40,000 public gas lamps lighting 215 miles of London's streets. Electric lighting began with the arc lamp. In the U.S.A. the Brush Company had 25,000 lamps (out of a total of about 90,000) burning every night in 1884. The Journal of Society of Arts, London, in December 1884, recorded impressions of a journey from U.S.A. to Britain:

> "I know of nothing more dismal than to be transplanted from the brilliantly illuminated avenues of New York to the dull and dark streets of London. This happened to me very recently. I drove from the Windsor Hotel, New York, to the Cunard Wharf, a distance of about 4 miles through streets entirely lighted by electricity. I drove from Euston to Waterloo (London) without seeing a single electric light."

Traffic signals also have an interesting history. In 1868 semaphore arm signals with gas lamps were installed in London and met with a good response from the public. Unfortunately they exploded and injured a policeman and this put back the development of traffic signals until the first manually operated three color signals were installed in New York in 1918. There followed systems in France, Germany, Britain and Italy, and in 1932 the first automatic traffic signals.

Let us now turn from Mr. O'Dea's "Social History of Lighting" to the present, the opening of this Symposium with the title "Providing Visibility and Visual Guidance to the Road User."

The groups of topics in the Symposium correspond to many of our technical committees and indeed the title of the Symposium could be a good alternative title for Division 4, except that the Division endeavors to cover the whole transport scene where it is possible to do so.

The panel discussion this morning on "Visual Performance Needs for Driving at Night" is particularly interesting because it is a very difficult topic with which we in CIE have struggled for many years from the road lighting angle. Now Dick Schwab has agreed to take a broader look at it by chairing our technical committee "Fundamentals of the visual task for night driving." I hope that this discussion will help everyone here understand more clearly the problems involved.

I think it is also significant and timely that there are six papers on the important subject of traffic signs. These papers cover a wide range of aspects that must be thoroughly researched if traffic signs are to be correctly designed and illuminated so as to perform equally well by night as by day.

I am also pleased to see that road lighting has its share of the program, because there are many aspects still to be researched, particularly the performance in wet conditions.

There is also an important paper on vehicle lighting, and the closing discussion on future research and implementation requirements could be of great importance for the future working program of Division 4.

I think it is a particularly good idea to include the tour to the Turner-Fairbank Highway Research Center in this Symposium. It will be most useful for researchers from other countries, indeed from other continents, to see at first hand the organization and facilities for highway research in the U.S.A.

To conclude: I am convinced that this joint Symposium will be of considerable value and importance for the participating organizations and individuals.

REMARKS TO VISIBILITY SYMPOSIUM PARTICIPANTS

Thomas B. Deen, Executive Director, Transportation Research Board

> Mr. Deen joined with Mr. Schwab and Dr. Bjorset in opening the Symposium and welcoming the participants. In addition to his remarks acknowledging the efforts of the TRB Committee on Visibility in organizing the Symposium, he commented briefly on TRB activities and current issues in the field of visibility.

TRB Activities Related to Visibility

In addition to the symposia and other activities planned by this committee, such as technical sessions during the TRB Annual Meeting, TRB can point to a long history of concern with visibility issues. In the National Cooperative Highway Research Program, for example, there have been more than a dozen research projects directed to illumination and visibility. These projects alone have totaled over $2,000,000 in research funding, making them a significant proportion of the total research activity in NCHRP.

Two current projects relating to pavement markings and delineation questions are "Temporary Markings for Construction, Maintenance, and Utility Projects" and "Service Vehicle Lighting and Traffic Control Systems in Work Zones."

Issues in Nighttime Visual Guidance

Not all but most of the discussions at this Symposium are focused on the problem of nighttime visibility. The emphasis seems appropriate. We have over the years developed good lighting standards for highways, particularly for freeways and urban arterial streets. These standards are fairly well accepted, and followed by organizations like AASHTO, for example. Many urban areas are well illuminated, using the latest technology, as the aerial view in a nighttime arrival at any major airport usually demonstrates. But there are still many rural, suburban, and even urban locations with poor lighting or none at all, with inadequate signing and with poor roadside delineation. And when energy costs have gone up, many areas have experienced lighting levels that went down or even out. So the need for lighting and good nighttime visibility is not something that is necessarily recognized and accepted.

Those deficiencies that do exist are being addressed, at least to some extent. The recent initiation of 100 percent Federal funding eligibility for highway safety delineation and marking shows recognition of night driving problems. In announcing this funding eligibility recently, FHWA Executive Director Richard D. Morgan noted that in the U.S.A. during 1981, 57 percent of highway fatalities occurred at night. Thirty-eight percent of all fatalities occurred on unlighted streets and highways. Overall, the nighttime

fatality rate in the U.S.A. is more than three times the daytime rate.

Some broad statistics from the National Safety Council are quite revealing. From 1973 to 1983, U.S. highway fatalities declined remarkably, from 55,800 to 44,600. This reduction was generally distributed in both vehicle and pedestrian deaths, urban and rural, daytime and nighttime. But while all fatalities declined by 20 percent, and rural nighttime fatalities declined by over 18 percent, urban nighttime fatalities actually increased by 6 percent -- from 9,600 to 10,200. Urban nighttime non-pedestrian fatalities increased from 5,900 to 7,000, or by more than 18 percent. Apparently, the many successful measures contributing to the phenomenal record of reduced highway deaths in the last 10 years have not had the same dramatic effect on these categories of nighttime accidents as they have on daytime and rural accident experience.

A look at "Fatal Accident Reporting System 1982," a national summary of fatal accident data, is equally revealing. One table in this report shows fatalities by day of the week and three-hour time groups -- a total of 56 cells. The following seven time-blocks account for the highest numbers of fatalities:

Friday	Midnight to 3 am	1,093
"	6 pm to 9 pm	1,345
"	9 pm to Midnight	1,781
Saturday	Midnight to 3 am	2,390
"	6 pm to 9 pm	1,323
"	9 pm to Midnight	1,634
Sunday	Midnight to 3 am	2,091

These seven time periods, all involving hours of darkness, accounted for more than a quarter of the nation's 1982 highway fatalities (to be precise, 11,657 out of 43,271 or 26.7 percent). These time periods, those when the most-impaired drivers are operating in the most-impaired driving environment, clearly deserve attention.

It is obvious that the new federal initiatives to support improved delineation and to curb the drunken driver are correctly aimed at a major national problem. It is equally clear that the Symposium agenda squarely identifies the research and other visibility issues surrounding this significant national problem.

The program shows that some fundamental issues are being addressed -- how much visibility and guidance is needed, how should its quality be measured when it is provided, how does the driver use what he gets, what levels are appropriate for different aspects of the driving task. The reports on recent relevant research programs will help steer future research, not only in the Federal Highway Administration's projects on Night Visibility, for example, but also in other nations. So we welcome your interest in this Symposium and trust that the exchange of information that takes place will benefit you as well as those others in the transportation community who may be later informed as a result of this meeting.

TOWARD A COMPREHENSIVE TECHNOLOGY FOR APPLYING VISIBILITY DATA TO ROAD LIGHTING DESIGN

H. Richard Blackwell and O. Mortenson Blackwell, Columbus, Ohio

This Symposium seems a most timely opportunity to assess the state of current knowledge in many fields relating aspects of the road environment to driver performance at night. We would like to offer our assessment of the state of knowledge concerning the use of visibility data in the design of road lighting. Our assessment will draw upon CIE Report No. 19/2, and will include as well new material which has become available during the last three years. We consider that a comprehensive technology for use in applying visibility data to road lighting design is taking shape. This technology includes bases for development of visibility demand criteria for different traffic situations, the development of assessment methods to establish the visibility supplied by different road lighting installations, and the use of an overall index to describe the visual performance potential of different installations.

Visibility Demand Criteria for Differing Traffic Situations

We consider that the 1975 Gallagher-Meguire driver performance data provide the basis for establishment of visibility criteria for different traffic situations. Consider Figure 2, in which the Gallagher-Meguire data and 19/2 methods have been used to relate the driver performance index of time-to-obstacle to a measure of object visibility. Note that no single function suffices. Rather, there must be a family of curves relating the driver performance index to the visibility index, each curve describing a particular driver. The Gallagher-Meguire sample included 1,316 drivers and hence may be used confidently to describe overall driver populations.

Figure 1 - Visibility Demand Functions Derived from the Gallagher-Meguire Data (1975).