Vision at Levels of Night Road Illumination: Literature 1967-1969

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•THIS IS a consolidated review of research relating to vision at levels of night road illumination published in the 3-year period from 1967 to 1969.

Taylor (180) has prepared a graphic book on accidents, and Gramberg-Danielsen (81) has written a basic book on seeing and traffic that should be translated into English. Roadside hazards that should not exist are discussed by Blatnik (29). Sheppard has analyzed color vision from the engineering viewpoint (172), Nimeroff has revised the colorimetry handbook (148), and Wyszecki and Stiles have compiled a handbook of data on color (191). Arens (21) has revised his book, and the translation of LeGrand's book on light and color (130) has also been revised. Another book by LeGrand on form and space vision has been translated into English (129). Two useful books on experimental technique (174, 184) and a book by Fry on optics (75) are available. Ogle's book on optics (149) has been revised.

The report of the Committee on Vision of the National Academy of Sciences (24), reviews on vision (145, 163), the effects of drugs and alcohol on vision (12, 17, 85), a bibliography on carbon monoxide (51), and a source book for the literature on lighting (162) are new during this period. The analysis of seeing and driving by Byrnes (43) has been republished.

Ketvirtis (121) has written a book on lighting of roadways and automobiles, and some problems on night seeing. Economics (189), optimization of road lighting (164), and new measuring reflectometers (28, 123) are subjects of papers that were published. Increased lighting from 0.22 to 0.62 ft-c on the Connecticut Turnpike made little difference in visibility (98). Higher and better placed luminaires do contribute to seeing and efficiency (122). Tunnel lighting abroad is described by Schreuder (169). Several papers (181) on road lighting indicate possibilities for its improvement.

Papers on glare problems include the following: European evaluation of glare and low luminance (0.2 to 0.3 cd/m^2) sources (13); time for readaptation in relation to increased age (182); increased glare from polarizing glasses, especially plastic, due to surface haze (105); median widths or lateral separation to minimize glare (155, 108) and reflected and other glare light on driver vision (18, 104). Glare is more intense for wearers of contact lenses (25, 26). Tinted windshields, glasses, or contact lenses lessen glare but reduce seeing distance proportionately and should not be used at night (188). Median barriers are partially effective in reducing glare, but the best means is separation of roadways to minimize glare from oncoming lights.

Running lights appear to be useful in reducing accidents (47), and 2,000 cp or 45,000 ft-L with an area of 20 in^2. (about 5 in. in diameter) is recommended (124).

The high- and low-beam headlight studies show increase in use of low beams in Birmingham, Great Britain, and a decrease in pedestrian casualties (49). There are widely differing uses in various parts of the United States (88), which were observed to be independent of topography.

Headlights tend to position oncoming cars farther on their side of the centerline (7, 8). Davey (55) reviewed the headlight systems used in England and Europe with respect to the driver's vision. Lighting the hood of the car at night gave increased visual feedback and reduced tracking error by 40 percent (114). Allen (2) recommends

Paper sponsored by Committee on Visibility.

adding a ring of retroreflective material around the headlight to show its position when the lamp is burned out and points out that disappearing headlights are not fail-safe and are often too dirty for effective use (4). Johanssen and Rumar (109, 110) propose a system for introducing polarized headlights. On nonilluminated roads, seeing distance at night was such that only 16 to 31 mph was safe (111).

The poor visibility of pedestrians wearing dark clothing was measured, and reflectorizing or white clothing was found to be necessary for reducing pedestrian deaths, especially when the driver has been drinking alcohol (90).

The chaotic arrangement of taillights on automobiles and possible relation of this to rear-end accidents have often been discussed (143, 156, 177). Mortimer's (144) tests indicate that separate taillights, turnlights, and stoplights are more effective, and he recommends an outside pair of green taillights, amber turnlight just inside the taillights, and a pair of red stoplights central to the turnlights. Projector and his associates (156) propose a system of red lights that provide different configurations to show a change in direction or speed of the car ahead. Gibson (78) recommends a tricolor system and possibly implies my support by referring to a paper of mine. This I deny, because any amber light on the rear of an automobile is ambiguous under various lighting conditions to deuteranomalous people. I favor only a system that furnishes information by changing shape (161). Problems of standardization and unification are available (156, 177).

In their paper on traffic signal cycles, Webster and Cobbe (187) in England recommend a 1.5-second perception-reaction time for a yellow signal clearance interval, and Jenkens (107) reports that they have compromised in Michigan on a 1.2-second interval.

Bugelski (34) describes an illusion wherein objects approaching a red signal light at night appear to go beyond the light when seen the distance of a city block away because, at at low angle of observation, a stimulus appears closer than another at or below eye level. Moving objects are not seen as well with raised or lowered gaze as when moving horizontally (100). Flashing lights proved less useful than expected (44).

Legibility of signs and their attention demand factors, contrast, color, and brightness were studied by Forbes and associates (70, 71, 72, 73). They recommend specifications for the design of signs and compromises with lighting conditions for best visibility at night. Pain (150) suggests that adding a relative brightness factor would refine Forbes's models. Allen (9) also gives recommended luminance values for signs, and Brass (30) gives values for internally lighted signs seen against a sky background. Further analysis of what signs are seen by drivers, when numbers of signs become too many, and what signs are good and bad continues (10, 108). Mackie (136) discusses learning progress for symbol types of signs, not all of which are self-explanatory to all people. Analysis of human factors has been applied in the design of warning devices (101).

The California fog study (45) reveals a reduction in speed of 5 to 8 mph in fog except in high-volume daytime and low-volume nighttime freeway operations when there is little change. In fog, red is most visible and green is useless; this is a strong argument against green taillights. In fog, present-day taillights have too little candlepower to be useful. Accidents due to fog were only 2 percent of all accidents and were judged insufficient to justify very expensive special protection, most of which was found to be of only slight help in accident reduction during the short periods of dangerous fog.

Lyman (135) provides 407 references on detection. Shea and Summers (171) discuss the problems of seeing distant points of light. Whitewall tires are recommended because they show better than black tires; reflectorization is considered to be better than white (3). Detection is reduced when it is required along with a mental task (113), and the diameter of the pupil of the eye is an index of the perceptual load. Visibility distances (166) for 140- by 40-cm cloth-covered objects of 3, 6, 16, and 82 percent reflectivity against dry, wet, and snowy roads vary from 34 m (112 ft, black on dry road) to 160 m (425 ft, white on wet road). On a snowy road, white was seen less well, 100 m (328 ft), and dark gray best 51 m (167 ft).

Lit (132) reviews visual acuity, and Cornog and Rose (52) report on the legibility of alphanumeric characters. Rattle and Foley-Fisher (158) correlate vernier acuity with

intersaccadic interval. Burg (35) compares dynamic and static visual acuity, finding that the dynamic acuity correlates better with a static chart than with the Orthorater. A marked decrease in both dynamic and static acuity with age is reported, possibly from changes in the complex nature of accommodation and the pursuit task that involves resolution and coordination of eye and neck muscles. Munker (146) indicates a decrease in acuity during moving in traffic from a half to a tenth of that observed during a static test. Vertical vibration of the test target decreased acuity more than small horizontal vibration. The discussion, following the paper, objected to "dynamic" visual acuity and favored "kinetische" or kinetic visual acuity. Gordon and Michaels (80) analyze basic aspects of driver perception of static and moving visual fields.

The disc is a good representative target for testing contrast, and the differences found for various targets are reported by Guth and McNelis (87). Low contrast tests, a modified Titmus test, and an Allen's test show a decline in vision with age. The Allen 50 to 60 percent contrast showed no greater loss in average scores under mesopic conditions than did the 90 percent contrast Titmus test (73).

Pedestrian visibility was measured by Rumar (165) for varying contrast and headlight beam misalignment. Silhouette is no help within about 3 ft from the edge of the road. He recommends forcing the pedestrian to protect himself. Retroreflectorization of helmets for motorcyclists is recommended to increase their visibility (91). Allen (5) emphasizes that windshields should be replaced when the surface deteroriation forms a haze and lessens vision through the glass.

The color of signal lights and considerable information about colors and their seeability were compiled by Breckenridge (31). Daylight fluorescent orange is recommended for the protection of humans from accidents (140). Colored pavements are being tested (97). The value of red light for dark adaptation is questioned by Dohrn (61). The Stabells (176) found that colors can be seen at luminances below the break in the usual dark adaption curve, which indicates a need for revision of the duplicity theory.

Defective color vision remains stable over some years (65). Reaction times for red light are a tenth those of white light and a fourth those of green light (6). A detailed study of signal light recognition by color-vision defective people revealed errors for 11 percent at high and 13 percent at low intensity. More errors were made in daylight than at night! Amber was mistaken for red 22 percent of the time at high intensity and 24 percent at low intensity. Protans make mistakes at low but not at high intensity. Deutans have more difficulty seeing amber lights (173). The decreased visibility of red for protans measured by Clark (50) indicates that specific tinted glasses can delay the recognition of signals. The use of red filters of progressingly longer dominant wavelengths can be used to estimate the loss for identification of red signals (83).

Wearing sunglasses at night caused a British singer to be fined (15). Henderson's study (92) on yellow glasses and glare resistance gives conflicting findings that suggest that the technique used was inadequate. Phillips and Rutstein (151) report a detailed survey on amber night-driving glasses and new tests showing that their 10 subjects did not see as well with yellow glasses and had less glare resistance to yellow light. Plastic yellow spectacles were worse because of the increased veiling glare. Yellow headlight tests did not support the French claim of 8 percent increased visual acuity despite a 15 percent loss of light. Instead they found a 2.5 percent loss in vision. Increasing the luminance of the yellow to make up for the filter loss gave a slight 3 percent gain in visual acuity (48). Redetection was slower following glare from yellow light than it was following glare from white light of equal intensity, and more so for younger persons. Glare recovery decreases with increasing age (159).

Engine and other noises associated with driving heavy trucks have a low frequency spectrum, less than 600 Hz, and can increase the speech interference level far above 70 dB. Even though the danger of hearing loss over a long time is less in truck driving than in other noisier occupations, applicants for truck driving should be tested for hearing and documented by an audiogram (93).

Drugs usually have an adverse effect on seeing, and several recent publications discuss this problem (69, 84, 116, 134, 185). Green (85) lists 23 categories of drugs that may influence driving. Cooper (51) has prepared an extensive bibliography on

carbon monoxide, and measurements of carbon monoxide concentrations are reported for several cities (32). Although the results (63) are inconclusive, prolonged simulation of driving performance may be better with Diazepam (Valium). Laroche (128) found that use of streptomycin and dihydrostreptomycin resulted in green blindness.

Crancer et al. (53) reported that during simulated driving, marihuana produced more speedometer errors and alcohol more accelerator, brake, signal, speedometer, and total errors.

All reports on alcohol indicate that accidents increase as the blood alcohol rises (12, 17, 103, 139, 102, 106, 142, 175, 179). A study of the effects of amitriptyline and alcohol together indicates that this antidepressant adds to the deleterious effects of alcohol on driving ability (127). When the visibility of a pedestrian is border line, the seeing distance declines rapidly for drivers after drinking alcohol. Only a reflectorized dummy is seen at 40 mph by drivers with a high blood alcohol concentration (90).

Reaction times of young drivers (20 to 25 years) to auditory stimulation within the car and to a light outside the car increase with increased driving time. Four hours of nonstop driving in daytime, darkness, and after one night of sleep deprivation showed no significant differences (133). Another study at Uppsala University gives physiological data on fatigue from simulated automobile driving (64). Pregnancy may have an adverse effect on night vision (60).

Beginning drivers are less dangerous than 18- to 20-year-old drivers. The worst accident rate was found for 18- to 20-year-old drivers with low mileage experience, next for the 21- to 22-year-olds with low mileage experience, and third for the 18- to 20-year-olds with median mileage experience (19). Allen (1) gives driving tips for the aged, and Planek et al. (152) present a broad survey of the problems of older drivers. Dynamic visual acuity declines with age (68). Burg's (37) analysis of the California data shows slight correlation between horizontal phoria and age and also shows a trend toward exophoria in older people, more so in females than males. The total visual field is greatest at 16 to 35 years and then declines with age. Females (except after age 80) show larger nasal and temporal fields than males, and the greatest differences are in the temporal fields (41). Light sensitivity was fairly level at ages 25 to 40 and thereafter declines. The luminance threshold appears to be more closely related to age than is glare recovery (36). Vision declines with age; older people need more light and, because it is not presently possible to provide better road lighting for oldsters, they are handicapped and gradually forced to give up driving at night (161).

Vision and driving were examined in a Texas symposium (181). Further analysis of the California data by Burg (38, 40) shows dynamic visual acuity has the best correlation with the driving record, followed by static visual acuity, fields, and glare recovery. Age, sex, and annual mileage driven play a large role in the driver record. The performance of males was better than that of females on static and dynamic visual acuity and lateral phorias, and the performance of females was better on fields, glare recovery, and low illumination thresholds (38).

Low luminance tends to draw the driver nearer to the center of the road and to cause him to reduce his speed. Drivers can maintain constant speed and lane position at 0.168 mL (137). Positive afterimages are discussed by Fry (76). Problems of seeing during naval operations at night provide some useful information on the night automobile driving problem (125).

More interest in driving problems is noted by the medical profession. MacFarland (138) reviews some aspects of accidents, Antia (20) tries to find predictors for accidents, and Gramberg-Danielsen (82) discusses some European court decisions. Abnormalities seen during an autopsy can explain some accidents due to visual disability, and more use of such findings are needed (194). One-eyed drivers may be more of a factor in accidents than earlier studies showed (120). One problem of the monocular driver is that he loses more time from seeing the road while he checks speed. An additional nearside mirror and goggles are recommended (33). Keeney (118, 119, 120) reviews various pathological conditions and their relation to safety in driving. Some, but not all, epileptics may be allowed to drive under specified conditions (66, 99). The accident record of medical and surgical patients is about the same as that of a random sample of male drivers (42). Keeney's (120) analyses of the medical aspects of the

Kentucky program showed that 10 percent of 1,153 drivers had medical conditions that interfered with safe driving.

Night myopia has been traced back to Maskelyne in 1758 by Levene (131), and Young (192) describes interrelations of myopia and personality.

A theoretical model is proposed for showing improvement of night vision from correction of the optical aberrations of the eyes (153). Bewley (27) points out the hazard from wide spectacle frames that block out parts of the field of view, reminding us of the earlier work of Weale (16). A poorly fitting spectacle frame decreases vision and increases driver annoyance and fatigue. Much of this hazard could be avoided if the fitting methods of Grolman (193) were followed.

Contact lenses and possibly serious complications are discussed, and Diamond (59) states that only one of a pilot-copilot team should be permitted to wear them during flight. Corneal contact lenses transmit into the eye more than 7 percent more light than do spectacle lenses, and the sensitivity of contact lens wearers to light is 11 percent more; both factors contribute to the increased glare experienced with contact lenses (25, 26). Davey (55, 56, 57) discusses the loss of visual fields from helmets and problems of protecting the vision of motorcyclists.

In Great Britain, 1 percent of 1,190 drivers tested had defective vision and 5 of these drivers were monocular. The Association of Optical Practitioners found 1.12 percent of drivers had substandard vision (16). In Munich, 92.7 percent of 106,140 drivers had vision better than 70 percent of the norm, and 0.1 percent had serious deficiency of less than 30 percent of the norm (147). A study in Tennessee of 175 drivers revealed that 20 had significant phorias, 15 had substandard acuity, 5 had poor (< 20/70) acuity, 45 had poor color vision, and 8 had field loss (94). Kaestner (112) reexamined about 13,000 records of Oregon drivers. The written test had more predictive value for males than for females and the road test had more for females than for males. Five-year accident averages and other data are included. Much useful information was gathered in Kentucky (120).

In its provisional standards for vision required for a driver's license, the American Medical Association divides vehicles into 3 classes: public service vehicles, taxis, and private cars (11). Acuities of 20/25, 20/40 in the bad eye, and 20/40 or better in one eye and fields of 30 deg nasal and temporal each eye, 30 deg, and 140 deg respectively are required for each class. Pathological limitations are listed. Lenses of more than 10 diopters are prohibited unless the visual field is 140 deg. Provision for special licenses and the frequency of examinations are discussed. New vision standards for Michigan drivers are described (126).

Powell (154) presents the viewpoint of the Illinois Secretary of State on license examination experience. License requirements are summarized for some European countries (183).

Keeney (119) discusses in-depth problems of vision testing, vision requirements for automobile driving, and the responsibility of judging cases of border-line visual abilities. A British viewpoint is stated (196). The vision of airline pilots at intermediate distances, especially in the over-45 age bracket, should be measured, and proper spectacle correction provided (89). Rates of vision responses are summarized by Sands (168). Although instruments are not as important in automobile driving as in flying, the changes in near vision should be kept in mind. Kaufmann (117) urges that a visual acuity of 1.0 be required in Germany. Almost every year someone points out the advantages of reflectorized license plates to increase the visibility of automobiles at night (46).

Consideration of what the driving task actually is rather than vaguely attributing it to seeing is a hopeful sign in the current literature. Mathematical analyses are initiated (77, 157). General rules and what to look for at night are listed by Fales (67). A research program is submitted for highway safety (22). Cumming (54) gives an analysis of the skills involved in driving and the advantages to be gained if the input of information to the driver is neither too little nor too much. Senders et al. (170) also consider the sensory information input and the abilities and limitations of the driver to process and respond properly to his task. Pilots are being tested under conditions of sensory input overload (62). At a 1969 Berkeley conference, factor analysis methods were proposed to find out what actually is the automobile driving

task. The tendency to concentrate on a single element, when the driver's processing ability is overreached, is dangerous to safety and can spoil driver communications (190).

Burg (39, 40) summarizes the vision information and driving records of his large-scale California study. Dynamic visual acuity has the best relationship with the driving record; static visual acuity, glare resistance threshold, and field size may be useful tests. Seeing problems from within an automobile, design problems, and seeing needs are summarized by Gioia and Morphew (79). Seeing-timing data provided by Sands (168) are useful also at the slower rates of automobile driving. Fry (74) gives an analysis of the use of the eyes in steering an automobile. Planning ahead to correct misalignment with the road is necessary because steering is rate control (including reaction time); it may take a second for completion. Anticipation must be considered in the visual problem and task analysis. The overestimation or underestimation of actual speed by the driver needs to be included in the analysis of reaction timing (23), and accurate judgment of speed is important for much of the driving task (167). Presentation of information near where the eyes are viewing the road will save 0.4 second, the time necessary to accommodate and converge the eyes on the dashboard; this is a suggestion toward automation for the driver (178). Eye-movement analysis by Thomas (195) will be useful.

Specification for a convex mirror of not less than 1,200-mm radius and proper positioning of these mirrors are proposed with a discussion of learning to use convex rear-vision mirrors (186).

An instrumented car is in use in Holland for the study of driver behavior (141). Denton (58) describes a moving road simulator, and a new reaction time tester is reported (14). A television display used to investigate seeing from right, center, and left of the automobile indicates that the usual left side may not be the best position for the driver's eyes (115). A psychological questionnaire failed to identify risk-taking propensity of high- and low-accident-prone drivers (86).

A similar review of the literature on vision at levels of night illumination was made by the author in 1967 (160). In addition, a bibliography on night visibility (95) and one on headlight glare (96) are available.

REFERENCES

1. Allen, M. J. Tips for the Older Driver. Optom. Weekly, Vol. 58, No. 23, 1967, pp. 31-32.
2. Allen, M. J. Headlight Ring Retroreflectors. Am. Jour. Optom., Vol. 44, 1967, pp. 765-768.
3. Allen, M. J. White Tire Treads and Truck Visibility. Jour. Am. Optom. Assn., Vol. 39, 1968, p. 827.
4. Allen, M. J. Disappearing Headlights. Jour. Am. Optom. Assn., Vol. 40, 1969, pp. 601-602.
5. Allen, M. J. Automobile Windshields—Surface Deterioration. Am. Jour. Optom., Vol. 46, 1969, pp. 594-598.
6. Allen, M. J., et al. Visibility of Red, Green, Amber and White Signal Lights. Am. Jour. Optom. Vol. 44, 1967, pp. 105-109.
7. Allen, M. J., et al. The Effect of Low Vs. High Beam Headlights and Ametropia on Highway Visibility at Night. Am. Jour. Optom., Vol. 45, 1968, pp. 80-85.
8. Allen, M. J., et al. Daytime Headlights and Position on the Highway. Am. Jour. Optom., Vol. 46, 1969, pp. 33-36.
9. Allen, T. M., et al. Luminance Requirements for Illuminated Signs. Highway Research Record 179, 1967, pp. 16-37.
10. Ancker, C. J., Jr., et al. The Oversaturated Signalized Intersection—Some Statistics. Transp. Sci., Vol. 2, 1968, pp. 340-361.
11. Committee on Medical Aspects of Automotive Safety, American Medical Assn. Visual Factors in Automobile Driving and Provisional Standards. Archiv. Ophth., Vol. 81, 1969, pp. 865-871.
12. Committee on Medicolegal Problems, American Medical Assn. Alcohol and the Impaired Driver. AMA, Chicago, 1968, 234 pp.

13. Glare in Street Lighting. Lichttechnik, Vol. 20, 1968, pp. 1A-5A.
14. Optician Invents Driving Reaction Timer. Optician, Vol. 155, 1968, p. 198.
15. Night Driving Glasses. Optician, Vol. 155, 1968, p. 99.
16. Defective Vision of Drivers. Optician, Vol. 154, 1967, p. 90.
17. 1968 Alcohol and Highway Safety Report. Govt. Printing Office, Washington, D. C., 1968, 182 pp.
18. Glare and Driver Vision Report. Available From National Technical Information Service, Springfield, Va., PB 180 964, 1968, 61 pp.
19. Neophyte Young Drivers Are Found Less Dangerous Than Teens With Some Practice. Highway Research News, No. 36, 1969, pp. 8-9.
20. Antia, K. H. Biographical and Medical Data About the Automobile Driver—A Review of Literature. Highway Research News, No. 37, 1969, pp. 51-61.
21. Arens, H. Colour Measurement. Focal Press, London, 1957, 88 pp.
22. Baldwin, W. R. Visual Science in Highway Safety: A Program for Research. Optom. Weekly, Vol. 58, No. 16, 1967, pp. 29-38.
23. Barrett, G. V., and Fox, B. H. Driving at Requested Speed: Comparison of Projected and Virtual Image Displays. Optom. Weekly, Vol. 60, No. 20, 1969, pp. 33-36.
24. Benson, W., and Whitcomb, M. A., eds. Current Developments in Optics and Vision. National Academy of Sciences, Washington, D. C., 1968, 128 pp.
25. Bergevin, J., and Millodot, M. Étude Comparative de l'Éblouissement avec le Port des Lentilles Ophthalmiques et Cornéennes en Vision Nocturne. Cah. Verres Contact, Vol. 16, 1968, pp. 24-29.
26. Bergevin, J., and Millodot, M. Glare With Ophthalmic and Corneal Lenses. Am. Jour. Optom., Vol. 44, 1967, pp. 213-221, 745-746.
27. Bewley, L. A. Spectacle Frames Reduce the Field of Vision: A Driving Hazard. Jour. Am. Optom. Assn., Vol. 40, 1969, pp. 64-69.
28. Birkhoff, A. J. Description of a Pavement Reflectometer and Some Comparison Reflectance Measurements of Pavements. Inst. Res. Vision, Ohio State Univ., 1967, 45 pp.
29. Blatnik, J. A., et al. Roadside Hazards. Eno Foundation, Saugatuck, Conn., 1968, 28 pp.
30. Brass, J. R. Improved Highway Signing for Safer Driving. Illum. Eng., Vol. 62, 1967, pp. 298-304.
31. Breckenridge, F. C. Colors of Signal Lights, Their Selection, Definition, Measurement, Production and Use. Govt. Printing Office, Washington, D. C., 1967, 59 pp.
32. Brice, R. M., and Roesler, J. F. The Exposure to Carbon-Monoxide of Occupants of Vehicles Moving in Heavy Traffic. Jour. Air Pollution Control Assn., Vol. 16, No. 11, 1967, pp. 597-600.
33. Broschmann, D. Der Einäugige un Strassenverkehr. Verkehrsmedizin, Vol. 12, 1965, pp. 571-576; Optician, Vol. 154, 1967, p. 29.
34. Bugelski, B. R. Traffic Signals and Depth Perception. Science, Vol. 157, 1967, pp. 1464-1465.
35. Burg, A. Visual Acuity as Measured by Dynamic and Static Tests: A Comparative Evaluation. Jour. Appl. Psych., Vol. 50, No. 6, 1966, pp. 460-466.
36. Burg, A. Light Sensitivity as Related to Age and Sex. Perceptual and Motor Skills, Vol. 24, 1967, pp. 1279-1288.
37. Burg, A. Horizontal Phoria as Related to Age and Sex. Am. Jour. Optom., Vol. 45, 1968, pp. 343-350.
38. Burg, A. Vision and Driving. In Current Developments in Optics and Vision (Benson, W., and Whitcomb, M. A., eds.), National Academy of Sciences, Washington, D. C., 1968, pp. 22-35.
39. Burg, A. Vision and Driving Research. Dept. of Eng., Univ. of California, Los Angeles, Rept. 68-27, 1968, 132 pp.
40. Burg, A. Vision and Driving: A Summary of Research Findings. Highway Research Record 216, 1968, pp. 1-12.
41. Burg, A. Lateral Visual Field as Related to Age and Sex. Jour. Appl. Psych., Vol. 52, No. 1, 1968, pp. 10-15.

42. Buttiglieri, M. W. Driving Record of Medical and Surgical Patients. Perceptual and Motor Skills, Vol. 29, 1969, pp. 427-434.
43. Byrnes, V. A. Vision and Its Importance in Driving. Sight Saving Rev., Vol. 37, No. 2, 1967, pp. 87-91.
44. Evaluation of Minor Improvements. California Div. of Highways, Sacramento, 1967, 70 pp.
45. Reduced Visibility (Fog) Study. California Transportation Agency, 1967, 132 pp.
46. Campbell, B. J., and Rouse, W. S. Reflectorized License Plates and Rear End Collisions at Night. Highway Safety Res. Center, Univ. of North Carolina, 1968, 25 pp.
47. Cantilli, E. J. Daylight "Running Lights" Reduce Accidents. Traffic Eng., Vol. 39, No. 5, 1969, pp. 52-54.
48. Christie, A. W., et al. Visual Acuity in Yellow Headlights. Road Research Laboratory, Crowthorne, Berkshire, England, Rept. LR156, 1968, 25 pp.
49. Christie, A. W., and Newby, R. F. Some Further Data Relating to Dipped Headlights Campaigns in Birmingham and Other Towns. Road Research Laboratory, Crowthorne, Berkshire, England, Rept. LR210, 1968, 15 pp.
50. Clark, B. A. J. Effects of Tinted Ophthalmic Media on the Detection and Recognition of Red Signal Lights. Aerospace Med., Vol. 39, 1968, pp. 1198-1205.
51. Cooper, A. G. Carbon Monoxide, a Bibliography With Abstracts. U. S. Public Health Service, Pub. 1503, 1966, 440 pp.
52. Cornog, D. Y., and Rose, F. C. Legibility of Alphanumeric Characters and Other Symbols. National Bureau of Standards, Misc. Pub. 262-2, 1967, 460 pp.
53. Crancer, A., Jr., et al. Comparison of the Effects of Marihuana and Alcohol on Simulated Driving Performance. Science, Vol. 164, 1969, pp. 851-854.
54. Cumming, R. W. The Analysis of Skills in Driving. Australian Road Research, Vol. 1, 1964, pp. 4-14.
55. Davey, J. B. Head Lamps and Driver's Vision. Optician, Vol. 153, 1967, pp. 211-216.
56. Davey, J. B. Motorcyclist's Eye Protection. Optician, Vol. 153, 1967, pp. 525-529.
57. Davey, J. B. Some Investigations Into Motorcyclist's Eye Protectors. Ophthalmic Optician, Vol. 7, 1967, pp. 820-824, 829.
58. Denton, C. G. Moving Road Simulator—A Machine Suitable for the Study of Speed Phenomena Including Motion After-Effect. Ergonomics, Vol. 3, 1966, pp. 517-520.
59. Diamond, S. Medical Complications of Contact Lenses and Their Aero-Medical Implications. Aerospace Med., Vol. 38, 1967, pp. 739-741.
60. Dixit, D. T. Night Blindness in the Third Trimester of Pregnancy. Indian Jour. Med. Res., Vol. 54, 1966, pp. 791-795.
61. Dohrn, R. H. Effect of Low Level Red or White Light on Dark Adaptation. Am. Jour. Optom., Vol. 46, 1969, pp. 103-108.
62. Drinkwater, B. L. Performance of Civil Aviation Pilots Under Conditions of Sensory Input Overload. Aerospace Med., Vol. 38, 1967, pp. 164-168.
63. Dureman, I., et al. A Close Response Study of Diazepam (Valium) and 4306CB (Tranxilen) During Prolonged Simulated Car Driving. Psychology Dept., Univ. of Uppsala, Sweden, Rept. 54, 1968, 23 pp.
64. Dureman, I., and Bodén, C. Fatigue in Simulated Car Driving. Psychology Dept., Univ. of Uppsala, Sweden, Rept. 49, 1968, 23 pp.
65. Dvorine, I. The Re-Examination of Color Vision Defectives After a Lapse of Years. Optom. Weekly, Vol. 58, No. 12, 1967, pp. 19-23.
66. Espir, M. L. E. Epilepsy and Driving. Lancet, Vol. 7486, 1967, pp. 375-377.
67. Fales, E. D., Jr. Night Driving: How to Handle Its Deadly Hazards. Pop. Mech., Vol. 130, No. 3, 1968, pp. 65-67, 204.
68. Farrimond, T. Visual and Auditory Performance Variations With Age: Some Implications. Aust. Jour. Psych. Res., Vol. 19, 1967, pp. 193-201.
69. Fish, L. J. The Side Effects of Modern Drugs With Particular Reference to the Eye. Ophthalmic Optician, Vol. 8, 1968, pp. 807-810, 817, 877-879, 893.

70. Forbes, T. W. Factors in Visibility and Legibility of Highway Signs. National Academy of Sciences, Washington, D. C., 1969, 28 pp.
71. Forbes, T. W., et al. Letter and Sign Contrast, Brightness, and Size Effects on Visibility. Highway Research Record 216, 1968, pp. 48-54.
72. Forbes, T. W., et al. Color and Brightness Factors in Simulated and Full-Scale Traffic Sign Visibility. Highway Research Record 216, 1968, pp. 55-65.
73. Forbes, T. W., et al. Low Contrast and Standard Visual Acuity Under Mesopic and Photopic Illumination. Jour. Safety Res., Vol. 1, 1969, pp. 5-12.
74. Fry, G. A. The Use of the Eyes in Steering a Car on Straight and Curved Roads. Am. Jour. Optom., Vol. 45, 1968, pp. 374-391.
75. Fry, G. A. Geometrical Optics. Chilton Book Co., Philadelphia, 1969, 290 pp.
76. Fry, G. A. Positive Afterimage and Measurements of Light and Dark Adaptation. Am. Jour. Optom., Vol. 46, 1969, pp. 397-410.
77. Gazis, D. C. Mathematical Theory of Automobile Driving. Science, Vol. 157, 1967, pp. 273-281.
78. Gibson, W. H. Red, Green, and Amber Taillights. Optom. Weekly, Vol. 60, No. 17, 1969, pp. 37-39.
79. Gioia, A. J., and Morphew, C. E. Evaluation of Driver Vision. Automotive Safety Center, Gen. Motors Corp., 1968, 14 pp.
80. Gordon, D. A., and Michaels, R. M. Static and Dynamic Visual Fields in Vehicular Guidance. Highway Research Record 84, 1965, pp. 1-15.
81. Gramberg-Danielsen, B. Sehen und Verkehr. Springer-Verlag, Berlin, 1967, 275 pp.
82. Gramberg-Danielsen, B. Verwaltungsrechtliche Entscheidungen zur Fahrerlaubnis bei Sehmänglen. Klinische Monatsblätter für Augenheilkunde, Vol. 149, 1966, pp. 576-580.
83. Gramberg-Danielsen, B. Die Abhängigkeit der Sehschärfe von der Lichtfarbe bei Protogestörten. Ber. Dtsch. Ophthal. Ges., Vol. 68, 1967, pp. 426-427.
84. Gramberg-Danielsen, B. Medikament, Auge und Verkehr. Klinische Monatsblätter für Augenheilkunde, Vol. 153, 1968, pp. 280-288.
85. Green, H. Drugs With Possible Ocular Side Effects. Hatton Press, London, 1969.
86. Gumpper, D. C., and Smith, K. R. The Prediction of Individual Accident Liability With an Inventory Measuring Risk-Taking Tendency. Traffic Safety Res. Rev., Vol. 12, No. 2, pp. 50-55.
87. Guth, S. K., and McNelis, J. F. Threshold Contrast as a Function of Target Complexity. Am. Jour. Optom., Vol. 46, 1969, pp. 491-498.
88. Hare, C. T., and Hemion, R. H. Head Lamp Beam Usage on U. S. Highways. Southwest Res. Inst., San Antonio, Texas, 1969, 40 pp.
89. Harper, C. R., et al. Intermediate Vision Testing of Airline Pilots. Aerospace Med., Vol. 37, 1966, pp. 841-843.
90. Hazlett, R. D., and Allen, M. J. The Ability to See a Pedestrian at Night: Effects of Clothing, Reflectorization, and Driver Intoxication. Highway Research Record 216, 1968, pp. 13-22; Am. Jour. Optom., Vol. 45, 1968, pp. 246-258.
91. Hazlett, R. D., et al. Motorcycle Helmet Visibility and Retro-Reflectorization. Am. Jour. Optom., Vol. 46, 1969, pp. 666-675.
92. Henderson, H. L., et al. The Effectiveness of Night Driving Glasses Under Part-Task Simulation. Am. Jour. Optom., Vol. 45, 1968, pp. 170-187; Driver's Safety Service, New York, 28 pp.
93. Hermann, H., and Lentage, H. Protracted Observations of the Influence of Noise on the Drivers of Heavy Trucks. Zentralblatt für Arbeitsmedizin, Vol. 17, No. 3, 1967.
94. Hiatt, R. L., and Effron, A. M. Visual Factors in Automotive Driver Safety. Jour. Tenn. Med. Assn., Vol. 61, 1968, pp. 278-282.
95. Night Visibility: Selected References. HRB Biblio. 45, 1967, 16 pp.
96. Headlight Glare. HRB Biblio. 46, 1968, 60 pp.
97. Guidance Aspects of Colored Pavements and Pavement Markings. Highway Research Record 221, 1968, 84 pp.

98. Effects of Illumination on Operating Characteristics of Freeways. NCHRP Rept. 60, 1968, 148 pp.
99. Hirschman, J. Epilepsy and Fitness to Drive. Dtsch. Zeitschrift für die Gesamte Gerichtliche Medizin, Vol. 57, No. 1-2, 1966.
100. Honegger, H. and Schäfer, W. D. Sehschärfe für bewegte Objekte bei Blickhebung und Blicksenkung. Ber. Dtsch. Ophthal. Ges., Vol. 68, 1967, pp. 419-426.
101. Hulbert, S. F., and Burg, A. Application of Human Factors Research in Design of Warning Devices for Highway-Rail Grade Crossings. NCHRP Rept. 50, 1968, pp. 82-105.
102. Hunter, W. A. The Effect of Alcohol on Visual Performance in Driving. Optom. Weekly, Vol. 58, No. 36, 1967, p. 43.
103. Hyman, M. A. Accident Probability and Blood Alcohol Concentrations of Drivers in Relation to Demographic Characteristics. Center of Alcohol Studies, Rutgers Univ., N. J., 1967.
104. Glare and Driver Vision. Inst. of Traffic and Transportation Eng., Univ. of Calif., Berkeley, 1968, 146 pp.
105. James, R. D., and Thorburn, H. J. Veiling Glare of Polarizing Lenses. Optician, Vol. 150, 1965, pp. 374-377.
106. Jatho, K. Die Wirkung des Alkoholgenusses auf die Gleichgewichtsfunktion und die Sehfunktion im Strassenverkehr sowie ihre diagnostische Beurteilung. Zentralblätt für Verkehrsmedizin, Vol. 14, 1968, pp. 1-11.
107. Jenkens, R. S. A Study of Selection of Yellow Clearance Intervals for Traffic Signals. Michigan Dept. of State Highways, Lansing, Rept. TSD-TR-104-69, 1969, 65 pp.
108. Johansson, G., and Backlund, F. Drivers and Road Signs. Psychology Dept., Univ. of Uppsala, Sweden, Rept. 50, 1968, 18 pp.
109. Johansson, G., et al. Experimentella Studier av Polariserat Mötesljus. Psychology Dept., Univ. of Uppsala, Sweden, Rept. I S-37, 1969, 48 pp., and Rept. II S-38, 1969, 13 pp.
110. Johansson, G., and Rumar, K. A New System With Polarized Headlights. Psychology Dept., Univ. of Uppsala, Sweden, Rept. 64, 1968, 17 pp.
111. Johansson, G., and Rumar, K. Visible Distances and Safe Approach Speeds for Night Driving. Ergonomics, Vol. 11, 1968, pp. 275-282.
112. Kaestner, N. F. A Second Look at Licensed Drivers in Oregon. Oregon Dept. of Motor Vehicles, Salem, 1967, 47 pp.
113. Kahneman, D., et al. Perceptual Deficit During a Mental Task. Science, Vol. 157, 1967, pp. 218-219.
114. Kao, H. S. R., and Nagamachi, M. Visual Operational Feedback and Design of Vehicle Front-End Illumination for Night Driving. Perceptual and Motor Skills, Vol. 28, 1969, pp. 243-246.
115. Kao, H. S., and Smith, K. U. Cybernetic Television Methods Applied to Feedback Analysis of Automobile Safety. Nature, Vol. 222, 1969, pp. 299-300.
116. Karani, S. Modern Drug Therapy and Visual Complications. Ophthalmic Optician, Vol. 7, 1967, pp. 277-283.
117. Kaufmann, G. Der Sehtest setz sich durch. Klinische Monatsblätter für Augenheilkunde, Vol. 153, 1968, pp. 288-290.
118. Keeney, A. H. Ophthalmology in Driving. Trans., Pacific Coast Oto-Ophthal. Soc., Vol. 48, 1967, pp. 167-178.
119. Keeney, A. H. Eyes and the Automobile. Trans., Pennsvlania Academy of Ophthal. Otolaryng., 1966, pp. 90-94.
120. Keeney, A. H. Ophthalmic Pathology in Driver Limitation. Trans., Am. Academy of Ophthal. Otolaryng, Vol. 72, 1968, pp. 737-740.
121. Ketvirtis, A. Highway Lighting Engineering. Found. of Canada Eng. Corp., Toronto, 1967, 334 pp.
122. Ketvirtis, A. Increased Highway Safety and Efficiency Through Higher Luminaire Mounting Heights. Illum. Eng., Vol. 62, 1967, pp. 384-389.
123. King, L. E., and Finch, D. M. A Laboratory Method for Obtaining Pavement Reflectance Data. Highway Research Record 216, 1968, pp. 23-33.

124. King, L. E., and Finch, D. M. Daytime Running Lights. Highway Research Record 275, 1969, pp. 23-31.
125. Kinney, J. A. S., et al. Analysis of a Variety of Visual Problems Encountered During Naval Operations at Night. U. S. Navy, S. M. C. Rept. 545, 1968, 20 pp.
126. Kuhlman, R. L., and Heinze, D. N. New Vision Standards for Michigan Drivers. Opt. Jour. and Rev. of Optom., Vol. 106, 1969, pp. 42-45.
127. Landauer, A. A., et al. Alcohol and Amitriptyline Effects on Skills Related to Driving Behavior. Science, Vol. 163, 1969, pp. 1467-1468.
128. Laroche, J. Modifications de la Vision des Couleurs chez l'Homme sous l'Action de Certaines Substances Médicamenteuses. Ann. Oculist, Vol. 200, 1967, pp. 275-286.
129. LeGrand, Y. Form and Space Vision. Millodot, M., and Heath, G. G., trs., Indiana Univ. Press, Bloomington, 1967, 352 pp.
130. LeGrand, Y. Light, Colour and Vision, 2nd ed. Hunt, et al., trs., Barnes and Noble, New York, 1968, 566 pp.
131. Levene, J. R. Nevil Maskelyne, F. R. S., and the Discovery of Night Myopia. Roy. Soc. London, Notes and Reports, Vol. 20, 1965, pp. 100-108.
132. Lit, A. Visual Acuity. Ann. Rev. Psych., Vol. 19, 1968, pp. 27-54.
133. Lisper, H. O., et al. Effect of Prolonged Driving Upon a Subsidiary Serial Reaction Time. Psychology Dept., Univ. of Uppsala, Sweden, Rept. 52, 1968, 15 pp.
134. Luethje, D. S. Fatal Single Vehicle Accidents. California Highway Patrolman, Vol. 30, No. 11, 1967, pp. 11, 60+.
135. Lyman, B. Visual Detection, Identification and Localization: An Annotated Bibliography. Available from National Technical Information Service, Springfield, Va., AD 667 500, 1968, 116 pp.
136. Mackie, A. M. Progress in Learning the Meanings of Symbolic Traffic Signs. Road Research Laboratory, Crowthorne, Berkshire, England, Rept. LR91, 1967, 25 pp.
137. Matanzo, F., Jr., and Rockwell, T. H. Driving Performance Under Nighttime Conditions of Visual Degradation. Human Factors, Vol. 9, 1967, pp. 427-432.
138. McFarland, R. A. Psychological and Behavioral Aspects of Automobile Accidents. Traffic Safety Res. Rev., Vol. 12, No. 3, 1968, pp. 71-80.
139. Alcohol Safety. Highway Safety Res. Inst., Univ. of Michigan, 2 Vols., 1969.
140. Michon, J. A., and Koutstaal, G. A. Safety Clothing for Human Traffic Obstacles. Ergonomics, Vol. 12, 1969, pp. 61-70.
141. Michon, J. A., and Koutstaal, G. A. An Instrumented Car for the Study of Driver Behavior. Am. Psychologist, Vol. 24, 1969, pp. 297-300.
142. Mirochinik, P. The Drinking Driver and Motor Vehicle Accidents in Alberta for the Period 1961 to 1965. Traffic Quart., Vol. 21, 1967, pp. 249-267.
143. Mortimer, R. G. Psychological Considerations in Design of an Automobile Rear Lighting System. Traffic Safety Res. Rev., Vol. 12, No. 1, 1968, pp. 13-16.
144. Mortimer, R. G. Dynamic Evaluation of Automobile Rear Lighting Configurations. Highway Research Record 275, 1969, pp. 12-22.
145. Mote, F. A. Visual Sensitivity. Ann. Rev. Psych., Vol. 18, 1967, pp. 41-64.
146. Munker, H. Experimentalle Untersuchungen zur dynamischen Sehschärfe. Ber. Dtsch. Ophthal. Ges., Vol. 68, 1967, pp. 294-298.
147. Munsch, B. Ueber den Sinn der Kraftfahrer-Sehtestung. Fortschritte der Medizin, Vol. 85, 1967, pp. 845-846.
148. Nimeroff, I. Colorimetry. National Bureau of Standards, Monograph 104, 1968, 47 pp.
149. Ogle, K. G. Optics, An Introduction for Ophthalmologists, 2nd ed. C. Thomas, Springfield, Ill., 1968, 244 pp.
150. Pain, R. Brightness and Brightness Ratios as Factors in the Attention Value of Highway Signs. Highway Research Record 275, 1969, pp. 32-40.
151. Phillips, A. J., and Rutstein, A. Amber Night Driving Spectacles: A Further Study. Brit. Jour. Physiol. Opt., Vol. 24, 1967, pp. 161-205.
152. Planek, T. W., et al. An Investigation of the Problems and Opinions of Aged Drivers. National Safety Council, Chicago, Rept. 5/68, 1968, 243 pp.

153. Pomerantzeff, O. Enhancement of Night Vision by Correction of Optical Aberrations of the Eye. Available from National Technical Information Service, Springfield, Va., AD 815 905, 1967, 17 pp.
154. Powell, P. Driver Vision and Traffic Safety. Optom. Weekly, Vol. 59, No. 16, 1968, pp. 25-31.
155. Powers, L. D., and Solomon, D. Headlight Glare and Median Width: Three Exploratory Studies. Highway Research Record 70, 1965, pp. 1-28.
156. Projector, T. H., et al. Analytic Assessment of Motor Vehicle Rear Signal Systems. Century Research Corp., Arlington, Va., 1969, 205 pp.
157. Rashevsky, N. A Note on the Mathematical Biology of Automobile Driving. Bull. Math. Biophys, Vol. 29, 1967, pp. 187-188.
158. Rattle, J. D., and Foley-Fisher, J. A. A Relationship Between Vernier Acuity and Intersaccadic Interval. Optica Acta, Vol. 15, 1968, pp. 617-620.
159. Reading, V. M. Disability Glare and Age. Vision Res., Vol. 8, 1968, pp. 207-214.
160. Richards, O. W. Vision at Levels of Night Road Illumination: Literature 1966. Highway Research Record 179, 1967, pp. 61-67.
161. Richards, O. W. Visual Needs and Possibilities for Night Automobile Driving. Available from National Technical Information Service, Springfield, Va., AD 176 566, 1967, 194 pp.
162. Riege, J. Handbuch der Lichttechnischen Literatur. Inst. für Lichttechnik, Univ. of Berlin, 1967, 402 pp.
163. Ripps, H., and Weale, R. A. Color Vision. Ann. Rev. Psych., Vol. 20, 1969, pp. 193-216.
164. Rowan, N. J., and Walton, N. E. Optimization of Roadway Lighting Systems. Highway Research Record 216, 1968, pp. 34-47.
165. Rumar, K. Night Driving: Visibility of Pedestrians. Internat. Road Safety Congress, 1966.
166. Rumar, K. Visibile Distances in Night Driving. Psychology Dept., Univ. of Uppsala, Sweden, Rept. 44, 1967, 13 pp.
167. Salvatore, S. Judging Vehicle Speed From Visual Clues. Optician, Vol. 154, 1967, pp. 83-86.
168. Sands, E. J. The Role of Vision in Midair Collisions. Optom. Weekly, Vol. 58, No. 3, 1967, pp. 36-38.
169. Schreuder, D. A. Trends in European Tunnel Lighting Practice. Illum. Eng., Vol. 62, 1967, pp. 390-396.
170. Senders, J. W., et al. The Attentional Demand of Automobile Driving. Highway Research Record 195, 1967, pp. 15-33.
171. Shea, R. A., and Summers, L. G. Visual Detection of Point Source Targets. National Aeronautics and Space Administration, Rept. CR563, 1966, 65 pp.
172. Sheppard, J. J., Jr. A Critical Review of the Experimental Foundation of Human Color Perception. Available from National Technical Information Service, Springfield, Va., AD 630 316, 1966, 175 pp.; Human Color Perception, American Elsevier Pub. Co., New York, 1968, 192 pp.
173. Shirley, S. Y., and Gauthier, A. J. Recognition of Coloured Signal Lights by Colour Defective Individuals. Traffic Injury Research Foundation of Canada, Ottawa, 1966, 11 pp.
174. Sidowski, J. B., ed. Experimental Methods and Instrumentation in Psychology. McGraw-Hill, New York, 1966, 803 pp.
175. Smart, R. G., and Schmidt, W. Responsibility, Blood Alcohol Levels and Alcoholism. Traffic Safety Res. Rev., Vol. 11, No. 4, 1967, pp. 112-116.
176. Stabell, B., and Stabell, U. Night Vision as Chromatic Vision. Scand. Jour. Psych., Vol. 8, 1967, pp. 145-150.
177. System Associates, Inc. Rear Lighting System Changeover Study. Available from National Technical Information Service, Springfield, Va., 3 Vols., PB 182 078, PB 182 079, and PB 182 080, 1969.
178. Specifications for Partially Automated Control Systems for the Driver. Systems Research Group, Ohio State Univ., Columbus, Rept. EES-3, 1969, 158 pp.
179. Tarrants, W. E. Myths and Misconceptions in Traffic Safety. Highway Research News, No. 31, 1968, pp. 52-66.

180. Taylor, F. E. How to Avoid Automobile Accidents. Crown, New York, 1968, 144 pp.
181. Visibility in the Driving Task. Proc., Texas A&M Univ., 1968, 165 pp.
182. Tiburtius, H. Ueber die Gerfährdung alter Menschen im nächtlichen Strassenverkehr unter besonderer Berucksichtigung der Blendung. FPF (Med.), Vol. 13, 1967, pp. 411-418.
183. Ungar, P. E., and Barnett, J. Aspects Techniques de la Securité Routière. Centre International de Documentation sur l'Inspection et la Technique des Véhicules Automobiles, Brussels, Bull. 27, 1966, pp. 3.1-3.9.
184. Venables, P. H., and Martin, I. A Manual of Psychological Methods. North-Holland Pub. Co., Amsterdam, 1967, 577 pp.
185. An Examination of the Pharmacology of the Eye. Optician, Vol. 155, 1968, p. 101.
186. Walraven, P. L., and Michon, J. A. The Influence of Some Side Mirror Parameters on the Decision of Drivers. Soc. Automotive Engrs., New York, 1969, 6 pp.
187. Webster, F. B., and Cobbe, B. M. Traffic Signals. Road Research Laboratory, Crowthorne, Berkshire, England, Tech. Paper 56, 1966, 111 pp.
188. Webster, L. A., and Yeatman, F. R. An Investigation of Headlight Glare as Related to Lateral Separation of Vehicles. Eng. Exp. Station, Univ. of Illinois, Bull. 496, 1968, 113 pp.
189. Witheford, D. K. The Economic Analysis of Freeway Lighting. Traffic Quart., Vol. 21, 1967, pp. 289-303.
190. Woods, D. L., and Rowan, N. J. Driver Communication. Texas Transp. Researcher, Vol. 5, No. 1, 1969, pp. 14-16.
191. Wyszecki, G., and Stiles, W. S. Color Science: Concepts and Methods, Quantitative Data and Formulas. John Wiley and Sons, New York, 1967, 628 pp.
192. Young, F. A. Myopia and Personality. Am. Jour. Optom., Vol. 44, 1967, pp. 192-201.
193. Grolman, B. An Analog Device for Lens Fitting. Am. Jour. Optom., Vol. 46, 1969, pp. 810-818.
194. Freytag, E., and Sacks, J. G. Abnormalities of the Central Visual Pathway Contributing to Traffic Accidents. Jour. Am. Med. Assn., Vol. 204, No. 10, 1968, pp. 871-873.
195. Thomas, E. L. Movements of the Eye. Sci. Am., Vol. 219, No. 2, 1968, pp. 88-95.
196. Fitness to Drive. Optician, Vol. 155, 1968, pp. 556-558.