisfactory lighting where the road bends, rises or dips, and may in fact result in dark areas or patches which are likely to prove sources of danger. Further, on hilly

roads, uniformity of lighting units and spacing may result in an unnecessary degree of glare. On bends it is generally desirable that the lamps should be placed on the outside of the curve. Examples have been brought to our notice in which, owing to unsuitable positioning of the light sources, the carriageway and footway at the middle part of the bend appear quite dark, with the result that a pedestrian stepping off the kerb may be completely invisible, whilst the driver does not have adequate notice of the existence of the bend. We recommend that lighting authorities should study the conditions in such cases with the object of ascertaining whether the circumstances would not justify the provision of an artificial light coloured background upon which a sufficient amount of light could be directed to enable drivers to realise the existence of the bend and against which pedestrians would be rendered visible by contrast. We consider also that the provision of white kerbs may be found useful at bends.

25. The question of glare is undergoing thorough investigation by a number of organisations, but as yet no simple method of evaluation has been established. Generally speaking, and other things being equal, glare tends to diminish as the mounting height increases, and the adoption of the mounting height of 25 ft. recommended in Paragraph 23 should largely overcome the difficulty, except near the crest of hills. In many instances glare is at present attributable to the use of directional fittings which concentrate the light to an excessive degree in a particular direction, and to the use of directional fittings under unsuitable conditions, e.g. on relatively low posts placed at considerable distances apart. We have endeavoured to formulate in quantitative terms a recommendation dealing with the problem, but have found it difficult to do so on account of the lack of means at present available of evaluating glare, the absence of precise knowledge of the conditions which give rise to glare, and the difficulty of expressing the characteristics of directional fittings in a manner which bears some relation to the degree of glare which they may produce and yet does not react unfairly on fittings which are found in practice to be satisfactory. Two definitions of the so-called magnification ratio of directive fittings have been suggested, namely,

(*a*) the ratio of the peak candle power to the average value in all directions lying within a cone having its apex in the fitting and a semi-vertical angle of 45°;

(*b*) the maximum ratio of the increased to the original candle power in any direction resulting from the use of refractors and/or reflectors.

The latter is open to the objection that the ratio so defined has no direct relation to factors such as the average illumination or the road brightness, which have considerable bearing on glare; whilst a recommendation based on a limiting value of the ratio

defined according to the former might operate unfairly on fittings which may be entirely satisfactory in practice and yet, owing to shadows occurring within 20°-30° from the vertical, yield high values of the ratio, and in addition it is perhaps open to evasion by slightly increasing the intensity over a limited angle in the downward direction. Moreover, neither of these definitions takes into account the angle at which the maximum beam is concentrated. Despite these difficulties we feel that the problem of glare is so pressing as to require from us some guidance to lighting authorities. Pending the submission of revised and more adequate recommendations in a subsequent report, we therefore make the following suggestions (which need care in their application to any particular case) in the expectation that they will be of value in obviating excessive glare. For convenience we adopt the following modified form of definition (*a*) above :—

> The ratio of the peak candle power to the average of the values in all directions downward from the source and lying between 30° and 45° from the vertical. (With this modification the ratio is not raised unduly by shadows cast immediately below the source.)

We consider that fittings for which this ratio does not exceed 6 may often be used with advantage, particularly when mounted at or about 25 ft. above the carriageway, but the use of fittings having a higher ratio should be abandoned. We recognise that on many traffic routes the existing posts are low and that it may be some time before they can be replaced by higher posts; we consider that in such cases, particularly when the spacing exceeds 150 ft. and the mounting height is less than 18 ft., the ratio of any fitting used should not exceed 3. In this connection we recommend that the spacing/height ratios given in the British Standard Specification should not be exceeded. We would emphasise that each installation should be treated on its merits, subject to the limitations of the ratio indicated above, and that attention should be paid to the essential problem of improving visibility rather than to the practicability of adopting fittings having the maximum permissible ratio.

26. The arrangement of the light sources along the highway appears to be largely a question of individual preference, and many different views have been expressed in evidence. It has been stated, for instance, that central suspension renders it difficult to provide adequate visibility near the kerb and footway, especially on wide roads, and that it induces traffic to keep to the crown of the road; other witnesses, on the other hand, have expressed a preference for central suspension. A staggered arrangement of the posts has been recommended by certain witnesses, whilst others have suggested that in fog this arrangement makes it very difficult for drivers to recognise the line of route. Practically all the witnesses who have dealt with the question of arrangement agree

that confining lamp posts to one side of the road results in defective lighting and is to be discouraged, except in the special case of bends, when, generally speaking, there is an advantage in placing the posts on the outer side of the curve. We are in full agreement with this view, and recommend that single side lighting should be avoided, except at bends.

27. As we have already stated, we are dealing in this Report with only one particular class of road; we would, however, emphasise that there should be easy gradation from the standard adopted for such roads to that obtaining in side streets. Such gradation may conveniently be produced by increasing the power and, if necessary, the height of the first two (or more) lamps in the side street to intermediate values. Similar considerations apply to the junctions between the lighted and unlighted portions of traffic routes.

28. It has been represented to us that visibility, in so far as it depends upon road brightness, involves consideration of the methods and materials used in road surfacing and that by the provision of suitable surfaces substantial improvements in street lighting could be effected. The relations between the type of road surface and the type of lighting installation are complex. To obtain the most effective result with certain types of installation a surface is required which is semi-polished (though not so polished as to be slippery), and its lightness of colour is of secondary importance, whilst with others a light matt surface is to be preferred. Even on the same road, with the same lighting, the change from wet to dry conditions effects a transformation in appearance and brightness characteristics. Despite these requirements we have to recognise that the selection of road surfacing materials must continue to be governed primarily by considerations of economy and the production of durable non-skid surfaces.

29. It is to be remembered that the degree of polish and the resulting reflection from the road surface will vary with age and the amount of traffic. Furthermore, where light colour is relied upon it must be borne in mind that the tar and bituminous materials commonly employed as binders for the stone chippings used in surface dressing are black, and that even under the most favourable conditions the binder tends to work to the surface, with the result that however light in colour the chippings may have been initially, the whole surface tends to darken as time goes on. Concrete roads present a permanent advantage in this respect provided they are not dressed with tar or bituminous materials. Whatever may be revealed by further research into the factors which make for the best optical properties of road materials, we recognise that for a considerable time to come tar and bituminous materials will continue to play a predominant part in road surfacing and maintenance. In view of the practical difficulties to which we

have drawn attention we feel that no great help can be expected by lighting authorities in this connection, and that the trend of design of lighting installations must have regard to this circumstance; we recommend, however, that in the selection of surfacing and surface dressing materials consideration should be given as far as practicable to the question of the lightness of colour as well as to that of reflection characteristics.

(4) Technical Control.

30. We attach the greatest importance to the adequate maintenance of installations to the standard to which they have been designed. We are informed that the officials at present responsible for street lighting throughout the country range from qualified lighting engineers to persons whose primary concern is with some quite unrelated activity such as fire control or sanitation. It is apparent that if lighting schemes are to be properly designed and the installations satisfactorily maintained, the committee concerned should be advised by an engineer competent to deal with the problems which arise.

31. The extent to which he should be a whole time officer must depend upon the circumstances of the case. In most counties which may become de facto lighting authorities, and in large cities and towns, we consider that economy and efficiency would result from the appointment of an officer who has specialized in this class of work. Where circumstances do not warrant the whole-time appointment of a lighting engineer the situation may be met if the engineer to the authority has made a special study of street lighting and is competent to deal with the technical aspects of the problem, or by the appointment to his staff of an officer who has specialized in street lighting practice and whose time should be allocated, as far as may be necessary, to the planning and maintenance of street lighting installations.

(5) Experimental Work.

32. Soon after we had begun our deliberations it became apparent that certain technical questions could be investigated satisfactorily only by full-scale tests, and in view of requirements demanding variations in many different factors we decided that it was necessary to erect an installation for the purpose. For our first experiments we found it would be desirable to use a straight and reasonably flat length of road about ½ mile long, and so to design the installation that all the important factors could be varied within the limits of the installation itself. We have to acknowledge the help we have received in this connection from representatives of the electrical industry.

33. In order that the maximum possible use may be made of the installation we have asked the witnesses who have given evidence on behalf of the technical organisation if they will suggest

other experiments which they consider may yield results of value. We recognise that the scope of the experiments which can be carried out on a flat straight road is limited, and, as we have mentioned previously, we propose undertaking subsequently further practical investigation into the special conditions obtaining at bends, road intersections, and junctions, and on gradients. We have already been enabled, by virtue of facilities which representatives of the gas industry have been good enough to place at our disposal, to carry out certain preliminary experiments of this nature.

(6) Extraneous Lighting.

34. Our attention has been drawn to the influence which auxiliary or extraneous lighting, i.e., incidental private lighting, illuminated signs, and so forth, may have upon the efficiency of a street lighting installation. Although it has been suggested that in some cases such lighting may prove helpful, the general feeling is that it renders effective street lighting more difficult and may even increase the risk of accident unless some degree of control is exercised by the lighting authority. Certain limited powers of this kind are already in existence; the London County Council, for instance, has made a bye-law under Section 164 of the London Building Act, 1894, with respect to "lamps, signs and other structures overhanging the public way," whilst in the City of Glasgow advertisement signs may not be erected, except under special conditions regarding placing, until a licence has been obtained from the Corporation (Glasgow Corporation Order, 1924, Section 38), who can thus exert some restraining influence on the use of signs which might prove detrimental to the street lighting. Moreover, under Section 48 of the Road Traffic Act, 1930, a local authority is required to demand the removal of any object which so closely resembles a traffic sign that it might reasonably be taken to be such a sign.

35. The powers referred to in the preceding paragraph do not generally appear to have any direct relation to street lighting, but are concerned mainly with public safety from such points of view as the weight, positioning, and minimum height of the structures, and confusion with traffic signs. We are of opinion that, these considerations apart, definite power to control extraneous lighting, but only in so far as it may be seriously detrimental to the street lighting, should be given to lighting authorities.

36. It has been suggested to us that where shop lights are relied upon to supplement street lighting the latter should be augmented when the shops are not illuminated; we are unable to accept this point of view, since we feel that all street lighting installations should be complete in themselves and that no reliance should be placed on any extraneous means of lighting.

(7) Interference with Railway Signals by Street Lighting.

37. As a consequence of representations made to the Ministry of Transport by the Railway Clearing House regarding interference by street lighting with the sighting of railway signals we were asked to consider whether we could formulate any recommendations which would tend to prevent such a position arising as would, on this account, jeopardize the safety of trains. At our invitation the Railway Clearing House submitted a memorandum on the question and their representatives attended one of our meetings at which the matter was discussed. We gathered that cases had occurred in which the visibility of a railway signal had been impaired by the presence of street lamps in its vicinity, and that although little or no difficulty had been experienced by the railway companies in arranging with the lighting authority for the screening or repositioning of the offending lamps the companies were concerned that a potentially dangerous situation might arise and perhaps continue for some little time before circumstances led to its detection and remedial measures could be undertaken. This obviously undesirable state of affairs would be avoided if lighting authorities contemplating the erection of a new street lighting installation or the modification or extension of an existing installation in the vicinity of a railway line would notify the railway company beforehand with a view to making such adjustments (usually of a minor nature) as might be necessary in order to avoid possible interference with railway signals. We accordingly recommend that in such cases lighting authorities should consult with the railway company concerned before work on any new or improved installation is put in hand.

(8) Summary of Conclusions.

The following summary is intended to emphasize the principal conclusions at which we have arrived, and should not be read independently of the paragraphs in the body of the Report to which reference is made :—

A. *The Lighting of Traffic Routes.*

(1) There should be reasonable uniformity in the lighting of portions of traffic routes (as defined in Paragraph 2) presenting similar characteristics, but minor variations are not necessarily disadvantageous. (Paragraph 9.)

(2) The present system of administration is not conducive to the achievement of uniform and effective lighting on traffic routes. (Paragraph 10.)

(3) Consideration should be given to the responsibility for the lighting of traffic routes being confined to large administrative units (Paragraph 12), and to the suggestion that the cost of lighting roads (as defined for this purpose in

Paragraph 12) should be aided by grants from national funds administered by the responsible Government Department. (Paragraphs 11 and 12.)

(4) Adjoining authorities should confer together with the object of securing uniformity of lighting on routes of common interest. (Paragraph 15.)

(5) For traffic routes the minimum standard of lighting should be that which enables drivers to proceed with safety at 30 miles per hour without the use of headlights; on such routes the lighting units should be of at least the number and power of those required for a generously planned Class F of the British Standard Specification. (Paragraph 21.)

(6) There is no existing code of lighting which we care to recommend in all respects for the lighting of traffic routes. (Paragraphs 18 and 19.)

(7) The available light should be so employed as to produce the maximum contrast between the brightness of the object to be viewed and its background, provided there is no undue glare. (Paragraph 22.)

(8) Care should be taken to ensure the adequate lighting of kerbs and footways. (Paragraph 22.)

(9) In general, a mounting height of 25 ft., with 6 ft. overhang, is desirable. (Paragraph 23.)

(10) The positioning of lamps should be studied with a view to securing the best visibility, rather than uniform spacing, but normally the distance between lamps should not exceed 150 ft. (Paragraph 24.)

(11) On bends the lamps should be placed on the outside of the curve; the provision of artificial backgrounds in appropriate cases and of white kerbs at bends should be considered. (Paragraph 24.)

(12) Excessive glare may be largely avoided if care is taken in the selection and use of directive fittings. (Paragraph 25.)

(13) Single-side lighting should be avoided except at bends. (Paragraph 26.)

(14) There should be easy gradation from the standard of lighting adopted for traffic routes to that obtaining in side streets, and at the junction between lighted and unlighted portions of traffic routes. (Paragraph 27.)

(15) Although the selection of road surfacing materials may necessarily be governed primarily by considerations other than those of optical properties, regard should be had, as far as practicable, to reflection characteristics and lightness of colour. (Paragraph 29.)

(16) The trend of design of lighting installations must have regard to the nature of the materials available for road surfacing and surface dressing. (Paragraph 29.)

B. *Miscellaneous.*

(17) Lighting authorities should be advised by an engineer competent to deal with street lighting. (Paragraphs 30 and 31.)

(18) Power to control extraneous lighting should be given to lighting authorities, but only in so far as it may be seriously detrimental to the street lighting. (Paragraph 35.)

(19) Street lighting installations should be complete in themselves and no reliance should be placed on extraneous lighting. (Paragraph 36.)

(20) Authorities contemplating the erection or modification of a street lighting installation in the vicinity of a railway line should notify the railway company beforehand with a view to avoiding possible interference with railway signals. (Paragraph 37.)

(Signed) F. C. Cook (*Chairman*).
J. F. Colquhoun.
C. A. Masterman.
W. H. Morgan.
C. C. Paterson.
E. S. Perrin.
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