

DALTONIANA

NEWSLETTER

OF THE INTERNATIONAL RESEARCH GROUP ON COLOUR VISION DEFICIENCIES

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(Verantw. uitg.)

Tweemaandelijks Tijdschrift

Nr. 34 - 15th January 1979

LITERATURE SURVEY

Psychophysical correlates of photoreceptor activity, by
B. SAKITT (Stanford U.), Vision Res. 16 (2), 129-140, 1976.

Psychophysical data from 4 experiments with a female rod monochromat and a normal S show that (a) above rod saturation, the rod monochromat could not see any test field with her eyes open, but could detect the test by means of discriminable weak afterimages caused by bleaching as little as 10^{-5} of the rhodopsin; and (b) these weak afterimages occurred in the normal Ss and had the spectral sensitivity of rhodopsin. Data suggest that the weak afterimage originates in the outer segment, but cannot be explained by the usual equivalent dark light hypothesis which accounts for strong afterimages produced by intense bleaches. Two retinal regions that received 70 and 85% bleaches were subjectively identical for the 1st 11 min. Thereafter, the 2 different bleached areas could be discriminated. Saturation in dark adaptation was also shown in the rod monochromat. No increment could be detected on the bleached area until 9 min had elapsed. Results are consistent with the hypothesis that the rod photoreceptor signal remains saturated for many minutes after an intense bleach is turned off. - Patrice M. Dunn.

Rod-cone interaction : some indirect evidence, by P.A.
ASPINALL (Dept. Ophthal., Univ. Edinburgh, Scotland),
Acta ophthal. (Kbh.) 55/2, 294-302, 1977.

Rod-blue cone interaction (as suggested by Trezona) was studied by means of testing dark adaptation thresholds and colour discrimination in young diabetics and colour normals. Evidence is presented that the reason for disturbed blue-green and yellow-blue colour discrimination in diabetics is receptorial in origin. If it is assumed that this disturbance depends on a reduction in the number of blue cones, and if photopic rod suppression is caused mainly by the blue cones, this condition would infer a sooner transition from cone to rod phase in dark-adaptation.

33 young diabetics with normal visual acuity and without retinopathy were studied. Dark adaptation thresholds were measured with yellow and blue-green objects. Colour discrimination was tested with the aid of the Pickford-Nicolson anomaloscope and the IOO-hue test. The results showed significant correla-

tions between blue-green and yellow-blue discrimination losses and shortening of the time to cone-to-rod transition. The results thus, accepting the assumptions above, support the proposal of rod-blue cone linkage. - Anders Hedin.

Effect of field size on red-green color mixture equations, by J. POKORNY and V. SMITH (U. Chicago), J. opt. Soc. Amer. 66 (7), 705-708, 1976.

Experimental results show that, in 10 color-normal adults, green-red mixture decreased continuously as field-size increased. Data are consistent with the interpretation that the cone visual photopigments decrease exponentially in effective optical density as the field size increased. - Patrice M. Dunn.

Examination of colour vision by use of induced contrast colours, Design of a new series of tissue paper contrast tests, by E. HANSEN (Dept. Ophthal., Rikshospitalet, Oslo, Norway), Acta ophthal. (Kbh.) 54/5, 611-622, 1976.

A new colour vision test was designed. It comprises achromatic E letters surrounded by various hues and seen through tissue paper. Eight hues were selected on the basis of earlier published data on maximum desaturation in red-green and yellow-blue colour vision deficiencies. Brightness matching was used to obtain the grey letter brightnesses equivalent to the surround in different types of deficiency. 52 subjects with congenital and acquired colour vision deficiencies and 11 elderly colour normals were tested. The colour normals performed the test with no or few errors. Plates with certain surrounding hues were failed by subjects with different deficiency types. Screening efficiency was equal to that of some other pigment tests (AO H-R-R, Ishihara, Panel D-15). - Anders Hedin.

The Davidson and Hemmendinger Color Rule as a color vision screening test, by W.R. BIERSDORF (Dept. Ophthal., Ohio State Univ., 1314 Kinnear Rd., Columbus, Ohio 43212, U.S.A.), Arch. Ophthal. 95/1, 134-138, 1977.

The DH Color Rule has the ability to produce a unique response for a tritanope as well as for red and green defective subjects. It is a slide rule device 36.7 x 7.8 cm, with two painted movable slides of constant lightness. One slide gradually changes color from purple to green through neutral gray, the other from blue to brown through neutral gray. A portion of both colored slides appears through a rectangular aperture and the slides are adjusted until a color match is made. On the rear side a number and a letter identifying the match can be read. The match points are presented in a chart. When used with a Macbeth lamp of color temperature 5400 K, the DH Color Rule is very sensitive in detecting and correctly classifying small degrees of color defect (anomalous trichromats) as well as correctly discriminating them from dichromats. The Rule was superior to the AO H-R-R plates and the D-15 test and equal to the Nagel anomaloscope in this study. For dichromats and achromats it was more time-consuming than the other tests and the discrimination was less certain. - Ingeborg Schmidt.

A possible explanation as to why the newly sighted commonly perform well on pseudoisochromatic colour vision tests, by I.E. GORDON and D. FIELD (Dept. Psychol. Univ. Exeter, Exeter, Devonsh., England) Perception 7/1, 119-122, 1978.

The authors offer an explanation of a surprising result reported by R.L. Gregory and J.G. Wallace (Recovery from early Blindness : a case study. Exp. Psychol. Soc. Monogr. No. 2, Cambridge, Heffer & Sons). These authors observed a patient whose vision was restored after 50 years of blindness. The patient experienced many difficulties in perceiving however he read on the Ishihara Color Vision Test (1972) every single number correctly. It is suggested that the relatively poor visual acuity enhances legibility of pseudoisochromatic test pattern by removal of certain spatial frequencies which act as noise and interfere with the perception of a pattern. Experiments on students and staff carried out at the La Trobe Psychology Department, Bundoora, Victoria, Australia confirmed that Ishihara plates are more legible when seen as defocused images. - Ingeborg Schmidt.

The usefulness of color vision testing and color fields, by J.M. RENALDO (963 E. Commercial Bldg. Fort Lauderdale Fl. 33334, U.S.A.) J. amer. optom. Assoc. 48/11, 1411-1412, 1977.

Routine color vision testing in order to differentiate between hereditary and acquired color deficiencies and usefulness of testing color fields as an adjunct to ordinary perimetry are emphasized. - Ingeborg Schmidt.

The unique green phenomenon and colour vision, by S.R. COBB (Dept. Psychol., Univ. Glasgow, Scotland) Clinical Genetics 7, 274-279, 1975.

To investigate the mode of inheritance of the unique green phenomenon (Waeler suggested that it is caused by a gene carried on the X-chromosome) a new technique is used in conjunction with the single field techniques of Waeler. The position of the unique green point in the spectrum is shown to correlate with the mid-matching point on the blue-yellow axis of the Pickford-Nicolson anomaloscope. It is concluded that there might be a highly photolabile visual pigment present, which absorbs maximally at about the yellow region of the spectrum. - E.A. Klasen/L.N. Went.

The locus of unique green in deuteranomalous trichromats, by J.A. ALEXANDER, L.J. LEASON and J. CLANCY (School of Optometry, University of New South Wales, N.S.W., Australia) Amer. Optom. a. Physiol. Opt. 54/8, 567-578, 1977.

A color-naming experiment to determine the spectral locus for unique green (U) was carried out as described by Smith (Smith D.P. Vision Res. 11/7, 739-742, 1971), on 20 color normals (11 males, 9 females) and 24 deuteranomalous trichromats (23 males and 1 female). The deuteranomals were classified into "mild" and "medium-to-severe" deuteranomals. The loci of U for the male normal observers was found to form a bimodal distribution as earlier investigators had reported (M.L. Rubin, Amer. J. Ophth.

52/2, 166-172, 1961 and W. Richards, J. opt. Soc. Amer. 57/8, 1047-1055, 1967). A bimodal distribution of the spectral locus for U^g was also found for the deuteranomalous group; U^g was located at long wavelengths only by the "mild" deuteranomals, U^g was located at shorter wavelengths by individuals whose defects^g ranged from mild to severe. The results are discussed and presented as further evidence for the existence of two types of deuteranomaly. - Ingeborg Schmidt.

Linkage disequilibrium for two X-linked genes in Sardinia and its bearing on the statistical mapping of the human X-chromosome, by G. FILIPPI, A. RINALDI, R. PALMARINO, E. SERAVALLI and M. SINISCALCO (Sloan-Kettering Institute for Cancer Research, New York, N.Y., U.S.A.), Genetics 86, 199-212, 1977.

In large scale population studies in Sardinia around 1960, in which the genes for G6PD deficiency, protan and deutan colour defects and the X_g bloodgroup were studied, there seemed to be a tendency for a non random distribution of deutan defect between the two groups of G6PD deficient (G6PD(-)) and G6PD normal (G6PD(+)) males (M. SINISCALCO, pp. 106-111 in: Genetics of migrant and isolate populations, Ed. E. Godschmidt, Williams and Wilkins, Baltimore, 1963). To confirm or refute this finding a random sample of 279 schoolboys who had been screened for colour vision were tested for their G6PD activity. Of 107 deutan defectives 87 were G6PD(+) and 20 G6PD(-), but of 47 protan defectives all were G6PD(+), as compared with 125 who had a normal colour vision of which 97 were G6PD(+) and 28 G6PD(-). The X_g (a+) and X_g(a-) were equally distributed over the G6PD(+) and G6PD(-). It is concluded from these data that the observed G6PD-protan disequilibrium is most likely the result of a combination of "founder effect", selection and close linkage during the last 2500 years. If the findings are correct this is the first example of linkage disequilibrium for X-linked traits. - L.N. Went.

The acquired defects of chromatic discrimination: clinical and pathogenic views on the dyschromatopsias that are due to some ocular diseases (Le deficienze acquisite della discriminazione cromatica: considerazioni cliniche e patogeniche sulle discromatopsie secondarie ad alcune affezioni oculari), manuscript thesis in ophthalmology of Giovanni VACCARI (Clin. Ocul. Univ. degli Studi di Firenze, Italy), academic year 1977-78. 66 pages, 15 fig., annexes.

The author examined by means of the FM 100 hue test (a) 100 normal subjects of different age groups, confirming Verriest's data on the influence of age on the total score and the tritan trend; (b) 25 diabetic subjects with and without retinopathy, confirming the tritan trend and showing a correlation between total score and visual acuity (the effects of a change in illuminant were also investigated), (c) 36 glaucomatous subjects, confirming the tritan trend, showing that this defect is more correlated to the visual acuity than to the visual field impairment, and showing that hue discrimination improves when the test

illuminance is increased, (d) 1 case of retrobulbar neuritis, showing the improvement of the Type II RG defect during recovery. Furthermore many consideration on normal and abnormal colour vision, electrophysiology etc. - Guy Verriest.

A familial syndrome of progressive cone dystrophy, degenerative liver disease, endocrine dysfunction and hearing defect.
I. Ophthalmological findings, by E. HANSEN, I. FRØYSHOV LARSEN and K. BERG (Dept. Ophthal. and Medical Dept. A., Univ. Hosp. Oslo 1 and Inst. Med. Genet. Univ. Oslo). Acta ophthal. 54, 129-144, 1976.

Seven patients, 6 females and one male, with progressive cone dystrophy together with systemic and metabolic disorders were reported. The characteristic ophthalmological feature exhibited by these patients is the loss of function of the photopic mechanisms. The scotopic mechanism is well preserved in the early stages. One patient developed amaurosis in one eye and fere amaurosis in the other. The least affected patient (13 y. of age) had fairly good central cone vision, but a rod response only outside the central area (i.e. a true "tube vision" in respect of the cones). Attenuated retinal vessels, disc pallor and general atrophic appearance without pigmentation were typical findings. Increasing impairment of vision during pregnancy was seen in two patients. The cone dystrophy appears to be part of a disease affecting several organs. The familial occurrence suggests that this disorder is inherited. - Egill Hansen.

II. Clinical and metabolic studies, by I. FRØYSHOV LARSEN, E. HANSEN and K. BERG, Clinical genetics 13, 176-189, 1978.

The patients showed endocrine defects at different levels of regulation. None of the patients had children; two were probably infertile and three had repeated abortions. Two patients had primary hypothyroidism and another two had low normal thyroid function with protracted thyrotropin-releasing hormone (TRH) test response, indicating a hypothalamic disorder. A defect in the ACTH reserve, as tested by Metyrapone, was found in two patients. Diabetes mellitus of the "maturity-onset type diabetes of the young" was observed in three patients and a fourth had a borderline glucose tolerance with further impairment during pregnancy. Hypertension was observed in the diabetic patients. Diabetes was seldom present among the relatives, but hypertension occurred frequently. Four of the patients had liver degeneration, demonstrated by elevated transaminases and unspecific parenchymal degeneration, fatty infiltration and isolated liver cell necrosis in the biopsy. All the patients, except the youngest, had progressive hearing loss, classified in four cases as neurogenous and probably cochlear. In the boy, the hearing loss was a neurogenous congenital hypacusis. There were several cases of hearing defects among the relatives, so it is difficult to relate this to the syndrome. Enlarged sella turcica were found in three, and in one of these an "empty sella" was demonstrated by surgery. Elevated creatine phosphokinase was also observed. All the different lesions suggest a systemic disorder, possibly a membrane defect. - Egill Hansen.

III. Genetic studies, by K. BERG, I. FRØYSHOV LARSEN and E. HANSEN; Clinical Genetics 13, 190-200, 1978.

Genetic analyses revealed a segregation ratio indicating recessive inheritance of the syndrome, and the kindred from which 6 of the 7 patients originated was heavily inbred. Thus, the results of the segregation analyses as well as of the inbreeding analyses provide evidence that this previously unrecognized disorder is inherited as an autosomal recessive trait. Genetic marker analyses were conducted with respect to 22 marker systems, and linkage information was obtained with respect to 15 of them. No strong suggestion of linkage emerged from the analyses, but very close linkage could be excluded for several of the genetic marker systems. Pedigree analyses was helpful in establishing the spectrum of clinical manifestations belonging to the syndrome proper. The data presently available suggest that elevated levels of creatine phosphokinase, which were found in all patients, may be useful in tracing heterozygotes for this disorder. This possibility will be further examined. - Egill Hansen.

What is the cause of tobacco-alcohol amblyopia? by P.M. DREYFUS (School Med. Univ. Calif., USA) In : Controversy in Ophthalmology, ed. R.J. BROCKHURST, S.A. BORUCHOFF a.e., W.B. Saunders Co. Philadelphia, pp. 844-850, 1977.

The author reviews current concepts regarding the etiology of the visual syndrome called "tobacco-alcohol amblyopia". He concludes that a middle-aged patient who complains of dimness of vision, particularly for colors, and in whom one elicits impaired central vision with bilateral central, centrocecal or paracentral scotomata and intact peripheral fields, is most likely to be afflicted with nutritional amblyopia. Although in many patients the nutritional component may have been engendered by substantial intake of alcohol over a prolonged period of time, alcohol abuse is by no means a prerequisite for the establishment of the diagnosis. -Ingeberg Schmidt.

Tobacco-alcohol amblyopia, by W.St. FOULDS and A.R. PETTIGREW (Univ. Glasgow, Glasgow, Scotland) In : Controversy in Ophthalmology, Ed. R.J. BROCKHURST, S.A. BORUCHOFF a.o.; W.B. Saunders Co. Phil., pp. 851-865, 1977.

The paper represents an essay on the controversy about the existence of a "tobacco-alcohol amblyopia". The clinical features are reviewed. The red-green dyschromatopsia can best be demonstrated by the FM 100-Hue test. Complete cessation of smoking is followed by a gradual improvement in vision and by normalization of the visual field and color vision. Improvement in color vision is slower than of visual acuity, the latter returning to normal after about 6 months, whereas the former continues to improve over a period of 2 years or more. There are a priori grounds for the belief that CN is the toxic factor in tobacco smoke but that tobacco amblyopia will not result unless a dietary deficiency or defective absorption of sulfur amine acids, B₁₂, folate or possibly of other B group vitamins is also present. - Ingeborg Schmidt.

What is the etiology of alcohol and tobacco amblyopia?
by D.O. HARRINGTON (School of Med., Univ. Calif., San Francisco, USA) in : Controversy in Ophthalmology, Ed. R.J. BROCKHURST, S.A. BORUCHOFF a.o., W.B. Saunders Co. Phila., pp. 866-872, 1977.

There is increasing evidence that tobacco amblyopia is due to a number of factors : one is chronic cyanide poisoning and another a deficiency in a non-cyanide containing hydroxocobalamin preparation of vitamin B₁₂. With abstinence from tobacco visual field defects (bilateral centrocecal scotomas, grossly exaggerated when red stimuli are used) shrink and finally disappear in 6 to 8 months unless there is optic atrophy. An amblyopia from ethyl alcohol is nonexistent. The amblyopia often associated with chronic alcoholism is a nutritional deficiency disease. The term "tobacco-alcohol amblyopia" is a misnomer. - Ingeborg Schmidt.

The early phase in Leber's hereditary optic atrophy, by E. NIKOSKELAINEN, R.L. SOGG a.o. (Div. Ophthal. Stanford Univ. Med. Center, Stanford, California, 94305, USA) Arch. Ophthal. 95/6, 969-978, 1977.

Five members of a family with Leber's disease were examined, 3 affected brothers and 2 unaffected females, a sister and the mother. Visual fields were studied with the Goldmann perimeter, color vision tested with the HRR and Ishihara plates, the panel D-15 test and the FM 100 Hue test. The visual evoked potentials (VEP) were studied and fundus pictures taken. Fundus changes as well as color vision disturbances were documented before changes in visual acuity took place. The authors found that the FM 100 Hue test was the most sensitive indicator of the early involvement of Leber's disease showing a defect in the red-green axis. However the VEP did not appear abnormal until a decrease in visual acuity was observed. - Ingeborg Schmidt.

Acquired color vision defects in retrobulbar neuritis, by J.F. GRIFFIN and S.H. WRAY, Amer. J. Ophthal. 86/2, 193-201, 1978.

Twenty-three patients whose visual acuity had returned to 20/40 or better following an attack of idiopathic retrobulbar neuritis were studied. Both pattern-reversal VER and Farnsworth-Munsell 100-Hue examinations were conducted. In all but two affected eyes VER latency was abnormally delayed. Abnormally high 100-Hue error scores were reported for all affected eyes. The value of the 100-Hue test as a diagnostic tool in cases of suspected optic nerve damage is discussed. - Gary L. Trick.

Hemianopic color blindness, by M. ALBERT, A. RECHES and S. SILVERBERG (Boston U., Med. School), J. Neurol. Neurosur., & Psychiat. 38 (6), 546-549, 1975.

Presents the case history of a 59-yr-old male who developed cortical blindness after cerebral infarction in the distribution of both posterior cerebral arteries. When the patient recovered from this condition, he was found to be color blind in the left visual field but not in the right. This unusual situation resulted in apparently contradictory performances on hemifield and free-field tasks of color discrimination, naming, and recognition. The contradictions may be explained by interhemispheric competition between a hemisphere which could discriminate colors and a hemisphere which was color blind. - Patrice M. Dunn.

Color perception of color anomalies, by T. KANEKO (Institute of Psychology, The University of Tsuba) Folia ophthalmol. jap. 28/6, 868-870, 1977.

Difficulties on color perception with color anomalies were categorized as follows : (1) Those in color identification and color discrimination as in reading letters in the Ishihara Test; (2) Those in color reproduction as in painting or visual adjustment of color of TV; (3) Those in search for colored targets as a traffic signal; (4) Those in aesthetic appreciation of color beauty as in looking a scenery or picture.

The difficulties experienced by the author (deuteranomalous himself) were illustrated : green was frequently mistaken for brown under poor or careless viewing conditions. Errors were usually overlooked unless noticed by others. Anomalous persons commit errors in their daily lives more frequently than they thought themselves. A systematic study on errors is necessary by ecological observations of the behavior of anomalies, possibly by school teachers. - Yasuo Ohta.

Consideration for color-defective applicants at a technological college, by M. AKITA (Psychol. Lab., Kyoto Inst. Technol.), Folia ophthalmol. jap. 28/6, 875-876, 1977.

An example about how color-defective students are treated educationally at an engineering school. Color blindness is not a crucial condition for matriculation to the college. However, special guidance for color blindness is given in advance through a booklet for color-defective applicants to the Departments of Dyeing, Design and Architecture in which departments they might be expected to face difficulties in their studies. Incidence of color blindness, found only among male students at the college in 1976, shows a much lower frequency (2.1%) than the frequency among Japanese college and university males (3.6%). The college continuously collects practical information about what difficulties color-defective students have met in their studies and rewrites the guidance based on the information, if necessary. These activities bring about a greater understanding of the problems existing between color blindness and students' major subjects and the information

collected enables the college to give more suitable help for students having trouble due to color blindness.-Yasuo Ohta.

Anomalous vision in daily activities of congenital color vision defectives, by N. OHBA, T. FUJINO, T. TANINO, M. YANO, S. TOTSUKA and Y. INABA (Dept. Ophthal. Univ. Tokyo School of Med., Tokyo, Japan), Folia ophthal. jap. 28/6, 876-878, 1977.

Congenital color vision defectives were simply questioned whether and how they have recognized anomalous vision or got trouble in life. Out of a total of 131 college students having the defect, 72 subjects or 54.9% gave frank and affirmative response with descriptions of actual difficulty encountered, and the statements as to the situations in which they got trouble were agreeable with the characteristics of the defect. A nice correlation was found between the abnormal experiences and the degree of the defect in that severe cases felt trouble more frequently. It was, however, highly probably that the anomalous vision is, in view of their statements, practically not very severe but only occasional and rather trivial. - Yasuo Ohta.

The damaging effects of light on the retina. Empirical findings, theoretical and practical implications, by J. LANUM (Dept. Psychol. Corpus Christi State University, Corpus Christi, Texas 78417, USA) Survey Ophthal. 22/4, 221-249, 1978.

A complete literature review on retinal damage by light of intensities well below those causing thermal burns. This damage primarily affects the receptors. Slow recovery is possible if damage does not proceed to destruction of the inner segments. Many variables affect the extent and severity of light damage. Based on the available evidence from animal experiments it is suggested that retinal damage may be produced by room lighting, phototherapy techniques, ophthalmoscopes and fundus cameras. The material is arranged in four chapters: I. Physiological effects of light on the retina. II. Parameters of light damage (including the action spectra of light damage, the species showing light damage etc.). III. Current theories concerning light damage. IV. Laboratory and clinical implications. - Ingeborg Schmidt.

Phototoxicity to the newborn primate retina, by K.H. MESSNER M.J. MAISELS and A.E. LEURE-du PREE (The Milton S. Hershey Medical Center, 500 University Drive, Hershey P.A., 17033, USA) Invest. Ophthal. Visual Science 17/2, 178-182, 1978.

Experiments on newborn stump-tail monkeys, one eye of which was continuously exposed to 400 fc of cool white fluorescent light, for periods from 12 hours to 7 days, demonstrated progressive damage to the rods and cones. The potential for phototoxicity to be additive to the normal aging of the retina was proposed. The authors concluded that there is a sound basis for the practice of patching the eyes of infants undergoing phototherapy. - Ingeborg Schmidt.

Trichromatic vision in the cat, by J. RINGO, M.L. WOLBARSCHT, H.G. WAGNER, R. CROCKER, F. AMITHOR (Duke University Eye Center, Durham, North Carolina 27710, USA) Science 198 nr. 4318, 753-755, 1977.

Many cat retinal ganglion cells have inputs from three separate cone systems as found by using electrophysiological techniques. Those with peak sensitivities at 450 and 555 nm have been previously described. A cone with a peak sensitivity of 500 nm can be differentiated from other cones by spectral sensitivity and from rods by receptive field differences, functioning above rod saturation levels and by cone-rod breaks in the dark-adaptation curves. The receptors were not identified anatomically, only functionally. The similarity of the three-cone cat retina to the extramacular retina of the rhesus monkey suggests that the cat may have photopic trichromatic vision. - Ingeborg Schmidt.

Cat color vision : the effect of stimulus size, by M.S. LOOP and L.L. BRUCE (Dept. Physiol. Biophys. and Neural and Behavioral Biology Program, University of Illinois, Urbana 6180, USA), Science 199, No. 4334, 1221-1222, 1978.

Adult cats were trained to discriminate blue from green and gray. They indicated their choice by pressing either of two clear plexiglass response panels with their noses for a reward of food. Visual stimuli were rear projected into a viewing screen positioned 1.5 cm behind the response panels. The cats could discriminate the intensity of the stimuli whose areas ranged from 33 to 0.36 cm². However they could not discriminate color when the stimulus was < 0.36 cm² (< 20° visual angle). The results of this and past studies indicate that cats can discriminate color only if the stimulus subtends a fairly large visual angle. - Ingeborg Schmidt.

Physiology of normal and abnormal color vision, by D.P. SMITH (suite 4, 609 St. Kilda Rd., Melbourne 3004, Australia) Austral. J. Optom. 58/1, 4-30, 1975.

The paper represents a review on the physiology of colour vision based on recent neurophysiological and anatomical studies on vertebrate retinas and on the human abnormal colour vision based on recent psychophysical studies. As research has demonstrated, red-green dichromacy is due to the absence of one of the two photopigments normally active in the red-green range of the spectrum. In the red-green anomalous trichromacies one of these photopigments is replaced by an abnormal photopigment. The qualities of this photopigment have not been accurately identified. In retinal preparations from eyes of achromats not only rods but also cones have been found. There is psychophysical evidence that more than one receptor type participates in their visual functions. 7 1/2 pages of references conclude the review. - Ingeborg Schmidt.

ORIGINAL PAPER : ABOUT THE CITY UNIVERSITY COLOUR VISION TEST

by L. van Heel, S. van de Merendonk and L.N. Went

(Leiden, The Netherlands)

Following the Parma symposium it was considered important to use the newly developed City University Test as a possible screening method for Tritan defects. During the course of this study some experience was obtained with this test for the analysis of protan and deutan defects.

The City University Test consists of 10 test plates, on each of which four spots of different colour are surrounding a coloured spot in the middle of the page; 1.6 cm apart and 0.8cm in diameter; the background is black. For each of the four surrounding spots it is indicated which spot most closely resembles the colour of the center spot for a normal, a deutan, a protan- or a tritan- defective individual.

In the undergoing results the colour defectives were subdivided in five groups; notably no subdivision being made within the deuteranomalous group.

plate nr.	DEUTERANOMALY(n=20)				DEUTERANOPIA(n=11)*				PROTANOMALY(n=5)				PROTANOPIA(n=11)			
	N	P	D	T	N	P	D	T	N	P	D	T	N	P	D	T
1	12	5	3			4	7		3	2			1	10		
2	10		10				11		4		1		4	7		
3	14		6				11		5					11		
4	16		4		3	2	6		5				11			
5	16	1	3		2		9		5				3	8		
6	16		4		1		10		5				7	4		
7	14	5	1			11			5				8	3		
8	16		4		4				5				7	4		
9	15		5			1	10		4	1			6	4	1	
10	10		10				11		4	1			3	5	3	

All the deuteranopic individuals read 6 plates or more different from normal, whereas only 3 of 20 deuteranomalous individuals made 6 errors or more; all 3 were severe deutan defectives. Half of the deuteranomalous and 3 of the 5 protanomalous persons made no mistakes at all.

A number of the plates appear to be unsuitable, notably plates 1 and 7 erroneously may give a protan instead of the expected deutan response, whereas plate 4 is rather unreliable both for deutan and protan defectives. Only protanopes and deuteranopes can be diagnosed with this test with certainty as

as being defective.

Plate nr. 3 is the only one which is read as expected by all the dichromatic individuals.

Results of tested Tritan defectives : plate nr. 1 N7 T2; nr. 2 N8 T1; nr. 3 N7 T2; nr. 4 N9; nr. 5 N9; nr. 6 N8 T1; nr. 7 N5 T4; nr. 8 N7 T2; nr. 9 N5 T4; nr. 10 N6 T3.

For a quick diagnosis of tritan defectives the test does not seem to be very reliable; one out of nine persons made no mistakes, two made only one error and four made two.

PAPERS READ AT THE 3rd INTERNATIONAL IPS
VISUAL FIELD SYMPOSIUM
(Tokyo, 3rd-6th may 1978)

Acquired colour vision losses - The earliest functional losses in glaucoma, by R. LAKOWSKI.

The degree of acquired colour vision loss in various stages of glaucoma is related to the extent of field loss as obtained from a perimeter. However, losses in yellow-blue amounting to anomalous and dichromatic vision are found in about 20% of ocular hypertensives. There are no significant correlations between a number of clinical variables (e.g., IOP) and colour vision variables except for macular sensitivity. Correlations do exist, however, between the extent of colour vision deficiencies and the raised values of chromatic dark adaptation thresholds.

A new interpretation of the relative central scotoma for blue stimuli under photopic conditions, by R. LAKOWSKI and P. DUNN.

A modified Goldmann perimeter with photometrically equated stimuli has been employed to investigate the relative central scotoma obtained with a blue stimulus reported by a number of authors. The method used was static perimetry. The scotoma is shown to represent increased parafoveal sensitivity to blue stimuli rather than decreased foveal sensitivity.

Trial of a color perimeter, by Hiroshi KITAHARA, Kenji KITAHARA and Hiroshi MATSUZAKI.

A color perimeter was prepared for static perimetry, particularly the two-color threshold technique on the fovea and extrafoveally. This trial perimeter has a 500 W xenon lamp as light source. The test light is guided by glass fiber, so that it can move freely. The colored test lights were obtained by 16 interference filters of dominant wavelenghts between 400 nm and 700 nm₂ at 20 nm intervals. The maximal luminance is 22,000 cd.m⁻² without any filter. The background light is round with 50° visual angle at its maximum, and its maximal luminance is 2,000 cd.m⁻² with no filter at 10° visual angle. For the adjustment of the test and background luminance 5 neutral density filters and a wedge

are used. Duration of the test exposure is controlled between 10 msec to 9,999 msec by a time regulator. The testing method and the results are mentioned.

Fundus photo-perimetry and application, by Y. OHTA, T. MIYAMOTO and K. HARASAWA.

This was constructed with the purpose of photographing both the fundus and the visual field with one single exposure under direct observation. A fundus camera with infra-red TV was so modified that one might photograph the fundus after having plotted the visual field with a 19' target through a monitor TV screen, and that the plotmarks might be superimposed on a Polaroid or 35mm size film. The measurable area is approximately 25° from the foveola, and any of the factors such as background illuminance, fixation target, target luminance can be easily controlled. The color of the target is changeable to either white, red or green. With this instrument, we have examined central scotoma, caecocentral scotoma, hemianopsia and other visual field defects due to various diseases, both kinetically and statically, this in order to make a comparison with other perimeters. The instrument may be applicable widely to various studies such as fixation in amblyopia, etc.

Report on colour perimetry, by G. Verriest.

This report was devoted to a survey of the modern trends in colour perimetry, and to a summary of the author's report on the answers and comments on the 3rd questionnaire that was issued by the IPS RG on Colour Perimetry.

PAPERS READ AT THE 7th INTERNATIONAL
ERGOPHTHALMOLOGICAL SYMPOSIUM
(Nagoya, 12th-13th may 1978)

Improvement of the traffic signals, by I. Inuma.

Mistakes of signals are not so frequent, even in color-blind drivers, but sometimes happen at night, especially between red and yellow. The 3 color lenses removed from a signal apparatus and reduced for experiment were shown to 138 dyschromats independently one by one in a dark room and were mistaken in 35%. The red for yellow mistakes were 22% but decreased to 15% in case of dimly illuminated surrounding of the light. I have pointed out some cases of dichromats diagnosed on the anomaloscope and becoming able to see the 671 or 546 nm light reddish or greenish when the intensity of the light source is reduced. Likewise, the breadth of the Rayleigh equation range in abnormal trichromats is reduced by decreasing the intensity of the light source or by instillation of a miotic. I consider these phenomena as an extraordinary Bezold-Brücke hue shift in pathological eyes as a result of visual dysfunction in glare in color

Accordingly, in order to expect no mistakes in colorblind drivers due to hue shift, traffic signals should be improved to discriminate the 3 color lights not only by hue, but also by other factors, i.e. shape, position on the signal board with dim illumination.

Problems for color-deficient drivers, by H. ICHIKAWA and M. KOBAYASHI.

We brought up various problems existing in the background of the aptitude test against the color-deficient and we suggested the procedures about the theme of vocational aptitudes. In the fields of scanning-attention in the process of color cognition, the visual surroundings and physical conditions, which above all are the factors limiting and enhancing attention, play an important role for the determination. However, we have pointed out that the difficulty in evaluating these factors makes it unreasonable hard to determine the criterion for the aptitudes. The factors can be collectively converted to the terms of working environments. From our study we conclude that it would be difficult to classify an aptitude (degree of color defects) in common for all countless kinds of vocational tasks and clearly indicated that there was no other way than making specific standards for every different tasks. It is our conclusion that we have to take into consideration proper criteria examined by specific measures to be applied for every different kinds of tasks independently.

An experimental study comparing the visual performances of normal and congenitally colour defective drivers in the recognition of road safety targets, Part I : Experiments made in 1977, by G. VERRIEST, O. NEUBAUER, A. UVIJLS and W. SINTOBIN.

The here described 1977 experiments were performed on a real road and concerned : (1) the perception distances in daylight of 4 traffic signals for observers driving at a speed of 40 km/h : the mean seeing distances of the protan and deutan subjects were reduced to about 53% of the normal values for the new red octagonal stop signal and to about 85% of the normal values for the danger signals (triangle with a corner pointing upwards), experience being more profitable to the normal observers; the mean results of the protans and deutans were more satisfactory and were sometimes even better than normal for seeing the priority signal (triangle with a corner pointing down), for reading the word "stop" on the stop signal and for recognizing on the danger signal the sign for a curve to the left from this for a curve to the right; (2) the perception distances in daylight of the red brake light(s) of 3 kinds of vehicles, again for observers driving at a speed of 40 km/h : the mean perception distances of the colour blind people are strongly reduced especially in the protans (from 39% to 73% of the normal values for all runs), in sunny daylight and for the first runs, the defective observers having now more benefit from experience than the normals; (3) the perception distances at night of the red rear lights of 8 kinds

of vehicles, again for observers driving at a speed of 40 km/h : the perception distances of the protans were still about 60% and that of the deutans still about 90% of the normal ones, with less marked learning effects than in 2 preceedings experiments; (4) the differentiation in daylight of the intermittently lighted red (brake), orange (direction indicator) and white (rear driving) rear lights of 7 types of cars at given and increasingly greater distances of the observers : here the deutans made twice as many mistakes as the protans, while all responses of the normals were correct; the learning effect was obvious.

PAPERS READ AT ICOLL (Madrid, 1978)
(by courtesy of L. ROSITANI-RONCCHI)

Suprathreshold time integrative properties of the retina; explored by delivering pair of pulses of different hues, by F.T. ARECCHI and L. RONCHI (Istituto Nazionale di Ottica, Arcetri, 50125 Florence, Italy).

Two short pulses are presented, at different eccentricities, across the visual field. Once fixed luminances and duration, the interpulse interval is varied from zero to 1 sec. The threshold of transition from the fusion condition (in the case of homochromatic pulses) or from the mixture condition (for pulses of different hues) to that of temporal discrimination, is recorded. Mixture threshold estimates are found to depend on the presentation order (say, red before green or green before red). This technique allows to make inferences about the relative changes in rise-and decay-branches of the time responses to either flash, as a function of retinal eccentricity.

The treatment of data requires special cautions, to take into account the spatial bias, coming into play in peripheral vision, concomitantly with partial temporal overlap.

Dichromatic colour vision and Stiles' π mechanisms, by O. ESTEVEZ (Laboratory of Medical Physics, University of Amsterdam, Herengracht 196, Amsterdam, The Netherlands).

It has recently been shown that the spectral sensitivities of Stiles' π -mechanisms π_3 , π_4 and π_5 of a given observer can be linearly transformed to fit color-matching functions of the color observers (Estevez, O. and Cavonius, C.R. : Human color perception and Stiles' π -mechanisms; Vision Res., 17, 417-422, 1977), and conversely, that linear combinations of average color-matching functions can provide a satisfactory fit to the average π_3 , π_4 and π_5 of Stiles (Pugh Jr., E.M. and Sigel, C. : Evaluation of the candidacy of π -mechanisms of Stiles for color-matching fundamentals; Vision Res., 18, 317-330, 1978).

These results suggest that the spectra of π_3 , π_4 and π_5 might be likely candidates for the basic spectral sensitivities of the human cone pigments. Since it is both accepted that some

dichromats can exhibit reduced forms of normal color vision, and that they possess a single long wavelength cone pigment, the equivalence of color-matching functions and Stiles' π -mechanisms has been directly tested in protanope and deuteranope subjects. The results support the hypothesis that both π_4 and π_5 (after correction for individual pre-retinal absorption) represent the sensitivities of the medium and long wavelength cone pigments of normal color vision.

Visual acuity and colour perception with short exposure times, by M. AGUILAR, J. PEREZ CARPINELL and V. CLIMENT (Departamento de Optica, Facultad de Ciencias Fisicas, VALENCIA, Spain).

The relationship between luminance, visual acuity and short exposure times is given by a sigmoid expression, which is valid until a critical time of a 0.1 seconds magnitude. The most convincing results, in our judgement, are those of Graham (1937) and Martin and co-workers (1950). For longer exposure times, it is admitted that visual acuity varies little with time.

However, in our experiences, we have found a remarkable variation between the luminance necessary to see a Landolt ring and the time of exposure, up to magnitudes of 1 second for the letter one. This relationship may be expressed analytically by $L = at^n + L_{00}$, where the parameters a and n depend on the colour of the adaptation field. The exposure time has a stronger influence on visual acuity when that colour is yellow.

A model for color vision, by J. REVELLAT and F. SCHMITT (Ecole Nationale Supérieure des Télécommunications, 46 Rue Barrault, 75634 PARIS, France).

An opponent colors model of human vision based on psychophysical and neurophysical evidence is presented. It allows the quantitative definition of important perceptual parameters such as hue, saturation and brightness. The model predicts spectral sensitivity as measured by flicker photometry, loci of constant hue and the Bezold-Brücke effect, loci of constant saturation, and loci of constant brightness versus luminance. The results are in very close agreement with the data existing on the subjects. Some extensions of the model are examined to account for other properties of the color vision.

Interaction between saturation and lightness of pigmented samples, by M.L.F. DE MATTIELLO and M. GUIRAO (Laboratorio de Investigaciones Sensoriales. - CONICET. Facultad de Medicina - UBA. C.C. 53 - 1453 BUENOS AIRES, Argentina).

The same eighth sets of colored samples were used to measure saturation and lightness relative to changes in colorimetric purity and reflectance. Wavelength was kept constant. Each one of four pigments, blue 460 nm, green 535 nm, yellow 575 nm and red 610 nm, were mixed with black and white, obtaining two ranges of reflectance, 5 to 40% and 40 to 80% respectively. Observers estimated numerically the saturation and the lightness of the samples in separate sessions. The data show that within the same

hue and for identical values of P_c , saturation estimates are different whether the values of reflectance are in the pigment plus black or pigment plus white range. The change is evident in the blue and green regions. With respect to lightness it was noticed that, for red and blue, values are different depending on whether the samples are in the high or in the low ranges of reflectance. This difference was not observed in the other hues.

The threshold conditions for visual perception, after 25 years, by M.A. BOUMAN, A.M.W. SCHOLTES and P. ZUIDEMA (Dept. Med. Physiol. Physics, Phys. Lab., State University, Princetonplein 5, UTRECHT, The Netherlands).

The quantum coincidence concept for threshold conditions originally reads : K-quantum absorptions are needed within τ seconds within an area of diameter D regardless the actual spatial configuration of the absorptions. This spatial summation has later been shown to be dependent on configuration and on the length of the time-interval between testflashes. We investigated theoretically and by computer simulation what extensions of the concept in principle are needed to satisfy also these new experimental facts. The simplest extension seems the introduction of one more hierarchical level of summation : K-sub-units of the original summation area have each to absorb at least one quantum. Once this condition fulfilled, more quanta in a sub-unit within another time t adds a chromatic component to the otherwise scotopic percept. The validity under relevant conditions of Piper's law-threshold energy proportional to the root square of test area, inevitably leads to two-foldness of the coincidence for the absolute threshold and for the chromatic threshold. The latter conclusion stems from experiments on the achromatic interval. It lasts on the average about one second before a sub-unit after having been stimulated can contribute again to the scotopic (lowest) threshold mechanisms by absorption of a new quantum. The summation areas as well as the sub-units are in this model discrete and contiguous members of a concrete retinal mosaic structure of ammatidia.

Distortions of retinal images inherent in signal transmission by the visual pathways, by K.H. RUDDOCK and V.A. WATERFIELD (Biophysics Section, Physics Department, Imperial College, LONDON SW7 2BZ, UK).

The distorted visual appearances of certain images, referred to as visual illusions, have been interpreted either as evidence of interaction between central, cognitive processes and incoming visual signals (e.g. Gregory, 1970), or as distortions inherent in the transmission properties of the visual pathways (e.g. Ginsburg, 1975). We have studied responses to illusory patterns of a single subject, who possesses a central visual defect. The principal expression of this defect is the subject's inability to resolve red pattern subtending less than some 1° of visual angle (Bender and Ruddock, 1974), although some central visual responses are normal, even for red patterns which are not perceived (Ruddock and Waterfield, 1978). We have tested his res-

ponses to illusory patterns printed in red or in black and red. The experimental results show that he detects some illusions, even though the illusory patterns are not perceived, whereas other illusions are not detected unless all elements of the patterns are perceived. We conclude that some distortions of the visual image are an inherent property of signal transmission by the visual pathways, as suggested by Ginsburg (1975).

ANNOUNCEMENTS

XVIIth SYMPOSIUM OF THE INTERNATIONAL SOCIETY FOR CLINICAL ELECTROPHYSIOLOGY OF VISION, Schloss Reinhardsbrunn, G.D.R., 5th-10th June 1979)

The XVIIth Symposium of the International Society for Clinical Electrophysiology of Vision (ISCEV, formerly ISCEG) will take place in Schloss and Parkhotel Reinhardsbrunn from June 5th (arrival) to June 10th (departure), 1979. Main topics : 1) Visual electrodiagnosis in systemic diseases; 2) Visual electrophysiology and localized stimulation. Free papers are allowed but will not be published in the proceedings. Those wishing to read a paper are requested to tell the organizing secretariat the title not later than September 30th, 1978 and to send an abstract (250 words i.e. about 20 lines) not later than January 31st, 1979.

Mailing address : Sekretariat der Augenklinik der Medizinische Akademie, Nordhäuser Strasse 74, DDR-50 ERFURT, GRD.

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Abstracts deadline : June 1, 1979.

Information : J.J. VOS, Institute for Percept on TNO
P.O. Box 23, 3769 ZG Soesterberg, The Netherlands.

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