DALTONIANA

NEWSLETTER
OF THE INTERNATIONAL RESEARCH GROUP ON COLOUR VISION DEFICIENCIES

President: Prof. Dr. J. FRANÇOIS, Gent (Belgium)

Secretary for the Western Hemisphere:
Dr. R. LAKOWSKI
Department of Psychology, University of British Columbia, VANCOUVER 8 (Canada)

General Secretary and Editor of the Newsletters:
Dr. G. VERRIEST
Dienst Oogheelkunde, Akademisch Ziekenhuis
De Pintelaan 135 - B-9000 GENT (Belgium)

Secretary for the Socialist Countries:
Dr. M. MARRE
Universitäts-Augenklinik, Fetscherstrasse 74
8019 DRESDEN (D.D.R.)

(Verantw. uitg.)

Tweemaandelijks Tijfschrift

Nr. 18 - 1st january 1975.

LITERATURE SURVEY

The density and photosensitivity of human rhodopsin in the living retina, by M. ALPERN and E.N. PUGH (Vision Research Lab., Univ. of Michi . Ann Arbor Mich. 48104, U.S.A.), J. Physiol. 237/2, 341-370, 1974.

The visual pigment contained in a 5° circular patch situated 18° temporally from the fovea was studied in vivo using retinal densitometry. The action spectra of a 10% bleach agrees well with the action spectra at absolute threshold and with the C.I.E. scotopic spectralsensitivity curve. The visual pigment studied must be human rhodopsin. Its density is estimated in five different ways with good agreement and is much higher than that expected from in vitro measurements. - J. Birch-Cox.

Identification of cone mechanisms in graded responses of foveal striate cortex, by P. GOURAS and P. PADMOS, J. Physiol. 238/3, 569-582, 1974.

The earliest response detectable in foveal striate cortex of anaesthetised Rhesus monkeys following light stimulation is a graded potential which is positive at the cortical surface and negative in the grey matter. Action spectra obtained in the presence of strong selective chromatic adaptation indicate the participation of all three cone mechanisms in this response but antagonism between cone mechanisms is also apparent. The proportion in which an individual cone mechanism contributes to the total response varies from one area to another implying topographical differences in the representation of cone mechanisms in the striate cortex. - J. Birch-Cox.

Chromatic adaptation study by subjective-estimation method, by H. SOBAGAKI, T. YAMANAKA, K. TAKAHAMA and Y. NAYATANI (Electrotechnical Laboratory, Osaka Branch, Nakaji, Amagasaki, Hyogo, 661 Japan), J. opt. Soc. Amer. 64/6, 743-749, 1974.

Assessment of the change of chromatic adaptation between observations made with a fluorescent lamp with a correlated color temperature 6500 K and CIE standard source A. 13 observers with normal color vision participated in the test. 95 surface colors, 5x5 cm, five of which were achromatic. Each observer estimated the hue, saturation and lightness of each sample for a specified illumination. The results were found to fall approximately in the middle of the range of results of previously reported studies. Lightness constancy was found irrespective of the change of chromatic adaptation. The degree of color constancy of hue and of saturation is different for different Munsell hues. Discrimination of saturation becomes worse under source A than under the fluorescent lamp. The results are discussed with relation to several models for chromatic adaptation and color spacing. - Ingeborg Schmidt.

Color discrimination as a function of observer adaptation, by M.R. POINTER (Research Division, Kodak Limited, Harrow, Middlesex, England, HA1 4TY), J. opt. Soc. Amer. 64/6, 750-759, 1974.

A colorimeter was constructed to measure the size of just-noticeable color difference as a function of observer adaptation. Test and matching fields 1.6°, adaptation field 15°, of luminance 3400 cd/m^2. To permit comparison of data on a basis of equal appearance rather than equal chromaticity, color-appearance shifts could be measured by a binocular matching technique. Nine different adaptations were used : dark adaptation, adaptation to five near Planckian white-light sources that had color temperatures in the range of 6500 to 2000 K, and adaptation to three colors : red, green and blue. Very little difference was found between the sets of discrimination data obtained for dark adaptation and for adaptations to the five white lights. This was not true for the results obtained for color adaptation. The discrimination steps were usually longest with red adaptation. Discrimination was most sensitive for blue adaptation. There was significant decrease of step size (compared to that for white light adaptation) when the chromaticity of the test color approached that of the surround. This effect was present for all three color adaptations. - Ingeborg Schmidt.

Increment thresholds across minimally distinct borders, by F. WARD and B.W. TANSLEY (Center for Visual Science, University of Rochester, Rochester, New York, 14627), J. opt. Soc. Amer. 64/6, 760-762, 1974.

The border contour remaining when juxtaposed, heterochromatic fields were equated in luminance by the minimally distinct border method was assessed by an increment-threshold technique. The results suggest that the increment threshold method is sensitive only to differences between achromatic channels, not to relative brightness differences due to chromatic-channel imbalance. - Ingeborg Schmidt.

Influence of luminance contrast on hue discrimination by R.L. HILZ, G. HUPPMANN (Institute for Medical Optics, Univ. of Munich, D8 München 40, Barbarastr. 16, W-Germany) and C.R. CAVONIUS (The Psychological Laboratory, Univ. of Cambridge, Cambridge CB2 3EB, England), J. opt. Soc. Amer. 64/6, 763-766, 1974.

Hue discrimination is poor when measured with fine gratings in which alternate bars differ in wavelength but not in luminance, or with small test objects that differ in wavelength from their background. It improves if a small luminance contrast is added. The effects on hue discrimination of the size of the test object or of the spatial frequency of the grating are studied. When a luminance contrast is included, maximum sensitivity occurs when the grating has a spatial frequency of about 3 cycles/deg. and it is better than with a conventional bipartite field. - Ingeborg Schmidt.

1. Exchange Thresholds in Dichromats, 1993-2002;
2. The Spectral Sensitivity of "Red" and "Green" Cones in the Normal Eye, 2003-2015; and
3. Pigments in Anomalous Trichromats, 2017-2031. All three articles in Vision Research, 13, 1973, on their respective pages, by W.A.H. RUSHTON, D.S. POWELL and K.D. WHITE.

In the first paper the authors describe a technique which they callexchange threshold. A 2° field is viewed on a background field. Initially the field is of a given intensity, I_F and wavelength λ_f, and at a point in time a, a different and variable intensity Iv and wavelength λv is substituted. A brightness transient occurs which is detected against the larger background field. The method consists of determining detection thresholds for the transient for different values of I_v.W. If the wavelengths are above 540 nm and the observer is a red-green dichromat, there will be intensity I_v for each wavelength λv, for which the observer does not detect the change in wavelength. This value called the isolept, occurs when the quantal sensitivity is matched at both wavelengths for the dichromats' single photopigment sensitive above 540 nm.

In the second paper, the authors show the exchange threshold technique may be extended to normal trichromats and

that the isolept values may be used to set analytical anomaloscope field into prot or deut modes. The technique is to exchange two wavelengths against a background now fixed in wavelength but variable in intensity. The wavelength pair are set at the isolept for the protanope, in which event the exchange is presumably mediated by the long-wavelength sensitive cones of the normal trichromat. Its detection threshold may be measured for a given background, e.g., 540 nm. The background is then replaced by a 640 nm background and the detection threshold will change. The principle is to find the intensity of the 640 nm background which yields the same detection threshold for the exchange as the 540 nm background. Rushton et al. assume that when the two bakground fields have an equivalent effect on the detection threshold for the long-wavelength sensitive cones, they are matched in quantal sensitivity for those cones. The results are consistent with this hypothesis.

In the third paper, the authors use their technique in the evaluation of anomalous trichromats. Essentially the exchange threshold technique allows them to set their analytical anomaloscope in the "anomalous" mode. Thus, the sensitivity of the anomalous pigment may be measured directly as the luminance needed in the Rayleigh match. They obtain sensitivities at 4 points between 540 and 640. The authors conclude that the sensitivity for the anomalous pigment of protanomals lies close to the normal middle-wavelength sensitive pigment (550 nm). The anomalous pigment of deuteranomals lies about halfway between the normal pigments (λ maximum 555 nm). - V.C. Smith.

Isolation of a Third Chromatic Mechanism in the Protanomalous Observer, by T.P. PIANTANIDA and H.G. SPERLING, Vision Research 13, 2033-2047, 1973; and

Isolation of a Third Chromatic Mechanism in the Deuteranomalous Observer, by T.P. PIANTANIDA and H.G. SPERLING, Vision Research 13, 2049-2058, 1973.

In these two papers the authors report their use of an increment threshold technique in anomals to isolate a third chromatic mechanism whose input is assumed to be the anomalous photopigment of the anomal. For protanomals they found a sensitivity with maximum at 545 nm and with shape narrower than the Dartnall nomogram shape. For deuteranomals they obtained a curve with maximum sensitivity at 560 nm and with shape similar to the Dartnall nomogram shape. Quoting the invariance of their isolated mechanisms under change of adapting field, PIANTANIDA and SPERLING conclude that such chromatic mechanisms represent the anomalous photopigment of the anomal. - V.C. Smith.

Investigations in regard of deuteranomaly (Untersuchungen zur Deuteranomalie), by H. SCHEIBNER (W.G. Kerckhoff-Institut der Max-Planck-Ges., Bad Nauheim), 72. Ber. dtsch. Ophthal. Ges. (Hamburg 1972), 290-295, 1974.

Using the Helmholtz-König color mixture apparatus color matches of a person with deuteranomaly were accepted by a deuteranope and rejected by a protanope. The author concludes from his experiments : In deuteranomaly there is one abnormal cone pigment, absorbing in the green range of the spectrum. Another cone pigment, absorbing longer wavelengths, seems to be the same as in normal persons. - P. Grützner.

Study concerning with the historical changes of the Ishihara's tests for colour blindness, by S. TAMIYA (Departm. Ophthal., Yokohama University School of Medicine, Yokohama-shi, Japan), Acta Soc. ophthal. jap., 77, 413-427, 1973.

Since the 1st edition of the Ishihara's test was published in 1916, many editions had been published till 1963. Selecting fifteen representative editions of them, the historical changes of colour and figure were studied.

These changes were not yet recorded by colourmetry without a few editions, so the author did it by representing of the Munsell notation by using the standard colour charts or spectrometer. Each edition has a little changes experimentally improved.

1) In early edition, the changes of hue were partially recognized.
2) In early edition, the changes of figure were recognized.
3) "Kana" were used in Japanese editions and "Arabic numerals" in international editions. - Yasuo Ohta.

Studies on the improvement of the color combination of the Ishihara tests for color blindness, by U. SHINJO (Deptm. Ophthal., Miyazaki prefect. Hospital, Miyazaki-shi, Japan), Acta Soc. ophthal. jap., 77, 392-399, 1973.

The author tried to improve the color combination of the Ishihara tests for color blindness by implying them in the form of the Landolt's ring. In the experiments, type II, III and VI of the test plates gave better results than those of the Ishihara. It is necessary to improve the type IV and V of the new plates furthermore. The result indicate the possibility of the new form Ishihara tests for congenital color deficiency. - Yasuo Ohta.

Color Vision Deficiencies in Youths 12-17 Years of Age United States, D. Slaby and J. Roberts (Division of Health Examination Statistics) Data from the National Health Survey, Series 11 No. 134, DHEW Publication No. (HRA) 74-1616, National Center for Health Statistics, Rockville, Md. Jan. 1974.

(I found interesting to reproduce both comments of Mrs. Schmidt and Prof. Taylor because they are complementary. - G. Verriest).

Data on the prevalence of color vision deficiencies in American youths 12-17 years of age are derived from the Health Examination Survey of 1966-70. Youths who correctly read 7 plates (No. 1, 2, 5, 8, 11, 14 and 16) of the Ishihara test for colour blindness, 1960 ed. 24 pl., were classified as having normal color vision. When any of the Ishihara plates were failed, the HRR plates (1957) were administered. Who passed all 6 screening plates was considered to have normal color vision, who failed was examined by the diagnostic series. 21.7 million youths (95.7%) passed all 7 Ishihara plates, 0,2% of all youths examined failed the Ishihara plates and passed the HRR screening plates and 4.1% (approximately 934,000 youths) had defective color vision. Of the boys 7.53% and of the girls 0,62% were found to have defective color vision. Racial and age differences were negligible. The most common color vision deficiency was of the red-green type. 0.56% of all youths did exhibit a combination of red-green and blue-yellow defects, none failing only the HRR blue-yellow screening test. R-G defects only affected 6.6% of boys and 0.4% of girls. The proportion of youths with a mild R-G defect was slightly greater than of those with a medium or strong defect. None of the girls was found to have a strong R-G defect. 4.1% of the boys were deutans, 1,7% protans and 1.8% of undetermined R-G deficiency. More than two thirds of the girls had the undetermined R-G deficiency. No significant regional differences in the prevalence of color deficiencies were found although in the South the rate among white boys was significantly greater than among black boys. Differences across income levels were negligible. A most of all of the B-Y deficiencies were of the undeterminded type, the majority of them of a mild degree. The data are compared with the findings of the Health Examination Survey among children, 6-11 years of age (1963-65) (s. Daltoniana No. 11, p. 4) and with those from other studies. - Ingeborg Schmidt.

In the course of the 3rd program of the U.S. National Health Survey, the opportunity was taken to estimate on a specially selected group, designed to be a fair sample of youths between the ages of 12 and 17, taking account of age, sex, race, family income, geographic region and population size of place of residence. The method was to take

a stratified probability sample in each of five successive stages and details of the method are given in an appendix. Factors of physical and intellectual growth and development were the object of the study. The technique of colour vision testing was to screen the total sample with a qelection of seven of the Ishihara plates, as suggested by Sloan and Habel (1956), and then to verify those failing any of the Ishihara test plates with the A.O.C. and H.R.R. plates followed by classification on these plates as to type of degree of defect.

Some 6780 children (90% of the sample) tested by this gave an incidence of defect of 4.3%. By sex, 3545 boys (3047 white, 479 negro, 19 "other races") had an incidence of 7.53%; while 3223 girls (2688 white, 520 negro, 15 "other races") had 0.62% deficient. These figures were also broken down by year of age but apart from this no absolute figures are presented; the general technique being to present prevalance rates in the tables. Although standard errors are also given, the result is somewhat confusing since very careful reading is necessary to realise how small some of the sample are, in fact, once broken down. This is compounded by a tendency (e.g. Table A) to extrapolate the figures to the underlying population (which at 22.7 million is a most impressive figure!) before the "argument" has been entered.

If a table is reconstructed from the prevalance rates and the sample numbers, the actual numbers of colour defective children can be derived. This is probably not exact because of "rounding off" but approximates -

BOYS 267	(White	235	GIRLS 20	(White	19
	(Negro	31		(Negro	1
	(other races	1		(other races	0
		267			20.

No doubt because the colour vision tests were only a small part of the total survey the methods of investigation were limited to screening by one pseudo-isochromatic test (Ishihara) and classification (plus confirmation) by another. It is not generally considered that <u>any</u> P.I.C. test gives reliable results for either kind or degree of defect. No check from within the data can be given for the accuracy of classification as to the "degree" of defect, but the data itself gives some indication of the accuracy of "kind" of defect. Thus - among white girls, no fewer than 75% had to remain unclassified (as to whether protan or deutan) and no outright protans at all were found. Even in the satisfactorily large sample of white boys, 25% appear to remain unclassified.

Undoubtedly this careful sampling technique will be repeated. It is to be hoped that when this happens a Pickford anomaloscope will be employed but, of course, more highly trained experimentors will be necessary for such a technique;

as well as adequate time. Up to half an hour per case discovered on screening - and longer if blue/green and blue/yellow parameters are to be measured - but the results would be worth it. A larger female sample would also be desirable (it has taken me 10 years to collect just over 100 colour blind schoolgirls - during which about 20.000 were screened!). - W.O.G. Taylor.

Organ of vision in hypotensive disease, by A.S. SMELOVSKY, V.N. GOLYCHEV and V.G. PANSHINA (Chair of Eye Diseases of the Kalinin Medical Institute), Vestn. oftalm. 1974/2, 5-8.

Hypotonic disease (primary arterial hypotony) is a sytemic disease found in 5-7% of adults. The functions of all organs and systems suffer, including the visual organ. Most characteristic was a concentric narrowing of the fields for blue found in 172 eyes, of 120 patients, 21 to 60 years of age, whereas the fields for white and for red did not deviate from normals. Some patients with edema of the optic disc had an enlargement of the blind spot and some had uniocular macular dystrophy which tended to bring down the visual acuity. - Ingeborg Schmidt.

Functional investigations of the macular region in patients with diabetes mellitus, by G.I. ARCHANGELSKAYA (Dept. of Ophth. of the Wladimirski Regional Clinical Research Institute, Moscow), Vestn. oftalm. 1974/2, 13-15.

In diabetics the function of the macula was tested with the color threshold test of the E.B. Rabkin charts (1965), with the Haidinger brushes and with the photostress-test. In 18 diabetics who had no pathology of the fundus, a visual acuity correctible to 1.0 and normal fields, the results on the color threshold test were as follows : In 8 eyes the threshold for red was increased, in 6 for green, in 5 for blue and in 3 eyes for yellow. In another group of 12 diabetics with angiopathy or retinopathy, 6 eyes of them with reduced visual acuity with no refractive errors, all with normal visual fields, the threshold for red was increased in 13 eyes, for green in 4 eyes, for blue and yellow in 3 eyes. Of the three tests applied the color threshold test was the most sensitive. - Ingeborg Schmidt.

Studies on color vision anomalies in subjects with alcoholism, by Y. SAKUMA (Department of Ophthalmology, Tokyo Women's Medical College, Tokyo, Japan), Annals Ophthal. 5/12, 1277-1292, 1973.

Color vision tests (Ishihara plates 1970 ed., Farnsworth Panel D-15 test, modified FM 100 Hue test and Hioki's anomaloscope) were performed monocularly on 28 males with chronic alcoholism and on 30 males with alcoholic psychoses, age 26 to 61 years. The Ishihara plates failed to detect even fairly advanced acquired dyschromatopsias. Approximately 80% of all cases of chronic alcoholism and alcoholic psychoses and acquired color vision deficiencies, in most instances a red-green deficiency. In alcoholism color vision disorders seem to be more marked than impairment of visual acuity. - Ingeborg Schmidt.

Studies on color vision anomalies in subjects with alcoholism, by Y. SAKUMA (Department of Ophthalmology, Tokyo Women's Medical College, Tokyo, Japan), Annals Ophthal. 5/12, 1277-1292, 1973.

Color vision tests (Ishihara plates 1970 ed., Farnsworth Panel D-15 test, modified FM 100 Hue and Hiokis anomaloscope) were performed monocularly on 28 males with chronic alcoholism and on 30 males with alcoholic psychoses, age 26 to 61 years. The Ishihara plates failed to detect even fairly advanced aquired dyschromatopsias. Approximately 80% of all cases of chronic alcoholism and alcoholic psychoses had acquiredcolor vision deficiencies, in most instances a red-green deficiency. In alcoholism color vision disorders seem to be more marked than impairment of visual acuity. - Ingeborg Schmidt.

Assessment of acuity, color vision and shape perception by statistical evaluation of evoked potentials, by E.R. JOHN (Brain Research Lab., Dept. Psychiatry and Neurophysiol. Clinic, Dept. Ophthal. New York Medical College, New York, N.Y. 10029) Annals Ophthal. 6/1, 55-66, 1974.

Visual acuity was assessed electrophysiologically by comparing the evoked response to coarsely and finely patterned stimuli of equal luminance, differently colored visual stimuli produced evoked responses of different wave pattern and so did differently shaped visual stimuli. The results confirmed previous findings and indicated that the methods used are of sufficient precision to serve as tests with uncooperative subjects or as rapid and objective screening tests. - Ingeborg Schmidt.

The cortical counterpart of the chromatic aberration of the eye, by L. RONCHI and M. MILLODOT (Istituto Nazionale di Ottica, Arcetri-Firenze, Italy and Laboratory of Experimental Optometry, Univ. of Montreal, Canada) Amer. Journ. Optom. 51/9, 635-641, 1974.

The occipito-cortical visual response was evoked by a monochromatic stimulus, a lens of variable power in front of the eye. The power of the lens attaining optimum sharpness of the target depended on the wavelength of the stimulus. The chromatic aberration of the eye can be determined objectively by the evoked cortical potentials, within about 0.5 D. - Ingeborg Schmidt.

Effects of four psychological primary colors on GSR, heart rate and respiration, by K.W. JACOBS and F.E. HUSTMYER Jr. (Eastern Illinois University), Percept. Motor Skills 38, No. 3 Pt. 1, 763-766, 1974.

Four colors being most representative of red, yellow, green and blue were presented to 24 male college students with normal color vision, by projecting them for 1 min each on a 23x33 inch screen, 10 feet in front of the subject. A white stimulus was projected for 10 min between each color presentations. All colors and white were presented at 16 ft-cd. There was a signifi-

cant color effect on GSR responsitivity (= the maximum change in skin resistance during the 15 sec following each stimulus color presentation), but not on heart rate and not on respiration. Red was significantly more arousing than blue or yellow, and green more than blue. - Ingeborg Schmidt.

CORRESPONDANCE

Dear Dr. Verriest,

Bob Boynton and I moved to La Jolla a few months ago. (I came from Cambridge, England and Tallahassee, Florida; Dr. Boynton, of course came from Rochester after 22 years there). We hope to establish an active group here in vision research. My wife, Mary Hayhoe, is part of the group, and Dr. John Taylor of the Scripps Visibility Laboratory may be joining us shortly.

We are equipped in this department for psychophysical research only, but Dr. Boynton is continuing his work on intraretinal recording in primates in collaboration with Dr. William Baron at the Stanford Research Institute. In the more immediate neighborhoud at La Jolla there are many others with research interests in vision, including Lynn Cooper and Jay McClelland in this Department, G. David Lange in Neurosciences, and Carroll T. White at the Navy Electronics Laboratory.

Please mention this to anyone who might be interested in joining us (as a graduate student, postdoctoral fellow, or whatever). We have no guarantee of funds at this end, but we might be able to find some if we have sufficient advance notice. A postdoc could fit into the program either here (psychophysics), at SRI (electrophysiology), or possibly both. Anyone interested should write to me or to Dr. Boynton.

Sincerely,

Donald I.A. MacLEOD
Dept. of Psychology,
Univ. of California,
Post Office Box 109
LA JOLLA, Cal. 92037
U.S.A.

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

54. Papers of Prof. G. PERDRIEL (6, rue Huysmans, Paris VI, France).

PERDRIEL, G. - Les dyschromatopsies acquises de l'aviateur. Congrès de l'Aero-Medical Association. Médecine Aéronautique, 1er Trimestre 1956 - Pages 32 à 40.

PERDRIEL, G. & GUYARD, M. - Intérêt du diagnostic des dyschromatopsies congénitales. Société Ophtalmologique de l'Ouest de France, 1er Juin 1959.

GROGNOT & PERDRIEL, G. - Influence du bruit sur certaines fonctions visuelles, 5ème Journée de Médecine du Travail de Lyon - (10 Octobre 1958).

PERDRIEL, G. - La vision des couleurs dans les fonctions de sécurité. Société de Médecine Militaire et Société de Médecine de Nancy 4 Décembre 1959.

PERDRIEL, G. - Intérêt du test de Farnsworth 100 Hue dans l'étiologie des lésions maculaires et des névrites rétrobulbaires. Travail de candidature comme membre titulaire à la Société d'Ophtalmologie de Paris (21 Mai 1960).

PERDRIEL, G. - L'examen de la vision des couleurs en pratique courante. Année thérapeutique et clinique en Ophtalmologie (Tome XI - 1960).

PERDRIEL, G. - L'intérêt du sens chromatique dans l'aviation. Conférence à Bruxelles - (14.10.1962).

PERDRIEL, G. - Le test de Farnsworth 100 Hue. Annales d'Oculistique n° 2 - Pages 120-130.

PERDRIEL, G. - La vision aux basses luminances et la sécurité des transports. Conférence fait à l'Hôpital du Saint Sacrement de Québec (6.2.1964).

PERDRIEL, G. - Procédés pratiques de diagnostic des anomalies du sens coloré. Conférence faite à l'hôpital de l'Enfant Jésus de Québec (8.2.1964).

PERDRIEL, G. - Intérêt de l'examen du sens coloré dans le diagnostic et pronostic des affections de la rétine et de la voie optique. Société d'Ophtalmologie de Montréal - (13.2.1964).

PERDRIEL, G. & DESBORDES, P. - Vision et sécurité des transports. Assises Nationales sur les accidents et le trafic - (Paris Oct. 1964).

PERDRIEL, G. - Vision des couleurs et aviation. Revue Icare, n° 31 - Automne 1964.

PERDRIEL, G. - Indications et contre-indications des verres de contact dans les transports. Conférence faite à l'Ecole Nationale des Arts et Métiers (22.11.1965).

PERDRIEL, G. & CHEVALERAUD, J. - La fatigue visuelle dans les transports. Nationales sur les Accidents et le Trafic - (23.9.66).

PERDRIEL, G. - L'examen ophtalmologique du candidat au permis de conduire. Assises Nationales sur les accidents et le trafic - (23.9.1966).

PERDRIEL, G. - La vision des couleurs et les dyschromatopsies. Conférence faite à l'Hôpital Cochin, Sce Pr BREGEAT - (21.12.66).

PERDRIEL, G. - Avantages respectifs du rouge et du blanc pour l'éclairage des aéronefs. Journées Internationales de la Lumière (Nantes, 2 Mai 1968).

PERDRIEL, G. & CHEVALERAUD, J. - L'examen du sens chromatique du personnel navigant. Société de Médecine Aéronautique - (20.6.1969).

PERDRIEL, G. - Problèmes d'aptitude posés dans les Armées par les anomalies du sens chromatique. Comité consultatif des Armées - (10.12.1971).

PERDRIEL, G. - Le diagnostic des dyschromatopsies et son application à la sélection chromatique dans les Armées. A paraître dans la revue des Corps de Santé des Armées - (17.2.1972).

CHEVALERAUD, J. & PERDRIEL, G. - Eblouissement et conduite automobile. Société d'Optique Physiologique - (Marchaby - 6 Mai 1972).

PERDRIEL, G. & CHEVALERAUD, J. - L'examen du sens chromatique dans les forces aériennes françaises. Congrès AGARD - (Juin 1972).