DALTONIANA

NEWSLETTER
OF THE INTERNATIONAL RESEARCH GROUP ON COLOUR VISION DEFICIENCIES

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LITERATURE SURVEY

Rapid light-induced changes in near infrared transmission of rods in Bufo marinus, by H.H. HARARY, J.E. BROWN and L.H. PINTO (Committee on Higher Degrees in Biophysics, Harvard University, Cambridge, Mass. 02138, USA) Science 202, No. 4372, 1083-1085, 1978.

Rapid transient changes in axial transmission of near infrared light through the outer segments of retinal rods of Bufo marinus are induced by illumination. These changes may be useful in the study of photoreceptor function. The reason for these changes are not clear. - Ingeborg Schmidt.

Rod threshold : influence of neighbouring cones, by D.W. BLICK and D.I.A. MacLEOD, Vision Research 18, 1611-1616 1978.

Original indications, resulting from the work of Stiles (1939), Flament and Stiles (1948) and Westheimer (1965, 1970), that rod and cone systems acted independently in their lateral interactions and consequental desensitisation by local surrounds, have been challenged by recent psycho-physical investigations backed up by anatomical and electrophysiological evidence. Using the Stiles-Crawford effect I to stimulate preferentially the rod and cone participation, together with a red annular surround, rod thresholds were obtained with a surround entering the pupil first centrally and then marginally, varying in intensity. Large differences found indicated an effect by the surround on the rod threshold - a consequence of cone activity. The activitation by the annular surround

was shown to depend almost exclusively on the qurround's effect on cones - the rod participation being insignificant - rod-cone interaction thus being indicated. Further evidence, pertinent to the debate, is surveyed and a discussion follows on the various physiological possibilities. One such extends Westheimer's (1965) interpretation that light in the outer receptive field may decrease the cell's responsiveness by inhibiting its activity, hence increasing its sensitivity. These new findings could thus be explained by lateral interactions of an inhibitory nature from cones on rods via specific anatomical inputs. However, central mechanisms are also considered in the discussion, and since electrophysiological evidence does not support the hypothesis of a peripheral origin for the desensitisation experienced in psychophysical studies (at least in mammals) a higher site appears more favourable. - Janet Voke.

Spectral response of the human eye, by N. BEN-JOSEF and A. ROSE (Applied Physics Division, School of Applied Science and Technology, Hebrew University, Jerusalem), J. opt. Soc. Amer. 68/7, 935-937, 1978.

The purpose of the paper is to offer a reasonable argument to the existing red cut-off of the scotopic eye in terms of nature's attempt to achieve a low absolute threshold for vision. A thermal activation energy of about 1.5 eV is necessary to protect the observed absolute luminance threshold of 10^{-7} mL against thermal excitations. The point at which the luminosity curve departs from the thermally activated curve marks the true optical threshold energy $E_{opt} = h\nu$ for the eye response. This point is at about 1.8eV i.e. at 0.685 μm. - Ingeborg Schmidt.

Luminance and opponent color contributions to visual detection and to temporal and spatial integration : Comment, by C.R. INGLING Jr. (Department of Biophysics and Institute for Research and Vision, The Ohio State University, Columbus, Ohio 43210, USA), J. opt. Soc. Amer. 68/8, 1143-1146, 1978.

King-Smith and Carden (see Daltoniana No. 27, p. 1, 1977) conclude, from the similarity of the spectral sensitivity curves measured with a CFF criterion to curves measured using a tiny spot on a white background, that both criteria tap the same channel, or system, the achromatic or luminance system. Numerous electrophysiological and psychophysical experiments of the authors indicate that despite similarities in spectral sensitivity or other properties, detection of flicker and detection of small spots are probably mediated by different channels. - Ingeborg Schmidt.

Luminance and opponent color contributions to visual detection and to temporal and spatial integration : Authors reply to comments, by P.E. KING-SMITH and D. CARDEN (Visual Sciences Unit, Ophthalmic Optics Dept. U.M.I.S.T., PO Box 88, Manchester, M60 1QD, England), J. opt. Soc. Amer. 68/8, 1146-1147, 1978.

In reply to Ingling's comments the authors state that their result can be understood in terms of detection by two parallel

systems, luminance and opponent-color. However, for a more precise analysis of spatio-temporal properties it is necessary to subdivide the luminance system into "spatial opponent" and "temporal flicker" channels. The differences to Ingling's system are emphasized. - Ingeborg Schmidt.

Inhibition between channels selective to contour orientation and wavelength in the human visual system, by W. LOVEGROVE (University of Tasmania, Sandy Bay, Hobart, Tasmania, Australia 7005), Perception and Psychophysics 22/1, 49-53, 1977.

Orientation specific color aftereffects may be explained on the basis of neural channels selectively sensitive to orientation and wavelength. The experiments described in this paper examined the effect of wavelength on two orientation specific grating aftereffects, the tilt illusion and simultaneous orientation masking. For each aftereffect, the apparent orientation and the detection threshold of a test grating depended upon both the orientation and the hue of the test and conditioning gratings. The results are interpreted as indicating inhibition between visual channels specific to the orientation and the wavelength of the contours. - Gary L. Trick.

Properties of concentrically organized X and Y ganglion cells of macaque retina, by F.M. de MONASTERIO (Section of Physiology, Laboratory of Vision Research, National Eye Institute, National Institute of Health, Bethesda, Maryland 20014, USA), J. Neurophysiology 41/6, 1194-1417, 1978. Center and surround mechanisms of opponent-color X and Y ganglion cells of retina of macaques, by F.M. de MONASTERIO, J. Neurophysiology 41/6, 1418-1434, 1978. Properties of ganglion cells with atypical receptive-field organization in retina of macaques, by F.M. de MONASTERIO, J. Neurophysiology 41/6, 1435-1449, 1978.

Intraocular recordings were obtained by microelectrodes from ganglion cells in the retina of anesthetized juvenile Rhesus and Cynomolgus monkeys. Stimuli from three independent beams could be presented to the eye in Maxwellian view. Near monochromatic light in the 400 to 680 nm band was obtained with narrow-band interference filters. Test and background stimuli could be independently presented, varied in size and shape and displaced in relation to each other. The first two papers describe the functional properties of X and Y macaque ganglion cells having a center-surround organization whose spatial and spectral properties are similar to those of types I, III and IV of the lateral geniculate body (T.M. Wiesel and D.H. Hubel, J. Neurophysiol. 29, 1115-1156, 1966). The third paper describes functional properties of ganglion cells lacking a typical center-surround organization (Type II, V, VI). In addition to extending the X/Y dichotomy to the macaque retina, the results provide evidence that the degree of linearity of the spatial summation of incoming (cone) signals to the center and surround

mechanisms of the cells is related to the degree of cone specifity of these signals, rather than simply to the presence or absence of opponent-color responses. - Ingeborg Schmidt.

Shift of the Stiles-Crawford function peak with wavelength, by C. BOURDY (Laboratoire de Physique Appliquée du Muséum national d'Histoire Naturelle, 43, rue Cuvier, F 75005 Paris, France) J. Optics (Paris) 9, 205-215, 1978.

After a short review of studies made on the Stiles-Crawford effect I and its relation to wavelength, we concentrate more specifically on the location and significance of the Stiles-Crawford function peak. This is followed by experimental results which show the variation with wavelength of the location of this maximum efficiency point, regarded as the effective center of the pupil. For three wavelengths (blue λ = 470 nm, green λ = 536 nm, red λ = 653 nm), and seven observers representing both forms of color stereoscopy, we were able to reveal a peak shift with regard to the pupil's geometric center (C). This shift varies from one subject to the next, and is different for each eye in the same subject, with the blue peak almost always nasal, and the red peak either nasal or temporal with respect to C. After analyzing the optical and dynamic factors of this variation, we interpret it with regard to a few specific aspects of color localization (horopter and stereoscopy). In particular the correlation between the location of the red and blue peaks and horopters, seems to us to confirm the part played by the Stiles-Crawford function peak considered as the perspective center. - The Authors.

Vernier-horopter and colour (Horptère-Vernier et couleur), by C. BOURDY (Laboratoire de Physique Appliquée aux Sciences Naturelles, 43, rue Cuvier, Paris, France) Vision Res. 18, 445-451, 1978.

The variation of the Vernier-horopter for blue (470 nm), green (536 nm) and red light (653 nm), were investigated for 7 observers selected with the two kinds of color stereoscopy. We found differences not only in the localization but also in the shape of the horopters, which seems to indicate some modifications in the directional values according to the observers and the wavelengths. - The Author.

Color naming evidence of tritan vision in the fovea, by M.H. BORNSTEIN and M.D. MONROE (Department of Psychology, Princeton University, Princeton, New Jersey), Amer. J. Optom. and Physiol. Optics 55/9, 627-630, 1978.

Six male and six females, ages 18-22 years, who had normal color vision by the Ishihara test, were tested on Munsell colors presented in a tachistoscope, on artificial daylight of 17.1 cd/m^2. The stimuli were seven glossy Munsell colors, blue to green. Munsell hue designations and dominant wavelengths were : 5BP 6/10(467nm), 10BG 6/8(488nm), 5BG 6/10(493nm), 2.5 BG 6/10(496nm), 7.5G 6/10(505nm), 7.5 GY 6/10(559nm) and

5GY 6/10(565.5nm). Each color subtended a visual angle of approximately 1.24x1.47° and was presented binocularly in three locations : foveally, 3° to the left of fixation and 3° to the right of fixation. The observers were to identify each stimulus as blue, blue-green, green or green-yellow by pressing a corresponding key as soon after stimulus onset as possible. Color naming demonstrated that short-wavelength vision is suppressed centrally. The anatomical and physiological mechanisms underlying tritan foveal vision are discussed. - Ingeborg Schmidt.

Early threshold observations of transient tritanopia, by W.S. STILES (89 Richmond Hill Court, Richmond, Surrey TW10 6BG, England) Philosph. Transact., Royal Soc. of London, B, 278, 233-240, 1977.

This appendix to a preceding paper by J.D. Mollon and P.C. Polden gives a brief account of the original threshold observations of transient tritanopia. The adapting field was a monochromatic red of 640nm, 10° in diameter and an intensity of about 2×10^4 td. The test stimulus was a monochromatic square of 1° side exposed in flashes of 0.2 sec duration and observed foveally. For test stimuli of short wavelength removal of the adapting field was followed by a considerable increase in the increment threshold. To confirm this observation the early stages of recovery were investigated by a cyclic method : at least 4 min adaptation to the field, then the field appeared in cycles, 30 sec on and 15 sec off. During the off periods the test stimulus of a particular wavelength and fixed intensity was flashed at 2, 5, 8, 11 and 14 sec after extinction of the field and the subject responded "seen" or "not seen". It was shown that for all 3 subjects, at the 2 sec observation time there is an increase in threshold for the short wavelength test (430 nm) stimulus against a recovery drop in threshold for the moderate (540nm) and long wavelength (620 nm) stimuli, that the individual differences in magnitude of changes are considerable and that for all test wavelengths the threshold after 2 sec falls of with time in a regular fashion. The results are discussed considering the blue, green and red mechanisms. From and additional experiment it was concluded that the short wave anomaly did not come into action in the first 30 msec of recovery. - Ingeborg Schmidt.

Colour-evoked potentials; development of a methodology for the analysis of the processes involved in colour vision, by C.T. WHITE, R.W. KATAOKA, J.I. MARTIN (Naval Electronics Laboratory Center, San Diego, California). Chpt. 12 in : Visual evoked potentials in man : new developments, ed. J.E. DESMELT. Clarendon Press, Oxford, pp. 250-272, 1979.

Red, green and blue flashed stimuli (using Wratten filters 92, 93 and 94) were superimposed on backgrounds produced by red, orange, yellow, green, blue-green or blue Corning filters and observed through plastic frosted lenses to remove any patterns. The subjects were normal trichromats and color

defectives. Specific components of the visually evoked potential (VEP) can be related to three basic colour processes which are not completely independent since under certain conditions marked inhibitory effects (primacy effects) were noted. Preliminary work indicates that a meaningful objective colour-vision VEP test might be developed, which might not only describe the altered colour world of a subject but might also suggest the possible source of the defect. It would enable to study individual differences between the two eyes of a subject. - Ingeborg Schmidt.

Assessment of colour vision defects (Prüfung von Farbsinnstörungen), by H. SCHEIBNER (Physiol. Inst. II, Univ. of DÜSSELDORF, G.F.R.), Med. Klin. 71, 1452-1459, 1976.

A short description of the principal kinds of congenital colour deficiency, of the protan, deutan and tritan confusion lines, and of the assessment of the red-green defects by means of the pseudo-isochromatic plates, of the arrangement tests and of Nagel's anomaloscope. - Guy Verriest.

Some notes on Anders Daae and his colour vision test (Noen data om Anders Daae og hans farvesanprøve), by E. HANSEN, Nord. Medicinhist. Årsbok 1978, pp. 113-121.

Anders Daae, who was a general practitioner in Kragerø, Norway, in the latter part of the last century, had a special interest in eye diseases. He also made important contributions to other branches of medicine. He and C. Homann were the first Norwegians to describe myalgia epidemica in 1872. He developed a colour vision test which was published at Kragerø in 1877 and in Berlin 1878. The test was composed of 70 woollen patches mounted on a plate in 10 rows. The colours in each row were those commonly used to test persons with defective colour vision except for two rows where the colours were similar for all patches. The efficiency of the test is about the same as for the Farnsworth's D-15 test. The test was well received in Germany, being ranked (by Cohn) second after Holmgren's test, and surpassing Stilling's test which also appeared in 1878. Various facts about Daae and his environment in Kragerø are presented.- The Author.

Reduction of deuteranopia from trichromatic vision (Reduktion der Deuteranopie aus der Trichromasie), by A. KRÖGER and H. SCHEIBNER (Physiologisches Inst. II der Univ. Düsseldorf), Ber. dtsch. ophthal. Ges. 75, 515-517, 1977.

The blind fundamental and the alychne of deuteranopes were determined. From them, a pair of deuteranopic colour matching functions and a spectral luminous efficiency curve were derived. The maximum of the spectral luminous efficiency curve is - in agreement with the absorption maximum of the photopigment erythrolabe - at 566 nm. - The Authors.

Missing colours and univariance (Fehlfarben und Univarianz), by W. PAULUS and H. SCHEIBNER (Physiologisches Inst. II, Univ. Düsseldorf), Ber. dtsch. ophthal. Ges. 75, 518-521, 1977.

On the basis of measured protanopic and deuteranopic blind fundamentals and pertaining tritanopic data taken from the literature, trichromatic fundamental sensation curves have been calculated. They are a modification of the curves communicated by Vos and Walraven (1971). The connection between blind fundamentals, primary colours, and the principle of univariance is discussed. The Authors.

Color discrimination of 57 congenital color defectives under different illuminants, by A. SERRA and C. MASCIA (Cattedra di Ottica Fisiopatologica dell'Università di Cagliari, Italy), Atti Fond. G. Ronchi, 33, 895-906, 1978.

Fifty-seven subjects suffering from congenital colour vision deficiencies are tested by means of 100-hue test both under C-illumination, and under high pressure Na-illumination of matched illuminance. If abstraction is made from five subjects, the total score increases when passing from C to h.p. Na. The shape of the response changes in an unpredictable manner. In a few cases it is the same under either illuminant. Often the original axis rotates and/or a tritan-like artificial defect comes into play. In some cases, even a scotopic axis (which, according to Verriest is centered on cap 54) appears. - Lucia Rositani-Ronchi.

Triplo-X constitution of mother explains apparent occurence of two recombinants in sibships segregating at two closely X-linked loci (G6PD and deutan), by A. RINALDI, M. VELIVASAKIS, B. LATTE, G. FILIPPI and M. SINISCALCO (Istituto di Genetica, Facolta di Scienze, Università di Cagliari, Sardinia, Italy), Am. J. hum. Genet. 30, 339-345, 1978.

It is well known that the loci for G6PD and color vision (protan and deutan) are closely linked. The majority of published recombinants for G6PD and deutan came in 1964 from Sardinia (4 in a series of 240 scorable sibs); two of these occurred in a single sibship.

An analysis of the mother revealed her to have a 47, XXX chromosome complement (analysis of both blood lymphocytes and fibroblasts) with 50% of her buccal mucosa cells containing 2 sex chromatin bodies. In 80% of her peripheral blood lymphocytes and cultured fibroblasts the mutant G6PD Mediterranean ($G6PD^-$) is expressed (as detected at the individual cell level).

This woman has three sons with a normal 46, XY-chromosome complement, all three of which are $G6PD^-$, while two have normal colour vision (D^+) and the third is a deutan (D^-). She has furthermore 7 relatives in 6 sibships who all are D^- and $G6PD^-$, proving that these two genes are in coupling in one of the X-chromosomes of the mother. From all these observations the genotype of the three X-chromosomes of the mother is supposed to be D^+ $G6PD^-$/ D^- $G6PD^-$/D^+ $G6PD^+$. Thus these two apparent recombinant sons have a normal segregation without recombination.

It is suggested that rare recombinational events in the CV/G6PD/haemophilia cluster should always be analysed for possible numerical X-chromosomal anomalies. - S. v.d. Merendonk and L.N. Went.

Dominantly inherited cystoid macular edema, by G.A. FISCHMAN, M.F. GOLDBERG and J.C. TRAUTMANN (University of Illinois Eye and Ear infirmary, 1855 W. Taylor St., Chicago Illinois 60612, USA), Ann. Ophthal. 11/1, 21-27, 1979.

Four members of a family, 2 males and 2 females, had dominantly inherited cystoid macular edema. The diverse characteristical signs of this syndrome were present. One woman was also tested with the 100 Hue test and exhibited an increased number of errors but no discernible axis. - Ingeborg Schmidt.

Colour vision in squint amblyopia (Das Farbensehen bei Schielamblyopie), by M. MARRE and E. MARRE (Medizinischen Akademie "Carl Gustav Carus", Fetscherstr. 74, 8019 Dresden, G.D.R.), Albrecht v. Graefes Arch. klin. exp. Ophthal. 210, 121-133, 1979.

Colour vision in squint amblyopia depends on the fixation modus. In eyes with foveolar or unsteady foveolar fixation the 3 primary colour vision mechanisms (CVMs) gave normal foveolar CVM patterns. The absolute spectral retinal sensitivity was somewhat, but not significantly lowered. The spectral sensitivity for hue discrimination was either normal, or slightly reduced in the short wavelength side, or slightly reduced over the whole visible spectrum. The spectral sensitivity for saturation discrimination showed normal curves. - In amblyopic eyes with parafoveal to perifoveal fixation mode the absolute spectral retinal sensitivity is lowered for about 0.45 - 0.60 log units in comparison to an approximately corresponding excentric retinal area in a normal eye. In eyes with parafoveolar to perifoveal fixation mode measurements of CVMs and of hue discrimination gave better results than could be expected with regard to the position of the fixating area as determined by visuscope. The values correspond to those obtained in retinal areas at least as close to the foveola as the amblyopic fixation point, but usually of an even more central position. The sensitivity for saturation discrimination showed no significant disturbance. - The Authors.

Luminance-brightness comparisons of LED alpha-numeric sources at suprathreshold levels, by R.L. BOCKER (National Bureau of Standards Optical Physics Division, Washington D.C. 20234, USA), J. opt. Soc. Amer. 68/7, 949-952, 1978.

The test sources used in the experiment were 7-segment LED alpha numerics. The chromaticity coordinates and average luminances are given. The white comparison source of 2856 K was produced by a special apparatus. At 58 cm viewing distance each stimulus subtended a visual angle of 1° with a 1° separation, perceived in a black surround. The white comparison source could be adjusted to a value between 5 and 8000 cd/cm^2. The observer adjusted the luminance of the white

source to appear equally as bright as a red, yellow or green LED. The brightness to luminance B/L ratios obtained for 15 normal trichromats, 25 to 57 years of age, were 1.13 for the yellowish-green, 1.28 for the yellow and 2.54 for the red. The results demonstrate that there can be substantial differences between photometric luminances based on the V(λ) function and brightness as perceived visually. (This phenomenon was already known to Helmholtz and more thoroughly investigated by A. Dresler, Das Licht 7, 203, 1937. I.S.). - Ingeborg Schmidt.

Concerning the social adaptability of persons with congenital defective colour vision, An abstract, by T. INAMURA (Inamura Physical Clinic), Folia ophthal. jap. 28/6, 890-892, 1977.

The improvement of social adaptability of persons with congenital defective color vision is of utmost importance. Not until there is a general social acceptance of color blindness, will those who are handicapped with defective color vision be permitted to confidently lead a normal life free of the psychological inferiority complexes which have heretofore interferred with their school and social activities. Therefore, to accelerate the improvement of the condition of color blind, the following necessary social changes must be initiated : 1) Entrance examinations to colleges and companies, with the exception of those which involve human risk, must be made free of unneccessary limitations placed on these people with otherwise normal facilities. 2) A general social movement must be initiated towards a greater public understanding of the subject of color perception in order to correct false impression regarding words such as "defect", "blind", etc... 3) Schools and companies must provide more reasonable, thorough and equitable methods behind the judgement and guidance of color perception tests for persons with defective color vision. 4) More general social changes must be considered to accord fair advantage to the color blind in order to ensure their safety and convenience, such as mistake-proof.

Then, current procedures of determining appropriate occupational specialities for the recruits in the Ground Self-Defence Force based on various examinations along with the general education and training system since their enrollment are described. Whatever the suggestions on the practical methology of determining appropriate occupations for the individuals having color vision deficiencies are greatly appreciated. - Yasuo Ohta.

The Mackenzie Memorial Lecture 1979 : "Of divers colours", by W.O.G. TAYLOR (16 Ronaldshaw Park, Ayr, Scotland), Trans. ophthal. Soc. U.K., 97, Pt.IV, 768-780, 1978.

Discusses the nature of the sensation of colour, and the reason for colour vision leading to the existence of defects in that sense. The different kinds of defect are considered and appropriate tests described. A new feature is the survey of the value of a careers advisory service for colour defectives,

leading to examples of its use in genetics, in early diagnosis of disease of toxicity. Taylor's modifications to the 100-hue test and its final automation are also described. Finally Taylor makes recommandations for future progress covering routine examination, both on starting primary education, on entering secondary education, analysis of the colour task at work, and the adoption of an enlightened system of colour coding. - The Author.

A general zone theory of color and brightness vision. I Basic formulation, by R.W. MASSOF and J.F. BIRD (Wilmer Institute, The Johns Hopkins University School of Medicine, Baltimore, Maryland, 21205, USA), J. opt. Soc. Amer. 68/11, 1465-1471, 1978.

A general theory of color and brightness vision developed from basic principles of the Helmholtz and Hering points of view is presented in a general mathematical form suitable for quantitative analysis. The physiological transformation of the Helmholtz photochemical excitations into the Hering sensation responses is represented as a vector of general operators. The result is a mathematical framework encompassing traditional psychophysical and sensory scaling experiments. - Ingeborg Schmidt.

A general zone theory of color and brightness vision. II. The space-time field, by J.F. BIRD and R.W. MASSOF (Applied Physics Laboratory, The Johns Hopkins University, Laurel, Maryland 20810, USA), J. opt. Soc. Amer. 68/11, 1471-1481, 1978.

Brightness and color varying in time and space constitute a vector space-time function : the visual sensation field. The sensory field generated from light-field variations is analyzed in terms of elemental space-time responses (Green's functions). Both chromaticity and intensity variations in either form or space are included in a unified theory, to bridge the gap between color theory and analyses of spatial and temporal brightness. Applications of the theory are demonstrated. - Ingeborg Schmidt.

The Retinex theory of color vision, by C.H. LAND, Scientific American 237/6, 108-128, 1977.

Color contrast phenomena and the color constancy effect prompted Land to write a new description how we see colors. He coined the term "Retinex", a retina-and cortex-system to describe "the ensemble of biological mechanisms that convert flux into a pattern of lightnesses". Land tries to demonstrate his theory by describing at length a multitude of experiments verifying the distinction of three independent retinex systems and disregarding common color vision theories. - Ingeborg Schmidt.