

6th

**INTERNATIONAL  
VISUAL FIELD SYMPOSIUM**



**PROGRAM**

**May 27-31, 1984**

**S. Margherita Ligure (Genova, Italy)**

**INTERNATIONAL  
PERIMETRIC SOCIETY**

## **PROGRAM**

6th  
INTERNATIONAL  
VISUAL FIELD SYMPOSIUM

27-31st May 1984

AT

Grand Hotel Miramare  
Via Milite Ignoto, 44  
16038 — S. Margherita Ligure (Genova), Italy  
(0185) 87014 - 87131



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## MEETING HOST

M. Zingirian

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## LOCAL ORGANIZING COMMITTEE

M. Zingirian, G. Calabria, P. Rossi, E. Gandolfo, F. Cardillo-Piccolino, A. Polizzi, M. Rolando, P. Capris, C. Burtolo, G. Corallo, C. Traverso, G. Barberi, V. Re.

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## REGISTRATION

May 27th, 13-19  
 May 28th, 8-11  
 Hotel Miramare, Congress Center

## INSTRUCTIONS FOR PAPERS

Unless otherwise specified, your paper will be 10 minutes long. We will have equipment available for both single and double projection of 35 mm slides. Please give your slides to the projectionist at least one hour before the session in which your paper is to be presented. Slides should be numbered and, if two projectors are to be used, "left" and "right" should be noted. Slides should also have your initials or name for identification.

## INSTRUCTIONS FOR POSTERS

Posters should be planned so that they can be presented within a 80 (horizontal) × 110 (vertical) cm. space. Materials for hanging your posters will be provided. You will be able to set up your poster on Sunday evening (May 27) or on the subsequent days, but before the poster session of May 30.

## WRITTEN MANUSCRIPTS

Manuscripts must be handed to Mrs. Els Mutsaerts during the first day of the Symposium. The rules of Documenta Ophthalmologica must be observed, or the manuscript cannot be accepted.

The entire manuscript must be submitted in original plus three photocopies. It should be typed double spaced on one side with ample margins. The organization of the manuscript should be as follows:

- |                               |               |
|-------------------------------|---------------|
| 1. Title page (and footnotes) | 6. References |
| 2. Key-words                  | 7. Tables     |
| 3. Abstract                   | 8. Figures    |
| 4. Text                       | 9. Legends    |
| 5. Acknowledgements           |               |

Authors should bear in mind that all corrections in the text other than typographical errors must be kept to a minimum and these extra corrections must be paid by the author.

## REGISTRATION, RECEPTION AND MEETING SITES

Sunday, May 27 - Registration - Congress Center, Hotel Miramare  
- Reception and Buffet - Villa Durazzo

Monday, May 28  
to

Wednesday, May 30 - Sessions - Congress Hall, Hotel Miramare

## LUNCHESES

You must make your own luncheon arrangements for the duration of the Congress. Those individuals who have chosen Halfboard will have lunch in their respective hotels. Lunch is also available at the Restaurant of the Hotel Miramare. Other fine dining facilities are available in the vicinity.





## **SOCIAL PROGRAM**

### **Sunday - May 27**

13.00 : Registration.

19.00 : Welcome Reception

### **Monday - May 28**

15.30 : Excursion to Genova.

### **Tuesday - May 29**

15.30 : Excursion to Portofino and San Fruttuoso.

### **Wednesday - May 30**

18.30 : Excursion to Camogli.

### **Thursday - May 31**

9.00 : Excursion to Pisa and Torre del Lago.

#### **NOTE:**

During the Congress mornings free access to public bus transportation will be available for spouses and accompanying persons from S. Margherita to Rapallo and Portofino.

## SCIENTIFIC PROGRAM

### Monday - May 28

- 8.30 - 9.00 Welcome and Opening Remarks.
- 9.00 - 10.45 *Session I* - Automation 1  
 Chairman: Zingirian  
 Moderator: Flammer
- Greve, Bakker and de Jong — *Automatic and semi-automatic perimetry.*
- Langerhost, van den Berg, van Veenendaal and Greve — *Results of a fluctuation analysis and DVC (defect volume change) program for automatic static threshold perimetry with the Scoperimeter.*
- Lynn, Batson and Fellman — *Internal inconsistencies vs root mean square as measures of threshold variability.*
- Zingirian, Gandolfo, Capris and Corallo — *Comparison between static and kinetic fluctuations determined by automated perimetry.*
- Funkhouser and Fankhauser — *Histogram adaptation in SAPRO operation.*
- Heijl — *The Humphrey field analyzer.*
- Hoskins, Hetherington, Shaffer and Migliazzo — *Development of an automated visual test utilizing the Humphrey visual field analyzer.*
- 10.45 - 11.15 Coffee Break.
- 11.15 - 12.30 *Session II* - Automation 2  
 Chairman: Heijl  
 Moderator: Dannheim
- Brusini and Tosoni — *Two years of clinical experience with the Perimetron automatic perimeter in glaucomatous patients.*
- Kani, Tago, Kobayashi and Shioiri — *A new automatic perimeter.*
- Gandolfo, Zingirian and Capris — *The automated program "Genoa Glaucoma Screening".*
- Frisén — *Cartographic properties of the Octopus visual field grid.*
- Mertz and Zirkel — *Development and use of gradient isopters in computerized perimetry.*
- 12.30 - 13.30 *Session III* - Fundus Perimetry  
 Chairman: Kani  
 Moderator: Enoch
- Okubo, Mizokami and Tagami — *Fundus perimetry and Octopus perimetry for the evaluation of nerve fiber bundle defects.*
- Webb, Essock and Enoch — *Measurement of layer-by-layer perimetry responses using direct retinal projection by the scanning laser ophthalmoscope.*
- Kani, Inque, Mimura and Ohmi — *Distribution of retinal sensitivity in amblyopia with eccentric fixation.*
- Mimura, Okamoto, Kani and Utsumi — *Critical flicker fusion frequency in amblyopia*

## Tuesday - May 29

- 8.30 - 9.50 *Session IV* - Colour Perimetry  
 Chairman: Campos  
 Moderator: Hansen  
 Hart, Kosmorsky and Burde — *Color perimetry of central scotomas in diseases of the macula and optic nerve.*  
 Menu and Santucci — *The effect of colour on contrast sensitivity as a function of eccentricity.*  
 Ronchi and Principe — *Lack of symmetry of red-green temporal responsiveness as a function of retinal eccentricity.*  
 Vola, Gondois and Gastaud — *Considerations about Stiles II mechanisms in glaucomatous Bjerrum areas.*  
 Kitahara, Tamaki, Kitahara, Noji and Kandatsu — *Extrafoveal relative red-green sensitivity.*  
 Kitahara, Tamaki, Noji, Kandatsu and Matsuzaki — *Increment threshold versus intensity curves for rods.*
- 9.50 - 10.50 Business meeting
- 10.50 - 11.20 Coffee Break
- 11.20 - 12.40 *Session V* - Neuro-ophthalmic Perimetry 1  
 Chairman: Frisén  
 Moderator: Keltner  
 Frisén — *The earliest visual field defects in mid-chiasmal compression.*  
 Bynke — *Peripheral loss of sensitivity in bitemporal and homonymous visual field defects.*  
 Mills — *Usefulness of peripheral testing in automated screening perimetry.*  
 Enoksson — *Importance of peripheral visual field in neuro-ophthalmology.*  
 Keltner, Johnson and Lewis — *Peripheral visual field loss in neuro-ophthalmology and glaucoma.*  
 Hard-Boberg, Wirtschafter and Coffman — *Evaluating the usefulness of visual field examinations peripheral to 30 degrees in neuro-ophthalmology.*
- 12.40 - 13.30 *Session VI* - Neuro-ophthalmic Perimetry 2  
 Chairman: Bynke  
 Moderator: Thompson  
 Thompson — *Pupillary signs in macular and optic nerve disease.*  
 Meienberg, Mattle, Jenni and Flammer — *Quantitative versus semiquantitative perimetry in neurological disorders.*  
 Honda and Takahashi — *Importance of visual field tests of patients with pituitary adenoma during pregnancy and post-pregnant lactation.*  
 Bodis-Wollner and Mylin — *Psychophysical and electrophysiologic procedures useful in the differentiation of «hysterical» and «cerebral» blindness.*

## Wednesday - May 30

- 8.30 - 10.00 *Session VII* - Ergoperimetry  
 Chairman: Matsuo  
 Moderator: Verriest  
 Verriest, Bailey, Calabria, Campos, Crick, Enoch, Esterman, Friedmann, Ikeda, Johnson, Overington, Ronchi, Saida, Serra, Villani, Weale, Wolbarsht and Zingirian — *Report: Occupational visual field. Practical aspects.*  
 Calabria, Gandolfo, Rolando, Capris and Burtolo — *Ergoperimetry in patients with severe visual field damage.*  
 Ikeda, Shioiri and Takao — *Deterioration in reading with narrowed visual fields*  
 Barca, Passani and Principe — *Light emitting diodes in extrafoveal vision: an ergoperimetric problem.*  
 Esterman, Blanche, Wallach and Bonelli — *Computerized scoring of the functional field. Preliminary report.*
- 10.00 - 10.45 *Session VIII* - Part 1 - Free papers  
 Chairman: Fankhauser  
 Moderator: Greve  
 Rossi, Terrile, Burtolo and Ciurlo — *Light threshold and temporal resolution in the central visual field.*  
 Enoch, Williams, Essock and Raphael — *Application of hyperacuity to assess vision through media and retinal opacities: methodology.*  
 Williams, Enoch, Essock and Barricks — *Application of hyperacuity to assess vision through media and retinal opacities: clinical trials.*
- 10.45 - 11.15 Coffee Break
- 11.15 - 12.00 *Session VIII* - Part 2 - Free papers  
 Chairman: Fankhauser  
 Moderator: Greve  
 Haas and Flammer — *Influence of diazepam on the perimetric outcome.*  
 Suzumura, Furuno and Matsuo — *Visual field volume and its objective evaluation using a shape coefficient method.*  
 Verriest, Colasanti, Fusco, Magli and Tortora — *Visual field examination by electro-oculography.*
- 12.00 - 13.00 *Session IX* - Poster session
- 13.00 - 15.00 Lunch

15.00 - 17.00 *Session X* - Glaucoma Perimetry  
Chairman: Drance  
Moderator: Phelps

Anderton, Coakes, Poinosawmy and Hitchings — *The nature of visual field loss in low tension glaucoma.*

Mikelberg and Drance — *The progression of visual field defects in glaucoma.*

Stürmer, Gloor and Tobler — *The glaucomatous visual field in detail, as revealed by the Octopus F - Programmes.*

Heijl and Bengtsson — *The short-term effect of laser trabeculoplasty on the glaucomatous visual field.*

Traverso, Fellman, Starita and Spaeth — *Visual field changes following argon laser trabeculoplasty.*

Holmin — *Computerized perimetry before and after argon laser trabeculoplasty (ALT).*

Le Blanc — *Peripheral nasal field defects in primary open angle glaucoma.*

Airaksinen, Drance and Schulzer — *Retinal nerve fibre layer and visual fields in ocular hypertension and early glaucoma.*

Phelps and Blondeau — *Acuity perimetry in glaucoma.*

	Sun., May 27	Mon., May 28	Tues., May 29	Wed., May 30	Thurs., May 31			
8.00	Registration	Registration: 8.00-11.00	Lunch	Lunch	Excursion to Pisa Guided Tour of Pisa			
8.30		Welcome & Opening Remarks				Session IV Colour Perimetry	Session VII Ergoperimetry	
9.00		Session I Automation 1				Business Meeting	Session VIII/1 Free Papers	
9.30							Coffee break	Session VIII/2 Free Papers
10.00		Session II Automation 2				Coffee break	Session IX Poster session	Lunch in Pisa
10.30								
11.00		Lunch				Social event: Excursion to Portofino and S. Fruttuoso	Social event: Excursion to Camogli	Trip to Torre del Lago
11.30								
12.00		Lunch				Social event: Excursion to Genova Visit to sites of interest	Social event: Excursion to Camogli	Lunch
12.30								
13.00	Registration	Cocktail (Martini Terrace)	Dinner in S. Margherita (Covo di Nord-Est)	Session X Glaucoma				
13.30					Dinner in Genova («Tunnel» Club)			
14.00	Reception & Buffet in S. Margherita L. (Villa Durazzo)	Dinner in S. Margherita (Covo di Nord-Est)	Dinner in Camogli (Cenobio dei Dogi)	Social event: Excursion to Camogli				
14.30					End of meeting			
15.00								
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# Abstracts

## A. Read Papers

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### *SESSION 1 – Automation of Perimetry 1*

**E.L. Greve, D. Bakker and D.G.M.M. de Jong**  
AUTOMATIC AND SEMI-AUTOMATIC PERIMETRY  
*Academic Medical Center, Amsterdam, The Netherlands*

To everyone with experience in computer-assisted perimetry it will be clear that a number of patients do not respond satisfactorily to automated perimetry. The true number is unknown because patients are never examined under similar conditions in an automated and semi-automated mode. The only instrument that allows a study of the psychological factors involved is the Peritest. This investigation concerns the result of a comparison of automated and semi-automated visual field examination in glaucoma patients. The results indicate that psychological factors in computer assisted perimetry are underestimated.

**C.T. Langerhost, T.J.T.P. van den Berg, W.G. van Veenendaal and E.L. Greve**  
RESULTS OF A FLUCTUATION ANALYSIS AND DVC (DEFECT VOLUME CHANGE) PROGRAM FOR AUTOMATED STATIC THRESHOLD PERIMETRY WITH THE SCOPERIMETER  
*Academic Medical Center, Amsterdam, The Netherlands*

We examined the components of fluctuation of the visual field in 9 welltrained glaucoma patients. Using static threshold measurements, repeated 3 times within several days, we analysed the influence of shortterm and longterm fluctuation by means of analysis of variance. The shortterm fluctuation within one session far outweighed the longterm fluctuation between sessions. Based on this experience, a DVC-program was designed to accurately compute both fluctuation variables and defect volume, in order to determine whether significant change has occurred. In glaucoma patients we measured threshold values in the 30° visual field two times at random within one session, and repeated this three months later. Usefulness of the DVC-program to determine clinically relevant change of visual field defects will be discussed.



**J.R. Lynn, E. Batson and R.G. Fellman**  
**INTERNAL INCONSISTENCIES VS ROOT MEAN SQUARE AS MEASURES**  
**OF THRESHOLD VARIABILITY**  
*Dallas, Texas, U.S.A.*

The root mean square (RMS) used by Octopus as a measure of intratest variability requires duplicate threshold testing in ten spots. In an effort to eliminate the time tax this implies, internal inconsistencies of double reversal threshold testing (4,2,2) have been recorded from each point tested on the Squid programmable perimeter without any time penalty to the glaucoma patients who served as subjects. The internal inconsistencies have been quantitated and compared with RMS's which were obtained during the same sessions. Both were compared with the variability surrounding 50% threshold tests conducted at four locations which were selected by computer from the original pattern after the standard testing was completed.

**M. Zingirian, E. Gandolfo, P. Capris and G. Corallo**  
**COMPARISON BETWEEN STATIC AND KINETIC THRESHOLD FLUCTUA-**  
**TIONS DETERMINED BY AUTOMATED PERIMETRY**  
*Dept. of Ophthalmology, University of Genova, Genova, Italy*

Static threshold fluctuations have already been analyzed by other Authors. In this work, short and long-term intraindividual threshold fluctuations in static perimetry were compared with those obtained by kinetic perimetry under the same testing conditions.

Both normal and pathological visual fields were considered. A computerized Goldmann perimeter (Perikon, Optikon) was employed to reproduce constant examination conditions and to avoid any variables due to different examiners. This investigation has demonstrated that intraindividual threshold fluctuations in both static and kinetic procedures are well correlated, even if small differences are present due to the gradient steepness.

**A. Funkhouser and F. Fankhauser**  
**HISTOGRAM ADAPTATION IN SAPRO OPERATION**  
*Universität-Augenklinik, Bern, Switzerland*

The SAPRO program, being developed for the OCTOPUS 201 and presently undergoing clinical trials, is not only spatially adaptive, it also adjusts its measurement process according to the light sensitivity distribution that it encounters. This feature along with related aspects will be described, based on illustrative examples. Some further developments concerning program operation will be presented as well.

**A. Heijl**  
**THE HUMPHREY FIELD ANALYZER**  
*The University of Lund, Dept. of Ophthalmology in Malmö, Malmö, Sweden*

The Humphrey Field Analyzer is a new automatic visual field device consisting of a computer controlled projection perimeter, a CRT, a dual disk drive and a printer. The test programs include many thresholding and supraliminal screening programs plus a space-adaptive strategy. Several different modes of supraliminal screening modes are available. Custom programs include meridional and circular profiles, high resolution grids and user-defined point clusters. Test results can be displayed and printed out in four different formats. The disk drives are used for storing, averaging and comparing fields and to supply start values for thresholding or fast thresholding in follow-up examinations.

The paper will describe the concepts and general operating principles of the HFA as well as its theoretical capabilities and limitations. It will be illustrated with many examples of actual field tests.

**H.D. Hoskins, J. Hetherington, R.N. Shaffer and C. Migliazzo**  
**DEVELOPMENT OF AN AUTOMATIC VISUAL TEST UTILIZING THE HUMPHREY VISUAL FIELD ANALYZER**

*Dept. of Ophthalmology, University of California, San Francisco, California, U.S.A.*

Automated perimetry has proved effective in the clinical management of glaucoma patients. Octopus perimetry using programs 31 and 32 have become standards for longterm follow-up of patients. These programs have faults, however, in that they require rather extended study of the patient, the concentration of points tested is somewhat deficient in the central ten degrees and there is no testing of the periphery without adding additional tests. It is desirable to have a program that will allow testing of the entire field in a threshold related manner with assessment of any defects found. The program needs to determine the individual patient threshold, provide a screening mode which can detect more than 95% of glaucomatous defects and allow an assessment mode to quantify depth and area of defects. Using the Humphrey Visual Field Analyzer, a 120 point full field threshold related screening program has been compared to a central 30 degree «Octopus-type 31» threshold perimetry to determine the ability of the screen to locate glaucomatous defects. Algorithms have been developed to allow testing of additional points where indicated by the screening program to assess the area and density of defects. Results of these studies will be presented.

## *SESSION II – Automation of Perimetry 2*

**P. Brusini and C. Tosoni**

**TWO YEARS OF CLINICAL EXPERIENCE WITH THE PERIMETRON AUTOMATIC PERIMETER IN GLAUCOMATOUS PATIENTS**

*Service of Ophthalmology, Ospedale Civile, Udine, Italia*

A computerized automatic perimeter (Perimetron) was used for visual field examination of 122 patients with open-angle glaucoma in various stages of development.

Static-kinetic programs were found to be suitable for screening although with some reservations for the assessment phase, particularly in subjects with glaucoma in the initial stage.

The examination is often too long and tiring if perimetric defects are severe and complex, partly because the software is sometimes inadequate. Long-term follow-ups (up to two years) have demonstrated the usefulness of this instrument in periodic visual field evaluation of glaucomatous patients. The reliability of the results, nevertheless, is very dependent on the level of collaboration of the patient and the type of program used. In normal subjects, the specificity of the Perimetron was good with a low number of false positive results.

The most important advantages of this perimeter are objectivity and standardization of the test parameters. Disadvantages are represented by excessive sensitivity of the automatic control of fixation, some defects of the software and finally the lack of an automatic comparison between consecutive tests.

**K. Kani, H. Tago, K. Kobayashi and T. Shioiri\*\***

**A NEW AUTOMATIC PERIMETER**

*Hyogo College of Medicine, Nishinomiya - \*\*Tokio Optical Co.Ltd., Tokyo*

A new automatic perimeter was developed, which consists of a hemisphere, light emitting diodes and a computer system. It contains screening, diagnostic, glaucoma, macula, central and peripheral field suprathreshold tests and threshold determining tests programs. We would like to demonstrate the instrument and discuss the practical data.

**E. Gandolfo, M. Zingirian and P. Capris**

**THE AUTOMATED PROGRAM «GENOA GLAUCOMA SCREENING»**

*Dept. of Ophthalmology, University of Genova, Genova, Italy*

Among the static-kinetic programs, the Armaly-Drance glaucoma screening strategy is universally accepted as a valid perimetric test for detecting early glaucomatous visual field defects. In our opinion, this program can be improved, because of recent progress in automated perimetry. The features of the Armaly-Drance program that can be modified are the following:

- Distribution of the tested points in the paracentral area: a more even arrangement of these points is desirable.
- Characteristics of the stimulus: individual threshold related stimuli can make the examination more accurate.
- Kinetic trajectories in the nasal v.f.: a higher number of kinetic stimuli with more isopters can increase the probability of nasal step detection.
- Stimuli presentation sequence: a random presentation of static and kinetic stimuli is recommendable.

The Automatic Goldmann Perimeter (Perikon) allows a precise and rapid execution of the Armaly-Drance modified strategy.

Clinical results of the «Genoa Glaucoma Screening» are evaluated and compared with those of traditional programs.

**L. Frisén**

**CARTOGRAPHIC PROPERTIES OF THE OCTOPUS VISUAL FIELD GRID**  
*Dept. of Ophthalmology, The University of Göteborg, Göteborg, Sweden*

The Octopus perimeter has replaced the familiar meridians and parallel circles of the classical polar equidistant projection with an orthogonal grid. The cartographic deformations inherent in this novel projection have been analysed on the basis of a simple mathematical model. The analysis disclosed practically negligible changes in isopter shapes within about 40 degrees of eccentricity. For larger eccentricities, normal isopters acquire prominent mid-quadrant bulges. This may cause difficulties in recognizing, e.g., partial contraction of the monocular crescent. Isopter segments running close by the vertical meridian are deformed in such a way that parallelism with the vertical meridian may be difficult to detect. The new projection is more destructive of symmetry properties than the classical projection. It is not appropriate for estimating visual field area.

**M. Mertz and U. Zirkel**

**DEVELOPMENT AND USE OF GRADIENT ISOPTERS IN COMPUTERIZED PERIMETRY**

*Eye Clinic, Technische Universität of Munich, Munich, Germany*

Usually, the presentation of visual field results is done by print-outs of the original data or by greyscale charts obtained by interpolation algorithms. Less often, data are used to calculate the three-dimensional «hill of vision». A new method is presented to create isopters of a new kind, based on the evaluation of original Octopus data by image analysis. These «gradient isopters» contain more information than those generally used, being of different width according to the actual slope of retinal sensitivity in the area tested. Thus, gradient isopters can be mixed electronically with the corresponding fundus picture, the results giving quantitative information of a «two step fundus perimetry» based on the use of both optimal fundus photography and perimetry.

### *SESSION III – Fundus Perimetry*

**K. Okubo, K. Mizokami and Y. Tagami**

**FUNDUS PERIMETRY AND OCTOPUS PERIMETRY FOR THE EVALUATION OF NERVE FIBER BUNDLE DEFECTS**

*Dept. of Ophthalmology, Kobe University, Kobe, Japan.*

Sensitivity in nerve fiber bundle defects, which may be observed in various conditions, has not yet been evaluated in detail.

In this paper, correlations between visual sensitivity and nerve fiber bundle defects, in various conditions and densities, were analyzed by means of kinetic fundus perimetry (quantitative maculometry) and the Octopus F program.

**R.H. Webb, E.A. Essock and J.M. Enoch**

**MEASUREMENT OF LAYER-BY-LAYER PERIMETRY RESPONSES USING DIRECT RETINAL PROJECTION BY THE SCANNING LASER OPHTHALMOSCOPE**

*Eye Research Institute of Retina Foundation, Boston, U.S.A.*

*Eye Research Institute of Retina Foundation and School of Optometry, University of California, Berkeley, U.S.A.*

*School of Optometry, University of California.*

Two of the tests of layer-by-layer perimetry evaluate inner retinal function by measuring two types of local spatial interactions. The «sustained-like» test (i.e., the «sensitization effect») evaluates the effect of small concentric backgrounds on sensitivity to a small target. The «transient-like» test evaluates the effect of introducing movement by rotating a windmill shaped background. Inner retinal anomalies can disrupt the normal spatial interactions measured by either of these tests. In the present applications of these tests, we take advantage of the simultaneous view of the retina and of the stimuli projected onto the retina provided by the Scanning Laser Ophthalmoscope. This method permits precise localization of test stimuli at desired retinal locations. The SLO record will be shown to demonstrate the experimenter's view of the retina during testing.

**K. Kani, K. Inoue, O. Mimura and E. Ohmi**

**DISTRIBUTION OF RETINAL SENSITIVITY IN AMBLYOPIA WITH ECCENTRIC FIXATION**

*Dept. of Ophthalmology, Hyogo College of Medicine, Nishinomiya, Japan*

Distribution of retinal sensitivity were measured in 10 amblyopic patients with eccentric fixation using a fundus perimeter.

In 9 out of 10 patients, the highest retinal sensitivity was detected in the eccentric fixation area. The fovea of the amblyopic eye did not correspond to the retinal locus with peak sensitivity in any patient. These results suggest that eccentric fixation develops in an attempt to fixate with a non-foveal retinal locus which has a higher sensitivity, and not a higher visual acuity, than the fovea.

**O. Mimura, Y. Okamoto, K. Kani and T. Utsumi**

**CRITICAL FLICKER FUSION FREQUENCY IN AMBLYOPIA**

*Dept. of Ophthalmology, Hyogo College of Medicine, Nishinomiya, Japan*

Critical flicker fusion frequencies (C.F.F.) of different retinal loci were measured in an amblyopic patient with eccentric fixating locus, monotonically increased with stimulus energy when the stimulus area was large. However, C.F.F. of the fixating locus in amblyopia showed no marked variation dependent on stimulus energy as long as the stimulus area was small. These results suggest that C.F.F. in amblyopia varies depending on the stimulus area.

## SESSION IV — Colour Perimetry

**W.M. Hart Jr., G. Kosmorsky and R.M. Burde**

COLOR PERIMETRY OF CENTRAL SCOTOMAS IN DISEASES OF THE MACULA AND OPTIC NERVE

*Dept. of Ophthalmology, Washington University Medical School, St. Louis, Missouri, U.S.A.*

Acquired dyschromatopsias have been thought by some investigators to differ in visual defects arising from optic nerve disorders as opposed to macular diseases. We have used a microcomputer-controlled color video tangent screen to examine patients with isolated central scotomas that have resulted from either optic nerve or macular disease. Colored test objects were used in a form of kinetic perimetry in which test object luminance had been previously matched to the luminance of a white surround at 10 foot lamberts by using heterochromatic flicker photometry. Central scotomas that were present by conventional kinetic perimetry (luminance increment sensitivity) were also present for colormodulated test objects (color saturation increment sensitivity). The qualitative shape characteristics of these defects was of more value in distinguishing optic nerve and macular diseases than was any difference between luminance and color detection of test objects.

**J.P. Menu and G.F. Santucci**

THE EFFECT OF COLOUR ON CONTRAST SENSITIVITY AS A FUNCTION OF ECCENTRICITY

*Centre d'Etudes et de Recherches de Médecine Aéronautique, Paris, France*

In the frame of ergonomics application (aircraft displays) it is necessary to know the effect of colour on contrast sensitivity as a function of eccentricity. An 8° stimulus is presented on a cathode ray tube placed in a constant white (D65) illuminated environment which gives a 40cd/m<sup>2</sup> luminance on 180° field of view.

Red ( $x = 0,665$   $y = 0,305$ ) green ( $X = 0,365$   $y = 0,557$ ) blue ( $x = 0,142$   $y = 0,672$ ) sinusoidal gratings are used. The orientation of the grating (vertical or horizontal) is defined using a psychophysical adjustment method.

The stimulus center is located at 0, 10, 20, 30, 40° nasally and 10-20° temporally. Data of four subjects are presented. The analysis of results shows no significant differences between the three colours in central vision.

The sensitivity curves as a function of eccentricity correspond to those published by other authors (Bourdy, Bowker); despite the experimental situations being generally different.

Based on such a small material these results are preliminary. Further experiments are in progress.



**L. Ronchi and V. Principe**

**LACK OF SYMMETRY OF RED-GREEN TEMPORAL RESPONSIVENESS AS A FUNCTION OF RETINAL ECCENTRICITY**

*Istituto Nazionale di Ottica, Firenze, Italy*

We describe an experiment where three «normal» observers are presented with a pair of suprathreshold flashes, one red, the other green, at various retinal locations. In some respects, our technique is similar to the «silent substitution», since two flashes of the same duration are delivered consecutively. The task consists of matching brightness (by the constant stimulus method). The green/red ratio was analysed at different luminance levels.

A U-shaped relation is found when plotting g/r versus eccentricity.

An interesting finding is that the response to a red-before-green pair differs from that of a green-before-red pair. The findings are interpreted by considering the eccentricity dependence of both chromatic and achromatic organizations. It is thought that these data might be of practical interest because of the widespread use of LED displays.

**J.L. Vola, B. Gondois and P. Gastaud**

**CONSIDERATIONS ABOUT STILE II MECHANISMS IN GLAUCOMATOUS BJERRUM AREAS**

*Marseille, France*

Comparison was made between increment threshold versus intensity (T.V.I.) curves  $\Pi_0$ ,  $\Pi_1$ ,  $\Pi_4$ , and  $\Pi_5$  plotted in 21 normal subjects and in 18 patients with open angle glaucoma. The results showed that in diseased eyes the thresholds of  $\Pi_0$ ,  $\Pi_1$ , and  $\Pi_4$  were at the highest border of the mean plus one standard deviation of the normal subjects. The  $\Pi_5$  mechanism was always normal.

Although no scotoma was found in examined glaucomatous eyes, the frailty of the nerve bundle in this area is obvious.

**K. Kitahara, R. Tamaki, H. Kitahara, J. Noji and A. Kandatsu**  
**EXTRAFOVEAL RELATIVE RED-GREEN SENSITIVITY**  
*The Jikei University School of Medicine, Tokyo, Japan*

Red and green sensitivity was measured using a hue cancellation method for up to  $10^\circ$  from the fovea along the horizontal meridian.

A  $1^\circ$  diameter circular test stimulus was superimposed on the center of a  $10^\circ$  circular white background. The green intensity was constant. The red intensity was gradually increased and the red/green ratio was measured at both ends of the gray range.

Results from normal observers and patients with optic nerve disease will be discussed.

**K. Kitahara, R. Tamaki, J. Noji, A. Kandatsu and H. Matsuzaki**  
**INCREMENT THRESHOLD VERSUS INTENSITY CURVES FOR RODS**  
*The Jikei University School of Medicine, Tokyo, Japan*

At the last IPS meeting, we described extrafoveal threshold versus intensity (t.v.i.) curves for cones. In the present paper, we used Stiles' two-color threshold technique to study the t.v.i. curves for rods up to  $10^\circ$  from the fixation point, using a Maxwellian view optical system.

The shape of the t.v.i. curves for rods was not in accordance with Stiles' Field Displacement Law. Therefore, it is suggested that the t.v.i. curve should consist of two different mechanisms. The detection properties for short wavelength incremental flashes in rod mechanisms will be discussed.

## SESSION V — Neuro-ophthalmic Perimetry 1

**L. Frisén**

THE EARLIEST VISUAL FIELD DEFECTS IN MID-CHIASMAL COMPRESSION

*Dept. of Ophthalmology, University of Göteborg, Göteborg, Sweden*

Review of computed tomograms from a large series of cases with midline, suprasellar extension of pituitary adenoma allowed identification of patients with potential, low-degree mid-chiasmal compression. Analysis of their pre-treatment and post-treatment records allowed identification of the earliest consistent visual field defect. This took the form of a temporal foreshortening of central isopters, usually somewhat more pronounced above, and often lacking a clear vertical step. The isopter deformations became progressively smaller with increasing target intensities. The earliest defects observed here did not extend beyond 15 degrees of eccentricity. They were less well defined in static profiles.

It appeared that the formation of vertical steps represents a more advanced stage of compression, where the temporal foreshortening also is more pronounced, and more skewed upwards.

Perimetric screening for early compression can be limited to careful kinetic charting of one central isopter of small radius.

**H. Bynke**

PERIPHERAL LOSS OF SENSITIVITY IN BITEMPORAL AND HOMONYMOUS VISUAL FIELD DEFECTS

*Dept. of Ophthalmology, University Hospital, Lund, Sweden*

In visual fields (VFS) recorded by the computerized perimeter «Competer», the mean threshold values were calculated in each hemifield at 2.5, 5, 10, 15, 20, 27.5 and 35° of eccentricity. VFs with non-scotomatous bitemporal (41 eyes) and homonymous hemianopic defects (36 eyes) were compared with normal VFs (26 eyes).

In the majority of the defective hemifields, the mean loss of sensitivity increased towards the periphery, and in small bitemporal and homonymous defects the VF area inside 10-15° was almost intact. This relative sparing of the central area may be explained by the large proportion of macular fibres in the visual pathway. The results demonstrate the importance of examining the VF outside 10-15° in neuro-ophthalmology and are essential for elaborating an efficient examination strategy in computerized perimetry.

**R.P. Mills****USEFULNESS OF PERIPHERAL TESTING IN AUTOMATED SCREENING PERIMETRY**

*Dept. of Ophthalmology, University of Washington, Seattle, Washington, U.S.A.*

In a study evaluating the screening ability of Goldmann, Fieldmaster 2000, and Dicon AP2000 perimeters, peripheral fields were tested using stimuli one log unit stronger than threshold-related central field stimuli. The 123 eyes tested were selected after an ophthalmologist's examination indicated the probability that a field defect would be present. The resulting assortment of field defects was felt to be representative of those found in a general ophthalmologic practice.

Field testing outside the central 25° consumed 40% of testing time at the automated perimeters. In 3% of eyes found abnormal by reference quantitative Goldmann perimetry, the peripheral field detected an abnormality which the central field has missed. In 10% of cases, a diagnostic characterization was made possible or improved in quality by the peripheral field. In 62% of cases, the peripheral field confirmed an abnormality detected on central testing, and enhanced confidence of the validity of the central field data. The screening peripheral field was entirely normal in 35% of abnormal eyes. Implications of these findings for designing screening protocols on automated perimeters will be discussed, and examples shown.

**P. Enoksson****IMPORTANCE OF PERIPHERAL VISUAL FIELD IN NEUROOPHTHALMOLOGY**

*Dept. of Ophthalmology, University Hospital, Uppsala, Sweden*

Examination of the central visual field is usually enough when searching lesions of the anterior visual pathway, *e.g.* the chiasm, but the peripheral field is important in controls and for a better understanding of the patient's situation. Some lesions in the vicinity of or in the visual cortex can only be detected by means of scrutinizing the peripheral field. These aspects will be illustrated by selected clinical cases.

**J.L. Keltner, C.A. Johnson and R.A. Lewis**  
**PERIPHERAL VISUAL FIELD LOSS IN NEURO-OPHTHALMOLOGY AND GLAUCOMA**

*Dept. of Ophthalmology, University of California, Davis, U.S.A.*

Using a computer analysis technique, we evaluated the prevalence, location, size and eccentricity characteristics of visual field loss in glaucoma and neuro-ophthalmologic disorders. Peripheral field abnormalities were identified by using 95% confidence limits for normal sensitivity values (determined for 350 normal eyes; 50 eyes in each of 7 age groups), and by using 95% confidence limits for isopter curvature characteristics (to denote nasal steps, wedges and localized depressions greater than normal inter-individual variations).

In addition to the parameters mentioned above, we evaluated the clinical diagnostic efficacy of the peripheral visual field in combination with the central visual field, as compared to the central visual field alone. Differences between the peripheral visual field characteristics in glaucoma and neuro-ophthalmic patient populations will be described.

**A. Hard-Boberg, J.D. Wirtschafter and S.M. Coffman**  
**EVALUATING THE USEFULNESS OF VISUAL FIELD EXAMINATIONS PERIPHERAL TO 30 DEGREES IN NEURO-OPHTHALMOLOGY**

*Dept. of Ophthalmology, University of Minnesota, Minneapolis, Minnesota, U.S.A.*

The increasing acceptance of automated static threshold perimetry has been accompanied by decreased attention to the examination of the visual field beyond 30 degrees. Many previous studies on the importance of the peripheral visual field in neuro-ophthalmology have not strictly defined the boundary between central and peripheral nor have they provided an algorithm for evaluating the usefulness of the peripheral field. We propose a protocol that can specify the percent usefulness of the peripheral visual field examination for: I, detection; II, topographic localization; III, potential to alter clinical management; and IV, potential to alter ergo-ophthalmological assessment at the: A, initial examination; B, first re-examination; and C, most useful case of any subsequent re-examination for: 1, specified diagnoses when patients have normal central 30 degree fields in both eyes; 2, specified central field abnormalities on initial and subsequent examinations; 3, specified central and peripheral field abnormalities on previous examinations; and 4, specified peripheral visual field abnormalities on previous examinations. A large series of kinetic visual fields will be retrospectively analyzed according to this protocol. The results will be discussed with regard to previous studies. An algorithm for the use of peripheral visual field examinations will be proposed with an assessment of the potential usefulness of performing the examination and the potential risks of not performing the peripheral examination.

## *SESSION VI — Neuro-ophthalmic Perimetry 2*

**H.S. Thompson**

**PUPILLARY SIGNS IN MACULAR AND OPTIC NERVE DISEASE**

*Dept. of Ophthalmology, University of Iowa, Iowa City, Iowa, U.S.A.*

Pupillary signs can be fit into the diagnostic puzzle of retinal and optic nerve disease if the relative afferent pupil defect is first quantified. This is done with neutral density filters. Pure macular disease does not produce a relative afferent pupil defect greater than 1 log unit. A macular lesion with acuity of 20/200 or better generally has a pupil defect no greater than 0.5 log unit. Most amblyopes have a small pupil defect in the affected eye — usually about 0.3 and hardly ever more than 0.6 log. Almost all patients with optic neuritis have a relative afferent pupil defect. The size of the pupil defect varies with the field lost and may be as high as 3.0 log units during the acute attack. After recovery a relative afferent pupil defect remains which is seldom over 2.0 log (mean = 1.0 log). Fresh retinal detachments have pupil defects to the tune of 0.3 log per quadrant (macula on). With the macula off the pupil defect is about 1.0 log bigger. Anisocoria produces a relative afferent pupil defect at the rate of approximately 0.1 log unit per mm of anisocoria (in light).

**O. Meienberg, H. Mattle, A. Jenni and J. Flammer**

**QUANTITATIVE VERSUS SEMIQUANTITATIVE PERIMETRY IN NEUROLOGICAL DISORDERS**

*Depts. of Neurology and Ophthalmology, University of Bern, Switzerland*

In quantitative perimetry the actual threshold of the differential light sensitivity is determined. In semiquantitative perimetry we test only whether the sensitivity is normal, relatively or absolutely disturbed. While the former method gives more information, but is time consuming, the latter gives less information, but is time saving. The aim of our investigation was to determine in which neurological conditions semiquantitative examinations deliver sufficient information, and in which conditions quantitative measurements provide significant additional information. To answer this question, we examined a large number of patients with different neurological disorders with both methods on the Octopus automated perimeter.

**Y. Honda and A. Takahashi**

**IMPORTANCE OF VISUAL FIELD TESTS OF PATIENTS WITH PITUITARY ADENOMA DURING PREGNANCY AND POST-PARTUM LACTATION**

*Dept. of Ophthalmology and Gynecology, Kyoto University, Kyoto, Japan*

Visual fields of 20 patients with radiological evidence of pituitary adenoma were measured monthly or bimonthly by a Goldmann perimeter during a period of pregnancy and post-pregnant lactation. Amenorrhoea was treated with administration of bromocriptine and/or Hardy operation (a few cases).

New appearance and enlargement of the visual field defects during the period were more frequently found (8/20 cases: 40%, including minor changes) than reported previously. Visual acuity was not affected during the period. The visual field test was shown to be safer than radiological tests in the pregnant patients and more sensitive to adenoma growth. Visual field defects induced by pregnancy in patients with pituitary adenoma were reversible in our cases when bromocriptine was administered or after delivery and post-delivery lactation. In some cases, post-delivery lactation delayed recovery of visual field defects. Our findings indicate the importance and usefulness of the visual field test of patients with pituitary micro- and macroadenomas during a period of pregnancy and post-delivery lactation.

**I. Bodis-Wollner and L. Mylin**

**PSYCHOPHYSICAL AND ELECTROPHYSIOLOGIC PROCEDURES USEFUL IN THE DIFFERENTIATION OF «HYSTERICAL» AND «CEREBRAL» BLINDNESS**

*Depts. of Neurology and Ophthalmology, The Mount Sinai School of Medicine, New York, U.S.A.*

In many patients recovery from cerebral blindness is accompanied by a recapture first of vision for coarse objects, and the ability to detect fine detail returns only later (Bodis-Wollner, 1978). In these patients, monocular spatial contrast sensitivity measurements reveal high frequency losses, whereas hysterical blindness is often accompanied by a profound loss which is independent of spatial frequency. While evoked potentials may be present in cerebral as well as hysterical blindness, in the former condition the response is absent at spatial frequencies above 5 c/d, whereas in the latter the cut-off is above 10 c/d. The presence of a random-dot correlogram (RDC) of non-cooperative patients is best monitored by direct observation, however, slight (between 2° and 5°) voluntary eccentric fixation as a cause of an abnormal EP waveshape recorded at the midline can be checked by comparing responses over lateralized electrodes.

## SESSION VII — Ergoperimetry

**G. Verriest, J.L. Bailey, G. Calabria, E. Campos, R.P. Crick, J.M. Enoch, B. Esterman, A.C. Friedmann, M. Ikeda, C.A. Johnson, I. Overington, L. Ronchi, S. Saida, A. Serra, S. Villani, R.A. Weale, M.L. Wolbarsht and M. Zingirian**

**REPORT: THE OCCUPATIONAL VISUAL FIELD. PRACTICAL ASPECTS: THE FUNCTIONAL VISUAL FIELD IN ABNORMAL CONDITIONS; ITS INTERFACES WITH VISUAL ERGONOMICS, VISUAL IMPAIRMENT AND JOB FITNESS; TECHNICAL NOTES**

This second part of the official report from the IPS Group on Functional Visual Field first describes the changes of the (functional) visual field due to age, refractive error and its correction, ocular and neuro-ophthalmic disease, drugs, hypoxia, muscular exercise, luminous environment and noise. A second section is devoted to the interfaces between functional visual field and ergonomics especially for driving, aircraft piloting, control tasks, design of structures that interfere with vision as spectacle frames, lighting engineering, optical instruments and visual display units. A third section deals with the interfaces with visual impairment namely visual field loss in the appreciation of visual disability, in defining low vision and blindness, in predicting functional ability and in designing treatment. A further section is devoted to the interfaces between visual fields and job fitness: existing regulations and their possible improvement, especially concerning driving and aircraft piloting. The last section consists of technical notes about testing distance, recording eye and head movements, assessing the dynamic functional visual field, and detecting of visual field defects in the frame of industrial medicine and road traffic licensing.

**G. Calabria, E. Gandolfo, M. Rolando, P. Capris and C. Burtolo**  
**ERGOPERIMETRY IN PATIENTS WITH SEVERE VISUAL FIELD DAMAGE**  
*Dept. of Ophthalmology, University of Genova, Genova, Italy*

Difficulties in space behaviour of patients with severe visual field damage of different nature have been previously investigated, but these results do not explain the severe difficulties of glaucomatous patients in environmental behaviour.

We have tried to investigate the actual absolute limits of visual fields in patients with large field defects attempting to study what Ikeda defines as «sensation visual field».

The investigation has been carried out utilizing black or grey curtains moving centripetally against a white screen. Recording the eccentricity of perception of the curtain we tried to define a functional visual field.

Horizontal and vertical curtains were used to simulate real life obstacles (steps, wall, door edge etc.). Our results show that often there is a difference between the absolute limits of the traditional visual field and the functional visual field tested with our method. We think that our method will prove useful in the definition of «real blindness». The importance of residual small islands of vision for space behaviour is stressed. The binocular integration of the two visual fields is hampered in glaucoma.



**F. Ikeda\*, M. Ikeda\*\*, S. Shioiri\*\* and M. Takao\***

**DETERIORATION IN READING WITH NARROWED VISUAL FIELDS**

*\* Service of Ophthalmology, Kanto Teishin Hospital, Shinagawa, Tokyo, Japan*

*\*\* Tokyo Inst. of Technology, Yokohama, Japan*

Patients suffer considerable deterioration in their visual tasks from narrowed visual fields. The effect of functional visual field size upon the reading time of letters was studied. Visual stimuli in the experiment were composed of about 80 Japanese phonetic letters, each extending to about 45° arc of visual angle. Forty of them were drawn on a relatively clear background but the rest on a background with some dots distributed randomly over the field, which made the letter more difficult to read. Only one letter was presented at a time on a white screen with a slide projector and the patient was asked to read it as quickly as possible to measure the reading time. The patient observed the stimulus monocularly and eye and head movements were permitted. The reading time increased up to 30 seconds, depending on patient, which was considerably longer than the 0.2 seconds or so, of normal subjects.

With a narrowed visual field, the patient had to scan over a letter from portion to portion and connect them to construct and recognize the letter. The reading time was measured in various patients of pigmentary degeneration or glaucoma.

A good correlation was found between visual field size and reading speed.

**L. Barca, F. Passani and V. Principe**

**LIGHT EMITTING DIODES IN EXTRAFOVEAL VISION: AN ERGOPERIMETRIC PROBLEM**

*Dept. of Ophthalmology, University of Firenze, Firenze, Italy*

An experiment is described where a number of normal observers have been requested to specify the color of eccentrically presented red and green LEDs. In spite of individual differences, a normal behaviour can be defined for different exposure times along various meridians of the visual field. The data seem to be of ergophthalmological interest.

The responses of subjects suffering from eye diseases affecting the visual field are also relevant. Therefore patients with previous history of active optic neuritis have been tested.

**B. Esterman, D. Blanche, D. Wallach and A. Bonelli**  
**COMPUTERIZED SCORING OF THE FUNCTIONAL FIELD. PRELIMINARY REPORT**

*Manhattan Eye and Ear Hospital, New York, U.S.A.*

The new computerized Autoperimeter has now been programmed to include the functional Relative-Value Scale. This combination plots the field, either monocular or binocular, and instantly prints the functional score. The score is called «functional» because it measures more than merely area; it assesses the total field's usefulness and expresses it in percent or simple fraction — as does the Snellen Scale for central acuity. Thus, consultants for industry or government now have a standard scale to help determine job fitness, driver safety, social security disability, worker's compensation, etc and to do this automatically, quickly, impersonally and as accurately as subjective testing will permit.

This year, the American Medical Association has adopted the Scale as standard for the U.S. with its publication of the 1984 edition of the official «A.M.A. Guides to Impairment — The Visual System».

As part of more extensive trials performed at the suggestion of the President of the International Ophthalmological Council, preliminary tests have already calibrated the combined Autoperimeter and Relative-Value Scales so that scores match those of the standard Goldmann. Certain problems arose. Their solution yielded some interesting fundamental biological observations; also ideas for monitoring (by the I.P.S.) of the Scales' manufacture and, if necessary, their future modification.

## *SESSION VIII — Part 1 - Free papers*

**P. Rossi, R. Terrile, C. Burtolo and G. Ciurlo**  
**LIGHT THRESHOLD AND TEMPORAL RESOLUTION IN THE CENTRAL VISUAL FIELD**

*Dept. of Ophthalmology, University of Genova, Genova, Italy*

We have previously reported that temporal resolution is constant within the central visual field, provided that threshold stimuli are used in each point. To further assess the relationships between stimulus luminance and temporal resolution, targets with a constant flickering frequency were presented in different points of the central visual field. The target luminancies at which the constant flickering frequency became the flicker fusion frequency of each point was compared with the light threshold in that point. There was a close relationship between the two luminancies with targets of small diameter, while a close relationship with targets of larger diameter was noted. A tentative explanation of this phenomenon is given on the basis of spatial summation and the law of Granit and Harper.

**J.M. Enoch, R.A. Williams, E.A. Essock and S. Raphael\***  
**APPLICATION OF HYPERACUITY TO ASSESS VISION THROUGH MEDIA  
 AND RETINAL OPACITIES: METHODOLOGY**

*School of Optometry, University of California, Berkeley, California, U.S.A.*

*\* Eye Diagnostic Laboratory, Castro Valley, California, U.S.A.*

This laboratory has recently developed a series of tests of central visual function based on vernier or hyperacuity tasks. Because of the unique character of hyperacuity responses, it is possible to evaluate vision through opacities using these tests. There is no limit on the degree or nature of opacities which can be penetrated if the test stimulus can be made sufficiently bright. In this paper, the rationale behind the development of this new methodology will be explained including: 1) the principal by which this test works when others have not; 2) the use of the hyperacuity test to differentiate optical from non-optical components of visual loss; 3) the use of a perimetric version of the test for assessment of visual function at a variety of points across the central retina; and 4) how to minimize the effects of modest degrees of image defocus. The utility of the hyperacuity test for the assessment of central vs. peripheral function, for the detection of eccentric fixation, and for the evaluation of the general quality of vision for reading and other purposes will be discussed.

**R.A. Williams, J.M. Enoch, E.A. Essock and M. Barricks\***  
**APPLICATION OF HYPERACUITY TO ASSESS VISION THROUGH MEDIA  
 AND RETINAL OPACITIES: CLINICAL TRIALS**

*School of Optometry, University of California, Berkeley, California, U.S.A.*

*\* Dept. of Ophthalmology, University of California, San Francisco, California, U.S.A.*

Two psychophysical tests, based upon a vernier acuity judgement, can be applied in cases of ocular media opacities in order to parcel out optical from retinal-neural visual loss. The development of these new tests was the topic of a companion paper. This paper describes the perimetric analysis of visual potential in individual, documented cases. To demonstrate the utility of the hyperacuity tests in detecting retinal pathology through opacities, the image-degrading effects of a cataract were simulated in several patients with known central retinal pathologies. Characteristic patterns of hyperacuity perimetric fields are obtained in the various retinal pathology cases. In actual cases of media opacity (cataracts, vitreous opacities) in combination with retinal anomaly, test results obtained before and after cataract surgery are compared for verification of the predictive capability of the hyperacuity techniques.

## SESSION VIII — Part 2 - Free papers

**A. Haas and J. Flammer**

INFLUENCE OF DIAZEPAM ON THE PERIMETRIC OUTCOME

*Dept. of Ophthalmology, University of Bern, Bern, Switzerland*

In order to detect and follow up early functional defects in glaucoma, we are concerned with small changes which occur in quantitative perimetry. Changes due to a disease state must be differentiated from artificial changes, for example, those due to influence of drugs.

In order to study a possible influence of tranquilizers on the visual field, we treated healthy volunteers with Placebo, 5 and 10 mg Diazepam, respectively. The visual fields were determined using program J0 on the Octopus automated perimeter. We evaluated the effect of treatment on the differential light sensitivities, their scatter, the learning and fatigue phenomena as well as reaction times.

**H. Suzumura, F. Furuno and H. Matsuo**

VISUAL FIELD VOLUME AND ITS OBJECTIVE EVALUATION USING A SHAPE COEFFICIENT METHOD

*Dept. of Ophthalmology, Tokyo Medical College, Tokyo, Japan*

We have measured the sensitivity distribution of the visual field and expressed it volumetrically using polar coordinates. 229 eyes of 145 normals were tested. Quantitative kinetic perimetry was used. Some glaucoma cases were examined and compared with the normal cases. The largest visual field volumes are found among 10 to 39 years of age. Then the volumes gradually decrease. The visual field loss of low tension glaucoma differs slightly from that of POAG.

**G. Verriest, A. Colasanti, R. Fusco, A. Magli and G. Tortora**  
VISUAL FIELD EXAMINATION BY ELECTRO-OCULOGRAPHY  
*Ghent, Belgium / Napoli and Salerno, Italy*

The authors describe a method of objective assessment of the visual field by means of the electro-oculographic registration of the refixation eye movements. The first results are encouraging. Several possible improvements of the method are discussed.

### *SESSION X — Glaucoma Perimetry*

**S. Anderton, R.L. Coakes, S. Poinosawmy and R.A. Hitchings**  
THE NATURE OF VISUAL FIELD LOSS IN LOW TENSION GLAUCOMA  
*Moorfields Eye Hospital, London, England*

A method is described for quantifying visual field loss from the visual fields obtained with a Goldmann Perimeter. Using this method the rate of visual field loss seen over a period of years in individuals with low tension glaucoma has been found.

The results of the study emphasize the «Stop-Go» nature of visual field loss in this disease, in which remissions lasting many years may be followed by relapse. Recognition of the rate of visual field loss is important when assessing the effect of any form of treatment for patients with low tension glaucoma.

**F.S. Mikelberg and S.M. Drance**

**THE PROGRESSION OF VISUAL FIELD DEFECTS IN GLAUCOMA**

*Dept. of Ophthalmology, University of British Columbia, Vancouver, British Columbia, Canada*

The characteristics of visual field defects in glaucoma have been well described. However, the rate and type of progression of these defects has not been well studied. Many aspects of glaucomatous visual field progression remain unclear. What is the rate of progression of these defects? Is the progression gradual or episodic? Are new scotomata common, or is it more common for established nerve fibre defects to progress in depth and width? Do new scotomata occur more frequently in the already affected hemi-field or in the unaffected hemi-field? Is there any relationship of isopter area to visual field progression? In order to answer some of these questions, we measured the scotoma and isopter area of kinetic visual fields and the area of the scotoma under the profile as well as the area under the profile of static visual fields as recorded with the Oculus perimeter in fifty glaucoma patients having greater than five years of follow-up. The results will be discussed.

**J. Stürmer, B. Gloor and H.J. Tobler**

**THE GLAUCOMATOUS VISUAL FIELD IN DETAIL, AS REVEALED BY THE OCTOPUS F-PROGRAMMES**

*Dept. of Ophthalmology, University of Basel, Basel, Switzerland*

Meridional profile perimetry was performed on 20 patients with chronic simple glaucoma and mild to severe visual field loss documented with the combination of programmes 31 and 32. 229 F<sub>2</sub> programmes consisting of 30° long profiles with 1° resolution and double measurements of light sensitivity were analysed. Additionally selected areas of the field of one extremely cooperative patient were examined over two years with F<sub>4</sub> programmes (threshold measurements four times at one point).

The analysis of the data revealed a positive correlation between mean loss and mean short term fluctuations. Short term fluctuations tended to be larger with increasing loss of sensitivity. However small short term fluctuations were also seen in areas of greatly reduced sensitivity. Analysis of the F<sub>2</sub> programmes showed 12 different abnormal patterns. The most frequently found was «increased scatter with normal sensitivity», which appears to be the earliest perimetric sign of glaucoma. Progression of glaucomatous damage produces the so-called relative scotoma, which is rather a «gray area of increased scatter», usually accompanied by reduced sensitivity with a poorly defined lower and upper threshold.

The data show why it is difficult, if not impossible, to detect progression of field loss over a relatively short period of time, e.g., 6 months, in patients with established glaucoma, despite repeated examinations. Only long term follow-up over years will establish a definite trend.

**A. Heijl and B. Bengtsson**

**THE SHORT-TERM EFFECT OF LASER TRABECULOPLASTY ON THE GLAUCOMATOUS VISUAL FIELD**

*Dept. of Ophthalmology, The University of Lund, Malmö, Sweden*

Visual field testing was performed with the Competer computerized perimeter in 42 eyes with glaucomatous field defects before, and one month after, laser trabeculoplasty. The pharmacological glaucoma therapy was not changed after the laser treatment. Despite the fact that the intraocular pressure was reduced in all eyes, no general regression of field defects was observed. The changes of the visual field were not correlated with the degree of pressure reduction achieved. Improvement and deterioration were equally common and it is likely that the registered visual field changes were due simply to random variation. The present results do *not* support the hypothesis that glaucomatous visual field defects are reversible when the intraocular pressure is lowered.

**C.E. Traverso, R. Fellman, R. Starita and G.L. Spaeth**

**VISUAL FIELD CHANGES FOLLOWING ARGON LASER TRABECULOPLASTY**

*Glaucoma Service, Wills Eye Hospital, Philadelphia, Pennsylvania, U.S.A.*

Argon laser trabeculoplasty (A.L.T.) is an effective method for lowering intraocular pressure in primary open-angle glaucoma. However, its long-term effects on the glaucomatous visual field are not well established.

We performed ALT on 250 eyes of 180 patients with uncontrolled glaucoma. Pre- and post-laser exams included disc drawings and/or stereophotographs; when vision was adequate, visual fields were obtained with an Octopus perimeter, using programs 31 or 32. Mean FU was 9 months. Mean IOP change after ALT was - 20% ( $\pm$  22).

In order to assess VF changes after treatment, we selected 117 eyes whose Octopus exams were not affected by pupil size changes of more than 0.5 mm, visual acuity changes of more than 2 lines, and/or more than 25% false answers. A 15% variation of the mean sensitivity, calculated in each quadrant, was the limit we used to qualify a VF change as significant. When mean sensitivity was less than 10 db this limit was increased to 40%. During the F.U. period visual fields remained stable in 65 eyes (56%), improved in 20 eyes (17%), and worsened in 32 eyes (27%). Although intraocular pressure changes and visual field changes did not always overlap as expected, argon laser trabeculoplasty influenced favorably the course of the disease in a large proportion of our sample.

**C. Holmin****COMPUTERIZED PERIMETRY BEFORE AND AFTER ARGON LASER TRABECULOPLASTY (ALT)***Dept. of Ophthalmology, University Hospital of Lund, Lund, Sweden*

ALT was performed in patients with high IOP ( $\geq 30$  mm Hg) and/or a significant progression of the visual field loss. The visual fields were checked by means of automatic perimetry (Competer) before and after ALT. The value P, which condenses the visual field results into a single number, makes it possible to calculate the linear regression coefficient, provided a sufficient number of observations are available. In a group of about 15 patients there were  $\geq 6$  observations before ALT and 5 observations after ALT. The regression coefficients before and after ALT were calculated. In order to keep the test conditions unchanged, the pressure-reducing therapy was continued after the treatment.

A pressure reduction of about 30 percent was achieved. The possible effect of the treatment on the rate of the visual field decay will be discussed.

**P. Le Blanc****PERIPHERAL NASAL FIELD DEFECTS IN PRIMARY OPEN ANGLE GLAUCOMA***Dept. of Ophthalmology, Dalhousie University, Halifax, Canada*

The incidence of isolated peripheral nasal field defects in primary open angle glaucoma as reported in the literature varies from  $<1\%$  to  $>10\%$ . This widespread variance clearly relates to the quality of the central field examination carried out in the different reported series. With the increasing use of automated static quantitative assessment of the visual field, it is of interest to have an updated perspective on this issue using such techniques to assess the visual field.

This study reports the visual field findings in 105 consecutive patients with primary open angle glaucoma undergoing visual field testing using the Octopus perimeter. Central fields were assessed using quantitative assessment programmes (#31, 32) while the peripheral field was tested using the two-level screening programme (#07). The incidence of *isolated* peripheral nasal defects is clearly much *lower* than when a comparable series of patients is tested using kinetic and static techniques on the Goldmann perimeter even though the overall incidence of peripheral defects is similar.



**P.J. Airaksinen, S.M. Drance and M. Schulzer**

RETINAL NERVE FIBRE LAYER AND VISUAL FIELDS IN OCULAR HYPERTENSION AND EARLY GLAUCOMA

*Dept. of Ophthalmology, University of British Columbia, Vancouver, Canada*

Photography of the retinal nerve fibre layer (RNFL) is a useful method for detection and demonstration of neural tissue damage in glaucoma. RNFL changes can be divided into localized and diffuse loss of nerve fibres. Similarly, diffuse and localized visual field changes can be demonstrated from program J0 of the Octopus.

We photographed the RNFL and examined visual fields with the Octopus J0 program in 50 glaucoma suspects and 50 patients with early glaucoma and correlated the findings. The results will be reported and their implications will be discussed.

**C.D. Phelps and P. Blondeau**

ACUITY PERIMETRY IN GLAUCOMA

*Dept. of Ophthalmology, University of Iowa, Iowa City, Iowa, U.S.A.*

Acuity perimetry differs from conventional perimetry in that peripheral visual acuity, not light sensitivity, is the visual function measured. One factor that limits the visual acuity at any location in the visual field is the concentration of ganglion cells in the corresponding area of the retina. In glaucomatous optic nerve damage there is a loss of ganglion cells and axons. In some patients the loss is focal, but in others it is widespread and scattered. We propose that acuity perimetry may be more sensitive than conventional perimetry for the detection of the diffuse type of damage.

In all patients we have tested, early visual field defects plotted by conventional perimetry have been accompanied by profound impairment of peripheral acuity. In some eyes loss of peripheral acuity is found in the opposite hemifield, as well as in the hemifield with impaired light sensitivity. Peripheral acuity is also impaired in some patients with ocular hypertension and in other patients who have asymmetric disc cupping but normal conventional visual fields.

## B. Posters (Session IX)

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### *I - Automation of Perimetry*

**L. Augustiny and J. Flammer**

THE INFLUENCE OF ARTIFICIALLY INDUCED VISUAL FIELD DEFECTS,  
ON THE VISUAL FIELD INDICES

*Dept. of Ophthalmology, University of Bern, Bern, Switzerland*

In order to quantify visual field defects, three visual field indices were calculated: SF (short-time fluctuation), ML (mean loss) and CLV (corrected loss variation). To study the influence of different visual field defects on the values of these indices, visual fields of normal subjects measured with program J0 on the Octopus were artificially changed. Hereby the calculation of the three indices allowed us to clarify the way they react to different artificially induced visual field defects. This makes it possible to infer how they are to be interpreted in clinical practice.

**T.J.T.P. van den Berg, W.G. van Veenendaal and E.L. Greve**

PSYCHOPHYSICS OF INTENSITY DISCRIMINATION IN RELATION TO  
DEFECT VOLUME EXAMINATION ON THE SCOPERIMETER

*The Netherlands Ophthalmic Research Institute, Amsterdam, The Netherlands*

For the assessment of changes in the visual fields of patients measures have been introduced that relate to the condition of visual field areas as a whole rather than to the condition of isolated positions (e.g. the Delta-program from the Fankhauser group). Due to the effect of averaging over a number of positions the advantage is that changes in the visual field can be detected with higher sensitivity. The gain in sensitivity is dependent on the averaging procedures that are performed as well as on the character of the visual field and its defects.

In order to optimize this gain basic information is needed on the psychophysics of intensity discrimination in static perimetry with emphasis on the sources of uncertainty involved. Some of this information can be found in literature. Based on the psychophysics involved on normal subjects we designed a procedure for sensitive assessment of the defect volume. The procedure is tested on a population of glaucomatous patients and a control group.

P.A. Rabineau, B. Gloor and H.J. Tobler

FLUCTUATIONS IN THRESHOLD AND EFFECT OF FATIGUE, IN AUTOMATED STATIC PERIMETRY WITH THE OCTOPUS

*Dept. of Ophthalmology, University of Basle, Basle, Switzerland*

Fluctuations in threshold and effect of fatigue on threshold as determined by static perimetry with the Octopus was determined in normals.

- 1) In 8 persons profiles extending from the centre to 30° were examined in 12 meridians with the F<sub>2</sub> programme (resolution 1°, each point determined twice). Not more than two profiles were done per day. Investigation time was never longer than 30 minutes. The mean difference in the whole group between two determinations at one point was 1.7 db.
- 2) 7 persons underwent four examinations by programme 31. One examination followed the other. The whole examination time was about one hour. No increase in fluctuations and no reduction in sensitivity were detected between the first and fourth examinations.
- 3) Two individuals were tested twelve times in a row with F programme; one performed the 12 examinations in 2 1/4 hours, the other in 3 1/2 hours. There was a small linear increase in fluctuations of 5% and 2% respectively from the beginning to the end of the examination.

*Conclusions:* During a period of one hour «fatigue» does not influence the threshold determination in the normal. Decrease in threshold over time may therefore indicate pathology in the visual field. Statistical analysis of the result shows additional interesting facts.

**J. Rovamo**

M-SCALING: A NOVEL PRINCIPLE FOR COMPUTERIZED PERIMETRY

*Dept. of Physiology, University of Helsinki, Helsinki, Finland*

In scanning perimetry visual field is usually tested with equally spaced stimuli that have the same size and luminance. This strategy has several drawbacks, however. For example, if test grid density is high enough so that small scotomas, significant for central vision, are not missed, then too much time is consumed for investigating peripheral vision. Also, if a stimulus is barely suprathreshold in central vision then it is too dim to be seen in peripheral vision and gives false-positive findings whereas if the stimulus is strong enough to be suprathreshold even in peripheral vision then it is so bright that relative scotomas in central vision are not discovered. These drawbacks can be avoided by optimal perimetry where stimulus parameters are M-scaled: (1) test grid density decreases with increasing eccentricity in direct proportion to the ganglion-cell receptive-field density (Rovamo & Virsu, 1979, *Exp. Brain Res.* 37:495-510), (2) stimulus area increases with eccentricity in inverse proportion to the ganglion cell density, and (3) stimulus luminance decreases with increasing eccentricity in inverse proportion to Ricco's area. In addition, quantitative thresholds, such as visual acuity, contrast sensitivity, colour discrimination, and critical flicker frequency, become independent of visual field location when stimulus parameters are M-scaled. Hence, in optimal perimetry normal profiles (perimetrograms) are independent of eccentricity and pathologies are readily recognized as pits in perimetrogram.

**P. Brusini and C. Tosoni**

**AUTOMATIC PERIMETRY IN GLAUCOMA: A CLINICAL COMPARISON OF TWO COMPUTER-ASSISTED PERIMETERS (PERIMETRON AND OCTOPUS 2000)**

*Division of Ophthalmology, Ospedale Civile, Udine, Italy*

Two automatic computerized perimeters (PERIMETRON and OCTOPUS 2000) were used to test the visual field of 43 patients (78 eyes) with open-angle glaucoma in various stages of development. A control group of 14 normal subjects (27 eyes) was also taken into consideration. The sensitivity of the two instruments was good, particularly so with developed and serious perimetric defects. In the group of patients with initial glaucoma and slight visual field defects the results, still satisfactory, were not quite as good, with a sensitivity of 86,5% for the PERIMETRON and 78,4% for the OCTOPUS 2000. In the test of normal subjects, both instruments demonstrated a good specificity, with a low number of false positive results.

An accurate manual kinetic and static perimetry with the Goldmann perimeter was used as a reference. The automatic perimetry results are very closely connected to the type of program used, the criteria adopted for the classification of the test results, the gravity of the examined defects and the level of collaboration of the subject examined.

The advantages of the PERIMETRON and OCTOPUS 2000 over manual perimetry are the objectivity and standardization of the test parameters. An improved fixation control device, and some modification of the software would make the two instruments even more reliable.

**C. Faschinger**

**PROGRAM SARGON OF THE COMPUTERPERIMETER OCTOPUS IN GLAUCOMA PATIENTS**

*Dept. of Ophthalmology, University of Graz, Graz, Austria*

Using the frequency distribution of early visual field defects in glaucoma derived from the results of Octopus perimetry, we developed a special Sargon program (user-defined program). The aim was to create a detection pattern with high resolution in areas with a high frequency of defects and to abandon the targets in areas with a low frequency, in order to shorten the test time.

**C.A. Johnson, J.L. Keltner and M.P. Jacob**  
NEW TEST PROCEDURES FOR THE SQUID AUTOMATED PERIMETER  
*Dept. of Ophthalmology, University of California, Davis, California, U.S.A.*

Two new test procedures for the Squid automated perimeter are described. The first method is a threshold sampling routine in which two target locations (approximately 5° and 25° eccentricities) in each of four quadrants (approximately 45°, 135°, 225° and 315° meridians) are evaluated for threshold prior to other target locations. The average difference between these thresholds and expected normal values for these locations is used to adjust all other expected threshold values within each quadrant. This procedure, in conjunction with testing time, and is most effective in eyes with moderate-to-extensive visual field loss. In nearly all cases, central static perimetry requires between 8-11 minutes to complete. The second procedure consists of kinetic testing of the peripheral visual field as a means of rapidly evaluating locations beyond 30°. Initial scans along four meridia are performed to determine optimum target size and intensity values for best evaluation of two peripheral isopters. A normal isopter takes approximately 60 seconds to complete. Abnormal isopters require slightly longer, due to more extensive evaluation of potentially abnormal areas and definition of anatomically significant boundaries (e.g., horizontal and vertical steps). Clinical examples will be presented.

**R.A. Lewis, J.L. Keltner and C.A. Johnson**  
PRELIMINARY CLINICAL TRIALS WITH THE HUMPHREY FIELD ANALYZER  
*Dept. of Ophthalmology, University of California, Davis, California, U.S.A.*

The Humphrey Field Analyzer is a new automated perimeter that performs static threshold testing and suprathreshold static testing. The static threshold test procedures use a target presentation pattern and staircase testing strategy that is similar to those employed on the Octopus and Squid automated perimeters. However, the Humphrey Field Analyzer begins with four equally-spaced target locations, determines their thresholds, and uses these measurements as starting values for the neighbors surrounding these targets. The visual field is thus evaluated according to a growth pattern of threshold determinations. This poster describes our preliminary clinical evaluations of the central visual field threshold test procedure of the Humphrey Visual Field Analyzer. Manual kinetic testing on the Goldmann perimeter and Humphrey visual field tests were performed on more than 150 eyes with glaucoma or neuro-ophthalmologic disorders. The Humphrey static threshold test times ranged from 8-18 minutes per eye, with an average time of 14-15 minutes. Detection and false positive rates, advantages and disadvantages, and clinical examples will be presented.

**B. Schwartz and P.A. Nagin**

PROBABILITY CONTOUR MAPS FOR EVALUATING CHANGES WITH TIME OF VISUAL FIELDS WITH THE OCTOPUS AUTOMATED PERIMETER  
*Tufts-New England Medical Center, Boston, Massachusetts, U.S.A.*

In order to analyze trends or changes of visual fields with time two statistical approaches can be used. The first is regression analysis with time and the second is a paired «t» test. We have developed computer programs to present the statistical probability of changes in the visual fields with time as a probability contour map. In addition, the slopes of the regression lines are presented as a contour map indicating the degree of positive or negative values. The same techniques of contour mapping can be applied to paired «t» test analysis. Each point in the visual field is analyzed.

We will present examples of the use of these methods in following the visual fields of patients under different clinical situations. The contour map is useful clinically since it allows one to quickly determine significant trends or changes of visual fields.

**E. Gandolfo, P. Capris, G. Corallo and M. Zingirian**

COMPARING DIFFERENT AUTOMATED STRATEGIES FOR STATIC THRESHOLD DETERMINATION  
*Dept. of Ophthalmology, University of Genova, Genova, Italy*

Three different static perimetric strategies are clinically compared in normal and pathological visual fields.

The first strategy is the widely used method of limits; the second is the repetitive «up and down» method. The third strategy represents a certain modification of the method of limits, by using infra-liminal stimuli with two different incremental ratios of target luminance : 0.5 L.U. steps increment for a first threshold approximation and 0.1 L.U. steps increment for the threshold assessment phase. A computerized Goldmann perimeter was employed. Our study demonstrates only small differences in the results obtained with the three methods when performing a traditional meridian test. Practical advantages and disadvantages are discussed.

**E. Gandolfo, P. Capris, G. Corallo and M. Zingirian**  
**EFFECTS OF RANDOM PRESENTATIONS ON KINETIC THRESHOLDS**  
*Dept. of Ophthalmology, University of Genova, Genova, Italy*

The effect of stimulus randomization on kinetic thresholds was studied. The same target was presented first in a sequential manner (the examined subject knowing the target direction) and then in a randomized manner (the subject unaware of the stimulus direction). Normal subjects (10 individuals) and patients suffering from visual field defects due to various pathological conditions (3 patients with glaucoma; 3 with neuro-ophthalmological diseases, and 4 with retino-choroidal alterations) were tested.

The automated Goldmann perimeter Perikon was employed to obtain good fixation control during perimetric testing. Stimuli randomization caused a statistically significant contraction of isopters (average 2-3° for a 14e stimulus). Sequential stimuli presentation seemed to give more consistent results on repeated examinations, provided that the subjects showed a good level of attention.

**A. Heijl**

**A SIMPLE ROUTINE FOR DEMONSTRATING INCREASED THRESHOLD  
SCATTER BY COMPARING STORED COMPUTER FIELDS**  
*Dept. of Ophthalmology, The University of Lund. Malmö, Sweden*

It has previously been shown that before a glaucomatous visual field defect can be clearly demonstrated the same area often shows increased variation at repeated threshold determinations. Computerized perimeters with the capability of storing visual fields can easily be programmed to compare and analyze consecutive fields from the same eye in various ways. By using a programme where the range of thresholds measured at consecutive examinations are printed out for all points tested, areas with increased scatter can easily be identified.

The poster demonstrates how, in very early glaucoma, such an analysis can demonstrate problem areas before clear-cut visual field defects are obvious.

N. Jacobs

VARIATION OF THE INCREMENT THRESHOLD WITH AGE: PRACTICAL IMPLICATIONS

*Manchester Royal Eye Hospital, Manchester, England*

It has been assumed that the retinal threshold sensitivity profile decreases predictably with age. On this basis, the significance of relative scotomata is decided on certain types of perimeters.

The Dicon perimeter measures the individual profile by simultaneous stimulation in 4 quadrants at equal eccentricity under photopic conditions. This circumvents possible error due to local field defects.

We measured this «hill of vision» in 130 healthy eyes, and found that there is a large variation between individuals, with no relationship to age. Refractive error affected only the shape of the central sensitivity peak.

## *II - Fundus Perimetry*

**A. Centaro<sup>\*,\*\*</sup>, G. Savage<sup>\*</sup>, J. Enoch<sup>\*</sup> and N. Newman<sup>\*\*\*</sup>**

FUNDUS PHOTOPERIMETRIC STUDIES OF DRUSEN OF THE OPTIC NERVE HEAD

<sup>\*</sup> *School of Optometry, University of California, Berkeley, California, U.S.A.*

<sup>\*\*</sup> *Dept. of Ophthalmology, University of Modena, Modena, Italy*

<sup>\*\*\*</sup> *Pacific Medical Center, San Francisco, California, U.S.A.*

The etiology of drusen of the optic nerve head has never been established conclusively. Likewise, the functional consequences of this condition are difficult to explain. In this study, we further define and localize these alterations in function by using fundus photoperimetry and quantitative perimetry.

The photoperimetric technique has confirmed that visual field defects often occur in areas which do not correspond with ophthalmoscopically visible drusen. Although this lack of correspondence has previously been noted, it has never been documented with such a precise and immediate method as we have used. Furthermore, in three of six patients studied, moderate to marked time-dependent losses in sensitivity have been found. The others demonstrate stable areas of visual loss expressed as enlarged blind spots and/or nerve fiber bundle anomalies.

Layer-by-layer perimetric analyses (as evolved in this laboratory) of areas within or adjacent to visual field defects, reveal normal inner retinal function in selected patients. These and other quantitative tests facilitate the localization of functional visual loss to retinal and/or optic pathway sites.



**J. O'Donnell\*, J.M.Enoch, E.A. Essock and R. Williams**  
**FUNDUS PHOTO PERIMETRY IN PATIENTS WITH GIRATE ATROPHY**  
*School of Optometry, University of California, Berkeley, California, U.S.A.*  
 \* *Dept. of Ophthalmology, University of California, San Francisco, California, U.S.A.*

Fundus photo-perimetry, the combination of fundus photography and visual field analysis within the same instrument, provides the opportunity to study the relationship between observed retinal anomalies and visual function at common loci. We report fundus photo-perimetric results in patients with gyrate atrophy of the retina. Correlations are made between the fundoscopically observed, scalloped margin of remaining retina and the limit of the peripheral functional visual field. Perimetric isopters conform closely to the scalloped, gyrate retinal margin. In some instances, visual function can be demonstrated in islands of remaining retina which are totally surrounded by dystrophic areas. This study demonstrates the utility of fundus photo-perimetry in correlating observed lesions and functional anomalies and in following the course of degenerative retinal diseases.

### *III - Colour Perimetry*

**E. Hansen, B.T. Olsen, T. Seim and A. Valberg**  
**A MODIFICATION OF THE GOLDMANN PERIMETER DESIGNED FOR COLOUR PERIMETRY**  
*Dept. of Ophthalmology, Rikshospitalet and Institute of Physics, University of Oslo, Oslo, Norway*

A light source of great intensity is an important requirement for projection colour perimetry as interference filters can be used to obtain near monochromatic lights.

A xenon lamp has been mounted in the Goldmann perimeter using the optic pathway of the apparatus for the stimulus light and at the same time giving a high intensity background field of limited size which can be adjusted along the horizontal meridian.

Stimulus duration as well as duration of the background field are controlled by electromechanical shutters. Maximum intensity of the stimulus light is 6500 cd/m<sup>2</sup> and that of the background field 5200 cd/m<sup>2</sup>.

The modified perimeter has been used for registration of Stiles' functions as well as for registration of transient tritanopia across the visual field.

M. Ikeda, N. Sekiguchi and S. Shioiri  
 COLOR PERIMETRY WITH A COLOR NAMING METHOD  
*Tokyo Institute of Technology, Yokohama, Japan*

There are three different criteria that can be employed in color perimetry: (1) a mere detection of light, (2) a mere detection of color without specifying its hue, and (3) a detection of a specific color such as red, orange and so on. The color perimetry based on the last criterion is vitally important from an ergonomical point of view, since there are specific colors that we should detect at the periphery when information is presented to us in terms of colors (e.g. traffic signals or colored display panels). In the present experiment the color visual fields were determined by a quantitative color naming method for stimuli 450, 510, 570 and 650 nm, roughly corresponding to blue, green, yellow and red. When one of the stimuli was presented at a certain retinal location, the subject was asked to report the amount of achromatic and chromatic components perceived in the stimulus with subjective estimation such as 2 achromatic and 8 chromatic, and the latter was further divided into two unique hues such as 6 red and 2 yellow. Thus, the visual field was quantitatively mapped in terms of detecting unique hues of red, yellow, green and blue. Four normal subjects participated in the experiment. All of them showed good perception of the hues at fovea but the perceived intensity of these four hues decreased towards the periphery. The perception of red and green colors decreased rapidly, of yellow and blue more gradually.

#### *IV - Neuro-ophthalmic Perimetry*

G. Calabria, E. Gandolfo, C. Burtolo, A. Oneto\* and N. Pizio\*  
 VISION CHANGES IN PARKINSONS' DISEASE: ELECTROPHYSIOLOGICAL  
 AND PERIMETRIC FINDINGS

*Dept. of Ophthalmology, University of Genova, Genova, Italy*

*\*Dept. of Neurology, University of Genova, Genova, Italy*

It has been recently demonstrated that in Parkinsons' disease visual evoked potentials (VEPs) are frequently characterized by a pathological increase in the latency of their main positive peak<sup>(1)</sup>. However, data are lacking on whether such a pathological change is correlated with clinically detectable visual impairment. The aim of this communication is to evaluate the possible existence of visual correlate to VEP changes in Parkinsons' disease. Specifically, visual field abnormalities have been searched for, since it has shown that careful examination of such a parameter may be as useful as the assessment of VEPs in identifying the presence of damage in the visual system, at least in multiple sclerosis<sup>(2)</sup>. Therefore, in the same group of patients with Parkinsons' disease VEPs by different stimuli were compared with the results of automated static perimetry (Peritest and Perikon). Preliminary results indicate that the two parameters are correlated; changes in VEPs are often associated with mild visual field defects represented by relative paracentral scotomata or an increased central threshold. To establish whether the visual changes are specific, the results obtained in the Parkinsonians were compared to those of a matched control group.

(1) I. Bodis-Wollner, M.D. Yahr, *Brain*, 101: 661, 1978.

(2) J.T.N. Van Dalen, H. Speckreijse, *Doc. Ophthalmol. Proc. Series 27*: 139, 1981

**F. Dannheim and W. Wesemann**

**VER-ANALYSIS WITH SIMULTANEOUS HEMIFIELD STIMULATION OF TRANSIENT POTENTIALS**

*Dept. of Ophthalmology, University of Hamburg, Hamburg, Germany*

Simultaneous stimulation of transient cortical potentials by checkerboard reversal is comparable to successive stimulation. It allows a direct comparison of the two hemifields. The application to cases with lesions of the central visual pathways and a correlation with computerperimetric findings is demonstrated.

**J.J. Corbett and H.S. Thompson**

**MECHANISM OF BLIND SPOT ENLARGEMENT WITH PAPILLEDEMA**

*Dept. of Neurology, University of Iowa, Iowa City, Iowa, U.S.A.*

Why is the blind spot enlarged in papilledema? The usual answer is that the retinal receptors around the disk have been pushed away from the disk by the swollen tissue of the nerve head. However, if this were true, an absolute field defect would be expected — and, as everyone knows, the enlarged blind spot has gently sloping borders.

When choroidal folds are combined with papilledema, the large shallow blind spot has been attributed to the acquired hyperopia. But in ordinary papilledema, the peripapillary retina is elevated and it must also acquire a relative hyperopia. Could the enlarged blind spot be nothing more than a refractive scotoma? If so, the enlarged blind spot should shrink dramatically with plus lenses. We will present evidence that suggests that this is indeed the case.

S.E. Feldon

QUANTITATIVE ASSESSMENT OF NEURO-OPHTHALMOLOGIC VISUAL  
FIELD DEFECTS

*Dept. of Ophthalmology and Neurological Surgery, University of Southern  
California and Estelle Doheny Eye Foundation, Los Angeles, California, U.S.A.*

Systematic typing of peripheral visual fields is essential to the topical diagnosis of lesions affecting the afferent visual pathways. Although these «model» field defects are essential for detection field loss by manual methods, some information is lost due to this targeted approach. Because computerized, quantitative, static perimeters such as the Octopus test visual sensitivity at equal intervals throughout the visual field, they are not subject to the strategic bias common to most forms of manual perimetry. Furthermore, the numeric nature of the Octopus output allows statistical comparisons both within and between fields.

A study was undertaken to quantitatively evaluate 80 patients with common neurological visual field defects — altitudinal, bitemporal, and hemianopic. Statistics were applied in order to demonstrate the extent to which these field defects corresponded to the usual «model». Wherever possible, correlations to the anatomy were made, using quantitative volume determinations obtained from high resolution computed tomographic scans. Some of the deviations from the expected field defects are explained by known pathophysiology, while others require further investigation.

## V - Glaucoma Perimetry

**C. Azzolini and P. Brusini**

### FLUORESCEIN ANGIOGRAPHY OF THE OPTIC DISK AND VISUAL FIELD DEFECTS IN OPEN-ANGLE GLAUCOMA AT THE INITIAL STAGE

*Division of Ophthalmology, Ospedale Civile, Udine, Italy*

We studied the vascularization of the optic disk by fluorescein angiography in 55 eyes affected with open-angle glaucoma at the initial stage. The results we obtained were compared to the visual field defects.

The fluorescein angiographic defects of the optic disk were distinguished according to their morphology and their duration.

The visual field examination was performed with a Goldmann perimeter by using kinetic perimetry, suprathreshold static perimetry between the isopters, meridional static perimetry, and, in some cases, circular static perimetry. In 9 patients (15 eyes) a Perimetron automatic perimeter was used with no. 10 program (3-5 isopters kinetic perimetry + kinetic delimitation of the blind spot + static examination of 129 points within 25°).

A significant connection between the fluorescein angiography date and the perimetric defects was found in only 9 cases (16.4%). This low percentage may be due to the fact that the fluorescein angiography alterations can precede the perimetric defects and to difficulty in detecting slight fluorescein angiographic defects.

**F. Cardillo Piccolino, G. Selis, D. Peiré and G.C. Parodi\***

### FLUORESCEIN FILLING DEFECTS OF THE OPTIC DISC AND FUNCTIONAL EVALUATION IN GLAUCOMA

*Dept. of Ophthalmology, University of Genova, Genova, Italy*

*\*Electrical Dept., University of Genova, Genova, Italy*

Fluorescein filling defects of the optic disc have been correlated with visual field alterations in glaucoma patients. But it is not yet clearly demonstrated whether filling defects increase in size as visual field loss progresses. In the present study, the optic disc perfusion of glaucoma and ocular hypertensive patients was analyzed by an image processor. The areas of absolute filling defects could be measured by detecting the corresponding density level on the angiographic images. During the follow-up of each patient (2 to 5 years) the size of filling defects was compared to the extension and evolution of the visual field loss.

No variation was observed when a visual field remained unchanged. Increase in size of disc filling defects correlated directly with progression of perimetric damage. The results of our study support the assumption that optic disc perfusion defects may precede functional deterioration in glaucoma patients.

**A. Heijl and C. Samander**

**PERIPAPILLARY ATROPHY AND GLAUCOMATOUS VISUAL FIELD DEFECTS**

*Dept. of Ophthalmology, The University of Lund in Malmö, Malmö, Sweden*

At the 1982 International visual Field Symposium Dr. Douglas Anderson proposed that the conformation of peripapillary tissues helps determine how susceptible a particular disc is to pressure-induced damage and also which portion of the disc and field will be most affected (Doc. Ophthal. Proc. Ser. 35:1-10, 1983).

We studied the correlation between peripapillary changes and visual field defects in 66 consecutive eyes with unidirectional (superior or inferior) glaucomatous field defects. There was a statistically highly significant correlation between the location of the largest peripapillary changes and the direction of the field defect. Thus it was much more common that eyes with peripapillary changes showed field defects in the opposite direction of the peripapillary changes than in the same direction. The correlation was as good or better if only pigmented lesions were taken into consideration, as when both pigmented and nonpigmented atrophies were considered.

**B.L. Petrig, E.B. Werner, C.E. Riva and J.E. Gunwald**

**RESPONSE OF MACULAR CAPILLARY BLOOD FLOW TO CHANGES IN INTRAOCULAR PRESSURE AS MEASURED BY THE PERCEPTION OF THE BLUE FIELD ENTOPTIC PHENOMENON**

*Dept. of Ophthalmology, Scheie Eye Institute, University of Pennsylvania, Philadelphia, Pennsylvania, U.S.A.*

The effect of induced elevations of intraocular pressure on the velocity of the leukocytes in the macular capillaries was studied in six normal subjects using a suction cup dynamometer to elevate the intraocular pressure. Subjects were studied over a range of intraocular pressures from baseline to 45 mm Hg. The velocity of the leukocytes was measured using a computer simulation of the Blue Field Entoptic Phenomenon. The subjects compared and matched the speed of simulated particles displayed on a CRT screen to that of their own entoptically perceived leukocytes.

In most subjects, the velocity of the particles was maintained at or near baseline up to an IOP of about 30 mm Hg. Above this pressure, the velocity fell in a linear fashion proportional to the IOP. The results indicate that the macular microcirculation is autoregulated over a range of perfusion pressures, but that autoregulatory mechanisms fail to maintain baseline blood flow at intraocular pressures which are still well below diastolic retinal artery pressure. The Blue Field Phenomenon may form the basis of a clinical test to evaluate autoregulation in glaucoma, vascular retinopathies, and other diseases.

**H. Kosaki, H. Nakatani, I. Azuma and K. Sakaguchi**

**EXAMPLES OF AREA MEASUREMENTS BY COMPUTER IN THE ASSESSMENT OF VISUAL FIELDS. ANALYSIS OF THE TREATMENT BY MECOBALAMIN OF CHRONIC GLAUCOMATOUS VISUAL FIELDS**

*Osaka, Japan*

It is customary in the diagnosis of glaucoma to use visual field topography for the assessment, and this has given us no problems. However, for the evaluation of progression in this disease, numerical data rather than patterns can be processed statistically and make it easier to detect minor field changes. For this purpose, we developed a method to measure isopter areas by computer, which we presented at the last IPS Symposium.

Recently, we performed a study in which we administered Mecobalamin 500 ug, 3 tab/day, orally for 6 months to 162 patients (278 eyes) with chronic primary glaucoma and abnormal visual fields. The patients' intraocular pressures had been adjusted to under 21 mm Hg for 3 months. After the Mecobalamin treatment, 30% of the cases showed visual field improvement, as judged by our area measurement method.

**V.J. Marmion**

**A COMPARISON OF CONTRAST SENSITIVITY FUNCTION AND FIELD LOSS IN GLAUCOMA**

*Bristol, England*

Contrast sensitivity function was measured in 30 patients with early glaucomatous visual field defects. Defects were found at the low frequency end of the scale and, to a lesser extent, at the high frequency end of the scale of the Arden Gratings. The error score produced by these defects was greater than the percentage reduction across a scotoma as demonstrated on the Friedmann Analyser. This suggests that contrast sensitivity dysfunction is an early defect in open angle glaucoma.

**S. Mizutani and A. Suzumura****DIURNAL VARIABILITY OF THE VISUAL FIELD, AS MEASURED BY THE OCTOPUS PERIMETER**

*Dept. of Ophthalmology, Aichi Medical University, Aichi, Japan*

The Octopus perimeter is useful for the detection of the initial changes in the visual field in glaucoma. In order to determine its sensitivity and repeatability, as well as to ascertain the method to utilize it to best advantage, an investigation was made of the diurnal changes in intraocular pressure and the diurnal changes in the visual field.

The subjects were patients suspected of having glaucoma. Diurnal variation in intraocular tension was determined. Octopus programs 31 and 33 were employed for the visual field testing.

Among the cases evidencing marked diurnal variation in intraocular tension were some who also showed diurnal changes in the visual field. Program selection and new procedures were considered as possible distinct adjuncts to early diagnosis.

**A. Polizzi, E. Gandolfo, N. Grillo and G. Calabria****EARLY MACULAR DAMAGE IN GLAUCOMA AND SUSPECTED GLAUCOMA PATIENTS**

*Dept. of Ophthalmology, University of Genova, Genova, Italy*

Five glaucoma and 16 suspected glaucoma patients were examined by traditional kinetic perimetry, automated kinetic-static glaucoma screening (Perikon), and threshold-related static perimetry (Peritest). In these patients macular recovery after photostress was tested by Goldmann-Weekers adaptometry, and colour discrimination was tested by Farnsworth 100 hue and Panel D 15. Ten normal subjects were examined as controls.

The results of the macular function tests in both glaucoma and suspected glaucoma patients were significantly different from those of the normals. In patients with glaucoma or ocular hypertension ( $10P \geq 24$  mmHg) the macular function appeared disturbed in a significantly higher percentage than in normal subjects. The correlation between visual field changes and macular function alterations is discussed.



## *VI - Miscellaneous*

**M.D. Benedetto and M. Cyrlin**

THE EFFECT OF BLUR UPON STATIC PERIMETRIC THRESHOLDS

*Dept. of Ophthalmology, University of Florida, Gainesville, Florida, U.S.A.*

Emmetropes with no visual pathology were cyclopleged and corrected for cupola distance. The subjects were tested on an Octopus Automated Perimeter with a range from  $-2.5$  to plano to  $+10.0$  Diopters of spherical blur. The clinical significance of under or over correction will be discussed and related to clinical populations.

The differentiation of thresholds with retinal location will be explored. In addition, this data will be related to kinetic perimetric findings.

This is important in the investigation of retinal pathology and ocular refractive conditions.

**P. Blondeau and C.D. Phelps**

ACUITY PERIMETRY: TEST PARAMETERS

*Dept. of Ophthalmology, The University of Iowa, Iowa City, Iowa, U.S.A.*

Our acuity perimeter permits us to measure peripheral acuity at eccentricities from zero to  $20^\circ$  along any meridian. The acuity stimulus, which is generated by laser interferometry, is round,  $1^\circ$  in diameter, and contains alternating red and black stripes. The separation and orientation of the stripes can be varied. We studied the influence of background brightness, stimulus presentation time, and stimulus orientation. Peripheral acuity is reduced at low background illumination but reaches a plateau when the background illumination is brighter than 4.3 apostilbs. It is stable at presentation times greater than  $1/8$  second, but declines with briefer presentations. A slight reduction of acuity occurs with oblique stimulus pattern orientation; this oblique effect is more marked in the periphery than centrally, and is greater in the horizontal and vertical meridians than in the oblique meridians.

Intraindividual variation is minimal. Normal mean values and variance have been determined.

**J. Flammer and M. Zulauf**

**THE DISTRIBUTION OF THE THRESHOLD OF THE DIFFERENTIAL LIGHT SENSITIVITY**

*Dept. of Ophthalmology, University of Bern, Bern, Switzerland*

The outcome of a measurement of the differential light sensitivity threshold is always affected by scatter. This scatter can be divided into short-term and long-term components. In this study we analysed the distribution of the short-term components of 13.000 threshold measurements. We compared the absolute scale (apostilbs) with the logarithmic scale (dBs), the center of the visual field with the mid-periphery, normal areas with relative scotomas.

**R. Haruta, K. Kani and T. Inui**

**A NEW NUMERICAL REPRESENTATION OF VISUAL FIELD IN REGARD TO THE DENSITY OF RETINAL GANGLION CELLS**

*Dept. of Ophthalmology, Hyogo College of Medicine, Nishinomiya, Japan*

The scale in charts for quantitative perimetry is not based on the distribution of the cortical visual cells. The eccentricity-related change in retinal ganglion cell density is linearly correlated with that of cortical visual cells.

We report a new numerical visual field representation taking into account the retinal ganglion cell density. The areas of the chart correspond to the retinal cell count. Isopters were plotted on the chart and the volume of the «island of vision» was calculated, the unit being retinal cell count x sensitivity.

With this method the visual system is represented not only on the retinal but also on the cortical level. The cortical magnification factor is shown.

**A. Serra**

**PLASTICITY OF PERIPHERAL VISION IN RELATION TO DISTORTION CAUSED BY MULTIFOCAL LENSES**

*Dept. of Physiopathological Optics, University of Cagliari, Cagliari, Italy*

Recently, multifocal lenses are being used by some people with various degrees of presbyopia. Their meridional distribution of optical power produce a distortion which has a counterpart in the estimate of the visual field. Data recorded by us, on a number of skilled and cooperative individuals reveal isopter constriction as well as a decreased peripheral vernier acuity. The plasticity of the visual system is revealed by the time change in the above effects, the observer being progressively adapted to the new perceptual situation.

**G. Calabria, E. Gandolfo and C. Burtolo**

**STATIC AUTOMATED PERIMETRY IN THE FOLLOW-UP OF LENS OPACITIES**

*Dept. of Ophthalmology, University of Genova, Genova, Italy*

Modern perspectives of cataract medical therapy have induced researchers to study objective methods for lens transparency evaluation. Visual acuity determination, slit-lamp examination, photographic and densitometric methods are unreliable. To avoid such inconveniences, computerized static perimetry was employed. Our strategy was based on two automatic perimeters: the Peritest (Rodenstock) and the Perikon (Optikon). The Peritest was very useful in the static analysis of cataract-induced threshold changes in the central visual field. Static meridian perimetry by Perikon was utilized for peripheral threshold changes. This method was tested in 50 patients. It appears to be reliable, well accepted by patients, rapid and easily standardized.

R. Fusco, G.N. Greco, A. Greco and G. De Crecchio  
PERIMETRY OF DIABETIC MACULOPATHY BEFORE AND AFTER ARGON  
LASER THERAPY

*Dept. of Physiological Optics, University of Napoli, Napoli, Italy*

34 eyes suffering from diabetic maculopathy have been examined with kinetic and static perimetry before and after argon laser photocoagulation. Eyes with exudative maculopathy received focal photocoagulation; the oedematous forms were subjected to «grid» photocoagulation of the macula. After treatment 80 percent of the cases with exudative maculopathy showed an increase of central retinal sensitivity while 20 percent remained unchanged. Among cases with oedema, 50 percent showed improvement of central retinal sensitivity, 38.5 percent were unchanged and 11.5 percent deteriorated.

**E. Campos and R. Gulli**

ANALYSIS OF THE BINOCULAR VISUAL FIELD OF STRABISMIC PA-  
TIENTS AND ITS OBJECTIVE CORRELATE

*Dept. of Ophthalmology, University of Modena, Modena, Italy*

Binocular visual field studies performed with fusible stimuli as test targets demonstrate that a binocular single perception is present in patients with small angle concomitant strabismus all over the visual field considered ( $30^\circ$ ). This binocularity is sustained by anomalous retinal correspondence (ARC). No suppression scotomas are found.

These perimetric results can be made objective by means of visual evoked responses (VER). VER show the existence of a binocular cortical integration in the same patients in which a binocular single perception was found with perimetry.

The significance of these findings is discussed.

**G. Verriest, R. Mahendrastari and G. Brondel**  
**BINOCULAR VISUAL FIELD IN DIFFERENT TYPES OF STRABISMUS.**  
**PRELIMINARY RESULTS.**

*Ghent, Belgium*

Monocular and binocular perimetry (without) dissociation between the two eyes) was performed by means of different techniques (kinetic manual Goldmann perimetry and static automatic perimetry) in normal subjects and in strabismus patients with and without amblyopia. Results show an increase of sensitivity in binocular vision in normals and in all patients with strabismus, particularly in the central visual field.

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