



Reports of the Committee on Vision: 1947-1990

Committee on Vision, National Research Council

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Reports of the Committee on Vision, 1947-1990

Joanne S. Albanes, Editor

Committee on Vision
Commission on Behavioral and Social Sciences and Education
National Research Council

National Academy Press
Washington, D.C. 1990

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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Preface

The Committee on Vision is a standing committee of the National Research Council's Commission on Behavioral and Social Sciences and Education. The committee provides analysis and advice on scientific issues and applied problems involving vision. It also attempts to stimulate the development of visual science and to provide a forum in which basic and applied scientists, engineers, and clinicians can interact. Working groups of the committee study questions that may involve engineering and equipment, physiological and physical optics, neurophysiology, psychophysics, perception, environmental effects on vision, and visual disorders.

The Committee on Vision was organized by the National Research Council in 1942 at the request of the Army, the Navy, and the Office of Scientific Research and Development to provide a mechanism for military personnel to gain access to scientific and technical information pertaining to vision, to promote the exchange of research findings on visual problems, and to stimulate research on vision. Sponsorship of the committee subsequently broadened to include the Air Force and a number of civilian federal agencies. As sponsorship broadened, the activities of the committee also expanded to include nonmilitary problems in vision.

The typical response of the committee to a request for information is the formation of a working group or panel. Working groups are established when a question is judged to be consonant with the interests and priorities of the Committee on Vision, when it is broad in scope and significant, and when the relevant information is not widely available in the scientific literature. Occasionally, the recommendation that a working group be established is made because of a scientific controversy for which an unbiased analysis of evidence is required, especially if the resolution of that controversy has major practical significance. The final product of the working group, its report, is reviewed by the committee and the National Research Council. Following this review (and after opportunities for the working group to deal with reviewers' comments), the report is published, submitted to the requesting sponsor, and presented to the scientific community.

Nowhere are the unique contributions of the Committee on Vision more evident than in the series of reports issued over the years under its aegis. Beginning with a manual for testing heterophoria and prism divergence in 1947, the committee has addressed such diverse topics as visibility,

dark adaptation, flicker fusions, eye movement, visual search techniques, form discrimination, contrast threshold, aging and perception, and the effects of microwave radiation on the eye. In addition to summarizing pertinent vision research of the day, many of these reports address issues of interest to the public or specific problems relating to the operational objectives of the government. Hence, in this summary of the committee's work the reader will note the inclusion of reports on a lighting plan for radar approach control systems, the visual effects of face masks, and the effects of video display terminals.

This summary report has been compiled as a part of the committee's continuing efforts to bring the work of the vision science community to the attention of a wider audience. The report presents a chronological listing of available reports prepared under the aegis of the Committee on Vision since 1947. An individual summary has been prepared for each report to provide the reader with some understanding of its content. The length of the report is indicated as well as its availability. This summary of reports will be of interest to vision specialists, whether they are involved in the development of federal programs and policies that draw from the vision sciences or in the support and conduct of basic research. The historical legacy will undoubtedly also be of value to serious research scientists.

Funds for the report were provided from the general budget of the committee, which receives support from the departments of the Army, the Navy, and the Air Force; the National Eye Institute; the National Institute on Aging; the National Aeronautics and Space Administration; the National Science Foundation; the American academies of Ophthalmology and Optometry; the American Optometric Association; and the Society for Information Displays.

SUZANNE MCKEE, CHAIR
COMMITTEE ON VISION

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AGING AND VISION

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AGING AND HUMAN VISUAL FUNCTION

Robert Sekuler, Donald Kline, and Key Dismukes, Editors
1982

The result of a symposium sponsored by the Committee on Vision March 31-April 1, 1980, in Washington, D.C., *Aging and Human Visual Function* is intended to review what is currently known about visual changes that occur with age and to examine the effects of these changes on an individual's well-being. This interdisciplinary study also explores the gaps in knowledge to better delineate the need for research in both basic and applied aspects of age-related alterations in visual functions. Five themes are examined: anatomical and physiological alterations, changes in basic visual functions, changes in perception and information processing, methodological issues, and the human impact of visual changes with age.

Major topics include the difficulty of distinguishing between normal aging and what traditionally has been considered pathology and the effects of aging on sensory processes. Other topics investigated are how aging affects the retina and how retinal aging can affect visual functions; the effects of aging on basic visual functions such as color perception, visual acuity, accommodation, and contrast sensitivity; and a review of low-vision service to increase the independence and improve the self-concept of the aging person.

350 pp. 87 figures 13 tables 713 references

Availability: Volume 2, Modern Aging Research Series. New York: Alan R. Liss, Inc., 1982.

AGING AND VISUAL FUNCTIONS OF MILITARY PILOTS: A REVIEW

Robert Sekuler, Donald Kline, and Key Dismukes, Editors
1982

This report reviews what is known about the effects of age on visual function and discusses the implications of age-related changes in vision for the flying performance of military pilots. Most visual functions decline to some degree with age, and the rate of decline has been roughly characterized in the general population. There is, however, virtually no data on military pilots, and extrapolation from the general population requires caution. Individual variation in the effects of age is great, and military pilots are a select group presumably in better general health than the general population. Several visual functions that decline with age seem particularly relevant to pilot performance: contrast sensitivity, dynamic acuity, recovery from glare, function under low illumination, and information processing. Vision examinations currently given to military and commercial pilots do not measure these visual functions. The feasibility of supplementing existing vision examinations with measurements of these functions needs to be explored. Research is needed on several major problems in this area. It is not possible at present to characterize well the effect of changes in visual function on the performance of complex tasks such as flying. This report suggests several specific measures that might help characterize the effects of changes in visual function on pilot performance. Data on changes in visual functions with age should be collected from military pilots, preferably with multivariate, longitudinally designed studies. Research is suggested to assess the extent to which experienced pilots may compensate for declining visual functions and to determine how such compensation is achieved.

The report suggests studies of the interaction of age with other factors, such as cardiovascular changes, that may affect performance, especially under stress.

11 pp. no figures no tables 83 references

Availability: *Aviation, Space, and Environmental Medicine* Vol. 53, No. 8, pp. 747-758, 1982.

WORK, AGING, AND VISION: REPORT OF A CONFERENCE

1987

At the request of the Veterans Administration and the National Institute on Aging, the Committee on Vision established the Working Group on Aging Workers and Visual Impairment. The working group was asked to examine the issue of keeping older workers in the work force longer, given the many changes that occur in vision with age. In order to accomplish this task, the working group organized a two-day conference around sessions focusing on individual and interactive elements of work, aging, and vision.

Members of the first panel were asked to describe what happens to the eye with age. The second panel considered the availability of information on the incidence and prevalence of visual impairment with age, the role of health status in leaving the work force, and demographic changes in the U.S. work force. The third panel explored the effects of visual changes on job skills. The fourth panel addressed issues (such as screening practices) related to keeping older Americans in the work force longer.

This report is based on discussion and papers presented at this conference and has been organized into three parts. The first part is a discussion of the problem of maintaining older workers in the labor force given the changes that occur in vision with age. The second is a description of some of the solutions proposed by conferees. The final section explores some of the factors involved in bringing about such changes.

Two appendices provide additional information: Appendix A contains a list of conference participants and the detailed program. Appendix B contains an annotated bibliography on work, aging, and vision.

A summary of this work was also released as a pamphlet (see *Eyes on the Workplace*).

67 pp. no figures 2 tables 49 references

Availability: Publication on Demand, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

EYES ON THE WORKPLACE

Ron Cowen
1988

The Working Group on Aging Workers and Visual Impairment was asked to examine the issue of keeping workers in the labor force longer, given the many changes that occur with age.

In order to accomplish its task, the working group organized an invitational conference to review the several dimensions of work, aging, and vision. Four panels were formed to explore various aspects of work, aging, and vision, including relationships between visual changes with age and changes in behavior; the role of health status in leaving the work force; the effects of changes in vision on job skills; screening practices; the availability of visual prosthetics; and economic incentives and disincentives for keeping older workers employed.

This illustrated pamphlet is based on the proceedings of the conference and working group discussions, *Work, Aging, and Vision*, supplemented by additional research materials. It is intended for use by workers and employers.

44 pp. no figures no tables 13 additional readings

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

AERONAUTICS AND SPACE

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VISUAL PROBLEMS OF SPACE TRAVEL

James W. Miller, Editor
1962

A variety of sensory and perceptual problems arise in connection with space flight, both for the occupants of space vehicles and in certain instances for support personnel. The solutions to these problems are interrelated and tremendously complex, thus requiring cooperative efforts among many scientific disciplines. This report discusses the problems of space flight insofar as they relate to the visual mechanism.

The report brings together results of pertinent research in both vision and astronautics. Substantial portions of the publication, *Sensory and Perceptual Problems Related to Space Flight*, edited by John L. Brown, have been quoted in the report.

In addition to updating the Brown report, this report presents a considerable amount of additional information regarding specific critical visual problems, as well as a recently completed, extensive bibliography of research in this field.

55 pp. no figures no tables 153 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISUAL REQUIREMENTS FOR FLYING: SOME ASPECTS OF REEVALUATION

Arthur Jampolsky and Aileen Morris
1964

The assignment of the working group that produced this report was to "reevaluate the visual requirements for flying." The term *requirement* in this effort has been interpreted to mean the assessment and classification of the visual characteristics of military and civilian personnel qualifying to fly.

Opinions were sought from operational personnel, operationally oriented visual specialists, and visual scientists. The problems were assembled from the different services and agencies. One of the main problem areas identified was the rapidly changing and demanding operational requirements in flying tasks in which vision was assumed to be important. This was coupled with the scientist's trend toward extensive validation of visual standards.

The report is organized into sections as follows: Statement of the Problem; Visual Classification; Role of the Visual Scientist; Grades of Visual Fitness; and Specific Recommendations.

25 pp. 1 figure 2 tables 10 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

VISION RESEARCH: FLYING AND SPACE TRAVEL

Milton A. Whitcomb and William Benson, Editors
1968

At a two-day meeting in spring 1964, held under the auspices of the Committee on Vision, papers were presented on visual problems related to low-altitude, high-speed flight, space travel, and incapacitating effects on pilots resulting from inadvertent viewing of a nuclear detonation.

This volume is a collection of these papers and represents the proceedings of the meeting. The papers are as follows: "Criteria for Laboratory Experiments Useful in Field Situations," W.P. Tanner, Jr.; "Visual Fitness for Space Travel," A. Jampolsky et al.; "The Effect of Flash Distribution and Illuminance Level Upon the Detection of Low Intensity Light Stimuli," R.E. Pennington; "Some Langley Research Center Plans in the Area of Visual Displays for Lunar Mission Simulation," D.R. Riley and B.M. Jaquet; "Visual Masking Using Different Test-Stimulus Patterns," R.C. Boyle; "Sextant Sighting Performance in the Ames Midcourse Navigation and Guidance Simulator," R.J. Randle and B.A. Lampkin; "Comments on Major Gordon Cooper's Observations from Orbit," J.H. Taylor; "Gemini In Flight Visual Acuity Experiment," S.Q. Duntley; "Operational Significance of the Blindness Problem," W.L. Jones; "The Nature of Radiation from Nuclear Weapons in Relation to Flash Blindness," J.H. Hill and G.T. Chisum; "Experimental Investigations of the Flash Blindness Problem," J.L. Brown; "Methods of Preventing Flash Blindness," F.E. Barstow; "Air Force Efforts in the Field of Flash Blindness," J.F. Culver; "A Flash Blindness Indoctrination and Training Device," J.F. Parker, Jr.; "Vision Problems in Low-Altitude, High Speed Flight," J.W. Miller; "Geographic Orientation During Low-Altitude Flight," J.J. McGrath; "Dynamic Visual Detection Recognition," C.P. Greening; "Operational Problems Associated With Low-Altitude Flight," R.W. Bailey; and "Some Operational Aspects of Visual Problems in Low-Flying, High Speed Aircraft," R.L. Jones and J.S. Joska.

197 pp. 109 figures 16 tables 109 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISUAL ELEMENTS IN FLIGHT SIMULATION

John Lott Brown, Editor
1976

This report summarizes the information gathered by a working group of the Committee on Vision on visual elements in flight simulators. It recommends research topics, techniques, and strategies that should receive more attention.

Flight simulators have now been in use for many years and their value has been amply proven. Although many of today's simulators are very expensive, they can pay for themselves by decreasing the cost and increasing the safety of learning to fly complex and expensive modern aircraft. Some aspects of aircraft control depend on an exterior view from the aircraft of the outside visual world. Training in these aspects of flight in a simulator therefore requires that the visual world be simulated to the extent that cues derived from it need to be employed by the pilot. There are a number of maneuvers that cannot be performed without direct visual contact under normal circumstances in commercial as well as in military aviation. The importance of including a simulation of the external world is now acknowledged. Unfortunately, there is currently no solid scientific basis for cataloguing visual cues with respect to their importance in aircraft control. As a consequence, current efforts to create appropriate visual simulations run the gamut from efforts toward almost complete replication of the visual world to highly schematized, two-dimensional perspective displays on cathode ray tubes.

12 pp. no figures no tables 20 references

Availability: Aviation, Space, and Environmental Medicine Vol. 47, No. 9, pp. 913-924, 1976.

VISION RESEARCH FOR FLIGHT SIMULATION: REPORT ON A WORKSHOP ON SIMULATION OF LOW-LEVEL FLIGHT

Whitman Richard and Key Dismukes, Editors
1982

This report was prepared on the basis of a workshop on issues in vision research on flight-training simulators, particularly those using computer image generation techniques. Examples of research strategies by individual authors appear as appendix papers to this report.

Appendices A through F provide examples of research areas and approaches that might help elucidate several long-range issues confronted in visual simulation. Primarily, emphasis is given to low-level flight, in which extraction of visual information from terrain features is crucial but little understood. Several strategies are suggested for exploring which visual features should be used in low-level flight: systematic condensation of opinions, particularly those of pilots (Appendix A), geometric analysis of potentially usable terrain information (Appendix B), and psychophysical analysis of visual processing modalities (Appendices C and D). Appendix E examines equipment requirements for display of whatever visual information is chosen. It also addresses characteristics of visual displays that limit the kind of information that can be displayed. Thus, Appendix E complements the other appendices and is applicable to visual simulation of any flight environment. Several authors have suggested particular lines of research that could be followed within their paradigms.

The report also summarizes the theoretical perspective and working assumptions of the strategies covered to illustrate their power and limitations. An extended example is given to show how the strategies might be combined to analyze visual information requirements for low-level flight. The complementarity of these research strategies is emphasized.

99 pp. 8 figures 1 table 134 references

Availability: Publication on Demand, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

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CLINICAL APPLICATIONS

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MANUAL OF INSTRUCTIONS FOR TESTING HETEROPHORIA AND PRISM DIVERGENCE AT NEAR

1947

This report is an instruction manual for testing heterophoria, a condition in which the eyes have a constant tendency to deviate but are prevented from so doing by fusion. When a person looks at an object, an image of that object is formed separately in both the right and the left eye. These separate images are sent to the brain, where they are associated and interpreted as a single image; this process is known as fusion. Fusion is responsible for the two eyes working together in harmony; when anything prevents this, fusion is disrupted and one eye deviates.

For the purpose of heterophoria measurement, fusion can be disrupted by placing a Maddox rod in front of one eye. The image of a spot of light, when viewed through a Maddox rod, is converted into a line of light. When the two eyes see unlike images of the same object (one eye sees a spot of light while the other eye, the one behind the Maddox rod, sees a line of light), this disrupts fusion and tends to prevent the two eyes from working together. Thus, when heterophoria is present, the eye behind the Maddox rod will deviate while the other eye continues to look at or fixate the spot of light.

The measurement of heterophoria is one of the more difficult problems that the experienced examiner can meet, because many factors can influence the test and only a few of these are actually known. Unless the test is performed in exactly the same way at every testing station, an examinee may pass the test at one station on one day and fail it on the next day at another station. A uniformly standardized testing technique must be used at every station. This manual describes the testing technique to be followed at all testing stations.

Descriptions of apparatus and procedures are given for testing heterophoria and prism divergence with the binocular phorometer, with the portable monocular phorometer, and with trial frame and loose prisms.

7 pp. 2 figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

MANUAL OF INSTRUCTIONS FOR CLINICAL TESTING OF VISUAL ACUITY

1947 (revised 1951)

Visual defects are one of the major causes for physical disqualification from the Armed Services of the United States. Methods of testing vision have varied greatly among the services and from place to place in each service; as a consequence, visual test results are not comparable. A candidate presenting himself or herself for examination at one center might be qualified for visual acuity, while at another center he or she would be disqualified. The purpose of the manual is to describe the conditions and facilities necessary and the procedure to be followed in order to correct this situation.

The procedures outlined in the manual should be followed by every person who administers visual tests. It is the duty of the Medical Officer-in-Charge to supervise and inspect the proper administration of procedures outlined in this manual.

The manual describes procedures to be followed in testing visual acuity with wall charts. It is understood that the use of optical instruments may become sufficiently general at some future date to warrant a revision of the manual. Exact specifications of the test chart, the test room reflectances and illumination, and occluders are given. The procedures for administering the test are described in detail, including phrases to be used in instructing the examinee. Scoring procedures are described in full.

19 pp. 11 figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

REPORT ON INTERNATIONAL NOMENCLATURE FOR DESIGNATING VISUAL ACUITY

Kenneth N. Ogle
1953

The task of the subcommittee that produced this report was to obtain a majority point of view regarding a proposal to standardize (1) a particular mode of designating visual acuity and (2) a particular graduation of steps in letter size for the visual acuity charts. These two problems are interdependent and involve a number of fundamental problems.

Many ophthalmologists have insisted that the visual acuity test charts are primarily for clinical use (1) to determine the effect of certain ocular diseases on visual acuity and (2) especially to assist in the determination of the refractive correction for patients. Visual acuity itself is not important until the final refractive correction is approached in the refraction examination. The exact manner in which the letters of successive lines of the chart decrease in size would for this purpose be relatively less important. The majority of the members of this committee, however, felt that the design of test charts be such that reasonably accurate determinations of visual acuity itself could be made.

A uniform decimal scale or fractional designation of visual acuity requires some type of a uniform graduation in the sizes of the letters of successive lines of the test chart. There seems to be almost universal agreement that this graduation should approach that of a geometrical progression, that is, a graduation in which the size of the letters of one line bears a constant ratio to the size of the letters in the preceding (or succeeding) line of the chart. Such a method of preparing a visual acuity chart gives sizes of test letters of successive lines on the chart, which increase in a geometric progression. Instead of making all the letters on a given line of the chart the same size, it may be desirable to design the test chart so that successive letters increase in size.

The subcommittee made a number of recommendations on the basis of the discussion and of the considerations presented in the report.

15 pp. 3 figures 1 table 23 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

MANUAL OF INSTRUCTIONS: ARMED FORCES VISION TESTER

1951 (revised 1952)

This report is a manual of instructions for the Armed Forces Vision Tester. The Vision Tester is an instrument that may be used to test certain visual functions of near and far viewing distances. One person is tested at a time with one instrument. The examinee observes a series of test slides, some of which test distance vision, others near vision. The examiner asks standard questions while the examinee is observing each slide and determines the instrument score from the answers to these questions. The visual functions examined in the standard form of the tester are vertical and lateral phoria at distance and near, right and left eye acuity at distance and near, and depth perception at distance. A special test of distance acuity is available for testing illiterate examinees. It is also possible to test binocular acuity at distance and near and prism divergence at near. These special tests are described in the report.

24 pp. 2 figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

FIRST INTERPROFESSIONAL STANDARD FOR VISUAL FIELD TESTING

1975

This report contains a review of basic data and concepts for measurement of visual field and makes the following recommendations: (1) photometric standards for visual field test equipment should be expressed in luminance units; and that the illuminant and its desired operating characteristics be specified by the manufacturer for each visual field testing device; (2) in the specification of chromatic stimuli, the wavelength composition of the stimulus reaching the eye and the C.I.E. (Commission International de l'Eclairage) chromacity coordinates should be given; (3) background field luminance, test target parameters [target luminance, size (area), configuration, and exposure duration or rate of translation], viewing distance, and location of a target in the visual field should be specificable; and (4) office, field, and screening instrument design should incorporate test parameters that produce relatively stable response states.

35 pp. 14 figures 3 tables 74 references

Availability: AD 637389, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

**RECOMMENDED STANDARD PROCEDURES FOR THE
CLINICAL MEASUREMENT AND SPECIFICATION OF
VISUAL ACUITY**

1980

The primary objective of this report is to formulate test conditions, procedures, and criteria that can serve the clinical need associated with routine ophthalmological and optometric measurement of visual acuity. The aim is to enable different examiners to obtain the same test results.

The major emphasis is on the standardization of so-called distance acuity for distances approximating optical infinity. Recommendations are also made for tests at a suggested near distance of 40 cm (16 inches). The proposed near tests include (a) measures of acuity with capital letters under conditions comparable to those used to measure distance acuity and (b) tests of ability to read continuous text.

45 pp. 21 figures 4 tables 28 references

Availability: Advances in Ophthalmology Vol. 41, pp. 103-148, 1980.

CLINICAL APPLICATIONS OF VISUAL PSYCHOPHYSICS

Luis M. Proenza, Jay M. Enoch, and Arthur Jampolsky, Editors
1981

The Committee on Vision held a symposium in October 1978 on applications of psychophysics to clinical problems, in conjunction with the Second Study Group on Human Vision. The revised and edited proceedings of this symposium constitute this volume.

Three problem areas were selected for consideration: the utilization of recently developed contrast sensitivity, the assessment and development of vision in infants, and localization of anomalies in the visual pathway.

A concluding chapter summarizes the current very active state of the boundary between basic and clinical visual science.

304 pp. 235 figures 4 tables 312 references

Availability: New York: Cambridge University Press, 1981.

NUTRITION, PHARMACOLOGY, AND VISION: PROCEEDINGS OF A SYMPOSIUM

John E. Dowling, Luis M. Proenza, and Constance W. Atwell, Editors
1982

In November 1981 the Committee on Vision held a symposium on nutrition, pharmacology, and vision. The revised and edited papers presented at this symposium constitute this report.

Nutritional research has identified some 45 substances as essential to our diet (National Academy of Sciences, *Science and Technology, a Five-Year Outlook*, W.H. Freeman & Company, 1981); however the full range of cellular and tissue functions in which these essential nutritional substances participate is not known, and it is likely that additional research will identify yet other substances as also essential nutrients. Knowledge concerning the role of some of these essential substances has increased enormously within the last decade, particularly with regard to neuronal and visual functions. It is along this new frontier of adding functional pharmacologic insight to basic structural knowledge that this symposium was directed.

The following papers were presented at the symposium: "Some Aspects of Vitamin A Malnutrition," J.A. Olson; "Nutrition and Retinal Degeneration," E.L. Berson; "Selective Loss of 11-CIS Vitamin A in an Eye With Hereditary Chorioretinal Degeneration Similar to Sector Retinitis Pigmentosa," C.D.B. Bridges and R.A.A. Alvarez; "Is Taurine an Essential Amino Acid?" N. Lake; "The Rules of Vitamin E and Unsaturated Fatty Acids in the Visual Process," W.G. Robison, Jr., et al.; "Choline Metabolism and the Maintenance of Photoreceptor Cell Structure," R.H. Masland; "Nutritional Amblyopia," D.L. Knox et al.; "Changes in Retinal Morphology and Vitamin A Metabolism as a Consequence of Decreased Zinc Availability," A.E. Leure-Dupree and C.D.B. Bridges; "Nutritional Factors and Dark Adaptation," R.M. Russell; "Neurotransmitter Systems in the Retina," B. Ehinger; "Function of Neurotransmitters in the Retina," N.W. Daw et al.; "The Effects of Tyrosine and Other Nutrients on Neurotransmitter Synthesis in the Brain and Retina," C.J. Gibson et al.; "The Toxic Effects of Glutamate and Related Compounds in the Retina and the Brain," J.W. Olney; and "Pharmacologic Control of Cortical Plasticity," J.D. Pettigrew.

144 pp. 39 figures 4 tables 397 references

Availability: *The Retina* Vol. 2, No. 4, pp. 231-375, 1982.

MYOPIA: PREVALENCE AND PROGRESSION

1989

In this report the findings of research published since the early 1800s on the progression and prevalence of myopia (nearsightedness) are analyzed.

Myopia is the visual condition in which only nearby objects appear in focus, much like a camera permanently focused at a close distance. In a "normal" or emmetropic eye, distant objects are naturally in focus, like a camera focused at infinity. Prevalence estimates from the 1972 National Health and Nutrition Examination Survey of persons in the United States between the ages of 12 and 54 years indicate that 25 percent were myopic.

Individual differences are also known to occur in the progression of myopia. Ophthalmic clinicians widely acknowledge that, once a youngster becomes myopic, he or she will most likely become more myopic, and this increase in myopia will stop or slow down sometime in the teenage years or later. There is, however, a great deal of individual variability in the age at which progression ceases.

An extensive literature review was conducted. Over 500 articles were identified, the majority of which had been published in the last 40 years in English-language journals. A significant number of articles in nineteenth-century periodicals were also identified. In addition to the literature search, a limited number of published research findings in languages other than English were identified.

113 pp. 11 figures 24 tables 266 references

Availability: Distribution Service, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

CONSIDERATIONS IN CONTACT LENS USE UNDER ADVERSE CONDITIONS: PROCEEDINGS OF A SYMPOSIUM

Pamela Ebert Flattau, Editor
1990

Contact lenses are an alternative method to spectacles for correcting refractive error. Soft lenses are more comfortable and adaptation is so rapid that intermittent wear is practical. Disadvantages are fragility, cost, and inability to correct more than minimal astigmatism without modifications. Contact lenses are often fitted for cosmetic purposes. Contact lenses also offer an important alternative, however, to the restrictions presented by spectacles for engaging in certain activities—such as athletics or working in steamy or rainy atmospheres. Furthermore, in certain occupations, contact lenses made it possible to use equipment that would otherwise be incompatible with spectacle frames (headgear in firefighting equipment is just one example). Concerns persist, about the effects of such adverse conditions as: low humidity, low oxygen, environmental irritants (gas, smoke, dust), and tissue inflammation on contact lens wear.

A working group was established by the Committee on Vision familiar with the scientific, clinical, and technological aspects of contact lens use, with special emphasis on their use under adverse conditions. This report is the proceedings of a symposium organized by the working group held in San Antonio, Texas, on November 3 and 4, 1988, to describe current concerns regarding lenses to the military community (see *Contact Lens Use Under Adverse Conditions: Applications in Military Aviation*).

Approx.: 176 pp. 48 figures 11 tables 257 references

Availability: National Academy Press, 2101 Constitution Ave., N.W.
Washington, D.C. 20418.

**CONTACT LENS USE UNDER ADVERSE CONDITIONS:
APPLICATIONS IN MILITARY AVIATION**

1990

In response to a formal request from the Triservice Aeromedical Research Panel (TARP), the Committee on Vision formed a working group to summarize current scientific, clinical, and technological issues in the use of contact lenses and to review the operational requirements of military personnel to the use of contact lenses under adverse conditions. These conditions are understood to challenge the integrity of the cornea and include the following effects: (1) hypoxic effects (oxygen deprivation), (2) mechanical effects (corneal shape changes), (3) biochemical/biophysical effects (dry eye syndrome, corneal swelling, epithelial insult, etc.), and (3) infection and inflammation (bacterial, viral, fungal, allergies, etc.).

This report identifies the critical factors to be taken into account by the military services in adopting a formal position on the use of contact lenses by U.S. military personnel (see *Considerations in Contact Lens Use Under Adverse Conditions: Proceedings of a Symposium*).

44 pp. no figures no tables 40 references

Availability: Publication on Demand, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

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COLOR VISION

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COLOR VISION

1973

This volume consists of papers presented at a 1971 symposium on color vision. The papers include: "Color Vision Deficiencies," L.M. Hurvich; "Comparison of Color Vision Tests Used by the Armed Forces," H.M. Paulson; "Color in Visual Signaling," D.B. Judd; "Comparative Photointerpretation from Panchromatic, Color, and Ektachrome Infrared Photography," A. Anson; "Color, Pattern, and Related Visual Influences in Architecture," J.E. Flynn; and "Color in Architecture," W. Faulkner.

124 pp. 68 figures 8 tables 74 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

PROCEDURES FOR TESTING COLOR VISION

1981

Color vision tests are used in selecting personnel for certain occupations that require the use of color vision. These tests are also used clinically to identify and differentiate congenital and acquired disorders involving color vision. Several basic techniques are used for testing color vision. Many different devices are available commercially. It is extremely important that color vision testing devices be validated before being adopted for screening; this requires demonstration that a test actually does identify and discriminate among color vision deficiencies as required for a particular occupational task. Some, but not all, commercially available tests have been adequately validated. This information, however, may not be available from any single source, making it difficult for users to decide what tests are most appropriate for their needs.

A working group was established to assemble information on existing color vision tests and to assess their utility and the extent to which they have been adequately validated. This report, describes the administration, scoring, and interpretation of various color vision tests and evaluates validation studies that have been performed on these tests. Additional material is included to make this report a self-contained reference source on procedures for testing color vision. Characterization of color vision and the classification of color vision defects are described. An appendix on the principles for test design is included for nonspecialists. Recommendations are made for the appropriate use of color vision tests in occupational screenings. The report includes information on most of the more commonly used tests.

120 pp. 21 figures 5 tables 195 references

Availability: Publication on Demand, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

DARK ADAPTATION AND NIGHT VISION

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REVIEW OF WARTIME STUDIES OF DARK ADAPTATION, NIGHT VISION TESTS, AND RELATED TOPICS

William Berry
1949

The initial plan of this project was to summarize the articles prepared under the stimulation of military requirements during the years 1941-1946. It was assumed that it would be possible to prepare a report comparable to the reviews of scientific literature that appear from time to time in various scientific journals. During the development of the project, according to the author, it became apparent that the initial plan would have to be modified, and the decision was made to prepare informative abstracts of the original articles arranged in chronological order of their appearance.

The considerations that led to the decision are summarized as follows:

1. The articles and reports are largely individual in nature, nonsequential, and unprogrammatically.
2. In every case, the form of presentation of the results of experiments, test procedures, etc., was prescribed by the regulation military practice.
3. A considerable amount of data and information is contained in the reports, and it is of such a nature that its appraisal for scientific merit and usefulness should be made by a wide circle of competent scientists.

This report consists of 106 abstracts, plus three tabular summaries of the reported data on the reliability of the test devices, their intercorrelations, the data derived from validation studies, an index of the topics treated in the reports, and an evaluation of the work done and the results achieved.

96 pp. no figures 96 tables 100 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

A BIBLIOGRAPHY ON DARK ADAPTATION

Dorothea J. Crook, John A. Hanson, Patricia I. McBride, and Joseph W. Wulfeck
1953

Between 1930 and 1950 probably no aspect of vision has deserved or received more attention than night vision and dark adaptation. In response to the demands of two wars, biochemical and electrophysiological research have received increased support. The requirement that specified levels of dark adaptation be maintained, the need for finding an alternative for total darkness in becoming dark adapted, and the hope of speeding up dark adaptation have resulted in widespread efforts to identify and establish the ranges of the variables affecting the instantaneous threshold and the subsequent course of dark adaptation. In addition, numerous night vision testers have been developed and masses of normative, validity, and reliability data have been accumulated.

An *Annotated Bibliography on Visual Performance at Low Photopic Illumination Levels* has been prepared by Rock. The research on development, validity, and reliability of night vision testers has been summarized in a comprehensive report by Berry. Reviews by Adams in 1929 and by Lythgoe in 1940 have emphasized the mechanisms and theory of dark adaptation, but the literature dealing specifically with the experimental data on dark adaptation, especially as related to its associated variables and their ranges, has grown more and more extensive and scattered.

This bibliography brings together a number of such references in an effort to make these experimental data more easily accessible. While it includes items relating dark adaptation to many variables, its basic concern is with the effects of pre-exposure variables. The heaviest emphasis is on the effects of the duration and the intensity of the preceding light, and the relation between them. There is also a fair sampling of references on the effect of wavelength of the preceding light. In addition to material on the effects of intensity, duration, and wavelength, literature from other areas is included.

27 pp. no figures no tables 417 entries

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

REPORT OF THE WORKING GROUP ON ILLUMINATION AND DARK ADAPTATION

William S. Verplanck
1953

This group was appointed for the purpose of preparing a critical review of the literature on dark adaptation as a function of antecedent conditions of illumination, with emphasis on wavelength. This summary notes that the project involved the preparation of a bibliography, the review of papers cited in this bibliography, with the preparation of evaluative abstracts of each, and finally, the publication of a paper summarizing the status of knowledge on this and closely associated topics. For a number of reasons it proved impossible for the working group to carry this task through to completion. This report describes the work achieved and the arrangements made for its completion.

3 pp. no figures no tables 9 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

EFFECT OF FLASHES OF LIGHT ON NIGHT VISUAL ACUITY: PART I

Glenn A. Fry and Mathew Alpern
1953

The purpose of this study is to find out the ability of the eye to see a dark object against a sky background at night after the eye has been exposed to a flash of light or a series of flashes. A peripheral test object and a fixation point have been used for measuring the ability of the eye to see. This investigation has succeeded in demonstrating the operation of three basic principles: (1) The adaptation of any given part of the retina can be regarded as being independent of adaptation processes in other parts of the retina. (2) Reciprocity between time and intensity can be assumed to hold at least over a three-second interval. (3) The effect of a flash displaced from the part of the retina used in viewing an object can be accounted for in terms of stray light. The amount of stray light falling at any given part of the retina can be computed from the Stiles-Holladay equation.

The exposure of the eye to a flash patch not only impairs the capacity of the photoreceptors to respond to subsequent stimulation but also produces a positive afterimage. A complete understanding of the effect of a flash of light cannot be claimed until the role played by this positive afterimage is taken into account. When the flash patch is exactly the same size and shape as the test patch, it might be questioned whether small eye movements, which cause a fresh portion of the retina to receive a portion of the image of the test patch, might affect the results. Consequently, exploratory experiments have been undertaken with much larger flash patches to investigate the role played by this factor.

In all of this work, the site of the beam entering the eye has been restricted by artificial pupils, which are smaller than the natural pupil, so that variations in the size of the natural pupil have not influenced the results. There are changes in pupil size that occur as a result of a flash of light, but it was decided to study these effects in a separate investigation, which is described in another report (see *Effect of Flashes of Light on Night Visual Acuity: Part II*).

28 pp. 19 figures 1 table 7 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

EFFECT OF FLASHES OF LIGHT ON NIGHT VISUAL ACUITY: PART II

Glenn A. Fry and Merrill J. Allen
1953

The objective of this study is to discover a satisfactory method of predicting the course of constriction of the pupil of a dark adapted eye when exposed to a flash of any duration or a series of flashes involving a complex and changing distribution of brightness in the visual field. This problem is quite complicated for several reasons. It involves the differential distribution of rods and cones over the retina with their independently varying states of adaptation and speeds of reaction. It involves the distribution of ganglion cells and their connections through the bipolars with the rods and cones. It involves the mechanism in the midbrain for summing the impulses received simultaneously from various areas of the retina and also the mechanism for summing impulses spread out in time; it also involves the response of the sphincter muscle of the iris to the pattern of impulses relayed to it by the ciliary ganglion from the Edinger-Westphal nucleus.

The role played by stray light has to be taken into consideration; this is particularly important in the case of a bright patch subtending a small solid angle and having a dark background. The small number of photoreceptors stimulated directly by the bright patch might well have a negligible effect on pupil constriction in comparison with the effect produced by the thousands of photoreceptors that are stimulated only by the stray light in the eye.

In the experiments described in this report, the beams of light entering the eye are restricted by artificial pupils normal to the axes of the beams.

17 pp. 18 figures no tables 12 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

**THE EFFECT OF PRE-EXPOSURE ON DARK ADAPTATION:
AN ANNOTATED BIBLIOGRAPHY**

Patricia I. McBride, Dorothea E. Johannsen, and Joseph W. Wulfeck
1955

The relation between pre-exposure and the course of the subsequent dark adaptation is of special interest from both the theoretical and practical points of view. This bibliography summarizes research concerned with the effects of different pre-exposure variables on subsequent dark adaptation.

Since this bibliography is concerned only with the effects of pre-exposure variables, only those parts of experiments that include the effects of pre-exposure are described. In a few instances, holding to this policy resulted in the elimination of large portions of a study; most of the experiments are fully described, however. Coverage of references is intended to be comprehensive through spring 1954.

An attempt was made to summarize the important results. The manner in which the data were originally presented (tabular or graphic) is indicated. If an experiment consisted of several parts, the results from each part are identified by numbers.

60 pp. no figures no tables 69 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

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**FLASH BLINDNESS SYMPOSIUM: PROCEEDINGS OF THE
U.S. ARMY NATICK LABORATORIES**

John M. Davies and David T. Randolph, Editors
1967

The purpose of this symposium, and the report based on it, was to arrive at an understanding of the state of knowledge in flash blindness technology, with the underlying aim of determining how this information could or should be applied to military problems.

Considering our use of light as a weapon, the eye is among the most valuable targets. The cornea and lens of the eye may be damaged in various ways by exposure to intense light, but the most critical visual component is the retina. Injury to the retina may take the form of retinal lesions; the effect of the injury then will depend partly on the location. Small lesions may cause very little decrement; if on the fovea, the loss of vision may be nearly complete. Even if not on the fovea, a severe chorioretinal lesion may allow blood to flow into the vitreous body; this type of blindness may be temporary. This symposium concentrated upon the temporary degradation of vision caused by bleaching of the visual pigments, such as rhodopsin and cyanolate, chlorolate and erythorolabe, and the effects that may follow that bleaching.

In recent flash blindness studies, rather short-duration blinding flashes have been used, sometimes as short as the microsecond range, but now even shorter pulses are available. Lasers with pulse durations as short as perhaps 30 nanoseconds have been used to produce retinal lesions. Apparently, these devices have not been used to produce flash blindness.

Another phase of the symposium needs specific mention. A part of it was concerned with eye protection; the discussion was based primarily upon classified information and is not included in the written summary.

265 pp. 95 figures 17 tables 49 references

Availability: AD 697793, National Technical Information Service (NTIS),
5285 Port Royal Road, Springfield, VA 22161.

**NIGHT VISION: CURRENT RESEARCH AND FUTURE
DIRECTIONS SYMPOSIUM PROCEEDINGS**

1987

Night vision encompasses many different visual functions under a variety of ambient lighting conditions. Since night operations are a crucial part of around-the-clock combat readiness, the U.S. Air Force has been interested in evaluating visual performance at night. A working group addressed the topic of night vision with four specific objectives in mind: (1) a definition of the relevant parameters of night vision; (2) an update of the literature pertaining to night vision, especially new findings, test procedures, and concepts since 1950; (3) the development of guidelines for establishing a comprehensive night vision laboratory; and (4) recommendations for the development of night vision screening tests.

The first two objectives were addressed by convening a symposium at Brooks Air Force Base in 1985. The proceedings of the symposium form the basis of this report. The findings and recommendations presented here are based on working group discussions following that meeting. Reference is made throughout this section to the papers in this volume that have some relevance to the recommendations under discussion.

The recommendations address five broad topics: (1) the specification of ambient illuminance levels; (2) task analysis and characterization of the work environment; (3) research areas of potential utility to the development of night vision tests; (4) the development of night vision screening tests; and (5) recommended equipment for a night vision laboratory.

This report contains 19 papers in addition to the summary report.

335 pp. 80 figures 13 tables 511 references

Availability: Publication on Demand, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

ENGINEERING AND EQUIPMENT

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STANDARD COLOR FILTERS FOR ELECTRONICS EQUIPMENT

Deane B. Judd
1952

This report attempts to provide specifications for standard color filters and to indicate the basis for the specifications. It recommends that signal lights employed on the control panels of electronic communications equipment be confined to three colors: red, green, and blue. These colors should be chosen to conform to the basic definitions of aviation red, aviation green, and aviation blue, respectively, of Federal Standard No. 3, Colors, Aeronautical Lighting, with the supplementary requirement for the green color that its chromaticity coordinates (x , y) meet the condition: y not greater than $0.667(1 - x)$. Working standards of chromaticity are available for commonly available types of glass to produce these colors by combination with incandescent lamp light. Suitable working standards for plastic have yet to be developed.

9 pp. 5 figures no tables 7 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

**REPORT OF WORKING GROUP ON AIRFIELD TAXIWAY
LIGHTING AND DESTINATION MARKING SYSTEMS**

Paul M. Fitts
1953

This report represents opinions of a working group with regard to a project conducted by Dunlap and Associates for the Bureau of Aeronautics, U.S. Navy, with respect to airfield taxiway lighting and destination marking systems. The report covers the topics of taxiway lights, taxiway turn-off markers, destination markers, legibility, pilot opinion, and compatibility.

3 pp. no figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

A BROAD-BAND-BLUE LIGHTING SYSTEM FOR RADAR APPROACH CONTROL CENTERS

Conrad L. Kraft and Paul M. Fitts
1953

The general public recognizes the darkened room surrounding a cathode ray tube as a synonym for radar. This darkened room is the conventional solution to the problem of improving the visibility of radar targets on bright trace cathode ray tubes. This solution does give fair scope visibility, but the operators must work in the dark, and operations must be discontinued whenever light is needed for maintenance of the equipment.

This report describes a polychromatic system of lighting radar centers that provides improved scope visibility, permits the use of an illuminated working environment, and makes possible 24-hour radar operations. The basic principle of this lighting system is frequency sharing. A broad band of blue light (the shorter wavelengths of the visible spectrum) is allocated for ambient room illumination, and the remaining portion of the visible spectrum is used for cathode ray tube reading and for other special purposes.

6 pp. 5 figures 1 table 2 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418

LITERATURE SURVEY OF MATERIAL PUBLISHED RELATING TO SPECIFICATIONS OF HAND-HELD BINOCULARS

Howard S. Coleman
1953

This is a survey of literature pertinent to the design of hand-held binoculars intended to be used visually. It covers over 5,000 open and classified literature items published between 1837 and 1953; the majority of the more important works were completed during the World War II years.

The report covers the influence of the design properties of binoculars on detection problems, and the method used in making allowances for variations in such factors on the performance of binoculars is briefly presented. This method consists of the determination of the loss in range caused by a given change in one of the design characteristics of binoculars. For example, using the method described, the loss in detection range could be determined for a wide range of weather and brightness conditions that would result if the exit pupil were reduced from 7 mm to 5 mm. Similarly, losses in the range that would be caused by imperfect light transmission, stray light, and aberrations could be computed in terms of the magnitude of the imperfection.

The results of the literature clearly indicate that the design of binoculars has not been based on visual tasks intended to be performed using such devices. It has largely been governed by preceding designs and the limitations imposed by technological skill in producing instruments at a rate said to be necessary to meet military requirements. Accordingly, it has been concluded that the procedure of designing binoculars should be changed by making allowances for the use to which such devices are to be put. Such allowances would include the limitations imposed by the characteristics of the target, the properties of medium between the target and the binocular, and the response of the human observer.

This study involves the collection of specific data dealing with the responses of the human eye used in connection with the binocular. At the present time the state of knowledge in this field is largely limited to the detection of stationary simple geometrical targets viewed under more or less uniform brightness conditions. The problems associated with the recognition of targets, targets in motion, heterogeneous brightness conditions, and the realistic military targets have been scarcely explored.

59 pp. 95 figures 5 tables 313 references

Availability: AD 895151, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

AN EVALUATION OF PROBLEMS OF CHART READING UNDER RED ILLUMINATION

Alphonse Chapanis
1953

This report describes the status of problems encountered in chart reading under red illumination. Material for the report was obtained primarily from a conference held in September 1952 at the Naval Medical Research Laboratory, U.S. Submarine Base. This report summarizes the consensus of the New London conference and includes such additional notes, discussion, and references as were supplied by various persons following the circulation of the first draft of the report of the conference.

The conference began with a review of the origin of the request to consider the status of problems of chart reading under red illumination. Several distinct questions are involved, which can be classified into three major groups: (1) operational requirements; (2) visual requirements; and (3) technical requirements.

11 pp. no figures no tables 28 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

LASER EYE EFFECT

H.G. Sperling, Editor
1968

The assignment of the working group was to study eye effects related to military and laboratory applications and to recommend safety measures, protective devices, and continuing research to support these areas. The results of the working group's efforts thus far are presented here under six topics: "Technical Characteristics of Lasers," J.A. Carruthers and M.S. Litwin; "Laser Eye Pathological Effects," W.J. Geeraets; "Laser Eye Functional Effects," H.G. Sperling; "Personnel Protective Measures," A.E. Jones; "Devices for Eye Protection," R.R. McGregor, and "Eye Examination and Treatment Standards," H.C. Zweng and H. Rose.

89 pp. 11 figures 3 tables 151 references

Availability: AD 667494, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

THE PROTOTYPE MAIL SORTING SYSTEM AT THE CINCINNATI POST OFFICE

1972

A new mail sorting system is currently being evaluated experimentally in Cincinnati, Ohio. This system uses a combination of human mail sorting augmented by computers. Eventually, this system will be used throughout the country. This report evaluates the visual task required of the human operators and the noise environment within which they work and recommends several modifications of the present system.

15 pp. no figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

OPTICAL PROPERTIES AND VISUAL EFFECTS OF FACE MASKS

1977

A working group was asked to suggest procedures for studying the optical properties and visual effects of the XM-29 mask. This report is based on material presented and discussed at Ft. Rucker on July 14–15, 1976. However, the techniques of field and laboratory testing described in the report may be generally used to study a variety of face masks.

The XM-29 field protective mask is designed for military use to provide respiratory protection against field concentrations of all chemical and biological agents in vapor or aerosol form. The mask covers the face and is suspended by a flexible six-point harness attachment such that a continuous peripheral seal is made against the face of the wearer. The facepiece consists of the peripheral sealing area, the harness-attachment area, the lens area, the component-mounting area, and the nosecup area.

The component-mounting area of the mask covers the forward region below the lens, the chin region, and the mandible region of the face. It contains the following components:

1. Forward-mounted acoustically transparent speech diaphragm;
2. Side-mounted adaptors for canisters, an outlet valve and resuscitation tube assembly located at the low point of the mask, and a water intake and valve assembly with internal and external portions.

The nosecup is an integrally mounted, flexible assembly that accommodates the oral-nasal configuration of the mask wearer and that contains one or more inlet valves.

6 pp. 2 figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

**THE MULTIPLE POSITION LETTER SORTING MACHINE:
AN EVALUATION OF VISUAL, AUDITORY, AND HUMAN
FACTORS PROBLEMS**

1979

At the request of the U.S. Postal Service, a working group was jointly established by the Committee on Vision and the Committee on Hearing, Bioacoustics, and Biomechanics to help evaluate visual, auditory, and human factors aspects of the Multiple Position Letter Sorting Machine. Letters are sorted at this machine by human operators who read address codes on letters displayed before them and then direct the letters to appropriate bins by operating a keyboard. Studies of operator performance on this machine have yielded differing estimates of operator error rates; in some cases, a high error rate was reported. The working group was asked for advise on reducing operator error rates and to review and comment on studies proposed by a U.S. Postal Service task force concerned with improving operator productivity.

This report contains the working group's evaluation of each of the six actions proposed by the U.S. Postal Service task force. The working group found that operator problems have already been characterized by existing literature, and in this investigation they found no evidence of major problems of an auditory or visual nature that had not been previously identified. In the course of the study, however, it became apparent that human factors, such as motivation and the nature of the operator-machine interaction, have a major impact on operator error rates. Consequently, this report includes discussion of these human factors and recommendations for related actions. Changes in operating procedures or in the design of the operator-machine interaction might involve substantial personnel policy issues or cost considerations. The conclusions of this report are presented in terms of potential actions recommended for feasibility study by the U.S. Postal Service.

30 pp. 1 figure no tables 42 references

Availability: ADA 076211, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

ELECTRONIC TRAVEL AIDS: NEW DIRECTIONS FOR RESEARCH

1986

This report explores the factors underlying the mobility process relevant to the design, development and use of mobility aids. Problems related to mobility and written communication account for most of the disability experienced by those who have little or no vision. Independent travel is an important goal sought by most visually impaired and blind individuals. Many hope that advances in electronics technology will yield an electronic travel aid that provides the same type of information about space as that which guides the travel of sighted pedestrians.

107 pp. 3 figures 5 tables 302 references

Availability: Publication on Demand, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418. Request ASCII computer diskette for use in electronic readers.

PHYSICAL OPTICS

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STUDIES OF VISUAL TELESCOPE SYSTEM EMPLOYING REFLECTION OPTICS

Theodore Dunham, Jr.
1951

A subcommittee of the Committee on Vision undertook a study of the possible uses of optical systems for employing reflecting elements for visual applications by the Armed Forces in January 1950. Although particular attention was given to the telescopes recently developed by Dr. A. Bouwers and his group in Holland, a number of other designs were also studied. The group was reorganized in July 1950 as a working group. This report summarizes the studies done through February 1951 and includes recommendations for further work in this field.

The basic principle of the reflecting systems discussed is based on the use of a concave spherical mirror to form an image, together with a meniscus lens with suitable thickness and surface curvatures to correct spherical aberration. A system of this type avoids the difficulty ordinarily encountered in forming, with sufficient accuracy for visual applications, an aspherical optical surface, such as is required for a Schmidt correcting plate to serve a similar purpose. Although a meniscus lens cannot provide quite as perfect correction on the axis as a Schmidt correcting plate, the extent of useful field of view is considerably greater.

The use of a meniscus lens to correct the spherical aberration of a concave spherical mirror appears to have been invented independently by D.D. Maksutov in Russia, A. Bouwers in Holland, D. Gabor in England, and H.F. Bennett in the United States. In October 1949, Dr. Bouwers visited this country and described to several groups including military representatives the developments that had been carried out in his laboratory. These included several types of reflecting monocular and binocular telescopes, microscopes, and cameras, all of which employ meniscus lenses in combination with one or two spherical mirrors. Many of these systems appear to have potentially attractive features, from the point of view of overall dimensions, weight, and simplicity of design. The group was asked to evaluate the relative advantages of instruments employing reflecting elements compared with comparable conventional refracting systems, giving particular attention to instruments intended for visual use.

51 pp. 38 figures 9 tables 14 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

THEORY OF SLANT VISIBILITY

Leonard Foitzik
1952

The meteorological visual range represents an extraordinarily complex quantity. The definition of the visual range is not uniform. In this report, the visual range is defined as the distance at which the contrast between the target and its surroundings equals the threshold of contrast of the eye, i.e., the target lies just at the boundary of visibility. The parameters are partly determined by meteorological factors (state of turbidity along the pyramid of vision, conditions of illumination, cloudiness), partly by the target properties (position of target, size of target, reflectivity and color of the target). An additional portion of the parameters can be traced back to physiological properties of the eye (dependence of the threshold of contrast on the angular subtense of target, on the target brightness, and on the target shape.) In meteorology, and especially in synoptic meteorology, the visual range is of interest primarily because it characterizes the state of turbidity of the air layers near the surface.

The Koschmieder theory of horizontal visual range is extended, at first, to inhomogeneous conditions of turbidity along the pyramid of vision, and a graphical method is presented for the determination of the visual range with any stratification of turbidity. A formula of visual range is derived for the case of a uniform decrease in turbidity with increase in distance. In order to be able to apply this formula to the slant visibility of aerial targets as observed from the ground, an extension of the formula is necessary for the consideration of the target size. A graphical method is described by means of which it is possible to determine the slant-range of a black aerial target for any target size and target altitude as well as for any condition of turbidity with uniform decrease in turbidity with altitude. Finally, a numerical survey of the magnitude of the slant-range of black aerial targets is presented in several tables.

22 pp. 10 figures 7 tables 7 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

A BIBLIOGRAPHY ON REFLECTING OPTICS 1925-1950

Stanley S. Ballard
1950 (revised 1955)

This bibliography on reflection optics would be useful to those working in a field of such increasing interest and importance. Special attention is given to technical papers that are relatively inaccessible because they appear in foreign publications or in journals of limited circulation.

The bibliography contains 229 literature references and 58 patents. Very little material is dated prior to 1934. The best sources of references were *Physics Abstracts* and the footnote references found in some articles, but not, themselves, listed in the abstract journals.

28 pp. no figures no tables 287 entries

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

1962 SYMPOSIUM ON PHYSIOLOGICAL OPTICS

1962

This report, which appeared as a complete issue of the *Journal of the Optical Society of America*, includes the texts of many of the papers presented at the Optical Society's 1962 spring meeting. The meeting included sessions on the microanatomy and biochemistry of the visual system, the electrophysiology of the visual system, refined image formation, simple discriminatory functions, and contributions to color discrimination theory.

The papers are as follows: "Structure and Molecular Organization of Retinal Photoreceptors," J.J. Wolken; "The Problem of Visual Excitation," G. Wald et al.; "Cellular Physiology of the Retina," W.K. Noell; "Electrical Activity in the Vertebrate Retina," T. Tomita; "Integrative Processes in Central Visual Pathways of the Cat," D.H. Hubel; "Functional Basis for 'On'-Center and 'Off'-Center Receptive Fields in the Retina," H.G. Wagner et al.; "Optical Properties of the Retinal Receptors," J.M. Enoch; "Optical and Motor Factors in the Formation of the Retinal Image," G. Westheimer; "Retinal Image Formation: Review, Summary, and Discussion," G.A. Fry; "Initial Stages of Dark and Light Adaptation," H.D. Baker; "Increment Threshold and Dark Adaptation," W.A.H. Rushton; "Spatial and Temporal Aspects of Retinal Inhibitory Interaction," F. Ratliff et al.; "Fluctuation Theory of Luminance and Chromaticity Discrimination," M.A. Bouman; "Neural Theories of Simple Visual Discriminations," H.R. Blackwell; "Simple Discriminatory Functions: Review, Summary, and Discussion," C.H. Graham; "Contributions of Threshold Measurements to Color-Discrimination Theory," R.M. Boynton; "Studies of Anomalous Contrast and Assimilation," H. Helson; "Further Studies on Acquired Deficiency of Color Discrimination," G. Verriest, and "Contributions to Color-Discrimination Theory: Review, Summary, and Discussion," L.M. Hurvich.

201 pp. 316 figures 39 tables 739 references

The Journal of the Optical Society of America Vol. 53, No. 1, 1963.

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

CURRENT DEVELOPMENTS IN OPTICS AND VISION

William Benson and Milton A. Whitcomb, Editors
1968

This report describes the current developments in optics and vision under the following topics: Dynamic Parallax: Dynamic Visual Cues in Flying; Vision and Driving; Holography: Principles and Properties of Hologram Photography; Present and Future Applications of Holography; Scientific Applications of Holography; Image Restoration and Enhancement: The Elastic Surface Transformation; Image Processing as it Relates to the Human System; Experiments in Spatial Filtering; Visual Factors Related to the Design and Use of Direct-View Electro-Optical Devices; The Influence of Spatial and Temporal Bandwidth on Threshold Contrast Sensitivity of the Eye; and Visual Detection of Oscilloscopic Tracings.

128 pp. 44 figures 3 tables 113 references

Availability: AD 673425, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

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TARGET RECOGNITION

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VISIBILITY: A BIBLIOGRAPHY

Morris C. Leibkind and Jack Weiner
1952

This bibliography is intended to provide reference information and background material for the many research and development projects in the field of vision being sponsored by the Committee on Vision. It provides a survey of much of the literature published from 1925 to 1950 on the subject of visibility as influenced by the various physical, psychological, and physiological factors inherent in the observer, target, background and atmosphere, and the engineering applications of visibility data. Such material as optical physics, the anatomy and physiology of the eye, pathological effects on vision, and routine optometrical testing has been excluded.

Only a few of the abstract and index journals issued after 1947 were systematically searched, although some of the leading scientific journals were covered through 1950. Many references appended to recent books and papers have not been included.

In addition, systematic searches were made of selected journals in the fields of optics, psychology, and meteorology, from 1925 through 1950, and further references were obtained from many of the papers and books reviewed. An appreciable amount of material was found by consulting the catalogs and special collections of a number of libraries.

90 pp. no figures no tables 2,000 entries

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

THE LIMITING CAPABILITIES OF UNAIDED HUMAN VISION IN AERIAL RECONNAISSANCE

Seibert Q. Duntley
1953

The ability of the human eye to recognize objects on the ground from moving aircraft is affected by the observer's speed and altitude, by atmospheric and lighting conditions, by the contrast formed by the object and its background, by the size and shape of the object, by impediments to vision imposed by the structure of the aircraft, and by the observer's environment. This report explores limiting visual capabilities by ignoring any limitations imposed by environment or by aircraft structure. Established techniques for the prediction of the limiting range at which objects can be visually detected have been extended by means of new history and new data and guided in application by reconnaissance experiments at model scale. Target recognition has been studied during these experiments, and correlations between recognition and detection have been found for the circumstances and targets encountered in visual aerial reconnaissance.

The end product of the work shows the maximum altitudes from which visual recognition of various military objects is possible from high-speed aircraft. The data applies only to a nearly cloudless day when the atmospheric clarity is such that the meteorological range is 10 nautical miles. The selection of this particular weather and lighting condition was purely arbitrary. Other conditions, such as clearer weather, hazier weather, overcast skies, twilight, moonlight, snow cover, etc., could have been explored by continued calculation. The contribution to be expected of optical aids to vision (binoculars, etc.) could also have been explored.

9 pp. 3 figures 1 table 5 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

CHARACTERISTICS OF TANK-MOUNTED SEARCHLIGHTS FOR DETECTION OF GROUND TARGETS

H. Richard Blackwell, Seibert Q. Duntley, and Winfred M. Kincaid
1953

The detection of military ground targets at night is difficult to accomplish at satisfactorily short ranges. One method of aiding detection is to provide auxiliary illumination of the ground targets with a searchlight. This report describes a method for determining the searchlight candlepower required for detection of specified ground targets and reports a number of calculations made with this method.

The situation of interest involves a tank-mounted searchlight used to aid the detection of enemy tanks by gunners in the tank bearing the searchlight, and by gunners in other tanks deployed in the near vicinity. The enemy tank may be silhouetted against the sky or against terrain varying in reflectance. The gunner may attempt to detect the tank with the unaided eye or may use optical magnification. It is required that the gunners detect the enemy tank at a range of 1,200 yards under some conditions, 1,500 yards under other conditions. The searchlight will be turned on for short periods only, so that the gunner has only a few seconds at most to examine the area illuminated by the searchlight for possible enemy tanks.

The results of the calculations with the searchlight candlepower distribution are described.

32 pp. 9 figures 12 tables no references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

FORM DISCRIMINATION AS RELATED TO MILITARY PROBLEMS

Joseph W. Wulfeck and John H. Taylor, Editors
1957

The proceedings of the symposium consists of five sessions. Session I was designed to define the problem of form discrimination and cast it into perspective within the framework of military applications and the rubrics of psychophysics, psychophysiology, and general psychology. Session II was designed to provide up-to-date information about some representative technical and procedural aspects of conducting research on form discrimination. Session III presented experimental results relating form to the elementary visual detection process. It served to point out those few pieces of research that have been conducted on the role of target shape at or near the brightness or contrast threshold. (Julian Hochberg's paper, not read at the symposium owing to time limitations, is published here in order to supplement the other two presentations.) Session IV essays the jump from detection to higher-level characterization of the stimulus and acts somewhat as a catch-all session for presentations of unscheduled papers and those difficult to fit in elsewhere. The final session represents the results and conclusions of the symposium.

263 pp. 95 figures 5 tables 60 references

Availability: PB 133133, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISUAL SEARCH TECHNIQUES

Ailene Morris and E. Porter Horne
1960

This volume of symposium proceedings deals with visual search, which continues to be an important tool of the Armed Forces in the avoidance of midair collisions, in air-sea rescue, in missile detection and guidance, and for general reconnaissance, surveillance, and lookout. Despite the advance, made since World War II in the development of electronic and acoustical methods of target detection, visual performance still plays a vital role in search operations. Field observations have revealed, however, that the patterns and procedures followed in visual search for whatever purpose vary markedly without demonstrable or observable causes for variation. Operations analysis, detection theory, visual psychophysics, and atmospheric optics were considered to be among the areas of possible contributions to the development of a theory of a successful visual search calculation and of experimental verification.

The purpose of the symposium was to bring together both operational and research experts on visual search techniques to examine operational practices and visual research data in order to develop optimal techniques and procedures. It began with an invited lecture "Operational Background and Physical Considerations Relative to Visual Search Problems" by E.S. Lamar. In the first session, representatives of the Armed Forces presented statements of existing doctrine and of operational needs and described measures that have been taken in practical situations to meet these needs. The military speakers raised questions to be answered by the scientists from their research data—questions that might provide the guidelines for the compilation of technical information into useful form.

Following the exposition of the practical aspects of visual search, there was a session comprised of reports on search strategies and probability functions. The statistical and temporal aspects of the possibility of detection were presented, the ideal sensor system was discussed, and there was an analysis of the factors to be considered in developing optimal visual search procedures.

The basic characteristics of the human eye as related to search were then described. Through laboratory data and scientific research reviews, the inherent capabilities of the eye as a receptor, detector, and sensor were defined.

Visual performance was illustrated through reports dealing with the effectiveness of visual search in unstructured fields, complex displays, and photographs and in aerial surveillance and vigilance tasks.

The comments of the invited discussants were presented as the final item in the various sessions. The prepared discussions and some of the extemporaneous comments made by other participants have been included in the volume.

256 pp. 112 figures 91 tables 154 references

Availability: AD 234502, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

FEASIBILITY OF DESCRIBING VISUAL DEMANDS OF MILITARY JOBS

Victor Fields, Editor
1962

The problem assigned to the working group was to determine whether the military services are capable of stating the visual demands of military jobs in such precise and objective terms as to be useful for setting visual qualification standards.

With this objective in mind, the Navy, the Army, and the Air Force were invited to make presentations in order to describe and explain the methods they employed in job analyses, with special emphasis on the procedures for identifying and defining the visual skills or abilities demanded of personnel in the performance of their assigned duties.

The procedures employed by occupational analysts in the military services to determine the required visual skills do not differ from those used to determine the mental, physical, biographical, and other requisities for a position. Thus, the statement of the visual requirements of any position stem from the subjective evaluations made by the occupational analyst.

At least three uses of visual standards are identified in the brief summaries of these presentations: (1) entrance, (2) retention, and (3) assignment.

10 pp. no figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

VISUAL FACTORS RELATING TO OPTICALLY- CONTROLLED INDIRECT-FIRE POINT TARGET WEAPONS

J.W. Gebhard, Editor
1968

Many studies of aerial reconnaissance have been made over the last 25 years. Over 500 papers have been written about what can be seen by the airborne observer using unaided vision, and much attention has been given to what the interpreter can see in an aerial photograph. Despite this effort, specific questions asked about the use of the eyes to detect, recognize, and identify objects in the ground for purposes of navigation, interdiction, rescue operations, and intelligence gathering continue to be very difficult to answer. In recent years, new questions about air-to-ground surveillance are being raised as a result of using artificial sensors—radar, infrared, and electro-optics—as a means for extending human visual capability. This report concerns the use of human vision to control an air-to-surface or surface-to-surface weapon through the intermediary of an airborne sensor that transmits an image of the ground scene to a remote video display.

The report is limited to visual aspects of the indirect-fire problem. Existing reviews and bibliographies of air-to-ground target detection, recognition, and identification were consulted, and a special bibliography that has particular relevance to the problem was prepared. Much, but not all, of this material has been examined: documents that are cited in the text of the report are listed separately under References. A glossary is given that defines terms as they have been used by the working group.

38 pp. no figures 4 tables 292 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISUAL SEARCH

1973

In 1959 the Committee on Vision sponsored a symposium on visual search. Continued interest in this subject prompted the committee to sponsor another symposium to survey theoretical and experimental developments during the past 10 years since the publication of the proceedings of the 1959 symposium.

The papers in this volume were presented at the committee's annual meeting in May 1970. Topics covered include: "Experiments in Visual Search," J.R. Bloomfield; "Visual Aspects of Air Collision," J.L. Harris; "Dynamic Visual Search Patterns," H.L. Snyder; "Detection of Peripheral Stimuli Under Psychological and Physiological Stress," H.W. Leibowitz; "Studies of Extrafoveal Discrimination and Detection," L.G. Williams; "Modulation Transfer Function Area as a Measure of Image Quality," H.L. Snyder; "Visual Scanning Behavior," J.W. Senders; and "Visual Information Storage," R.N. Haber.

150 pp. 90 figures 17 tables 104 references

Availability: AD 754327, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISUAL PROCESSING ISSUES IN COMPUTER-AIDED TARGET RECOGNITION: REPORT OF A WORKSHOP

Irving Biederman, Azriel Rosenfeld, and Pamela Ebert Flattau, Editors
1988

In the mid-1980s, the U.S. Army identified a major shortcoming in current automatic target recognition (ATR) capabilities and mounted a demonstration program to determine if an acceptable level of ATR performance could be achieved using state-of-the-art systems and multiple-sensor technologies. One of the main objectives of the program was to perform demonstrations and trade-off analyses for the development of the light helicopter.

In response to a request from the U.S. Army Human Engineering Laboratory, the Committee on Vision agreed to organize a workshop on vision issues related to the use of computer-aided target recognition systems. The resulting report provides a broad evaluation of the visual factors involved in the current design of displays specifically for multi-sensor, computer-aided target recognition systems. The workshop focused on displays that incorporate: (1) real-world scene information obtained directly from one of several sensors on a vehicle and (2) target-cueing symbols generated by artificial intelligence software operating on incoming data from other sensors. Discussion was organized around three areas: current use of the system, potential directions for display enhancement, and mechanisms for evaluating emerging new systems.

16 pp. 1 figure no tables 4 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W.,
Washington, D.C. 20418.

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THE VISUAL FACTORS IN AUTOMOBILE DRIVING: SUMMARY REPORT OF A SYMPOSIUM

1958

In the Armed Forces in the 1950s more deaths were caused by auto accidents than any other cause; auto accidents were also the leading cause of loss of time in the hospital. The prevention of these deaths and injuries was considered a fertile field for preventive medicine. A symposium was held to discuss visual factors in automobile driving and to suggest selection criteria for automobile drivers, including visual qualifications.

Because of the large amount of material to be covered in the outlining of the visual task, the discussion omitted reference to accident prevention, visual standards, driver licensing, fatigue, alcohol (including the effects of eye diseases), and defects in visual capabilities. Since vision is dependent upon light, variations in the intensity, spectral distribution, scattering, reflection and other physical characteristics were carefully considered.

During almost all of the driving task, the eye is not in a fixed position in relationship to the objects from which it is gleaning information. The motion of the automobile and its driver produce changes in visual abilities over the static situation; some abilities are enhanced, some reduced.

The framework within which the visual factors were considered focused on the following visual factors:

1. Detection—awareness of the presence of something.
2. Recognition—recognition of the object.
3. Dynamic relationships—significance of position, speed, and direction of travel.

25 pp. no figures no tables 71 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

VISUAL FACTORS IN TRANSPORTATION SYSTEMS

1969

A symposium was held in spring of 1969, bringing together people experienced in day-to-day operations in transportation systems with persons doing research on visual problems involved in these systems. The purpose of this juxtaposition was to encourage an exchange of information among operational people, managers of research, and research workers. It was hoped that a firsthand account of visual problems by operators would call attention to any problems that might be slighted in current research efforts and that this exchange of information might have some salutary effect on plans for future research.

The papers presented in this volume represent the proceedings of the symposium. In section one, The Highway Transportation System, the following papers are presented: "Visual Problems of Truck and Bus Drivers," W.C. Neidig; "Visual Problems in Automobile Driving," W.M. Heath; "Factors in Visibility and Legibility of Highway Signs and Markings," T.W. Forbes; "Requirements for Automobile Exterior Lighting," R.G. Martimer; and "Factors in Highway Lighting," D.M. Finch. In section two, The Air Transportation System, the following papers are presented: "Selected Visual Problems of an Airline Pilot," H.W. Orlady; "Visual Problems of the Air Traffic Controller," P.A. Nelson; "Some Display Concepts in Air Traffic Control," D.W. Connolly; "The Helicopter in High Density Traffic," J.K. Crosley, et al.; "Measurement of Height and Distance Information Provided Pilots by the Extra-Cockpit Visual Scene," C.L. Kraft; and "Visual Illusions in Aircraft Accidents," D.G. Pitts.

131 pp. 38 figures 6 tables 135 references

Availability: PB 196014, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISION SCIENCE

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SOME ASPECTS OF THE BASIS OF STEREOSCOPIC VISION

Kenneth N. Ogle
1953

This report discusses whether simultaneity is a factor associated with disparity between the images in the two eyes and is necessary for the emergence of the stereoscopic experience. It is well known that stereopsis can be obtained from disparate afterimages that are induced in each eye separately. Experiments show, however, that stereoscopic depth from afterimages is experienced only as long as the disparate retinal elements involved are in an excited state at the same time.

Simultaneity with respect to retinal location concerns the question whether the disparate stimuli, at least in part, must fall on specific horizontally associated disparate retinal elements. In 1873, van der Meulen and van Dooremaal reported their observations that bear on this question. They used the Hering "falling sphere" test. In this test, through a horizontal slit-aperture, the subject views a vertical thread (plumb line) as a fixation object and judges whether a small sphere dropped by an assistant appears to fall in front of or behind the fixed plumb line. A prism was placed base down before one eye so that the image of the slit to the eye would be seen entirely above the actual slit seen by the other eye. The images of the plumb line would be uninfluenced and would appear just the same as before. A small sphere now dropped near the plumb line would not be seen simultaneously by the two eyes. The upper half of the path of the fall would be seen by one eye, the lower half of the path would be seen by the other eye.

It was reported that the path of the falling sphere nevertheless could always be correctly judged nearer or farther than the plumb line. These authors concluded that stereoscopic depth is not to be conceived as a direct physiological phenomenon but as a psychical one, that is, the depth is produced by a psychophysical process. In this experiment, the stereoscopic vision arises solely through the means of imagined prolongations of the half-images, which then in the usual stereoscopic manner would be referred to horizontally disparate retinal points.

6 pp. no figures no tables 6 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

AN ANNOTATED BIBLIOGRAPHY OF FLICKER-FUSION PHENOMENA: COVERING THE PERIOD 1740-1952

Carney Landis
1953

In 1948, evaluation of the experimental findings of the Columbia-Greystone Brain Research Project suggested that the critical flicker-fusion threshold was probably lowered as a result of surgical ablation of portions of the human frontal lobes. A search for information in textbooks, handbooks, and monographs dealing with the physiological psychology of vision nowhere provided either an explanation of the observation nor indeed a comprehensive treatment of the flicker-fusion phenomena. It became apparent that many investigations had been made of flicker-fusion phenomena but there was no comprehensive theory or review of the topic.

Flicker-fusion phenomena have been investigated by one or more persons working in various disciplines, e.g., physics, chemistry, mathematics, physiology, zoology, botany, neurology, ophthalmology, optometry, astronomy, anatomy, pathology, internal medicine, endocrinology, nutrition, pharmacology, biology, biophysics, biochemistry, electrical engineering, illuminating engineering, and psychology. Flicker-fusion phenomena have been discussed under titles such as: persistence of vision, photopic versus scotopic vision, visual beats, visual ripple, intermittent vision, and duration of retinal impressions. They have been studied in many states of physical and mental pathology. The effect of a wide variety of drugs, chemicals, hormones, and the like on flicker-fusion phenomena has been reported. Yet, despite the fact that it has entered into such a wide variety of investigations, there is no comprehensive theory of flicker. The general theory of Plateau (1834) is as complete as that of any of his successors. Marbe, V. Kries, Sherrington, McDougall, Ives, Hecht, Crozier, and Ross have theorized, but in each instance in a limited fashion that encompassed only part of the available factual evidence. Even such a simple point as whether the flicker-fusion threshold is dependent on retinal functional limitations or on limitations imposed by the central nervous system has never been clearly answered.

130 pp. no figures no tables 1,300 annotated entries (2,000 references)

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

THE MEASUREMENT OF VISUAL FUNCTION

Milton A. Whitcomb and William Benson, Editors
1965

The purpose of this report is to provide a basis for reevaluating the testing procedures for each of the different visual parameters useful in visual classifications. A working group of the Committee on Vision reevaluated some of the aspects of the visual requirements for flying and made some general conclusions and recommendations regarding visual requirements, visual standards for performance tasks in general, and the role of the visual scientists in assessing visual capabilities and in assisting the agencies and services with their needs for visual classification systems.

The laboratory methods of assessing each visual function are presented in order to update the awareness of all possible testing techniques available in assessing the considered visual parameter. The clinical presentations are directed toward assessing those techniques best suited for practical utilization in measuring the considered visual parameter by (a) professional personnel, (b) nonprofessional (technical) personnel, and (c) machine or semiautomated methods. Special reference is made to updating techniques such as the utilization of electrodes, machines (orthorator types), and other semiautomated techniques capable of quantifying or scaling the test scores. Where appropriate, comments are made relative to training of the visual function and predictability of change with age.

The material presented provides a basis for making judgments relative to the preferred testing techniques best suited for the needs of the different agencies and services requiring visual classification and testing. These conclusions are derived from, or compared with, the array of laboratory techniques available. The concern is with the testing techniques most suitable for scoring and classification.

The papers presented in this volume are concerned with ideal and practical techniques for the measurement of each of the selected visual functions and cover the following topics: visual acuity; refractive error; color vision; distance vision; phoria and ocular rotation; accommodative amplitude; night vision; visual fields; intraocular tension; stress tolerance; and clinical and laboratory measurement of visual functions (other than those mentioned).

260 pp. 89 figures 4 tables 361 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

EYE MOVEMENTS AND PSYCHOLOGICAL PROCESSES

Richard A. Monty and John W. Senders, Editors
1976

This volume brings together scientists from such disciplines as neurology, physiology, engineering, medicine, and psychology to examine many aspects of eye movement. It begins with an examination of the physiology of eye movement control and then examines the role of eye movements in vision, methods of recording eye movements, the relation of eye movements to the perception of motion, position, and kinds of visual stimuli. Specific fields such as target detection, search and scanning, reading behavior, and highest cognitive processes are examined.

550 pp. 22 figures 21 tables 497 references

Availability: Lawrence Erlbaum Associates, Hillsdale, N.J.

ELECTROPHYSIOLOGICAL TECHNIQUES IN VISION

1977

This volume, the proceedings of a 1975 symposium, includes papers presented at the symposium on five major topics relevant to electrophysiological techniques for studying human visual functions. First, a historical overview provides a brief description and appraisal of the techniques that have been developed for stimulating and recording the visual responses of the human eye and brain. Second, psychophysical applications of human electroretinography are given: rapid developments in human electroretinography during recent decades have greatly increased its value for investigating psychophysical problems. This review of the current status of electroretinography considers the response waveform, recording techniques, and data analysis. Several examples of electroretinal data that have psychophysical significance are presented. Third, transient visually evoked potentials are discussed. Fourth, steady-state evoked potentials are treated. Finally, spatiotemporal mapping of scalp potentials are covered.

43 pp. 84 figures no tables 154 references

Availability: The Journal of the Optical Society of America Vol. 67, No. 11, pp. 1451–1494, 1977.

EFFECTS OF MICROWAVE RADIATION ON THE LENS OF THE EYE

1981

A working group of the Committee on Vision was formed in response to concern expressed by representatives of several federal agencies about workers who may be exposed to microwave radiation. The committee was requested to review the scientific literature concerning ocular effects of microwave radiation and to comment on the adequacy of existing studies, particularly in regard to the potential for ocular damage from microwave exposure below the current standard. The Department of the Air Force also requested comment on the desirability of routine screening for ocular changes in all its personnel working around microwave devices.

Potential hazards of human exposure to microwave radiation are of considerable concern because large numbers of people in the military services and in industry work in the vicinity of microwave generators and also because people may be exposed to radiation from devices such as microwave ovens and diathermy devices used in physical therapy. Cataractogenesis is the most clearly documented irreversible effect of overexposure to microwave radiation, but the mechanisms underlying this effect are poorly understood.

The current standard for maximum permissible occupational exposure to microwave radiation, recommended by the American National Standards Institutes (ANSI), is 10 mW/cm^2 . This report surveys existing studies of cataract induction by microwave radiation exposure and discusses the implications of this literature for human exposure at levels below 10 mW/cm^2 . The report also suggests the kinds of study still needed. The report does not comment on the appropriateness of the existing standard. Standards for whole-body exposure are based on considerations of all possible biological effects and also on policy issues such as degree of acceptable risk, margin of safety, and cost-benefit considerations.

13 pp. no figures no tables 55 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

EMERGENT TECHNIQUES FOR ASSESSMENT OF VISUAL PERFORMANCE

1985

Recent vision research has led to the emergence of new techniques that offer exciting potential for a more complete assessment of vision in clinical, industrial, and military settings. Four areas of vision testing are examined in this report: (1) contrast sensitivity function; (2) dark focus of accommodation; (3) dynamic visual acuity and dynamic depth tracking; and (4) ambient and focal vision.

Each of these topics is discussed in a separate section of the report; each section focuses on issues related to screening industrial and military visual functions. The report concludes with summary recommendations for research. The report text is followed by four appendices that give additional information and detail on spatial contrast sensitivity, detection sensitivity and response bias, Fourier analysis, and the use of tests for screening and selection.

66 pp. 23 figures no tables 181 references

Availability: Publication on Demand, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

VISION RESEARCH REPORTS

E. Porter Horne and Milton A. Whitcomb, Editors
1960

The purpose of this volume is to bring together the summaries of the scientific papers that were presented at the 36th, 37th, and 39th annual meetings of the Committee on Vision. The papers presented at the 38th annual meeting, which was devoted primarily to the symposium on visual search, were included in the proceedings of that symposium (see *Visual Search Techniques*).

At the 37th annual meeting, in addition to papers summarized herein, a symposium on illumination and visibility of radar and sonar displays was held. That portion of the meeting is also reported in *Illumination and Visibility of Radar and Sonar Displays* (see below).

This report includes such topics as: recognition of forms against a complex background; accommodation levels in empty visual fields; the status of research on the effect of pre-exposure on dark adaptation; the intensity factors in vision; and, general color-vision theory.

182 pp. 97 figures 4 tables 260 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

RECENT DEVELOPMENTS IN VISION RESEARCH

Milton A. Whitcomb, Editor
1966

The papers presented in this report concern recent developments in vision research. Topics covered include: (1) recent advances in the study of physiological reflex mechanisms in vision, (2) recent advances in instrumentation and procedures in vision research, and (3) the effects of drugs on vision.

The papers presented are the following: "Focusing Responses of the Human Eye," G. Westheimer; "Pupillary Movements Associated with Light and Near Vision: An Experimental Review of the Literature," I.E. Loewenfeld; "The Fusion Reflex," K.N. Ogle; "Vestibular Mechanisms and Vision," E.F. Miller II and A. Graybiel; "Visual Psychophysics with Animals," D.S. Blough; "Measurements of Light Reflected from the Retina," J. Krauskopf; "Stabilized Image Techniques," T.N. Cornsweet; "Principles of Neurological Feedback Control Systems for Eye Muscles," L. Stark; "Ocular Pharmacodynamics," A.M. Potts; "The Sensory Effects of Drugs: Electrophysiological Investigations of the Mechanism of the Action of Drugs on the Eye," G.B. Arden; "Studies in the Pharmacology of Extraocular Muscles," G.M. Breinin and J.H. Perryman; "Drug and Eye Movement Responses in Man," G. Westheimer; "The Effects of Drugs on Vision," L.S. Otis; and "Some Potential of Research on Drugs and Vision," R. Trumbull.

227 pp. 88 figures 10 tables 509 references

Availability: AD 627186, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISION RESEARCH IN MILITARY AND GOVERNMENT LABORATORIES

John Lott Brown
1967

Fairly extensive research on a variety of aspects of vision is conducted within service laboratories in the Air Force, the Army, and the Navy. There is also some research on visual processes conducted in laboratories by the Coast Guard and by the National Aeronautics and Space Administration. The Committee on Vision requested information concerning their in-house research; this report summarizes the results of that survey and describes the type and amount of vision research being done in the military and government laboratories. References cited in this report include those received as a result of that survey. They are neither complete nor a representative sample of all the work in military laboratories.

22 pp. no figures no tables 63 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

FRONTIERS OF VISUAL SCIENCE: PROCEEDINGS OF THE 1985 SYMPOSIUM

1987

Vision research is a science in transition. The improved understanding of genetics at the molecular level and rapid advances in computer architecture suggest that vision scientists are no longer limited in the methods and models available to them to tackle the most challenging research questions. The rate of advance in our understanding of the visual system is not yet equal, however, to that of technical advance. The transition will be complete when vision research has fully integrated the most promising of these new approaches and renewed the expansion of its knowledge base.

On December 11, 1985, the Committee on Vision brought together 14 leading investigators in vision research whose work embodies the integration of some of these newer models and methods. Participants illustrated how new approaches to fundamental visual processes have significantly improved our understanding of spatial vision, stereoscopic depth perception, color consistency, and color vision. The advantages of these new models are discussed with methods for attacking problems of vision along many fronts. The pitfalls and areas in which some of these new approaches fail to explain visual function are also considered.

The symposium report is divided into three parts, reflecting the three part structure of the program: (1) developments in the ideal observer concept; (2) computational theories for vision research; and (3) cone pigments and color vision polymorphism.

198 pp. 40 figures 1 table 192 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

**ADVANCES IN THE MODULARITY OF VISION: SELECTIONS
FROM A SYMPOSIUM ON FRONTIERS OF VISUAL SCIENCE**

1990

Converging lines of evidence indicate that the brain contains multiple neural representations (i.e., maps) of visual space, with different maps devoted to the analysis of different aspects of the visual scene. From a computational standpoint, such a processing arrangement makes good sense given the properties of the brain. Moreover, neurophysiologists have actually documented that the primate cortex is divisible into distinct visual maps, with as much as 60 percent of the cortex concerned with vision. Others are now using noninvasive techniques (e.g., positron emission tomography) to study local regions of brain activity in alert humans. And neurologists have known for some time that focal lesions can produce highly specific losses of visual function.

This is the report of a 1987 symposium that brought together individuals from these fields—computational theory, neurophysiology, and neurology—to discuss: (1) evidence for the modularity of vision; (2) topographic versus nontopographic mapping; (3) the plasticity of modules (i.e., to what extent can one module take over the function of another?); (4) means by which perceptual unification of the visual world occurs; and (5) the relation of the modularity concept to other functional concepts, such as focal/ambient distinction.

Approx.: 70 pp. 31 figures no tables 52 references

Availability: Committee on Vision, 2101 Constitution Ave., N.W.
Washington, D.C. 20418.

**ADVANCES IN PHOTORECEPTION: PROCEEDINGS OF A
SYMPOSIUM ON FRONTIERS OF VISUAL SCIENCE**

1990

Vision begins with the transduction of light into neural signals by photoreceptors. Significant recent advances in our understanding of this process of photoreception include the precise measurement of the wavelengths absorbed by visual pigments in the human eye and the role of the molecule cyclic GMP in the transduction of light to photocurrent.

Another area of recent progress is the analysis of the spatial mosaic of photoreceptors. The sampling of the visual image by the photoreceptor lattice influences visual acuity and sensitivity. Disorders of the array of cones as a consequence of retinal disease may well be the cause of perceptual deficits. Future research on vision will depend upon these new fundamental findings about photoreception.

This volume presents the work of scientific leaders on this frontier of vision research. The 1988 symposium speakers included visual physiologists and psychophysicists. The volume covers: (1) wavelength specificity of visual pigments; (2) receptor transduction in health and disease; (3) adaptation of photoreceptors to light; (4) variations of the photoreceptor lattice across the retina; and (5) photoreceptor sampling of visual images and aliasing. Comparisons between human and animal retinas are offered, and differences between photoreceptor function in normal and diseased eyes are emphasized.

156 pp. 39 figures 2 tables 214 references

Availability: National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

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VISUAL DISPLAYS

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STANDARDS TO BE EMPLOYED IN RESEARCH ON VISUAL DISPLAYS

1947 (revised 1950)

In this report, visual displays are defined to include all methods of transmitting information to the human being through the visual sense. Research in visual displays is defined to include investigation of visual response at three levels: (1) simple sensory discrimination; (2) recognition and identification of familiar patterns such as words, numbers, or symbols; and (3) interpretation, involving meaning and understanding as demonstrated by appropriate action, such as verbalization of the displayed information or manipulation of control levers and switches.

In order to obtain comparability of visual display research data from different laboratories, and thereby to increase the efficiency and value of research in this area, some standardization was needed with regard to subject groups, units of measurement, fixed values of stimuli not under investigation, and methods of experimental measurement. The subcommittee that produced this report agreed that the standards it recommended should be circulated for comment and later published so as to be available to workers in this field. However, these recommendations are considered as tentative and subject to considerable revision before they become an established guide to research workers. It was not the purpose of the subcommittee to specify standards or stimulus characteristics that result in optimum visual displays. Such specification must await the results of current and future research. Likewise, the subcommittee was not concerned with standards for the design of experiments or the quality of experimental work. Particular consideration was given to the avoidance of standards that would unduly hamper or stereotype research efforts.

4 pp. 2 figures no tables no references

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

ILLUMINATION AND VISIBILITY OF RADAR AND SONAR DISPLAYS

Robert H. Brown, Editor
1958

This report on illumination and visibility of radar and sonar displays is the result of a symposium held in conjunction with the Committee on Vision's 37th annual meeting. World War II was fought using radar scopes in darkness or semidarkness. The flashlight was an indispensable source of illumination. Since then, different methods for illuminating electronic displays have developed rapidly. The common objective of a mushrooming group of techniques has been to provide adequate illumination in the area around a display without interfering with its essential function.

One example, expressed in economic terms, illustrates the significance of orderly and planned communication. In a certain large installation, electrical power of 12 w per sq ft produces an illuminance of 3 ft c. In another installation, only 0.65 w per sq ft is required for approximately the same illuminance. Does improved visibility of the displays in the first installation justify the greater initial cost and the increased operating expenditures? The answer to this question, and to many similar questions, requires communication between researchers familiar with the different installations and also between researchers with different scientific and engineering backgrounds.

Even more marked than the growth of methods for illumination has been the accelerating invention of new displays. These include transparent phosphors, direct-view storage tubes, electroluminescent panels, bright displays, and new displays.

At the same time, there has been research concerned with the effect of variation in basic parameters upon the use of presently available and widely used displays. For cathode ray tubes, grid bias and receiver gain have received the most attention. Marked interest has been shown in other factors. This research has been directed toward the objective of utilizing displays more effectively in an environment with an ever-increasing illuminance.

The symposium on which this report is based originated in the 1957 Human Engineering Conference sponsored by the Office of Naval Research in Tulsa. During the symposium the first panel discussant noted the value of cross-fertilization between disciplines. Cross-fertilization requires a common medium and, in this case, the medium is the operational setting.

The symposium was organized on the assumption that communication on other than an accidental (or informal) basis is essential to the most adequate solution of common problems. Representation at the symposium

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was sought from leading workers in four areas. It was convenient, therefore, to schedule presentation, in four subject-matter sessions: operational requirements for cathode tubes and displays in relation to illumination problems; methods for controlling ambient illumination; display requirements imposed by visual factors; and new techniques under development. A discussion session concluded the symposium.

210 pp. 99 figures 7 tables 65 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

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AN EVALUATION OF THREE-DIMENSIONAL DISPLAYS

H.W. Leibowitz and R.L. Sulzer
1965

The purpose of this document is to evaluate three-dimensional (3-D) visual displays. It is assumed that the desirability of a 3-D display, as opposed to other equivalent display types, will be strongly dependent on the particular system under consideration. The current attempt to assess possible advantages and disadvantages of 3-D displays in relation to present and future systems is not concerned, therefore, with the advisability of recommending a 3-D display to the reader, who alone has the critical information regarding specific systems requirements. It is believed, however, that provision of general background material will be of some service. Taken together with detailed information regarding the application in question, it may provide the necessary basis for practical system decisions. Furthermore, it is hoped that a stimulus may be provided to the research that has been revealed by this study as urgently needed if more effective equipment is to be designed for use by the human operator.

The term *3-D display* is defined here to include volumetric and stereoscopic devices that are viewed with two eyes and produce depth impressions principally because of retinal disparity. Other sorts of displays of three-coordinate information have been in use for many years, most often taking the form of two flat-plane views. These more conventional presentations will no doubt continue to find many applications, and detailed discussions of their design and use aspects may be found in several of the listed references. However, the immediate concern is with the relatively new 3-D displays that are currently under development and study by a score of manufacturers and research and development laboratories.

35 pp. 5 figures 1 table 63 references

Availability: AD 45784918, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VIDEO DISPLAY TERMINALS AND VISION OF WORKERS: SUMMARY AND OVERVIEW OF A SYMPOSIUM

Barbara S. Brown, Key Dismukes, and Edward J. Rinalducci
1982

This summary discusses issues raised at a symposium on vision and video display terminal (VDT) work, held at the request of the National Institute for Occupational Safety and Health. Symposium participants critically reviewed laboratory studies of visual functions and field surveys of visual complaints of VDT operators to determine what conclusions can be drawn about the prevalence, severity, causes of, and possible remedies for reported difficulties.

Although speakers' perspectives differed, a number of points appeared to gain consensus: (1) Properly designed epidemiological studies comparing the incidence of visual problems in VDT operators with that in non-VDT workers are needed. (2) Visual issues are closely interrelated with ergonomic and job design variables, and the use of multivariate statistical analysis is necessary to determine what specific aspects of work involving VDTs may contribute to visual and other complaints. (3) No scientifically valid study has established that VDT use causes harm, in the sense of damage, to the visual system. (4) Existing knowledge indicates a number of measures that could be taken to improve worker comfort and performance. (5) Surveys of radiation emissions from VDTs indicate that levels of radiation are far below U.S. occupational exposure standards. (6) Standards should be based on research. Differing opinions on whether setting standards is useful and appropriate point to the need for caution in this area. Needs for further research are identified.

19 pp. no figures no tables 13 references

Availability: Behaviour and Information Technology Vol. 1, No. 2, pp. 121-140, 1982.

VIDEO DISPLAYS, WORK, AND VISION

1983

This report by a panel of the Committee on Vision primarily concerns issues involving vision and the visual system. However, because factors that affect operators' comfort and performance cannot be elucidated by analyzing only the optical characteristics of video display terminals (VDTs), relevant human factors and psychosocial issues are also considered. Because much of the concern about the possibility of radiation hazards has been based on misinformation, the results of surveys were analyzed in which the levels of radiation have been measured and compared with those levels with ambient levels of radiation emitted by human-made and natural sources and with current standards for occupational exposure. The question of what is an acceptable level of radiation exposure was not reopened. Whether there is evidence that ocular diseases or abnormalities, including cataracts, are associated with VDT-related work was discussed. The report only briefly discussed the possibility of disorders that do not involve vision (i.e., effects on pregnancy and skin rashes because there are few published data and because of lack of appropriate expertise).

In the course of its study, the panel reviewed diverse literature, including reports of field surveys of VDT workers and VDT work places, laboratory studies of visual functions in VDT work tasks, news articles, and pamphlets prepared by labor unions concerned with VDT issues. The panel also draws upon the substantial technical literatures on visual function, image quality, lighting design, ergonomic design, and industrial and organizational psychology.

273 pp. 31 figures 21 tables 401 references

Availability: Distribution Service, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

MOTION SICKNESS, VISUAL DISPLAYS, AND ARMORED VEHICLE DESIGN: PROCEEDINGS OF A CONFERENCE

1989

A working group was asked to review the operational requirements of anticipated low-profile armored vehicles and to determine the underlying visual/vestibular research issues relevant to the appropriate design of visual display system within those vehicles. To accomplish these goals, the working group convened a small conference to review what is known about motion sickness symptoms arising from the response of the oculomotor system to conflicting visual and vestibular cues.

Participants reviewed what is known about research in this area with specific reference to environmental conditions likely to be encountered in low-profile armored vehicles. Eight specialists from the fields of visual psychophysics, neuroscience, and human factors engineering met for two-days at Brandeis University in January 1988. Participants essentially provided a tutorial on the different methodological approaches to visual/vestibular issues relevant to the design of electronic visual displays. The edited proceedings of the discussion, together with highlights developed by the working group, are the contents of this report.

126 pp. 26 figures 11 tables 21 references

Availability: U.S. Army Laboratory Command, Ballistic Research Laboratory, Aberdeen Proving Ground, Md. Contractor report BRL-CR-629.

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MISCELLANEOUS

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**THE ARMED FORCES-NATIONAL RESEARCH COUNCIL
VISION COMMITTEE— HISTORY 1944-1949 AND
DESCRIPTION OF ORGANIZATIONAL STRUCTURE**

1955

This report gives background and details on the origins of the Committee on Vision, its early objectives, and its activities during the war years. In early 1944, informal contacts between officers of the Army and the Navy revealed mutual concern with military problems, whose solution involved detailed information of human visual capacity. It was suggested that a joint military committee on vision would prove valuable in organizing existing information and experience and in coordinating further research programs undertaken by the military services. In addition, it was agreed that the knowledge and experience of civilian specialists should be brought to bear on the visual problems.

As a result of these informal discussions, a request was submitted by the Army and Navy and to the Director of the Office of Scientific Research and Development (OSRD) for the establishment of a formal vision committee. The Army-Navy-OSRD Vision Committee was organized in response to this request. A full-time civilian executive secretary was appointed and office quarters were arranged in the National Academy of Science building in Washington. Official Army and Navy members of the committee were designated to represent organizational units of the services, and civilian scientists with professional competence in some aspect of visual science were officially appointed from OSRD. The first meeting of the committee was held in Washington on April 7, 1944. Twelve additional meetings were held prior to the end of the war in August 1945.

Meetings of the committee were planned to encourage service personnel to present problems concerned with vision for consideration. Military members contributed their practical experiences and the results of research investigations they had conducted relevant to the problems. The OSRD representatives gave professional counsel and also reported current experimental results. The objective of the committee was to provide opportunity for free and complete discussion of problems; the committee meetings provided the mechanism for liaison between military personnel having full appreciation of the problems and scientific experts with competence in general and theoretical aspects of vision research.

Some estimate of the committee's influence during the war years may be obtained by examining sample topics presented for discussion by the military members during this period. A list of such topics is presented

below specific reference to the minutes and proceedings of the committee meetings.

1. Visual standards for military service and standardization of procedures for visual examination.
2. Procedures for visual training, including lookout training, recognition training, and night vision training.
3. Solution of visibility problems including camouflage, visibility of markers, signals, ships, aircraft, submerged objects, insignia, and visibility in night ground, air, and sea operations.
4. Principles of instrument design for efficient presentation of visual information.
5. Specifications of illumination quantity and quality for instruments and working surfaces in order to secure optimum performance and preserve dark adaptation.
6. Physiological effects on vision, including the effects of anoxia, positive acceleration, and ultraviolet and infrared radiation.
7. Principles of optical design and specification for optical equipment such as sunglasses, sunscreening goggles, dark-adaptation goggles, binoculars, telescopes, height-finders, and range finders.

50 pp. no figures no tables topical index of minutes and proceedings

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

INFORMATION REQUIREMENTS FOR THE CONTROL OF COMBAT FORCES

J.W. Gebhard and R.M. Hanes, Editors
1959

A working group was established by the Committee on Vision with an interest in the visual display area.

The field encompassed by the visual display of information is an exceedingly broad one, which draws on physiological, psychological, and engineering resources. The working group's tasks were as follows:

1. Determination of Armed Forces display requirements.
2. Analysis and classification of display requirements.
3. Compilation of display concepts and techniques.
4. Guidance for R&D work in visual displays, and
5. Measurement standards.

This proceedings volume is the result of a conference held on June 24-26, 1959, during which representatives of the several services presented requirements for the display data used in making command decisions. The military presentations and the ensuing discussion are of general interest, both from the standpoint of decision making and the displays upon which decisions are based.

These proceedings are published in two parts: one is an unclassified summary and the other is the complete report, including the summary, which is classified secret (see *Inquiry Into Methods Used to Obtain Military Information Requirements*).

14 pp. 2 figures no tables 1 reference

Availability: Committee on Vision, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

INQUIRY INTO METHODS USED TO OBTAIN MILITARY INFORMATION REQUIREMENTS

1960

In 1958 a working group was established to ascertain what contribution the committee might have to research and development programs concerned with the visual display of data. The procedure adopted by the working group to accomplish this is briefly as follows:

1. *Determination of Armed Forces Data Presentation Requirements.* To obtain the requirements of the Army, the Navy, the Air Force, and the Marine Corps for current and future visual displays and to supplement these by requirements of the Federal Aviation Agency, the Weather Bureau, and other potential users of visual displays.
2. *Analysis and Classification of Data Presentation Requirements.* To analyze significant data presentation requirements in order to provide a preliminary basis for classifying visual display needs, assessing the strengths and weaknesses of present and proposed research and development programs in the visual display area.
3. *Compilation of Display Concepts and Techniques.* To survey the field of visual displays for the purpose of establishing a file of past, present, and future concepts and methodology and a list of techniques and equipment.
4. *Guidance for Research and Development Work in Visual Displays.* To delineate areas for new work on visual displays based on the analyses and compilations discussed above. The methods currently available for determining data requirements for any system are described in Part I of this report. Part II is an assessment of their merits. Part III describes a procedure that is recommended at the present time and until much more experimental data are available (see Information Requirements for the Control of Combat Forces).

28 pp. no figures 1 table 7 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

VISUAL PROBLEMS OF THE ARMED FORCES

Milton A. Whitcomb, Editor
1962

The purpose of this report on visual problems of the Armed Forces is to bring together the scientific papers that were presented at the Committee on Vision's meeting on March 30-31, 1961, at the Smithsonian Auditorium in Washington, D.C. Presentations were scheduled in four subject-matter sessions: vision under reduced stimulus conditions; perceptual problems of space travel; pictorial display for reconnaissance interpretation; and visual processes and problems of battlefield surveillance in ground warfare.

Papers presented in this report are the following: "Review of Recent Literature on Night Vision Testing," J.S. Kinney; "Contrast Thresholds as a Function of Retinal Position and Target Size for the Light-Adapted Eye," J.H. Taylor; "The Problem of Motion Perception and Orientation in the Ganzfeld," J.W. Miller and R.J. Hall; "The Electrophysiological Correlates of Vision in a Uniform Visual Field," D.I. Tepas; "The Apparent Frontoparallel Plane, Stereoscopic Correspondence and Induced Cyclorotation of the Eyes," G.S. Harker; "A Concept of Space Travel and Operations," R.P. Haviland; "Vision and the Mercury Capsule," E.R. Jones and W.H. Hann, Jr.; "Extant Perceptual Theories and the Perceptual World of Space Flight," W. Bevan; "Photographic Image Quality," G.A. Fry; "Viewing Equipment for the Photographic Interpreter," V. Van Keuren; "Image Enhancement as an Aid to Reconnaissance Interpretation," R.E. Andrea; "In Flight Pictorial Interpretation," C.W. Simon; "Goals, Problems, and Systems of Combat Surveillance in the U.S. Army," K.A. Ward; "Problems in the Display and Utilization of Numerous Classes of Battlefield Information," F.J. Harris; "Problems in Meeting Future Combat Surveillance Display Requirements," R.P. DeVoe and J.E. Hoagbin; "Problems in the Design of Sensor Output Displays," S.W. Smith; "Requirements for Research on Psychological Factors in Image Interpretation," J. Zeidner; and "Requirements for Research on Uses of the Unaided Eye in the Collection of Battlefield Information," F.H. Thomas.

193 pp. 86 figures 13 tables 116 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

SURVEY OF VISUAL RESEARCH LITERATURE ON MILITARY PROBLEMS DURING WORLD WAR II

Lewis O. Harvey, Jr.
1970

World War II research papers, reports, and meeting agenda originating in Australia, Canada, Great Britain, and the United States were collected by the Committee on Vision at the end of the war. Classified during the war, these papers remained largely disregarded in the following years.

The purpose of this report is to bring to public attention this material. The following topics are covered: night vision, target visibility, aircraft recognition training, visual standards and pilot performance, tank telescopes, dazzle, optical aids, and camouflage. The papers of Kenneth Craik, who was intensively active during the war making contributions to a number of committees and solving a wide range of problems, are also covered.

Critical comments and evaluations are given along with updating of the material when feasible.

392 pp. 112 figures 13 tables 404 references

Availability: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

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