

# DALTONIANA

## NEWSLETTER

### OF THE INTERNATIONAL RESEARCH GROUP ON COLOUR VISION DEFICIENCIES

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#### EDITORIAL

Following a suggestion made at the Edinburgh symposium, a new section is devoted to the colour vision tests and accessories available in the different countries. The following example relates to Belgium. The readers of Daltoniana are asked to send to the editor similar lists for their own countries... and also to provide us material for the other sections!

#### COMMERCIALLY AVAILABLE COLOUR VISION TESTS AND ACCESSORIES BELGIUM (1973)

TEST OR APPARATUS	PRICE (BF)	DEALER(S)
Ishihara test - 24 plates	1.060/835	A, B
38 plates	1.475/1.175	A, B
12 plates (children)	475	B
AO Pseudo-Isochromatic Color Test	2.080	C
Panel D-15	3.800	A
28 hue (Roth)	3.425	A
100 hue	9.325/10.175/13.560	A, D, E,
Sloan Achromatopsia Test	3.895	E
Burnham-Clark-Munsell Color Memory Test	13.560	E
Chromoptometric lantern of Beyne	74.000	F
Nagel anomaloscope	about 100.000	A
Macbeth Easel Lamp	6.560/10.700	E, C
Macbeth Executive BBX-324	17.560	E
Macbeth Prooflight Luminaire 7500°K FL75 - 4:0	9.540	E

The turnover tax (18%) is not included in most of the listed prices.

The AO H-R-R test is no more available.

In 1973 1 U.S. dollar was about 35 BF (now 44 BF).

Dealers who answered to our enquiry

- A VAN HOPPLYNUS S.A., rue Royale, 101, 1000 Bruxelles
- B F.J.M. DRAECK, Retsstraat, 51-55, 2200 Antwerpen
- C A. DE CEUNYNCK, Schrijwerkersstraat, 9, 2000 Antwerpen
- D EDITEST S.P.R.L., rue Général Capiaumont, 94, 1040 Bruxelles
- E ANALIS S.A., rue Dewez, 14, 5000 Namur
- F Paul LOUIS N.V., Grondwetstraat, 23-41, 1030 Brussel

G. Verriest.

LITERATURE SURVEY

Heterochromatic additivity, foveal spectral sensitivity, and a new color model, by S.L. GUTH and H.R. LODGE (Dept. Psychol. Indiana Univ., Bloomington, Ind. 47401), J. opt. Soc. Amer. 63/4, 450-462, 1973.

In three separate experiments it is shown that (I) heterochromatic additivity failures for foveally viewed trichromatic lights can be predicted using a vector model derived from bichromatic additivity data, (II) near-threshold bichromatic additivity failures are not quantitatively different from threshold-level failures, and (III) foveal spectral sensitivities obtained by direct brightness matching and threshold methods are greater in the long- and short-wavelength ends of the spectrum than sensitivities obtained by flicker photometry. A new opponent-color model that is appropriate for threshold-level color vision is expressed as a transformation of the CIE standard observer. The model allows the derivation of a light unit that correlates with signal detectability and predicts (a) confusion lines for deuteranopic and tritanopic vision, (b) spectral sensitivity as measured by flicker photometry (i.e. a sensitivity function much like the CIE  $V_{\lambda}$  function), (c) spectral sensitivity as measured by threshold (or direct-matching) techniques, (d) threshold-level heterochromatic additivity failures, (e) the apparent saturation of a threshold-level spectrum, (f) wavelength discrimination for a near-threshold spectrum, (g) loci of constant lightness-to-luminance ratios within the CIE chromaticity diagram, and (h) the essential quantitative differences between threshold and near-threshold heterochromatic additivity failures. - Ingeborg Schmidt.

Studies of spectral sensitivity as measured by a procedure of flicker threshold, by M.H. BORNSTEIN and L.E. MARKS (Department of Psychology and John B. Pierce Foundation Laboratory, Yale University, New Haven, Conn.) Amer. J. Optom. 50/5, 376-382, 1973.

Spectral sensitivities were measured by utilizing the method of critical flicker frequency. Monochromatic lights was provided by interference filters, the visual angle of the stimulus was 3.3°. A sectored disc interrupted the stimulus light at a focal point in the optical system. The subject adjusted a neutral density wedge controlling the radiance of the stimulus until flicker was just detectable. In experiment I intensity and frequency were correlated since at any given wavelength radiance increased monotonically with CPF. The experiment showed that spectral sensitivity determined by frequencies 20-35 Hz matches CIE photopic luminous efficiency. Higher frequencies (40-45Hz) yielded reduced sensitivity to long wavelengths. In experiment II it was attempted to isolate the effects on spectral sensitivity of changes in its radiance by using a steady light that was added to the stimulus. Increasing intensity alone narrows spectral sensitivity whereas increasing frequency broadens it. In experiment III the flicker thresholds were measured under conditions of chromatic adaptation to intense light (20,000 - 30,000 trolands, red, yellow or green) in order to isolate individual modulation-sensitive mechanisms. Three mechanisms were found which have spectral sensitivities similar to Stiles II<sub>1</sub>, II<sub>4</sub> and II<sub>5</sub> color mechanisms - Ingeborg Schmidt.

Brightness of isolated colored lights, by C.R. CAVONIUS and R. HILZ (Psychol. Labor. Univ. Cambridge, England, and Inst. for Med. Optics, Univ. Munich, Germany), J. opt. Soc. Amer. 63, 884-888, 1973.

The brightness of centrally fixated monochromatic lights produced by colored and neutral density filters on a 2° circular field in a dark surround was measured by three methods (1) magnitude estimation, (2) delayed matching in which the observer adjusted the luminance of an achromatic field until it matched the remembered brightness of the monochromatic field (3) conventional heterochromatic photometry. The photometric data resemble the CIE V(λ) function, but both the procedures (2) and (3) result in substantially higher sensitivities to short wavelength stimuli. After elimination of any scotopic intrusion the sensitivity to short wavelength stimuli resembles that of peripheral cones. The results should be kept in mind whenever it is necessary to specify the brightness of isolated short-wavelength lights or to attempt to equate lights that are of different colors.-- Ingeborg Schmidt.

Method of determination of equivalent luminance in mesopic vision, by S.P. KONARSKI, Prace Centralnego Instytutu Ochrony Pracy 1973, No. 77, p. 157-177.

A method of determination of the so-called equivalent luminance according to the CIE definition was proposed on the basis of the results of investigations carried out in order to establish the relative spectral sensitivity of the human eye in the mesopic adaptation region. The two figures resulting from the measurements and representing values of standard luminances i.e. photopic and scotopic of the test investigated equalised visually with the standard test from the viewpoint of the brightness sensation rendered possible to find a relationship between the standard quantities and relative spectral sensitivity of the eye for a determined level of adaptation luminance. The above-mentioned relationship was represented in the form of diagram and allows to determine graphically the equivalent luminance of the investigated source. This relationship is valid also for the light sources of whatever spectral distribution (deviations from means obtained for monochromatic beams in the wavelengths region of 420 to 460 nm do not exceed 20%). As it arises from this relationship the correction coefficients of results obtained with the aid of objective photometers in the mesopic luminance regions range within limits approximately from 0,01 to 15 for different luminance levels. - Felicia Jakubik.

Metameric "Color Rule" matches of normal, colour deficient, cataractic and aphakic observers, by H. KALOUS, Ann. hum. Genet. (Lond.) 36, 109-118, 1972.

The use of the "Color Rule" is described as a new tool for colour vision studies. The instrument is based on the metamorphism of subtractive mixture and is a slide rule with two painted colour scales of constant brightness, the colour varying in the one scale from purple to green, in the other from blue to brown. The color rule can compare quite favourably with anomaloscopes for distinguishing between the various types of red-green blindness; it seems also to detect tritanopes. Studies of a group of 195 colour normal observers and of a group of  $\pm$  70 colour defectives are described, according to influences of age, ethnic differences, and repeatability of the test. The color rule must only be used with a good illumination. - E.C. de Vries-de Mol.

The Toichi color sense test cards, by S. TSUTSUMI (National Tokyo Hospital), Acta Soc. ophthal. jap. 75, 862-874, 1971.

The Toichi test for anomalous color sensation is described. The method consists in matching of standard color cards, grouped in light and dark color groups. The method enables to classify color anomaly in 5 degrees : light 1, light 2,

middle 1, middle 2, high 1, and high 2. This classification would be useful in judging the fitness to practical color works. Ten principal colors were used in describing errors in color matching, namely red, red-yellow, yellow, yellow-green, and green, blue-green, blue, blue-purple, purple and red-purple. - Yasuo Ohta.

Studies on the illumination in the color vision test using the color discrimination tester; Report 2 : On the various fluorescent lamps, by S. SAI (Dept. Ophthal., Tokyo Medical College), Acta Soc. ophthal. jap. 75, 2211-2221, 1971.

These tests on color discrimination and achromatic color lightness discrimination were performed at the optimum illuminance of 550 lx using seven kinds of fluorescent lamps, in order to select the best one. However, the experiments showed that all seven fluorescent lamps are suitable as artificial light source for the illumination of the color discrimination test as there were never large differences in the results when compared with that in daylight. All fluorescent lamps which are over Ra 80 in average color rendering evaluation number are suitable for use. - Yasuo Ohta.

Spectral responses in the human electroretinogram and their clinical significance, by M. YOKOYAMA, T. YOSHIDA and K. UI (Department of Ophthalmology, Mie Prefectural University, School of Medicine, Edobashi 2, Tsu, Mie 514) Jap. J. Ophthalm. 17/2, 113-124, 1973.

An apparatus for monochromatic stimulation enabled quick automatic scanning over a spectral range between 400 and 700 nm at intervals of 20 nm. Successive ERG responses were recorded after 5 min preadaptation to a mesopic condition (1.6 trolands retinal illumination). With wavelengths longer than 620 nm the  $b_p$  wave (x-wave) was predominant, with wavelengths shorter than 600 nm the  $b_s$  wave was the main response. The amplitude both of the  $b_p$  and  $b_s$  wave were plotted against wavelengths. In normals the peak of the resulting curve was at 500 nm and the amplitudes were about 70% of those recorded under scotopic conditions. - In a 38 year old man with vitreous opacities the spectral response curves showed a loss in the region of the short wavelengths. In a 20 year old female with moderate myopia and lattice degeneration in all four quadrants of the peripheral retina the response was reduced at 500 nm resulting in a flattened type spectral response curve. In a 32 year old man with progressive cone dystrophy, relative central scotomas of 10-15° in both eyes, some type of achromatopsia and normal rod thresholds in dark adaptation, the spectral response curves showed marked loss at the red end of the spectrum. The method appears to be useful for clinical investigation. - Ingeberg Schmidt.

Current concepts concerning congenital colour vision defects (Conceptions actuelles sur l'hérédité des déficiences congénitales de la vision de couleurs), by J. FRANCOIS, S. DE BIE, G. VERRIEST, M. Th. MATTON (Ophth. Clinic. Univ. Ghent, Belgium), Ann. Oculist. 206/1, 1-20, 1973.

The present knowledge about the heredity of congenital dyschromatopsia is discussed. Special attention is given to the hypothesis of Mary Lyon; also to diseases with localisation in the non-homologous part of the X-chromosome. The work is completed by an extensive bibliography. - A. Pinckers.

Transmission through the X-chromosome of colour defectiveness in Turner syndrome, by P. CERNEA, M. COVIC, E. ZBRANCA and F. CONSTANTIN, Ann. Ottal. Clin. ocul. 1971/11.

Examination by means of pseudo-isochromatic plates and anomaloscope showed that colour vision was defective in 3 of 16 subjects suffering from Turner syndrome and that the defect is of maternal origin. - F. Bozzoni.

Pingelap and Mokil Atolls : Achromatopsia, by I.E. HUSSELS and N.E. MORTON, Amer. J. hum. Genet. 24, 304-309, 1972.

Among the inhabitants of the Pingelap and Mokil tolls congenital achromatopsia with high myopia has a frequency of 5% of the Pingalese and 1% of the Mokilese (Ponape District, U.S. Trust Territory of the Pacific Islands). The, most likely, autosomal recessive gene reached this high frequency since only one ancestor (with three wives) survived a typhoon around 1775. A total of 57 affected persons are examined; sex distribution and age distribution studies are performed as well as incidences among examined individuals and in pedigrees. A segregation analysis is done; the ethohistory is part of the study. - E.C. de Vries-de Mol.

Congenital tritanopia without neuroretinal disease, by D.P. SMITH, B.L. COLE and A. ISAACS (Victorian college of Optometry, Univ. of Melbourne, Australia), Invest. Ophthalm. 12/8, 608-617, 1973.

Reexamination of tritans from two families already documented in the literature as exhibiting congenital tritanopia (Henry, Cole and Nathan, Ann. Human Genet. 27, 219, 1964, Cole, Henry and Nathan, Vision Res. 6, 301, 1966), because of recent revival of the view that congenital tritanopia does not exist and cases mistakenly reported as such in the past have actually been undiagnosed cases of dominantly inherited juvenile optic atrophy (DIJOA). The criteria for the diagnosis of congenital tritanopia as distinct from DIJOA proposed and confirmed by D. P. Smith (Amer. J. Optom. 49, 183, 1972) are compared in a table. The five tritans extensively examined clearly met only four of the eight criteria diagnostic of DIJOA but the criteria met are those which that disease

has in common with congenital tritanopia. A blue-yellow defect was the only functional loss and there was no evidence of optic atrophy, in particular nothing to suggest a diagnosis of DIJOA. There was no evidence of any other ocular disease. There was no change in the state of tri- or dichromasy of those patients who were so assessed in 1966 and 1967. The authors are directed to the conclusion that inherited congenital tritanopia does exist. - Ingeborg Schmidt.

Rheumatoid arthritis and synthetic antimalarial agents (La polyarthrite rhumatoïde et les antipaludéens de synthèse), by A. PINCKERS, J. V.D. EERDEN (Ophth. Dept. Univ. Nijmegen, Netherlands), Ann. Oculist. 206/4, 305-309, 1973.

192 patients with rheumatoid arthritis were examined by EOG and F.M. 100 Hue. The F.M. 100 Hue is abnormal in 22% of cases without symptoms of intoxication. There is no correlation between F.M. 100 Hue-score and any of the rheumatological criteria. In cases of intoxication by chloroquine derivatives the F.M. 100 Hue is disturbed. In patients treated with hydroxychloroquine derivatives (close up to 1,5 kgm) no symptoms of intoxication could be found. - A. Pinckers.

Cordarone keratopathy (Thésaurismose cornéenne par cordarone), by V. THILGES, Ann. Oculist. 206/5, 385-392, 1973.

30 patients with cordarone keratopathy are examined. Colour vision examination (Ishihara) was normal. The author concludes that the retina is not affected by cordarone therapy. - A. Pinckers.

Effects of environmental color on two psychomotor tasks, by R.A.H. GOODFELLOW and P.C. SMITH (Bowling Green State University), Perceptual and Motor Skills 37, 296-298, 1973.

There were no significant differences in performance among 125 subjects on any of two psychomotor tasks (pursuit rotor and Crawford small parts dexterity task) when performed in booth painted red, green, blue, yellow or gray and matched for brightness and saturation. - Ingeborg Schmidt.

Spectral transmission of a new aviation and skiing filter, by R.W. EVERSON (Division of Optometry, Indiana University, Bloomington, Indiana), Amer. J. Optom. 50/5, 413-415, 1973.

A sunglass filter, called a DOC lens, of rose-colored tint, is reported by users to permit skiers to see snow contours, moguls and ski tracks better than other tints and to permit pilots to penetrate haze and smog more easily. The spectral transmittance, luminous transmittance and chromaticity of the lens are assessed. - Ingeborg Smidt.

Psychological significance of the army colour "blue" for the sanitary troops (Die farbpsychologische Bedeutung der Waffenfarbe "Blau" der Sanitätstruppen), by H. KLAR; Remarks on the same topic (Bemerkungen zu "Die farbpsychologische Bedeutung der Waffenfarbe "Blau" der Sanitätstruppen"), by F. HERMANN; Conclusion on the same topic (Schlusswort zu "Die farbpsychologische Bedeutung der Waffenfarbe "Blau" der Sanitätstruppen", by H. KLAR, Wehrmedizinische Monatsschrift (München) 1971/8, p. 245-250.

The dark blue colour signifies, passivity, rest, deep sentiment, satisfaction, fidelity, love, social and esthetic profession etc. - J. Kelecom.

Colour blindness among 10.000 recruits (Onderzoek inzake kleurenblindheid bij 10.000 dienstlichtigen), by KUYPERS and L. EVENS, Acta belgica de Arte medicinale et pharmaceutica militari, 1970 3-4, p. 323-331.

10.000 subjects were examined by means of the Ishihara test and the 707 subjects who made more than 3 errors at the Ishihara were examined by means of the HRR test with the following results : normal:82; not identified red-green defect : mild : 151; strong : 31; protan : mild : 12; medium : 51; stron : 76; deutan : mild : 41; medium : 166; strong : 97. Only 2,55% of the 10.000 subjects were considered as inapt for driving. - J. Kelecom.

Colour radiography used for investigations of intermediate phase of cerebral angiography, by J. ZAJNER and M. KOŁODZIEJ, Polish Neurology and Neurochirurgy, 1973/3, p. 311-312.

The authors described the method of evaluation of intermediate phase of carotid angiography using colour angiography. For this purpose the Radio-Colour-Scop writ was used. The obtained colour radiograms demonstrate much better the intermediate phase than the white-black radiograms. (Mentioned because of the colour vision implications). - Felicia Jakubik.

Color ignorance, not color blindness, by S.C. FISCHOFF, (Albany, N.Y.), Opt. J. and Review of Optom. 110/15, 25-26, 1973.

The author claims to have helped 118 so-called "color blind" (type not classified), who had originally failed a color vision examination, to pass any color test given (AO pseudoisochromatic plates, Ishihara, Stilling) and get into the service they desired (during the years 1943-1945). He trained them by flashing red, white and green lights, by color naming ("color awareness") and by not further identified color homework. - Ingeborg Schmidt.



Color vision. Symposium conducted at the spring meeting 1971 of the Committee on Vision National Academy of Sciences, Washington D.C. 1973, 124 pages.

It contains 3 chapters important for us : L.M. HURVICH : Color vision deficiencies; Helen M. PAULSON, Comparison of color vision tests used by the armed forces; and D.B. JUDD, Color in visual signaling. The other 3 chapters are on color in photography and in architecture. - Ingeborg Schmidt.

PREPRINTS OF SUMMARIES OF PAPERS WAITING  
PUBLICATION

Wearing of red glasses in incomplete achromatopsia, by A. GONELLA and A. DAMEL. To be published in Arch. Oftal. Norte argent. 5/2.

Red glasses improved markedly the results of the colour vision tests, the photophobia and the visual confort in a group of incomplete achromats. This is due to a better excitation of the photopic system. - A. Gonella.

Visual acuity for coloured optotypes, by J. MASSANISSO and A. GONELLA. To be published in Arch. Oftal. Norte argent. 8/2.

Coloured optotypes were presented to three groups of subjects : 1) the emmetropic subjects with normal colour vision gave nearly the same acuity for the different colours; 2) the ametropic subjects with normal colour vision showed more variation, to be explained by optical factors; 3) for what concerns the observers with defective colour vision, it was observed that the protanopic ones see better the red optotypes and that the aphakic ones see better the blue optotypes; the subjects suffering from juvenile maculopathy and from edema of the posterior pole did not see better for any colours; these appeared desaturated in the latter condition. - A. Gonella.

The photopic and scotopic functions of the retina, by A. GONELLA, A. DAMEL, J. MASSANISSO and QUAINTEENNE. To be published in Arch. Oftal. Buen.-Air. Refers to the mechanisms of colour vision and to the bioelectrical investigations done in different animals, especially in monkeys that presents the same chromatic discrimination characteristic as men : new conclusions were deduced relating to the photopic and scotopic functions of the retina.

The photoreceptors act as codifiers transmitting the impulses that are interpreted by a posterior bioelectrical mechanism (at the level layer of the bipolars, horizontal and amacrine cells), as an answer of luminosity L or color

C, called altogether S, that acts as a non opponent system responding always to the different wave lengths, but with different intensity and an opponent system that would consider different wavelengths as a mechanism of Hering's type.

This mechanism would act both in the photopic and scotopic function, that is to say that they would be in one or in other function predominating according to the retinal adaptation.

This makes possible to extract new physiopathological interpretations of different processes that would alter the visual functions individually.

LISTS OF THE PUBLICATIONS ON COLOUR VISION  
DEFICIENCIES OF MEMBERS OF THE RESEARCH GROUP

45. Papers by Dr. W.E. COLLINS (Civil Aeromedical Institute, AAC-118, Federal Aviation Administration, P.O. Box 25082, Oklahoma City, Oklahoma 73125, U.S.A.).

- R COLLINS W.E. - The effects of deuteranomaly and deuteranopia upon the foveal luminosity curve, J. Psychol., 48, 285-297, 1959.
- R COLLINS, W.E., CASOLA A.S. and ZEGERS R.T. - The performance of color-blind subjects on the color aptitude test, J. gen. Psychol., 64, 245-250, 1961.
- R COLLINS W.E. - The luminosity functions of normal, deuteranomalous, and deuteranopic subjects as determined by CFF and absolute threshold measures, J. Opt. Soc. Amer., 51, 202-206, 1961.
- R COLLINS W.E. - Subject differences in luminosity using absolute threshold and CFF techniques, J. gen. Psychol. 66, 53-59, 1962.
- SWEENEY D.R., ZEGERS R.T. & COLLINS W.E. - Color blindness in male negro children, J. soc. Psychol. 62, 85-91, 1964.

46. Papers by Dr. J.M. EICHENGREEN (The Colorado College, Colorado Springs, Del. 80903, U.S.A.).

EICHENGREEN J.M. - Time Dependent Chromatic Adaptation, (Doctoral Dissertation, Univ. of Pennsylvania). Ann Arbor, Mich. : Univ. Microfilms, 1971, n° 71-26005.

- R EICHENGREEN J.M. - Psychophysical Estimates of Opponent-Process Response Functions, Perception and Psychophysics, 13, 93-98, 1973.

47. Papers by Dr. J.M. ENOCH (Dept. of Ophthalmology, Washington Univ. Med. School, 660 S. Euclid Avenue, St. LOUIS Missouri 63110, U.S.A.).

- R ENOCH J.M. and STILES W.S. - The colour change of monochromatic light with retinal angle of incidence, Optica acta 8, 329-358, 1961.

ENOCH J.M. - Chapter 3, Part 1 : Vision (p. 202-289), in : A. SORSBY, Modern Ophthalmology, Vol. L, Basic aspects, Butterworth & Co. Ltd., London, 1963.

- R ENOCH J.M. - Retinal spectrophotometry, J. opt. Soc. Amer. 56, 833-835, 1966.

- R ENOCH J.M. - The two-color threshold technique of Stiles and derived component color mechanisms (p. 537-567), in : Handbook of Sensory Physiology, Vol. VII/4, Visual Psychophysics, Springer, Berlin/Heidelberg/New York, 1972.

48. Papers by Prof. W.S. FOULDS (Tennent Institute of Ophthalmology, University of Glasgow, GLASGOW, Scotland).

FOULDS W.S. - Visual disturbances in systemic disorders, optic neuropathy and systemic disease, Trans. Ophthal. Soc. U.K., 89, 125, 1969.

FOULDS W.S., CHISHOLM I.A., BRONTE-STEWART & WILSON T.M. - Cyanide induced optic neuropathy, Ophthalmologica Additamentum ad vol. 158, 350-358, 1969.

FOULDS W.S., CHISHOLM I.A., BRONTE-STEWART, J. & WILSON T.M. - The optic neuropathy of pernicious anaemia, Arch. Ophthal. 82, 427, 1969.

FOULDS W.S., CHISHOLM I.A., BRONTE-STEWART J. & REID H.C.R. - The investigation and therapy of the toxic amblyopias, Trans. Ophthal. Soc. U.K., 90, 739, 1970.

FOULDS W.S., LEE W.R. & TAYLOR W.O.G. - Clinical and pathological aspects of choroidal ischaemia, Trans. Ophthal. Soc. U.K., 91, 323, 1971.

BRONTE-STEWART J. & FOULDS W.S. - Acquired dyschromatopsia in vitamin A deficiency, Mod. Probl. Ophthal., 11, 168, 1972.

FOULDS W.S., CHISHOLM I.A. & REID H.C.R. - The effect on visual function of acutely raised intraocular pressure. The Optic Nerve -Proceedings of the Second Mackenzie Symposium. Edited J.S. Cant. Henry Kimpton, London, p. 323, 1972.

49. Papers by Prof. S.L. GUTH (Department of Psychology, Indiana University, BLOOMINGTON, Indiana 47401, U.S.A.).

R S.L. GUTH, J.V. ALEXANDER, J.I. CHUMBLY, C.B. GILLMAN & M.M. PATTERSON. - Factors affecting luminance additivity at threshold among normal and color-blind subjects and elaborations of a trichromatic-opponent colors theory, Vision Research 8, 913-928, 1968.