DALTONIANA

NEWSLETTER
OF THE INTERNATIONAL RESEARCH GROUP ON COLOUR VISION DEFICIENCIES

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LITERATURE SURVEY

Molecular genetics of human color vision : the genes encoding blue, green and red pigments, by J. NATHANS, D. THOMAS & D. HOGNESS (Department of Biochemistry, Stanford University, School of Medicine, Stanford, CA 94305, USA). Science, 232, 193-202, 1986; Molecular genetics of inherited variations in human color vision, by J. NATHANS, T.P. PIANTANIDA, R.L., EDDY T.B. SHOWS & D. HOGNESS (Department of Biochemistry, Stanford University, School of Medicine, Stanford, CA 94305, USA), Science, 232, 203-210, 1986.

These two papers may be among the most important papers on colour deficiency to be published since 1886.

Nathans and his collaborators have isolated and sequenced the genes that specify the three proteins that underlie normal photopic vision, and they have shown how the genes are altered in cases of colour deficiency. They began with a radioactively-labelled fragment of DNA that was derived from the gene for bovine rhodopsin. With this probe they were able to identify in human DNA not only the rather similar gene specifying the human rod pigment, but also - by manipulating the experimental temperature and thus the readiness of the DNA to 'hybridise' with a partially mismatching probe - they were able to identify other, rather less similar, genes that were likely to be those that specify the cone pigments.

To localize genes on particular chromosomes, probes were prepared from each of the genes and were hybridized with DNA from a panel of mouse-human hybrid cells that retain various subsets of the human chromosomes. From the pattern of results, the gene for rhodopsin was localized on chromosome 3 and one of the putative cone genes was localized on chromosome 7; the latter was taken to be that for the short-wave pigment, since tritan disorders are inherited autosomally. The other genes lie on the q-arm of the X-chromosome. To distinguish genes for the middle- and long-wave pigments, Nathans and his colleagues examined 25 colour-deficient men, collating Rayleigh matches with the pattern of hybridization to probes derived from the X-chromosome genes.

One curious finding was that more than one middle-wave gene might be present on the X-chromosome of a colour-normal man. However, the multiple middle-wave genes of a normal may differ only by a single, 'silent', nucleotide substitution; i.e. the amino acid sequences encoded by the gene are identical and it is not that two different versions of chlorolabe are being manufactured. There was never evidence for more than one gene for a long-wave pigment.

96% of the inferred amino acid sequence is identical for the long- and middle-wave pigments. By contrast, the short-wave pigment shows only a 43% identity with the middle- and long-wave pigments - a degree of identity comparable to that between the latter pigments and human rhodopsin. This finding is concordant with other evidence that the middle- and long-wave pigments were differentiated very recently, as a result of duplication of a gene on the X-chromosome.

The results of Nathans and his collaborators suggest that local mutations of the genes are unlikely to be a common source of colour deficiency. Rather, the trouble probably lies in (a) the juxtaposition and (b) the similarity of the genes for the middle- and long-wave pigments. During meiosis, when crossing-over of DNA material occurs between members of a pair of chromosomes, misalignments of the DNA may occur in the region that codes for the middle- and long-wave pigments. Because the sequences are so similar, the long-wave gene on one chromosome might get itself apposed to a middle-wave gene on the other chromosome. If now crossing-over occurs and if the break-point lies in the duplicated spacers between genes, then one chromosome might lose its middle-wave gene and the other chromosome end up with two. If, on the other hand, the break-point occurs within a gene, a hybrid gene might be formed that consists of part of the long-wave gene and part of the middle-wave gene.

A man who inherits an X-chromosome that lacks the middle-wave gene will be a dichromat. But if the X-chromosome carries a hybrid gene, then the outcome will depend on where the break-point occured at the time of crossing over. There is one sub-region of the gene (near the 5' end) that seems to determine the actual spectral sensitivity of the resulting photopigment. If this sub-region is drawn from the long-wave gene, then the hybrid gene may produce a photopigment very similar to the normal long-wave pigment; the male owner of this chromosome, if he lacks the normal middle-wave gene, will again be a dichromat. But there may be a whole range of possible break-points and some of these may produce hybrid genes that code for photopigments with spectral sensitivities intermediate between those of the normal long- and middle-wave pigments; a man who inherits such a hybrid gene will be an anomalous trichromat. Protanomals in the present sample had one copy of a hybrid gene and several normal middle-wave genes. Deuteranomals had both of the normal genes plus a hybrid gene. - J.D. Mollon.

Role of the blue mechanism in wavelength discrimination, by K. KAISER (Dept. of Psychol. York Univ., Downsview, Ontario M3J IP3, Canada) and M. BOYNTON (Dept. Psychol. Univ. of Calif. at San Diego, La Jolla, CA 92093, U.S.A.), Vision Res. 25, 523-529, 1985.

The role of blue cones as well as the pathways they supply (collectively called the "blue mechanism") is evaluated by comparing ordinary wavelength discrimination functions with those obtained using two methods designed to inhibit the blue mechanism selectively. These methods use a just-noticeable-border criterion (JNB), instead of the usual one of just-noticeable-difference, and a yellow preadapting field to induce transient tritanopia. Without transient tritanopia, the data obtained using the just-noticeable-border criterion reveal a small contribution of the blue mechnanism to wavelength discrimination. Transient tritanopia, with JNB, produces an additional selective loss of wavelength discrimination in a spectral region flanking 460 nm, which yields a function resembling those for tritanopes previously examined. - The Authors.

Differential light wavelength threshold depending on adaptation to colour, by M. TULISZKA, B. KEDZIA and U. KOKOWSKA Eye Clinic (Klinika Oczna) No I, pages 23-24, 1983.

Using a test field of 2° and 3.5 cd.m^{-2} luminance j.n.d. thresholds were measured in 3 subjects against bakcgrounds of 450, 550 and 600 nm. Two subjects were normal trichromats and one was a deuteranope (identified by means of Ishihara's charts). - Felicia Jakubik.

Information concerning colour derived from a single boundary, by R.W. DITCHBURN & J.A. FOLEY-FISHER (Dept. of Engin. Univ. of Reading, Whiteknights, Reading RG6 2AY, U.K.), Ophthal. Physiol. Opt. 3, 233-238, 1983.

Two experiments are described in which visual information is derived from a single moving boundary in the retinal image, all other boundaries being stabilized so that they contribute no visual information. In this situation the subject perceives the same colours on the two sides of the boundary as would be perceived in normal vision when, owing the eye-movements, all boundaries in the retinal image are moving relative to the retina. Thus complete information leading to perception of hue and saturation as well as brightness, and not merely differences of hue etc. on the two sides, can be derived from a single boundary. - The Authors.

Density of human cone photopigments as a function of age, by D. VAN NORREN & G.J. VAN MEEL (RVO-TNO, Soesterberg, The Netherlands), Invest. Ophthal. Vis. Sci. 26, 1014-1016, 1985.

The density difference betweer fully bleached and fully dark-adapted retinas was assessed for 77 eyes (47 subjects) in the age group 13-50 yr. No significant change in density was found as a function of age. The time constant of pigment regeneration was also found to show no age effects up to the age of 50 yr. These findings are at odds with another study on the density of foveal cones. - The Authors.

A proposal for the documentation of clinically applied color vision tests, by E. ZRENNER (Max Planck Inst. Physiol. Clin. Res., Bad Nauheim, FRG), Dev. Ophthal., 9, 157-170, 1984.

A protocol sheet (English and German versions provided) is designed to help insure a complete and correct documentation of the procedure, the evaluation and the interpretation of common clinical tests of color vision. It includes the Ishihara plates, the (standard or desaturated) Panel, the Nagel anomaloscope and the 100 hue test (without reference to the age factor). - Guy Verriest.

Studies on the printing color and the screening efficiency of the Ishihara test for color blindness. II Evaluation of the Ishihara test published in 1979 and 1980 and the criterion of the detection , by O. OKAJIMA (Dept. of Ophthalmol. Sanraku Hospital, Japan), Acta Soc. Ophthalmol. Jpn. 87, 341-345, 1983.

The author previously reported that the screening efficiency of the Ishihara test published in 1978 was much inferior to that of the test published in 1959. On the basis of this result, the printing colors of the edition of 1979 and 1980 were modeled on those of the edition of 1959. In this report color vision of 6,138 students was studied by the Ishihara test published in 1979 and 1980 and by anomaloscope examination. The screening efficiency of both edition was evaluated. The results were as follows: (1) The ratio of color vision defectives who misread 4 or less out of 21 plates, the normal range provided by the manual of the Ishihara plate, was 2.4% of all color vision defectives and was much less than the ratio at the edition of 1978 (10.1%). Both editions is thought to be as good as the edition of 1950's in the screening efficiency. (2) The standard for normal color vision should be changed to 3 misreadings or less. If this criterion is adopted, only 0.9% of color vision defectives would be overlooked and no normal subjects would be taken for color vision defectives. Color vision defectives who misread Ishihara plates only a little more than normal subjects are thought to be mild defectives. But no reports had evaluated clinical data from this point of view, so the authors studied if color vision defectives could be judged as mild by the number of misreading of the Ishihara test published in 1980, in comparison with 3 kinds of tests for grading of color vision defects, i.e. HRR test, the TMC test and the New Okuma test. The results were as follows: (3) The distribution of the medium and mild groups classified by each of those tests differed significantly ($p < 0.01$) among the 2 groups divided by number of misreading. (4) All defectives who misread not more than 10 plates were judged as mild by those tests for grading. - Yasuo Ohta.

Linearity of hue cancellation in sex-linked dichromacy, by K. KNOBLAUCH (Sec. Vis. Processing, Nat. Eye Inst. NIH Build. 10, Bethesda, Maryland 20205, U.S.A.), L. SIROVICH (Appl. Math., Dept. Brown Univ., Providence, R.I., 02912, U.S.A.) & B.R. WOOTEN (W.S. Hunter Lab. Psychol. Brown Univ., Providence R.I. 02912, U.S.A.), J. opt. Soc. Am. A 2, 136-146, 1985.

The results of several recent studies concur in the finding that for normal trichromats red-green hue cancellation data obey linearity properties over rather general conditions, but for most observers yellow-blue hue cancellation data do not. It is of interest to examine the question of cancellation linearity in sex-linked dichromats under the assumption that they represent reduced systems. We measured both the wavelength of the spectral achromatic point over a large range of intensities and yellow-blue hue cancellation functions over the full spectrum and at several luminance levels in protanopes and deuteranopes. Both sets of data for the two types of dichromat satisfy liearity properties. These results are consistent with a model in which both cone receptor response functions have the same form. Implications for trichromatic oponent response functions are considered. - The Authors.

Abnormalities of cone photopigments in genetic carriers of protanomaly, by T. YASUMA, H. TOKUDA & U. ICHIKAWA (Nagoya Univ. School of Med., 65 Tsuruma-cho, Showa-ku, Nagoya 466, Japan), Arch. Ophthalmol. 102, 897-900, 1984.

Anomaloscopic color matching was performed in 57 protanomalous boys. The relative luminous efficiencies of their mothers were measured by flicker photometry to clarify the characteristics of protanomaly carriers. The sensitivity loss in protanomaly carriers in the long wavelength region had a highly significant correlation with the anomalous quotients (AQs) of their protanomalous sons. This correlation means that both the luminous efficiencies of the protanomaly carriers and the AQs of their sons are determined by the same "anomalous" cone pigments.

Color vision and ophthalmological findings in a family with congenital tritanopia, by H. ICHIKAWA, Y. MIYAKE, T. YASUMA, K. ICHIKAWA, K. YAGASAKI (Dept. of Ophthalmology, Nagoya Univ. School of Med.), S. TANABE (Nagoya First Red Cross Hospital) and K. SHINZATO (Eye clinic, Urazoe Hospital, Japan), Acta Soc. Ophthalmol. Jpn. 87, 162-169, 1983.

Studies have been made on a family with 3 cases of congenital tritanopia. Two of these cases were complete and a third one incomplete. The proband could not distinguish yellow from white on the Lubik cubes. Inheritance was undoubtedly autosomal dominant. The affected siblings had a normal visual acuity. They showed pure tritanopic findings and no any red-green defect in several clinical color vision tests. They revealed no evidence of pathologic optic nerve in affected and unaffected family members. All three cases of tritanopia in the family showed a negative type of ERG with normal dark adaptation.

Some additional psychophysical studies, which were done on the proband, did not demonstrate any detectable blue cone response. The results suggest some defective functions in blue cone system by loss of the interreceptoral interaction between blue cone and longer wave-length sensitive (red and green) cones. - Yasuo Ohta.

Electrophysiological properties of a case of congenital tritanopia, by K. YAGASAKI, Y. MIYAKE and H. ICHIKAWA (Dept. of Ophthalmol. Nagoya Univ. School of Med., Japan), Acta Soc. Ophthalmol. Jpn. 87, 227-233, 1983.

The authors previously reported a pedigree of congenital tritanopia certified by ophthalmological and psychophysical examinations. Thereafter they examined a proband of this pedigree by means of electrophysiological methods. Such examinations revealed (1) no response of the blue cone system in the monochromatic (440 nm) ERG, (2) normal scotopic and photopic ERG, (3) normal EOG and (4) negative type response (b/a ratio <1) and delayed peak latencies of the oscillatory potentials (OPs) with intense white flash ERG. These results indicate that the region which causes the dysfunctional blue sensitivity lies at least in the retinal layer relating to the ERG. And it could be also suggested by the negative type of ERG with delayed peak latencies of the OPs that there exist some dysfunction in the "neural retina". - Yasuo Ohta.

Acquired defects of colour vision -Diagnosis (Erworbene Störungen des Farbensehens - Diagnostik), by M. MARRE and E. MARRE (Augenklinik, Med. Akad. "Carl Gustav Carus", Dresden, GDR), Abhandl. aus dem Gebiete der Augenheilk., Sammlung von Monographien, Band 50, VEB Georg Thieme Leipzig, 1986. 191 p., 72 fig., 4 colour plates, 33 tables.

I think that this book will have for the present generation of german students of colour vision defects the importance that Köllner's book had in 1912 for the scientists of his time. Indeed, it is an actual overview of all what we presently know about acquired colour vision defects : physical, electrophysiological and psychological bases; classification systems; characteristics including the influence of the fixation modes; clinical methods of examination; specialized methods of examination; diagnostic aspects; literature etc. This book will have to be in the library of every IRGCVD member with a sufficient knowledge of the german language! - Guy Verriest.

Short-term effect of slitlamp illumination and argon laser light on visual function of diabetic and nondiabetic subjects, by I.M. GHAFOUR, W.S. FOULDS and D. ALLAN (Tennant Inst. of Glasgow, Western Infirmary, Glasgow G11 6NT Scotland), Br. J. Ophthalmol. 68, 298-302, 1984.

Visual acuity, color vision, and contrast sensitivity in diabetic and nondiabetic individuals were measured before, 20 minutes after, and 24 hours after exposure to slit-lamp illumination either alone or during argon laser photocoagulation.

In some instances, significant deterioration of these visual functions was noted when the tests were repeted 20 minutes after light exposure; however, by 24 hours after light exposure, visual function of all groups had returned to preexposure levels. The visual acuity was the most systematically affected by the procedure; there were wide interindividual differences in the changes observerd in the other tests.

The selective impairment of the three color mechanisms (red-green-, and blue-sensitivie mechanisms) isolated by the new color campimeter in pathological eyes with fundus disease. II. Studies of static threshold campimetry in early glaucoma, by H. ABE, T. SAKAI and Y. YAMAZAKI (Dept. of Ophthalmol., Niigata Univ. School of Medicine, Japan), Acta Soc. Ophthalmol. Jnp. 87, 950-957, 1983.

Using the newly devised color campimeter the authors attempted to reveal the correlation between the retinal nerve fiber layer (NFL) defect and the corresponding deterioration of sensitivity in the Bjerrum area of early glaucomatous patients. Eleven early glaucomatous patients with clear media and slight NFL defect in the Bjerrum area were studied. The visual field abnormality was detected by the Friedmann Visual Field Analyser Mark II and measured by the color campimeter.

The static achromatic thresholds of the 3 color mechanisms within the central 25° visual field were measured by the selective adaptation method using monochromatic test lights and bright chromatic background.

The stimulus light of 27' or 51' was projected on the 30° background field. The stimulus lights of 440 nm, 540 nm and 580 nm were projected on yellow, purple and blue background respectively. For the background lights, the following color filters were used : yellow with Corning 3-67, purple with Wratten 32 and blue with Corning 5-57. The luminance values were 950, 280 and 77 cd/m^2 for the yellow, purple and blue background respectively. The stimulus duration was 100 msec. The interstimulus interval was 2 sec. The background and stimulus lights were seen through a 4 mm artificial pupil under the conditions of a dilated pupil and optimal refractive correction.

The results obtained in early glaucomatous cases are summarized as follows. (1) The sensitivity in the Bjerrum area for the blue-sensitive mechanism was distinctly more reduced than that for the red- and green-sensitive mechanisms and also for a white stimulus under photopic adaptation to a white background. (2) The grade of the sensitivity reduction in the Bjerrum area for the blue-sensitive mechanism was larger and denser than that measured by Friedmann's Visual Field Analyser Mark II. These results may lead to the conclusion that the measurement of the sensitivity of the blue-sensitive mechanism in the Bjerrum area is one of the most sensitive method to detect a visual damage in early glaucoma. - Yasuo Ohta.

Nonselective losses in foveal chromatic and luminance sensitivity in multiple sclerosis, by D. H. FOSTER, R.S. SNELGAR and J.R. HERON (Dept. of Commun. and Neuroscience, Univ. Keele, Staffordshire and the Dept. of Neurol., North Staffordshire Hospital Centr. Stoke-on-Trent, England), Invest. Ophthalmol. Vis. Sci. 26, 1431-1441, 1985.

A psychophysical technique involving simple increment threshold measurements was used to determine foveal chromatic and luminance sensitivity in patients with multiple sclerosis and in matched normal controls. The patient group showed substantial and nonselective losses in chromatic and luminance sensitivity relative to the normal control group, and these losses were significantly correlated with each other over individual patients. It is suggested that impairment of foveal visual function due to demyelination is not more specific to fibers carrying chromatic information than to fibers carrying luminance information. - The Authors.

Visual psychophysics with a video display controlled by microcomputer, by F.W. FITZKE (Dept. Vis. Sci., Instit. of Ophthalmol., Judd Street, London WC1H 9QS, U.K.), Proc. Physiol. Soc. 6P, 2, 1984.

A stimulus-display and data-processing system for visual psychophysics is demonstrated. Stimuli are produced on a colour monitor controlled by a BBC microcomputer. Their size, configuration, spectral composition and location can be easily and rapidly varied. Their intensity is determined by an interface incorporating a 12-bit D/A converter which varies the voltage of the analogue input to the monitor. A photomultiplier with a 12-bit A/D converter is linked to the computer and provides a record of the actual intensity. An eye-tracker based on the infra-red limbal reflexion technique allows monitoring of eye position so that stimuli can be presented during proper fixation or with compensation for eye movements. The system can be easily adapted for Maxwellian view by using small spots on the monitor as sources to be imaged in an observer's pupil. Examples will be provided to demonstrate the variety of applications of the system. These include mapping of visual thresholds at high spatial resolution and measuring dark adaptation et various locations following bleaches. - The Author.

Chromatic mechanisms in lateral geniculate nucleus of macaque, by A.M. DERRINGTON, J. KRAUSKOPF and P. LENNIE (Department of Psychology, University of Durham, Durham, United kingdom), J. Physiol., Lond. 357, 241-265, 1984.

Dichromatic observers have traditionally been classified by their confusion lines. In this paper the authors introduce an analogous technique for classifying individual neurons. Recordings were made from the lateral geniculate nucleus and the stimuli consisted of gratings that were modulated in chromaticity or luminance. For each cell the experimenters sought a null plane in their three-dimensional stimulus space, a plane within which modulation attracted no response from the cell.

Cells in the parvocellular layers of the l.g.n. fell into two distinct groups : (a) a group that appeared to draw inputs of opposite sign from the long- and middle-wave cones and (b) a smaller group that appeared to draw inputs from the short-wave cones, on the one hand, and some combination of the long- and middle-wave cones, on the other. A minority of the second group of cells were inhibited by the short-wave input and excited by long-/middle-wave input.

As the authors note, the parvocellular units of group (b) do not correspond to the "yellow-blue" opponent process of Opponent Colours Theory; these cells are better excited by modulation along a tritan line than by modulation along a yellow-blue axis.

Units in the magnocellular layers of the l.g.n. respond well to luminance, but most of them exhibit some chromatic opponency. The authors do not believe that the magnocellular units are the substrate for the "luminance" channel often postulated by psychophysicists. Rather they follow Ingling in supposing that the parvocellular system is responsible for discriminating local spatial detail, for the parvocellular units respond well to luminance modulation at high spatial frequencies. How then, they ask, were Krauskopf, Williams and Heeley (Vision Research, 1982, 22, 1223) able psychophysically to adapt "luminance" and chromatic channels independently? They suggest that luminance and colour signals may be separated later than the l.g.n. But my own guess is that the "luminance" stimulus used in the psychophysical experiments of Krauskopf, Williams and Heeley was the kind of "luminance" stimulus that would little stimulate the parvocellular system and would well stimulate magnocellular units : it subtended two degrees and its edges were masked by the congruent pedestal on which it was presented.-J.D. Mollon.

Color Vision, by P. GOURAS (Columbia University, College of Physicians and Surgeons, Department of Ophthalmology, New York, U.S.A.), Progress in Retinal Research 3, 227-261, 1984.

This scholarly and wide-ranging review covers the entire field of colour vision, from the chemistry of the photopigments to the basis of colour constancy. Gouras deftly integrates physiology, psychophysics and phenomenology, and identifies a number of areas where traditional views are undergoing change. Topics discussed in detail include : the relative numbers of different classes of cone; the question of whether short-wave and long-wave cones can act synergistically in opposing the signals of the middle-wave cones; the double role (in representing both luminance and chromatic information) of the X-type ganglion cells that draw opposed input from the long- and middle-wave cones; the relationship between "double-opponent" neurons and the operations required by the Retinex theory of Land; the influence of rods on colour vision; and the evolution of colour vision.

Gouras reiterates his long-standing view that the chromatically opponent neurons of the primate retina and LGN are not a substrate for the opponent processes of Hering. "The spectral

opponency in their response serves merely to narrow the action spectrum of this response and does this more and more as stimulus size increases." - J.D. Mollon.

OBITUARIES

Yves LE GRAND
(1908 - 1986)

Yves Le Grand was born in Paris, studied at the celebre Ecole Polytechnique with Charles Fabry, specialized very soon in fundamental and applied physiological optics, and obtained the Ph.D degree in 1937 with a thesis on diffusion of light in the eye. He teached physiological optics at the Institut d'Optique from 1942 to 1969. In 1949 he succeeded to Jean Becquerel as head of the Laboratory of Applied Physics of the Museum National d'Histoire Naturelle. Moreover he teached from 1950 to 1966 at the Institut Océanographique. He has been vice-president of the CIE from 1967 to 1971. He received in 1985 the Prentice Medal of the American Academy of Optometry.

His Traité d'Optique Physiologique in three volumes (1946-1956, translated in english from 1957 to 1980) has been as important in the 20th century as Helmholtz's textbook in the 19th century.

Moreover he published on convergence (1932), glare (1934), vision in Maxwellian view (1936) and with polarized light (1936), flicker (1937), lens fluorescence (1938, 1947), photometry of punctual sources (1939), night vision (1942), visual acuity with blurred tests (1947), standard response functions for protanopic and deuteranopic vision (1948), the Stiles-Crawford effect (1948), eye aberrations (1948), cycloplegia (1949), action on the eye of UV (1950) and IR (1952) and many other subjects including photometry, colorimetry, visual pigments, oceanography, astronomy, zoology, colour television and other practical aspects.

He has been a founder member of the International Research Group on Colour Vision Deficiencies and chaired its first symposium in Ghent. He helped many of us. - Claude Darras, Cécile Bourdy and Guy Verriest.

W.S. STILES
(1901 - 1985)

Dr. W.S. Stiles, OBE, FRS, died on December 15, 1985, at the age of 84. Trained in physics at University College, London, and in mathematics at St. John's College, Cambridge, he spent almost all his working life at the National Physical Laboratory of Great Britain. He must be counted among the greatest colour scientists of our century; and his Color Science, jointly written with his close friend Gunter Wyszecki, will long remain the definitive handbook in the field.

Dr. Stiles was an honorary member of the International Research Group on Colour Vision Deficiencies and he addressed the Group at its meeting at Strawberry Hill in 1979. Although he had himself rather few opportunities to make direct studies of colour-defective subjects, the analysis of colour deficiency has gained much from the concepts and techniques that Stiles introduced in the study of normal vision. The increment-threshold technique, novel when he adopted it in 1929, developed into the two-colour method, in which a brief monochromatic increment is delivered on a monochromatic field. This method has been widely used to test the presence and sensitivity of individual classes of receptor in both congenital and acquired deficiencies. Also of great value in clinical studies has been the Stiles-Crawford effect, which allows the integrity and alignment of cones to be estimated in the living eye.

Conversely, as he remarked in his 1979 paper to the Group, Stiles was "alive to the valuable inferences about the processes of human colour vision" that can be drawn from studies of colour deficiency. The set of König fundamentals published in the first edition of Color Science are close to the sets nowadays favoured - and were accompanied by a systematic discussion of how such fundamentals are derived. But in making deductions from colour-deficient observers, Stiles proceeded with his characteristic caution. Forty years ago, for example, he argued that the sensations of the colour blind could not be deduced from the rare cases of unilateral, congenital deficiency : owing to the plasticity of the developing individual, the unilateral daltonian would so develop as to give "maximum agreement between the names which would be applied when the two eyes were used in turn" (Nature, 160, 666, 1947).

To this distrust of arguments that depend on the description of sensations, Stiles adhered in all his visual research; and Brindley was to take him as the prototype of those who admit only "Class A" observations in psychophysical argument. Stiles was, above all, a great psychophysicist. He showed us how powerful could be the conclusions drawn from a structured set of threshold measurements. His concept of a "mechanism" has been extended to many sensory dimensions and it is now commonplace to test for the existence of "channels" that are independent in adaptation and in detection. And many minor anomalies and inflexions in Stiles' data - always scrupulously plotted - have subsequently turned out to be important phenomena in their own right.

Though eschewing subjective description in his scientific work, Stiles was an accomplished amateur painter, and he privately delighted in the richness of our internal palette. In personality, he was modest and kind. On public occasions, he enjoyed the rare talent of being able to express exactly the right sentiment with exactly the right words. He was a scientist and a gentleman. - J.D. Mollon.

Gunter WYSZECKI
(1925 - 1985)

On 22 June 1985, Dr. Gunter Wyszecki lost a long battle against leukemia and the world of color science lost one of its greatest figures. A longtime employee of the National Research Council of Canada, Wyszecki was acknowledged internationally as a leading expert on colorimetry and color vision.

Born in Tilsit, Germany, Gunter Wyszecki received his university training in mathematics at the Technical University of Berlin and was awarded a Dr. -Ing. degree for a study on normal and anomalous trichromacy. In 1953, he won a Fulbright scholarship and joined Dr. Deane B. Judd in the colorimetry and photometry section of the U.S. National Bureau of Standards. In 1954, Wyszecki went back to Berlin to work for a short time in Dr. Manfred Richter's colorimetry laboratory at the Bundesanstalt für Materialprüfung. In 1955, he joined the National Research Council of Canada (NRC) in Ottawa, where he worked until his death. Under his leadership from 1960 the Optics Section of the Council became one of the world's leading groups in colorimetry, color vision, photometry, radiometry and related fields.

Internationally, Wyszecki was best known for his scientific contributions to and leadership in the International Commission on Illumination (CIE). He was Chairman of the CIE Colorimetry Committee from 1963 to 1975. During this time the Committee developed many important recommendations in colorimetry, including 1 nm tables of the color-matching functions of the 1931 and 1964 Standard Observers, 1 nm tables of Standard Illuminants A and D65, the change from smoked magnesium oxide to the perfect diffuser as the primary standard of reflectance factor measurements, the 1974 ($U^*V^*W^*$) uniform color space and color difference formula, the 1976 CIELUV and CIELAB uniform color spaces and color-difference formulae, and the special metamerism index for changes in the relative spectral composition of illuminants. The Committee also conducted important studies of standard daylight sources, chromatic adaptation, whiteness evaluation and color terminology.

After serving from 1975 to 1979 as Chairman of the Action Committee, Wyszecki was Vice-President of the CIE from 1979 to 1983 and President from 1983 until his death.

He was the author or co-author of 86 scientific papers which ranged from highly theoretical mathematical treatises such as his 1968 paper (with W.S. Stiles) on "Intersections of the spectral reflectance curves of metameric object colors" to report of extensive and elaborate experimental studies such as his 1971 papers (with G.H. Fielder) on "New color-matching ellipses" and on "Color-difference matches". As well as the book "Color in Business, Science, and Industry" written with Judd, Wyszecki was the author of a book "Farbsysteme" published in German in 1960 and co-author, with W.S. Stiles, of "Color Science; Concepts and methods, Quantitative Data and

Formulas" which has become the "bible" of countless color scientists throughout the world. He also served on the editorial boards of Color Research and Application, Die Farbe, Metrologia, and Vision Research.

In addition to his activities in International and National Committees and Societies and his numerous publications, many of us knew Gunter Wyszecki for his incisive questioning and commentary at conferences and colloquia on color and in informal discussions. He had an uncanny ability to get to the heart of a matter by penetrating through the often confused and irrelevant words of others so that the prime and central issue was exposed and clearly expressed. He will be sorely missed. - Alan R. Robertson (from the Inter-Society Color Council News).

CORRESPONDANCE

Dear Guy,

..Bob Massof has recently asked me to take over the job of organizing the 1987 IRGCVD Symposium..the best compromise appears to be July 1-3. Interested attendees could also easily stay for the July 4th Independence day celebrations in Washington, D.C. These celebrations include various parades and concerts, followed by one of the world's largest fireworks displays at the Washington Monument.

Immediately preceding the IRGCVD meeting, we are also planning to hold a two-day topical meeting of the Optical Society of America at the same location. The OSA meeting will be on a vision topic complementary to color vision deficiencies. The OSA is willing to include information about the IRGCVD meeting (at no charge) in its mailings publicizing the topical meeting. The OSA is also willing to handle the advance costs of reserving facilities for both meetings.

..Sorry for the delay in sending you information for the Daltoniana announcement of the 9th Symposium. I don't yet have complete details about travel schedules or prices, hotel prices, etc. However, I can give you some general information about what will be available. With respect to rooms, I have been told that at least 21 air-conditioned dormatory rooms on the campus of St. Johns college will be available for a price of approximately $ 20/night. Fifteen of these rooms have single twin-size beds and six rooms have two twin-size beds, for a total of 27 beds. These dormatory rooms do not have individual bathrooms, but there is a bathroom on each floor. There are also several inexpensive hotels within walking distance of the college for rates ranging from about $ 20 (cheapest double rooms) to $ 40 (single rooms) per person per day. For attendees who prefer more luxurious hotels, the nearby Maryland Inn and Hilton Hotels will be available for room rates ranging from about $ 65 to $ 100 per night.

With respect to travel, The Baltimore-Washington International (BWI) Airport is only 20 miles from Annapolis and the Dulles International Airport is 55 miles from Annapolis. Both airports schedule numerous flights from London, Amsterdam, Frankfurt, Paris and other major cities around the world, and bus and limosine service to Annapolis is available from both airports. In addition, my travel agent has told me that inexpensive charter flights will very probably be available to BWI from centrally located European cities. These flights typically do not require a large number of people to travel together as a group, and they allow flexible travel schedules. Details for charter rates and schedules for mid- 1987 will not be available until the beginning of the year. However, it would be helpful if you could announce the possibility of charter arrangements in the next Daltoniana and request that interested persons write to me about their preferred travel dates and departure points.

... The Optical Society topical meeting preceding the Symposium will be on the topic of Color Appearance. Bill Wooten, from Brown University, has agreed to be program chairman of the Optical Society meeting and Joel Pokorny will be program chairman for the IRGCVD meeting. You may want to mention these items in your announcement in the next Daltoniana.

...As I wrote to you earlier, the Optical Society of America has agreed to be a Cooperating Society for the IRGCVD Symposium, and to advertize the meeting to all OSA members. In return, I think that it would be appropriate to include a short notice of the preceding OSA meeting in Daltoniana along with the announcement of the IRGCVD Symposium. The OSA meeting will be on the topic of Color Appearance, and will be held on June 29-30 at the same place as the IRGCVD meeting...

With best wishes

Bruce Drum.

CONTACT DR. MARRE IN ORDER TO BE PRESENT AT THE

SECOND REGIONAL IRGCVD SYMPOSIUM

NORMAL AND PATHOLOGIC COLOUR VISION

DRESDEN, GRD, September 25-27, 1986