7TH INTERNATIONAL VISUAL FIELD SYMPOSIUM

AMSTERDAM

7 - 10 SEPTEMBER 1986

PROGRAMME

INTERNATIONAL PERIMETRIC SOCIETY

PROGRAMME

7TH INTERNATIONAL VISUAL FIELD SYMPOSIUM

organized by the

INTERNATIONAL PERIMETRIC SOCIETY

7 – 10 SEPTEMBER 1986

AMSTEL HOTEL
AMSTERDAM
THE NETHERLANDS

CONTENTS

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SYMPOSIUM SECRETARIAT

All matters concerning local organization and accommodation:

before the symposium:

Foundation for Perimetric Research
Cannenburgerweg 19
1244 RE Ankeveen - 's Graveland
The Netherlands
Telephone: 035 - 63303

or:

Glaucoma department of the
Eye Clinic of the University of Amsterdam
Meibergdreef 9,
1105 AZ Amsterdam
The Netherlands
Telephone: 020 - 566.3616

during the symposium:

Office of the International Perimetric Society
Amstel Hotel
Prof. Tulpplein 1
1018 GX The Netherlands
Telephone: 020 - 226060

All matters concerning the scientific programe and secretariat of the IPS after the symposium:

Dr. A. Heijl
Department of Ophthalmology
Malmö General Hospital
S-21401 Malmö
Sweden
Telephone: 040 - 333562/331352

SYMPOSIUM BUREAU

Located in the Maurits room (see map)

Open:	Sunday 7th September	14.00 - 20.00 hour
	Monday 8th September	08.00 - 16.00 hour
	Tuesday 9th September	08.00 - 16.00 hour
	Wednesday 10th September	08.00 - 16.00 hour

Symposium Secretariat
Registration
Information
Social Programme
Slide preparation
Proceedings office

PROCEEDINGS:

The proceedings will be published by:

Dr. W. Junk / Martinus Nijhoff
Spuiboulevard 50
P.O. Box 163
3300 AD Dordrecht
The Netherlands

in: Documenta Ophthalmologica Proceedings Series

Editors: E.L. Greve & A. Heijl.

All papers should be handed in NO later than Sunday 7th or Monday 8th at the Proceedings office to Mrs. E.M.G. Mutsaerts or Mrs. S.R. Ompi.

HOTELS

Amstel Hotel
Prof. Tulpplein 1
1018 GX Amsterdam
Telephone: (20) 22 60 60

Amsterdam Apollo Hotel
Apollolaan 2
1077 BA Amsterdam
Telephone: (20) 73 59 22

Amsterdam Hilton Hotel
Apollolaan 138
1077 BG Amsterdam
Telephone: (20) 78 07 80

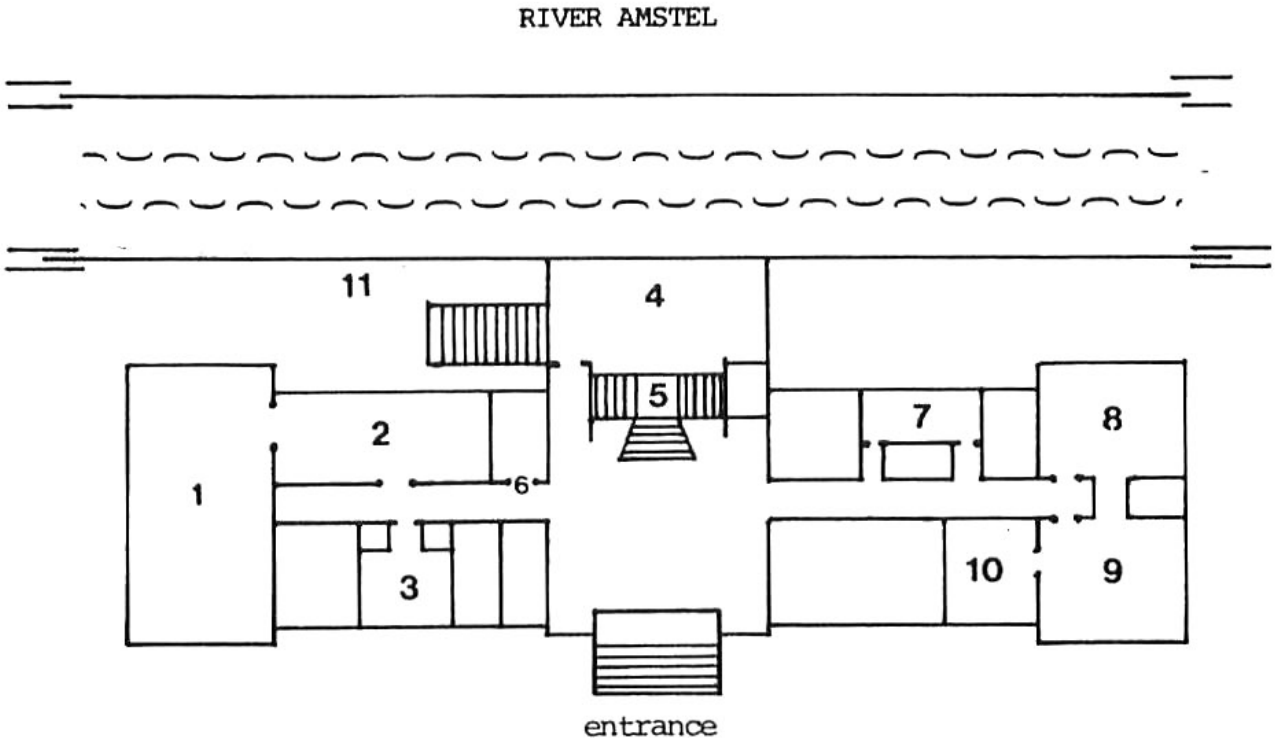
Hotel Beethoven
Beethovenstraat 43
1077 HN Amsterdam
Telephone: (20) 64 48 16

The distance between Amstel Hotel, where the conference is held, and the other hotels is about 10 kilometers. This is too far to walk.
It is a 15 minutes-ride by taxi.

There will be a shuttle bus-service from the hotels to the Amstel hotel and back starting on Sunday 7th at 17.00 hour and ending at Wednesday 12th at 23.00 hour.

Map of the Parterre of the Amstel Hotel.

A M S T E L H O T E L



1.	Meeting hall and dinner Wednesday
2.	Posters
3.	Secretariat, slides, information etc.
4.	Amstelbar: drinks and light food
5.	Stairway to hotelrooms and balustrade
6.	Entrance to restaurant
7,8,9,10	Technical exhibition and reception Sunday
11.	Pier, boatentrance for lunches Monday and Wednesday

	08.30 - 10.00	10.30 - 12.00	14.00 - 15.30	16.00	
	I P S B O A R D M E E T I N G				
Sunday 7th September			REGISTRATION		WELCOME RECEPTION 19.00-20.30
Monday 8th September	Session I. MEDIA	Session II. FUNDUS PERIMETRY Special Techniques	Session III. MISCELLANEOUS	Session IV. ERGO PERIMETRY	DINER ON BOARD CAPTAIN KOK RADERBOAT
Tuesday 9th September	BUSSINESS MEETING	Session V. VARIABILITY	TOUR HISTORICAL DUTCH COUNTRY THE DIKES		THE IPS DINNER RICE TABLE DINNER LIDO
Wednesday 10th September	Session VI. GLAUCOMA I.	Session VII. POSTERS 10.30-12.30	Session III. GLAUCOMA II. 14.30-16.00	END of the SCIENTIFIC PROGRAMME	COCKTAIL AND FAREWELL-DINER 18.30 AMSTEL HOTEL

Overall plan of the meeting.

Coffee break:	Monday	10.00 - 10.30
	Tuesday	09.30 - 10.30 (plus technical exhibition)
	Wednesday	10.00 - 10.30
Lunch:	Monday	12.30 - 13.30 on board
	Tuesday	included in tour
	Wednesday	12.30 - 13.30 on board
Tea:	Monday	15.30 - 16.00
	Tuesday	included in tour
	Wednesday	15.30 - 16.00

NB: The Subcommittee on Standards will meet on Saturday 6th of September on 16.00 hour in Maurits-room, Amstel Hotel.

SOCIAL PROGRAMME

I. For participants and accompanying persons

Sunday 7th Sept. 19.00-20.30 hour	Wellcome reception (drinks and snacks) Amstel Hotel
Monday 8th Sept. 18.30 hour	Tour through Amsterdam Harbour with the "Captain Kok", an old rader-saloon boat dating from 1911 in a very good condition. Entertainment with music and a buffet-diner will make this evening a very special one. Bus departure from hotels at 18.30 hour.
Tuesday 9th Sept. 13.00-23.00 hour	Ride to northern part of Holland. Visit to 3 typically Dutch villages: Marken-Volendam-Zaanse Schans. (Old Clock-museum; taste the cheese!). Tea. 15 Minutes drive to another area of historical interest. Taste the smoked eal from the Southern Sea. 17.00 hour: return by bus to Amsterdam 17.45 hour: boattrip through canals (highly recommended) to the Lido restaurant. 19.00 hour: reception and rice table - diner in Lido-restaurant. I.P.S. entertainment. THE I.P.S. EVENING This evening is sponsored by the major sponsors: Humphrey, Interzeag, Rodenstock, Alcon, Chibret. Bus departure from Amstel Hotel at 13.00 hour.
Wednesday 10th Sept. 18.00 hour 19.30 hour	 Cocktailparty on the Balcony, first floor Amstel Hotel. Farewell dinner in the Amstel Hotel, Mirror room.

SOCIAL PROGRAMME

II. For accompanying persons only

See page 9 for social programme for participants and accompanying persons.

Sunday 7th Sept. 19.00-20.30 hour	Welcome reception
Monday 8th Sept. 08.00-16.00 hour	Visit to the Worlds largest flower auction in Aalsmeer (only early in the morning).Coffee. Drive to The Hague, Madurodam: a miniature view of all the interesting things in Holland. See Holland in one glance. Visit to Delft and Scheveningen. Delft is a 17th century old town, beautifully restored and very attractive (Delftware!). In Scheveningen we will have lunch along the seaside. After lunch visit to "Panorama Mesdag". Paintings of seaside painter Mesdag in an unusual setting. NOTE: EARLY DEPARTURE BECAUSE OF VERY EARLY START FLOWER AUCTION. 07.00 hour: departure busses from hotels.
18.30-22.00 hour	see social programme for participants.
Tuesday 9th Sept. Amsterdam or Frans 13.00-23.00 hour	Morning free. suggestion: Rijksmuseum and museum Vincent van Gogh in Halsmuseum and Teylermuseum in Haarlem. See social programme participants.
Wednesday 10th Sept. 09.00-16.00 hour	Tour through Golden Age Amsterdam. Canals, courtyards (very special), antique shops and Royal Palace. Lunch in specially reserved rooms in 17th century patrician house along canal; with concert.
18.00	see social programme for participants.
19.30	see social programme for participants.

TECHNICAL EXHIBITION

FROM SUNDAY EVENING 7TH 18.00 TILL WEDNESDAY AFTERNOON 10TH 17.00 HOUR.

MAJOR SPONSORS:

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G. Rodenstock Instrumente (D.B.R.)
Topcon Europe (Netherlands)

SCIENTIFIC PROGRAM

SCIENTIFIC PROGRAM

The Scientific Programme consists of two parts:
1. spoken papers
2. posters

The selection is not based on a difference in the quality nor in the interest or importance of these two parts.

During the spoken sessions there will be ample time for discussion.

There is a special session devoted to discussion of the posters. This session will last approximately two hours.
A slide showing the title of each poster will be presented. Participants will have the opportunity to discuss posters in public (and of course with the author(s) at the posterstand).

SPOKEN PAPERS

08.30 - 10.00 **Session I. MEDIA**

Chairman S.M. Drance
Moderator: J. Flammer

1. Ph. Hendrickson., D. Eichenberger, B. Gloor and Y. Robert
Influence of ocular media on perimetric results: 1. Effect of IOL implantation.

2. D.K. Heuer., D. Anderson, R.W. Knighton and M.G. Gressel
The influence of simulated media opacities on threshold measurements.

3. U. Guthauser and J. Flammmer
Influence of cataracts on visual fields.

4. J.M. Wood and J.M. Wild
The role of intra-ocular light scatter in the attenuation of the perimetric responce.

5. T.J.T.P. van den Berg and E.L. Greve
Relation between media disturbances and the visual field.

6. P. Baraldi., J.M. Enoch and S. Raphael.
A comparison of visual impairment caused by nuclear and posterior subcapsular cataracts.

7. C. Faschinger
Computerperimetry in patients with corneal dystrophies.

10.30 - 12.00 Session II. FUNDUS PERIMETRY
Special techniques

Chairman J. Enoch
Moderator L. Frisén

8. K. Yabuki and R. Ogawa
Visual field in diabetic retinopathy. Light sensitivity in retinal lesions.

9. K. Mizokami., N. Katsumori and H. Miyazawa
Early foveal dysfunction in glaucoma.

10. T.M. Fausset and J.M. Enoch
A rapid and simple technique for kinetic visual field determination in young children and adult patients with central retinal lesions.

11. E.M. Brussell., M. Dixon, J. Faubert and G.A. Balazzi
Multi-flash campimetry: the rapid assessment of temporal resolving power.

12. B.Drum., M. Breton, R. Massof, H. Quigley, T. Krupin, J. Leight, J. Mangat-Rai and D. O'Leary.
Pattern discrimination perimetry: a new concept in visual field testing.

13. L. Frisén
A computer-graphics approach to visual field screening, using high-pass spatial frequency filtered resolution targets and multiple feedback devices.

14.00 - 15.30 Session III. MISCELLANEOUS

Chairman M. Zingirian
Moderator K. Kitahara

14. E. Aulhorn and W. Durst
Automated perimeter results: the need for a common language.

15 J.L. Keltner., C.A. Johnson and R.A. Lewis
J.A.W.S. (Joint Automated Weighting Statistic): A method of converting results between automated perimeters.

16. T.J. Smith and K.M. Goins
Standards of perimetry in clinical practice.

17. D.S. Minckler and T.E. Ogden
Primate arcuate nerve fiber bundle anatomy.

18. R. Haruta., K. Kani, K. Sakatani and T. Ohta
A new numerical representation of the visual fields of the chiasmal tumor.

19. H. Bynke
Pituitary adenomas with visual field defects treated 1946 - 1984.

20. J. Weber
Computerized perimetry in neuro-ophthalmology - comparison of different test patterns by an "information index".

16.00 - 17.30 Session IV. ERGO PERIMETRY

Chairman G. Verriest
Moderator E. Campos

21. G. Verriest
Procentual impairment by visual field defects.

22. E.S. Choy., S.M. Drance and R.P. Mills
Esterman testing of glaucoma disability.

23. E. Gandolfo
Functional quantification of the viusal field: A new scoring method.

24. A. Hedin
Effects of visual field defects on driving performance.

10.30 - 12.00 SESSION V. VARIABILITY

Chairman F. Fankhauser
Moderator A. Heijl

25. A. Heijl., G. Lindgren and J. Olsson
Variability of computerized threshold measurements across the central field in a normal population.

26. C.T. Langerhorst, T.J.T.P. van den Berg and E.L. Greve
Shortterm and longterm fluctuation of thresholds in automated perimetry in normals, ocular hypertensives and glaucoma patients.

27. E.B. Werner., K.I. Bishop, C. Sherman, P. Davis, T. Krupin and B. Petrig
Visual field variability in stable glaucoma patients.

28. R. Starita., J. Lynn, R. Fellman and J. Piltz
Total variance of serial Octopus visual fields in glaucomatous and normal eyes.

29. R.P. Mills., M. Schulzer, R.H. Hopp and S.M. Drance
Estimates of variance in visual field data.

30. B.C. Chauhan and D.B. Henson
The distribution of visual field scores in a normal population.

31. E. Capris., E. Gandolfo and M. Zingirian
Kinetic shortterm fluctuation in patients with glaucoma and suspected glaucoma.

08.30 - 10.00 Session VI. GLAUCOMA I.

Chairman E. Aulhorn
Moderator E.L. Greve

32. P.J. Airaksinen., P. Juvala, A. Tuulonen and H.I. Alanko
Change of neuroretinal rim area and visual fields over time.

33. A. Tuulonen., P.A. Juvala, D. Wu, H.I. Alanko and B. Schwartz
Optic disc pallor vs. viusal fields: a 9-year follow-up study.

34. N. Katsumori., K. Okubo and K. Mizokami
The changes of visual field sensitivity accompagnied by enlargement of glaucomatous optic cup.

35. J. Caprioli
Patterns of early glaucomatous visual field loss.

36. A. Glowazki and J. Flammer
Is there a difference between glaucoma patients developing diffuse visual field damage and glaucomatous patients developing more localized visual field defects?

37. F. Dannheim
First experiences with the new Octopus G1- program in chronic simple glaucoma.

38. E. Gramer., M. Bassler and W. Leydhecker
Cup/disk ratio, excavation volume, neuroretinal rima area of the optic disk in correlation to computerperimetric quantification of visual field defects in glaucoma with and without pressure.

Session VII. Poster session

14.00 - 16.00 **SESSION VIII. GLAUCOMA II.**

Chairman D. Anderson
Moderator F. Dannheim

39. C. Migdal, R.A. Hitchings and P. Clark
Glaucomatous field changes related to the method and degree of intraocular pressure control.

40. R. Fellman., J. Lynn, R. Starita and G. Spaeth
Correlation of intraocular pressure and visual field following Argon laser trabeculoplasty.

41. M. Virno., E.C. Campos, J. Pecori-Giraldi and G. Garofalo
Perimetric changes induced by artificial hypotension as an attempt towards determination of risk IOP in early open angle glaucoma.

42. J. Flammer and U. Guthauser
Visual field defects caused by the vasospastic syndrome.

43. C. Holmin., A. Aittala and C.E. T. Krakau
On the provocation of visual field defects in glaucoma cases.

44. M. Rolando., G. Corallo, C. Burtolo and E. Gandolfo
Glaucoma follow-up by means of the central differential threshold.

SCIENTIFIC PROGRAMME

POSTERS

1. D. Eichenberger., Ph. Hendrickson, Y. Robert and B. Gloor
Influence of ocular media on perimetric results: 2. Effect of simulated cataract

2. U. Urner-Bloch
Simulation of the influence of lens opacities on the perimetric results, investigated with orthoptic occluders.

3. L.B. Baldwin and T.J. Smith
Does higher background illumination lessen the effect of decreased retinal illumination in automatic perimetry?

4. H.D. Hoskins and S.D. Magee
A system for the analysis of automated visual fields.

5. A. Heijl., G. Lindgren and J. Olsson
A package for the statistical analysis of computerized visual fields.

6. C.E.T. Krakau
Artificial intelligence in computerized perimetry.

7. B. Schwartz and D. Wu
Trend analysis of automated visual fields.

8. J.M. Wild and J.M. Wood
Quantification of the visual field in computer assisted threshold perimetry.

9. R.J. Nooteboom and T.J.T.P. van den Berg
Behavior of visual field indices with a gradient adaptive method.

10. G.N. Lambrou., P. Schalk, R.V. Rechenmann and A. Bronner
Computer-assisted visual field assessment: Quantification, three- and four dimensional representations.

11. C.T. Langerhorst., T.J.T.P. van den Berg, R. Nooteboom and E.L. Greve
Shortterm and longterm fluctuation of thresholds in automated perimetry and the influence on the defect volume.

12. A. Heijl., G. Lindgren and J. Olsson.
Reliability parameters in computerized perimetry.

13. F. Jenni and J. Flammer
Experience with the reliability parameter of the Octopus automated perimeter.

14. E.L. Greve., A.N. Zeilstra, M.A.C.R. Raakman and D. Bakker
Excessive variability of results of computerized perimetry.

15. W.E. Sponsel., A. Hobley, D.B. Henson, B. Chauhan and N.L. Dallas
Quantitative suprathreshold static perimetry; the value of field score and asymmetry analysis in the early detection of chronic open angle glaucoma.

16. F.S. Mikelberg., S.M. Drance, M. Schulzer and K. Wijsman
The effect of pupil diameter on visual field indices.

17. H. Kosaki and H. Nakatani
Visual field screening by a symmetrical method: prototype of a new automatic perimeter.

18. A. Aittala., H. Bynke, C.E.T. Krakau and R. Ohman
A new computerized perimeter (Competer 750) for examination of neuro-ophthalmic patients.

19. D. Henson and H. Bryson
Clinical results with a new visual field screener 'Henson CFS2000'.

20. A.T. Funkhouser and H.P. Hirsbrunner
Sappar: an auxillary program for SAPRO.

21. J. Charlier., J. Sachy, F. Vernier and J.C. Hache
Dynamic representation of the visual field.

22. C.A. Johnson and R.A. Lewis
Staircase scoring procedures for automated perimetry.

23. J.R. Lynn., R.L. Fellman and R.J. Starita
A new contingent algorithm for static automatic perimetry based upon chain pattern analysis.

24. P.P. Apathy., S.G. Jacobson, L. Nghiem-Phu and J.M. Parel
Computer-aided analysis in automated dark-adapted static perimetry.

25. J. Faubert., A.G. Balazsi, O. Overbury and E.M. Brussell
Multi-flash campimetry and other psycho-physical tests in glaucoma.

26. F.W. Fitzke., D. Poinoosawmy, W. Ernst and R.A. Hitchings
Pheripheral displacement thresholds in normals, ocular hypertensives, and glaucoma.

27. Y. Okamoto., O. Mimura, K. Kani and T. Inui
Characteristics of two systems of human vision using fundus perimetry.

28. M. Tomonaga., K. Hamano and Y. Ohta
The measurement of normal retinal sensitivity in the central quantitative visual field using fundus photo-perimeter.

29. E. Gramer., G. Althaus and W. Leydhecker
Topography and progression of visual field damage in open angle glaucoma (POAG), low tension glaucoma (LTG) and pigmentary glaucoma with program DELTA of Octopus perimeter 201.

30. V.J. Marmion
A longtitudinal study of scotoma variation in glaucoma.

31. H. Masukagami., F. Furuno and H. Matsuo
Blind spots of normal and high myopic eyes measured by fundus photo-perimetry.

32. R. Fusco., P. Guacci, A. Di Capua and G. Ambrosio
The comparison of kinetic and static perimetry by means of Arden test, glare test, colour vision test, PERG and PEV in patients with glaucoma and ocular hypertension.

33. I. Azuma and S. Tokuoka
Early visual field changes in developing ocular hypertension.

34. D. Bakker., E.L. Greve and Z. Zeilstra
Comparative evaluation of the Humphrey Field Analyser, Peritest and Scoperimeter.

35. N.A. Jacobs., I.H. Patterson and I. Broome
The macular threshold: determination of population normal values.

36. C. Augustiny-Rutishauser and J. Flammer
Selective retests in automated perimetry. An experimental study for the evaluation of the effect of the regression to the mean.

37. G.P. Fava., P. Capris, M. Fioretto and E. Gandolfo
Binocular threshold campimetry in the amblyopic syndrome.

38. P. Brusini., P. Dal Mas, G. Della Mea, B. Lucci and C. Tosoni
Centro-coecal field examination in chronic alcoholism.

39. I. Kremer., B. Hartman, D. Weinberger and I. Ben-Sira
Static and kinetic perimetry results of red krypton laser treatment for macular edema complicating branch vein occlusion.

40. C.E. Traverso., K.F. Tomey and R. Fatani
Octopus perimetry in developing countries. An appraisal of patient performance.

41. M. Zulauf., A. Funkhouser, F. Fankhauser and C. Augustiny-Rutishauser
Spatial summation and dynamic range.

42. K. Kitahara., A. Kandatsu, R. Tamaki and H. Matsuzaki
Spectral sensitivities on a white background as a function of retinal eccentricity.

43. C.T. Langerhorst., T.J.T.P. van den Berg and E.L. Greve
Population study of local fatique with prolonged threshold testing in automated perimetry.

44. R.J. Britton and S.M. Drance
The normal optic disc.

45. J.M. Enoch and G.L. Savage
Anomalous visual response in Tourettes syndrome.
A preliminary study.

46. I. Iinuma
Application of the Troxler effect in campimetry in glaucoma suspects.

ABSTRACTS PAPERS

1

INFLUENCE OF OCULAR MEDIA ON PERIMETRIC RESULTS: 1. EFFECT OF IOL IMPLANTATION.

Ph. Hendrickson., D. Eichenberger., B. Gloor and Y. Robert.
University Eye Clinic, Zürich, Switzerland.

Improvement in OCTOPUS G1 perimetric results following cataract surgery and intraocular lens implantation was compared with improvement in visual acuity and in the contrast transfer (Pap/Mac) ratio. The latter provides an objective measurement of the imaging quality of the ocular media. All examinations were performed prior to surgery, as well as one and six weeks postoperatively.

This investigation afforded evaluation of how well the Pap/Mac-ratio can serve to discriminate loss of light sensitivity caused by opacification of the refractive media from that caused by disease of the retina or of the optic nerve.

2

THE INFLUENCE OF SIMULATED MEDIA OPACITIES ON THRESHOLD MEASUREMENTS

Dale K. Heuer, Estelle Doheny Eye Foundation, Los Angeles, California,
Douglas R. Anderson and Robert W. Knighton, Bascom Palmer Eye Institute, Miami, Florida, and
Michael G. Gressel, Lorain Community Hospital, Lorain, Ohio

The absorbing, scattering, and blurring effects of media opacities were simulated in the right eyes of five subjects with randomly-ordered series of neutral density filters (NDFs; 0.0, 0.3, 0.6, 1.0, 1.5, 2.0, and 3.0 log), diffusers (0.00, -0.23, -0.31, -0.38, -0.64, -0.93, and -1.24 log relative transmittance), and spherical plus overcorrections (+0, +1, +2, +3, +4, +5, and +6 diopter[s]). Threshold measurements were performed 0°, 5°, 10°, 15°, 20°, and 25° nasally along the 180° meridian on the Octopus 201 perimeter with its F4 program, which measures the threshold four times at each test point. Corresponding threshold measurements on the Humphrey Field Analyzer have also been performed for the diffusers (and are being performed for the NDFs) with twice-repeated profiles along the 0° — 180° meridian.

A 0.6 log NDF, which reduces retinal illumination the equivalent of halving the pupillary diameter, decreased the Octopus threshold measurements by 1.7 ± 0.4 dB (mean ± SD) and the Humphrey threshold measurements (thus far completed on only three of the five subjects) by 1.3 ± 0.5 dB. Diffuser #4, with which visual acuities with a projected Landolt C chart in a lighted examining lane were 0.92 ± 0.11 and with which Miller-Nadler glare disability scores were 35.0% ± 11.7%, decreased the Octopus threshold measurements by 6.6 ± 0.5 dB and the Humphrey threshold measurements by 8.1 ± 0.5 dB. One and two diopters spherical plus overcorrections decreased the Octopus threshold measurements by 1.2 ± 0.4 dB and 2.9 ± 0.6 dB, respectively.

Our data suggest that even media changes that cause only negligible effects on visual acuities may influence threshold measurements.

3

INFLUENCE OF CATARACTS ON VISUAL FIELDS

Urs Guthauser and Josef Flammer
University Eye Clinic, Inselspital, CH-3010 Berne

The outcome of perimetry of patients with cataract is difficult to interpret. Visual field changes due to a second disease like glaucoma are disturbed by the influence of the cataract. In order to study this influence, we measured visual fields of cataract patients before and after cataract surgery and implantation of intraocular lenses. In order to evaluate the relationship of visual field changes with the cataract density, we quantified the opacity of the lens with the help of a computerized instrument that measures the opacity of the lens with the help of the "Scheimpflug-principle".

There was a high correlation between the visual field changes, as measured with the program G1 on the Octopus, on one hand, and the density of the cataract on the other. The change of the visual acuity, however, was only weakly correlated with the lens opacity.

4

THE ROLE OF INTRA-OCULAR LIGHT SCATTER IN THE ATTENUATION OF THE PERIMETRIC RESPONSE

J M Wood, J M Wild, Department of Vision Sciences, Aston University, Birmingham B4 7ET. S J Crews, Retina Department, Birmingham and Midland Eye Hospital, Birmingham B3 2NS.

Perimetric examination of patients with media opacities is confounded by the problem of separating the reduction in sensitivity due to optical degradation from that due to neural attenuation. The purpose of the study was to develop a method whereby the reduction in perimetric sensitivity arising from intra-ocular light scatter could be quantified. The study consisted of two parts. The sample for the first part comprised clinically normal subjects trained in perimetric and other psychophysical tasks. Contrast sensitivity was determined using the Nicolet CS 2000 Contrast Sensitivity system, with and without simulated media opacities, for a 1 c/deg sine wave grating in glare-free conditions and in the presence of a wide angle and a narrow angle glare source. The media opacities were simulated using solutions of methyl cellulose contained in plano powered cells. Threshold was measured within the central 30^{o} , with and without the simulated opacities, using the Octopus automated perimeter (program 31; target size 3) and with the Dicon Autoperimeter 3000 (bowl luminance 10 asb and 45 asb). The second part utilized a sample of patients exhibiting a wide variety of uniocular media opacities. Contrast sensitivity and perimetric sensitivity was measured as before, but with the contralateral eye acting as the control. Results are presented in which the light scattering function, calculated from the data using the equation of Paulsson & Sjostrand (1982), is plotted against the attenuation in perimetric sensitivity at each eccentricity.

5

RELATION BETWEEN MEDIA DISTURBANCES AND THE VISUAL FIELD.

T.J.T.P. van den Berg and E.L. Greve.
The Netherlands Ophthalmic Research Institute and Laboratory of Medical Physics of the University of Amsterdam, Academic Medical Center, Meibergdreef 9, 1105 AZ Amsterdam, The Netherlands.

The effect of media disturbances on the retinal projection of the external light distribution can be described by means of the so-called point spread function (PSF).
The PSF is defined as the retinal light distribution resulting from an external point source. Consequently Visual Field changes because of media disturbances can be understood if the PSF could be measured. These Visual Field changes may include mesopisation (or scotopisation) because of increased light absorption in the lens, flannering because of increased light scattering in lens or cornea, localized relative depressions because of posterior cortical cataract etc.
We have designed a new method to learn more about the pathological PSF than is possible up to now. With this method it is possible to measure the part of the PSF outside 1 degree, relative to the central portions of the PSF. Using this as well as more conventional methods we have tried to establish the relation between media disturbances and changes in the Visual Field.

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A COMPARISON OF VISUAL IMPAIRMENT CAUSED BY NUCLEAR (NC) AND POSTERIOR SUBCAPSULAR (PSC) CATARACTS

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A clear description of the major optical degradation effects caused by different types of ocular media opacities is not available at the present time. In this paper we compare results of a hyperacuity test, the "gap function" in patients with PSC and NC. We have previously published extensively on NC and hyperacuity. It is assumed from clinical experience that early posterior subcapsular opacities often have more deleterious effect on visual acuity than roughly comparable anterior opacities or nuclear cataracts. Also, patients with PSC often report multiple images or "star burst" effects. These effects can be greatly reduced by low spatial frequency filtering, providing a white noise background and/or use of a small pinhole held close to the eye. If these problems are not present or are adequately controlled, the hyperacuity "gap function" shows less functional effect due to the opacity for PSC than NC in all cases tested. These findings also indicate that visual acuity provides an insufficient description of the effects of intraocular scatter on image formation.

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COMPUTERPERIMETRY IN PATIENTS WITH CORNEAL DYSTROPHIES

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We examined 6 eyes with lattice corneal dystrophy, 1 with granular and 1 with a recidivation of granular dystrophy after penetrating keratoplasty.

We performed program 31 of the OCTOPUS and in addition a SARGON program for the center with a high resolution of two degrees. Although the visual acuity was between o,2 and o,5 and the patients complained about high glare sensitivity, the quantitative values of the visual fields showed only low decrease.

8

VISUAL FIELD IN DIABETIC RETINOPATHY
LIGHT SENSITIVITY IN RETINAL LESIONS

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(Purpose) We examined light sensitivity in retinal lesions seen in diabetic retinopathy according to type and degree and according to the site of the lesions.

(Method) According to fluorescein angiogram findings, we classified retinal lesions into four types as follows. I Almost normal capillaries. II Hyperpermeability of capillaries. III Small non-perfusion area. IV Large non-perfusion area. As for perimetry Octopus programs 31 and 41 were performed for each eye. The combined visual fields were inverted and then superimposed photographically over the panoramic fluorescein angiograms. We selected examination points representative of the above four types of lesions and measured the mean sensitivity loss for each point, expressing it as a function of the normal sensitivity for the same age. Finally we compared the mean sensitivity loss between all lesions.

(Result) The mean light sensitivity loss for the above four types of lesions were 2.5, 4.4, 8.6 and 16.1 dB. In type IV the mean light sensitivity frequently indicated absolute scotoma of maximum luminance by Octopus. On kinetic measurement using a fundus photo perimeter non-perfusion area were detected as scotoma of various grades.

(Conclusion) In diabetic retinopathy the mean light sensitivity loss in retinal lesions depends on the grade of the retinal capillary lesion and in large non-perfusion areas the visual function was exceedingly reduced.

9

EARLY FOVEAL DYSFUNCTION IN GLAUCOMA

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Recently diffuse involvement of the field in the form of a generalized depression can be recognized as an early glaucomatous defect. In this study, by using fundus perimeter (Quantitative Maculometer) we evaluated the correlation between the foveal dysfunction and appearance of retinal nerve fiber bundle atrophy in the early stage glaucoma, because a generalized depression might logically involve the point of fixation.
We examined ten cases with early stage of primary open angle glaucoma who has the appearance of detectable retinal nerve fiber bundle atrophy within the maculo-papillar bundles.
The measurement of spatial contrast sensitivity function (CSF) were also carried out.
In this study it was demonstrated that open angle glaucoma can involve the central field including fixation before markedly distorting the peripheral visual field, and CSF damage develops roughly according to the grade of maculo-papillar bundle's atrophy.

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A RAPID AND SIMPLE TECHNIQUE FOR KINETIC VISUAL FIELD DETERMINATION IN YOUNG CHILDREN AND ADULT PATIENTS WITH CENTRAL RETINAL LESIONS

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Visual field determination in very young children and adults with unsteady fixation is an often frustrating and difficult task to perform. With little modification, the Canon Fundus Photo-perimeter allowed us to readily measure the visual fields of these young children and some adults with unsteady fixation due to central retinal disease. We were able to determine two to three central field isopters per child and field configurations on the adults for both eyes by coupling the infrared photo-perimeter with a VCR (VHS). With the procedure only taking seven minutes per eye, we feel it could be extended to cooperative 3 year olds and a whole host of visual field anomalies with little difficulty.

Sample data from several children and low vision adults with central retinal lesions will be presented. We encourage consideration of this technique, because only approximate central fixation (about ± 5 deg) is needed. Thus, the techniques are simple, rather rapidly applied, and require the purchase of none but commercially available equipment.

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MULTI-FLASH CAMPIMETRY: THE RAPID ASSESSMENT OF TEMPORAL RESOLVING POWER.

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Research findings over the past decade have implicated the early loss of flicker sensitivity in a number of pathologies. These results have justified the development of perimetric techniques for rapidly assessing the temporal resolving power of the human visual system. One such computer implemented technique is known as multi-flash campimetry.

It entails flickering a point of light at 5 Hz, and manipulating the duty cycle (the proportion of a cycle that is lit) until flicker is detected. 120 Points in each visual field can be tested in about a half hour, including practice and the replication of statistically deviant data. Two and three dimensional visual field plots can then be created that allow the easy identification of impaired regions. Since temporal resolving power also varies with sensitivity to light per se, multi-flash campimetry can also be used to detect conventional field loss in a variety of patient populations.

We now report a method for quantifying the degree of field loss based upon comparing the amplitude of the fundamental frequency needed by a patient to resolve flicker in the multi-flash procedure, with that required by healthy observers to detect flicker in a de Lange type sensitivity task. In support of this idea, data will be presented showing that the amplitude of the fundamental needed by healthy observers for flicker detection in the sensitivity task, can be used to predict their resolution thresholds in the multi-flash procedure.

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PATTERN DISCRIMINATION PERIMETRY: A NEW CONCEPT IN VISUAL FIELD TESTING

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The subject's task in conventional perimetry is to detect an incremental spot of light on a uniform background. Recent evidence indicates that, at least in glaucoma, this task can be insensitive to large amounts of postreceptoral neural damage. In an attempt to find more effective ways to detect early glaucomatous damage, we have developed an alternative perimetric technique that is based on pattern discrimination rather than light detection. The subject fixates a small square at the center of a large field of dynamic random dots and tries to detect a small patch of non-random, or coherent, dots of the same space-averaged luminance embedded in the background. The entire display is presented on a projection CRT under computer control. Background dot density can be set to one of 8 levels between 0% and 100%, and refresh rate can be set to any frequency up to 30 Hz. All test target parameters, including position, size, shape, exposure duration, dot density, dot arrangement and dot dynamics, are completely under computer control. In particular, spatial and temporal coherence parameters can be defined in terms of the regularity of spacing and motion of the target dots. All targets can be presented in either kinetic or static modes.

We will present preliminary control data and glaucoma patient data for four different static protocols that test different stimulus parameters: (1) size and (2) exposure duration thresholds for fully coherent targets, and (3) spatial coherence and (4) temporal coherence thresholds for large, long-duration targets. For ease of comparison to conventional automated perimeters, the test positions are a subset of those in the Humphrey 30-2 and Octopus 32 protocols.

Research supported by SBIR grant No. EY05136 from the National Eye Institute, USA.

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A COMPUTER-GRAPHICS APPROACH TO VISUAL FIELD SCREENING, USING HIGH-PASS SPATIAL FREQUENCY FILTERED RESOLUTION TARGETS AND MULTIPLE FEEDBACK DEVICES

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Computer graphics allows the introduction of new types of test tasks in visual field testing, and several modes of feedback. Resolution tests are particularly attractive because the results reflect directly the spatial density of functional neural channels. High-pass spatial frequency filtering makes confident resolution very easy. This permits quick threshold strategies.

I have developed a visual field screening program for the IBM PC. High-pass circular rings of different sizes are displayed on a test monitor while the system monitor shows options and test progression. The set-up allows bedside examinations. Thresholds are obtained for 50 locations within 30 degrees in 5 minutes average, using several adaptive strategies and feedback devices. Stable fixation is encouraged by text messages and a dynamic fixation mark, and is checked by occasional probing of the blindspot. The latter is located in a quick routine, which like the rest of the test calls up an easily seen target whenever there is a sequence of missed presentations. Subject errors are signalled on the test display. False responses can be corrected on the fly. The pace is adapted to the current reaction time. Testing can be suspended for rest at will, and can be aborted anytime, without loss of partial results. Results breaking a monotonous slope are retested. The records include several indices of reliability and other statistics. Records are stored on memory disks, and/or printed on paper. A high degree of patient acceptance is ensured by the interesting task, short test duration, silent operation, and the intuitively comprehensible mode of result presentation.

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AUTOMATED PERIMETER RESULTS: THE NEED FOR A COMMON LANGUAGE

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Available on today's world market is a very large number of automatic perimeters operating on widely different principles. The consequence is that information yielded by the resulting visual fields is extremely inconsistent. The different examination methods all have their own fully individual means of expression, and this leads to the greatest confusion among ophthalmologists, since no examiner is normally in a position to compare results obtained with different perimeters. The divergent presentation methods make it possible neither to observe a patient's clinical symptoms for any length of time, nor to make comparisons when dissimilar types of perimeters were used in the process; nor do they allow an uncomplicated, objective, scientific comparison of the quality of results. This is demonstrated here using a series of examination results, and suggestions are made for a common perimetric form of expression in the presentation of visual fields.

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J.A.W.S. (JOINT AUTOMATED WEIGHTING STATISTIC): A METHOD OF CONVERTING RESULTS BETWEEN AUTOMATED PERIMETERS

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The recent advent of automated perimetry has brought about a number of advantages for clinical perimetry. However, the large number of commercial devices in use makes it difficult to compare the results of one automated perimeter to those of another. To address this problem, we performed repeated testing on 12 normal eyes and 12 eyes of patients with glaucomatous visual field loss on six commercially-available threshold static perimeters (Humphrey Field Analyzer, Digilab 350, Fieldmaster 50, Octopus 500, Dicon 2000, Squid). Threshold values for each sector (0-10°, 10-20°, 20-30°) and quadrant were determined for each examination, and a linear least-squares regression was performed between each pair of automated perimeters. All of the regressions were statistically significant ($p<.05$), with correlations between 0.83 (Digilab ↔ Squid) and 0.97 (Humphrey Field Analyzer ↔ Octopus). The projection perimeters all had correlation coefficients greater than 0.95. For the projection perimeters, the accuracy of the conversion method seems to be limited by the test-retest reliability of individuals.

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STANDARDS OF PERIMETRY IN CLINICAL PRACTICE

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Skilled manual kinetic and static threshold perimetry is assumed to be the standard of practice. Assessment of newer techniques, especially automated, is usually made using this as a comparison. However, Trobe suggested that the actual standard in clinical practice may fall considerably short of this ideal. [Ophthalmology 1983] Even so, actual practice standards were probably overestimated because of self selection in his study group. We, therefore, polled the ophthalmologists in the state of Kentucky. With some effort, we obtained replies from all 137 practicing ophthalmologists. This complete sample eliminates upward bias. Data was obtained on, among other things, age of the physicians, practice type, number of patients seen, type of perimeters utilized, types of visual fields obtained, and number of visual fields done. Our complete data will be presented. Among our findings were the following:

88% of examinations were performed by technical staff.
Automated fields were most commonly performed (34%).
40% of automated perimeters test supra threshold only.
Only 10 of 67 practitioners using the Goldmann used Armaly-Drance techniques.
Only one practitioner out of 137 utilized manual static threshold perimetry.

We believe that our sample is an accurate reflexion of national standards. Clinical perimetry as practiced in no way approximates the ideal.

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PRIMATE ARCUATE NERVE FIBER BUNDLE ANATOMY

Minckler, DS and Ogden, TE - Estelle Doheny Eye Foundation-USC School of Medicine, Los Angeles

Visual field defects in glaucoma frequently correlate with damage to ganglion cell axons in an arcuate pattern 10 to 20° from fixation. While the site of primary injury to axons is probably in the optic nerve head, the precise correspondence between axonal transport alterations and visual field change in glaucoma remains to be established. Topographic correlations between retinal ganglion cells and axon projections through the optic nerve head have helped define the degree of dispersion of axons in disc tissues. Dispersion of axons is partially due to intermixing of axon bundles in the peripapillary retina. Layering of axons in the nerve fiber layer may vary between species of primates. Morphometric studies of nerve fiber layer axons demonstrate mirror image symmetry in fiber populations in arcuate bundles between paired normal eyes but preponderance of large axons in the inferior relative to the superior bundles. Large axons in arcuate bundles in glaucomatous monkey eyes are especially vulnerable to injury.

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A NEW NUMERICAL REPRESENTATION OF THE VISUAL FIELDS ON THE CHIASMAL TUMOR

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We have reported that the volume of the visual field can be represented by retinal ganglion cell'count X sensitivity. Our representation of the visual field was applied to evaluate the clinical courses of 53 cases with chiasmal tumor (pituitary adenoma, meningioma and craniopharyngioma). The relationship between the volume of the visual island by our new numerical representation and the neurosurgical factors such as tumor size on CT-image, size of sella on skull-X-rays and the direction of tumor-extension were studied using multivariate analysis.

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PITUITARY ADENOMAS WITH VISUAL FIELD DEFECTS TREATED 1946 - 1984

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Because of the fact that an increasing number of pituitary adenomas are diagnosed by endocrinologists and treated long before the visual pathway is involved, the futural diagnostic role of the ophthalmologists has been called in question.

In the Department of Neurosurgery, Lund, 339 patients with pituitary adenomas and visual field defects were subjected to treatment in 1946 through 1984. The mean annual incidence increased from 4.07 per million inhabitants in 1946-55 to 6.93 in 1976-84, i.e. by no less than 70 %. The mean duration of the visual impairment before treatment was found to be shorter and the mean visual function to be better after 1970 than before 1961. These results were ascribed mainly to an improved ophthalmic service.

A crucial observation was that the majority of the patients either lacked endocrine symptoms or suppressed them when they sought medical advice for visual loss.

In conclusion, the study demonstrated that perimetry and other ophthalmological methods are still of great diagnostic importance. It seems unlikely that the role of the ophthalmologists will change very much in the future.

To be published in full extent in Neuro-ophthalmology, Amsterdam.

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COMPUTERIZED PERIMETRY IN NEURO-OPHTHALMOLOGY - COMPARISON OF DIFFERENT TEST PATTERNS BY AN "INFORMATION INDEX"

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The influence of test patterns on the result of automated perimetry is well known for glaucoma. The information of additional test locations, measured with an objective "information index", shows exponential decrease with increasing spatial resolution and is higher towards the center. We wanted to find out wether the relationship is the same in neurological fields and calculated the information index for a number of those cases.

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PROCENTUAL IMPAIRMENT BY VISUAL FIELD DEFECTS.

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State University, Ghent, Belgium.

Using data from Elfriede Aulhorn (FGR), G. Calabria (Italy), Emilio Campos (Italy), Gordon R. Douglas (Canada), Ben Esterman (USA), Piroska Follmann (Hungary), Fumio Furuno (Japan), Louis Guillaumat (France), Egill Hansen (Norway), Anders Hedin (Sweden), Marcel Maertens (Zaïre), Marion Marré (DGR), Anastasia Nakowa (Bulgaria), G.I. Neemtseev (Soviet Union), Tutsure Ogawa (Japan), André Roth (Switzerland), Thomas Rosenberg (Denmark), Slobodan Savic (Yugoslavia), P.J. Spierenberg (The Netherlands), K.V. Trutneva (Soviet Union), Jean Vola (France), and probably others.

This report is a critical survey of different systems and of different national regulations which have been and/or are used for the procentual evaluation of the functional impairment due to monocular or binocular visual field losses.

It is intended as a basis on which the IPS could decide to recommend a given system.

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ESTERMAN TESTING OF GLAUCOMA DISABILITY

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Patients with severe glaucomatous visual loss were evaluated with the Esterman binocular program on an automated perimeter (CooperVision Diagnostics Dicon AP2000). Previous investigation had shown good correlation of binocular Esterman test results with those of combined monocular automated suprathreshold static and manual kinetic perimetry. Repeat testing showed reproducibility of Esterman results over time. In a new group of patients, the relative comparability of the binocular Esterman test with respect to combined monocular Goldmann III4e isopter results was confirmed. The Esterman visual function score was also correlated with a previously refined questionnaire which evaluates visual field disability perceived by the patients.

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FUNCTIONAL QUANTIFICATION OF THE VISUAL FIELD: A NEW SCORING METHOD.

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Esterman's grid for visual field scoring is both well-known and widely accepted as a valid system for the quantitative analysis of perimetric defects. However, it does not offer a completely precise functional assessment, because the threshold inside the studied perimetric areas is not evaluated.

In order to overcome this drawback we studied a new scoring method based on the position of 100 points strategically placed on the perimetric diagram. This method permits the quantitative analysis of the results of a perimetric examination manually or automatically carried out utilizing 4 targets (IV/4; 1/4; 1/3 1/2). The point arrangement has been studied on the basis of the physiological visual field width of elderly subjects. A correction index must be used with younger subjects.

Our method evaluates not only the defect's extension but also its depth. In such a manner, an exact quantification of the functional damage, useful in medical-legal and insurance problems, is obtained.

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EFFECTS OF VISUAL FIELD DEFECTS ON DRIVING PERFORMANCE

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Per Lövsund, National Road and Traffic Research Institute (VTI), Linköping, Sweden.

To elucidate the possible traffic safety risks induced by visual field defects, a method has been developed at the VTI. The test is based on a driving simulator where the subject drives a real car body in an artificial landscape produced by colour-TV projectors. On the screen, light stimuli of three different sizes are projected. The stimuli are randomly presented, one at a time, in any of 24 different positions. The measured parameter is the latency between stimulus appearance and braking. The vehicle dynamics, the landscape, and the stimuli are generated by a computer.

Using this method, we have studied normals and a number of subjects with different visual field defects. In the group of normals, the median values of the reaction times are fairly homogeneous. There are minor differences between central and peripheral stimuli; the difference is somewhat larger among the older normal subjects.

In the group of subjects with visual field defects, the individual variations are dominant. Some of the subjects show good compensatory mechanisms whilst most do not. The results support the opinion that homonymous visual field defects constitute an obstacle to safe driving.

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VARIABILITY OF COMPUTERIZED THRESHOLD MEASUREMENTS ACROSS THE CENTRAL FIELD IN A NORMAL POPULATION.

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Out of 210 individuals between 20 and 80 years of age, randomly selected from a normal population, 140 showed up for an eye health examination. Of these 135 were subjected to a complete examination including threshold-measuring perimetry of the central 30° field using the 30-2 program of the Humphrey Field Analyzer. A majority of the subjects accepted repeated perimetry two and four months after the first examination. Abnormals were excluded according to predetermined criteria. Analysis of the results in the remaining normal subjects showed that:

1. Inter-individual threshold variability is larger in the mid periphery of the visual field than more centrally.
2. Inter-individual deviations from the age-corrected normal threshold do not follow a Gaussian distribution, but are negatively skewed. The degree of skewness varies with the distance to the point of fixation.
3. Inter-test variability increases with eccentricity.
4. Short-term fluctuation varies across the visual field.

The increase of inter-individual, inter-test and short-term variability with eccentricity and the skewness of inter-individual deviations are of crucial importance in the interpretation of visual fields, and particularly when confidence limits for computer-measured threshold values are determined.

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SHORTTERM AND LONGTERM FLUCTUATION OF THRESHOLDS IN AUTOMATED PERIMETRY IN NORMALS, OCULAR HYPERTENSIVES AND GLAUCOMA PATIENTS.

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Of 30 glaucoma patients and ocular hypertensives and 9 normal elderly control subjects we repeatedly measured the differential light thresholds of the 25° visual field with our experimental automated perimeter Scoperimeter. The patient group included primary open angle glaucoma, high tension glaucoma and low tension glaucoma. The frequency of testing was once every 3 to 6 months for 1 to 2 years. The normal group was tested once every 6 weeks.

Each examination consisted of 2 threshold measurements in each of the 60 locations within the visual field. Shortterm fluctuation (SF) within one examination, andlongterm fluctuation (LF) between examinations were computed and analysed. We were especially interested in the behavior of LF because this will influence the evaluation of progression of visual field defects over a longer period of time. In general, we found that SF is larger than LF. However, in all groups we found a number of subjects to have large LF whereas others had little LF.
This paper will emphasize possible individual factors apart from the ophthalmological status, that influence fluctuation in static automated perimetry.

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VISUAL FIELD VARIABILITY IN STABLE GLAUCOMA PATIENTS

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Twenty nine patients were identified as having stable chronic open angle glaucoma based on a series of clinical criteria. Each patient had a minimum of three visual fields performed on the Octopus 201 perimeter over at least a one year period. Seventy four of the 76 points in program 32 were analysed. Analysis of the mean visual thresholds and standard deviations for each of these points showed the average variability of the visual field over time for the entire sample to be approximately 35%. The significance of this for the detection of progressive visual field loss in glaucoma will be discussed.

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TOTAL VARIANCE OF SERIAL OCTOPUS VISUAL FIELDS IN GLAUCOMATOUS AND NORMAL EYES. Richard Starita, John Lynn, Ronald Fellman, Jody Piltz. Glaucoma Associates of Texas, Dallas, Texas.

Using Octopus program 32, 10 glaucomatous eyes of 5 patients and 4 normal eyes of 2 age-match controls were studied. A series of visual fields were performed in the AM and PM weekly for 4 weeks and then monthly for 2 additional months. For each series, the total variance for each of the 74 test locations were calculated and the pooled variance obtained. The mean sensitivity for each visual field was determined.

The pooled varience ranged from 3 to 25 db in glaucomatous eyes and 1 to 3 db in the controlled eyes. There was no significant difference between the variances of AM and PM fields. Total variances correlated most closely with overall mean sensitivity. Using a correlation matrix a predictive model for total variance was constructed for baseline values in each eye.

Understanding of fluctuation of response is essential to the interpretation of serial visual fields. This study demonstrates that these fluctuations are significantly greater than previously suspected.

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ESTIMATES OF VARIANCE IN VISUAL FIELD DATA

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Local or generalized increases in variance of multiple threshold determinations may indicate abnormality. If variance could be reliably estimated from a visual field in which threshold was determined at each point only once, considerable test time could be saved. 42 patients with mild to moderate glaucomatous defects had meridional threshold perimetry performed at 1 degree intervals in four oblique meridia using the F2 program of the Octopus 201.

A variety of time-series analyses, including combinations of moving average methods, differencing, autoregressive models and forecasting techniques were applied to each of the two data runs to obtain variance estimates. A modification of the Holt-Winters forecasting algorithm was developed which resulted in the best correlation between the estimated and the observed variances.

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THE DISTRIBUTION OF VISUAL FIELD SCORES IN A NORMAL POPULATION

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Although considerable research in the quantification of glaucomatous visual fields has been undertaken over recent years, little research employing similar techniques in normals has been published. The purpose of this paper is to discuss the quantitative aspects of the visual fields of clinically normal subjects.

The central visual fields of 1198 subjects were measured utilising threshold related suprathreshold strategies. Quantitative techniques including informational analysis and cluster analysis, where the partial scores of adjacent stimuli with elevated thresholds are weighted, have been used to score the visual field. The topographical distributions of reduced retinal sensitivity are discussed with the aid of isometric surface-fitting plots. The field scores employing the quantification techniques show a skewed distribution with a positive tail corresponding to higher field scores. This normative database will serve for further research in visual fields in glaucoma, particularly in field score and right/left field score asymmetry.

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KINETIC SHORTTERM IN PATIENTS WITH GLAUCOMA AND SUSPECTED GLAUCOMA

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Threshold fluctuations have already been studied in static perimetry by many authors. In a previous work the static threshold fluctuations have been compared with kinetic ones.

In order to evaluate the possibility of detecting the early signs predicting future visual field defects in ocular hypertension, the shortterm threshold fluctuations have been studied in normal, glaucomatous and suspected glaucomatous subjects, by means of automatic kinetic perimetry (Perikon).

Significant differences have been found in the three groups of patients, showing a wider threshold fluctuation in glaucomatous and suspected glaucomatous patients.

These results, obtained by repeated threshold measurements during normal automatic screenings at different eccentricities, confirm the value of a shortterm kinetic fluctuation increase in predicting glaucomatous visual field damage in the peripheral as well as in the central visual field.

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CHANGE OF NEURORETINAL RIM AREA AND VISUAL FIELDS OVER TIME

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Neuroretinal rim area of the optic disc is a useful measure expressing the amount of neural tissue in the eye. Cross-sectional studies have shown good correlation of rim area and visual field findings, but there are no reports on follow-up studies correlating these two parameters over time.

In this study we examined 57 eyes of 57 patients including 12 normals, 30 ocular hypertensives and 15 patients with glaucoma. All patients' optic discs had been photographed at least 3 times during a mean period of follow-up of 9 (5-15) years. Neuroretinal rim area was measured and the values were corrected for the individual magnification of the patient's eye. From corresponding visual fields examined with a Friedmann analyzer the mean defect of each visual field was calculated. The yearly rate of change of neuroretinal rim area was compared with the yearly rate of change of the mean defect of visual fields. Results will be presented and discussed.

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OPTIC DISC PALLOR VS. VISUAL FIELDS: A 9-YEAR FOLLOW-UP STUDY.

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From 1971-1985 43 eyes (43 patients, 13 with open angle glaucoma and 30 with ocular hypertension) and 7 eyes (7 normal subjects) were photographed 3 to 6 (mean 4.1) times during the follow-up period of 4.9 to 14.6 (mean 9.0) years. In the 204 photographs we measured the rate of change of optic disc pallor and compared that to the rate of change of the mean defect calculated from Friedmann visual fields.

In 8 of the 13 glaucoma patients, the percent area pallor increased during the follow-up. In 6 of these 8 patients an increase also in the mean defect of the visual field was detected. The rate of change of pallor was greater in the glaucoma patients than in the ocular hypertensive patients. Half of the ocular hypertensive patients had a positive regression slope of the change of pallor and in 6 of these patients a change of the mean defect of the visual field was detected. In this group of ocular hypertensives the rate of change of pallor was in the same range as the glaucoma group. The rate of change of pallor and the mean defect of the visual field was zero in the normal subjects. The role of intraocular pressure for changes in pallor and visual field will be discussed.

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THE CHANGES OF VISUAL FIELD SENSITIVITY ACCOMPANIED WITH ENLARGEMENT OF GLAUCOMATOUS OPTIC CUP

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The correlation between visual field damage and enlargement of optic cup is not defined yet especially in the early glaucomatous stage.

In this study, we evaluated this correlation by means of cup to disc area ratio and visual field sensitivity measured by Octopus program 31. Optic disc and visual field were divided into 12 sectors according to the distributional patterns of nerve fiber bundle on the retina. Cup to disc area ratio (C/D.A) and the ratio of the average sensitivity of glaucomatous eye to the average sensitivity of normal eye (%S) at each sectors were calculated respectively. By our methods, exact determination of cup to field correlation was made possible.

In over 20 eyes with early glaucomatous visual field damage, which could be followed up for about 5 years, statistical analysis of disc-field correlation will be demonstrated.

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PATTERNS OF EARLY GLAUCOMATOUS VISUAL FIELD LOSS

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The pattern of visual field loss in patients with progressive glaucomatous optic nerve damage with high IOP may be different from patients with progressive damage at normal IOP. Methods of selection may be important in identifying different patterns; IOP criteria may not adequately segregate groups of patients with different causes of glaucomatous optic nerve damage.

We identified two groups of open angle glaucoma patients with distinctly different patterns of early glaucomatous visual field loss by Octopus perimetry. The first showed diffuse sensitivity loss throughout the entire visual field (large mean defect, small loss variance); the second showed dense, localized scotomata, either close to or far from fixation (small mean defect, large loss variance). Patients were selected in a masked fashion based only on visual field criteria. We studied a number of characteristics of these patients both retrospectively and in a cross sectional examination to detect possible systemic and ocular differences between groups. Significant differences in intraocular pressure levels and mode of disc cupping were detected. The preliminary results of this study are reported.

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IS THERE A DIFFERENCE BETWEEN GLAUCOMA PATIENTS DEVELOPING DIFFUSE VISUAL FIELD DAMAGE AND GLAUCOMATOUS PATIENTS DEVELOPING MORE LOCALIZED VISUAL FIELD DEFECTS?

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Glaucomatous patients with a mean visual field defect between 2 and 10 dB, as measured with program G1 on the Octopus automated perimeter, were selected for this study. The analysis was based on the visual field findings on the left eye. The patients were separated into a group with predominantly diffuse damage (low CLV) and a group with predominantly local defects (high CLV). We tested the hypothesis that these two groups belong to two different populations that might differ by age or by the glaucoma type. In order to compare patients with the same amount of total visual field damage, the patients were matched in pairs by the measured MD.

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FIRST EXPERIENCES WITH THE NEW OCTOPUS G1- PROGRAM IN CHRONIC SIMPLE GLAUCOMA.

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The visual fields of 117 eyes of 63 patients with chronic simple glaucoma and ocular hypertension were examined with the new Octopus G1- program. The optic disc was recorded with the Rodenstock Optic Nervehead Analyzer. The "visual field indices" are described and correlated with digital disk data.
Special emphasis is laid on findings in eyes with decent or questionable defects.

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CUP/DISK RATIO, EXCAVATION VOLUME, NEURORETINAL RIM AREA OF THE OPTIC DISK IN CORRELATION TO COMPUTERPERIMETRIC QUANTIFICATION OF VISUAL FIELD DEFECTS IN GLAUCOMA WITH AND WITHOUT PRESSURE. A clinical study with the Rodenstock Optic Nerve Head Analyzer (ONHA) and program Delta of the Octopus Perimeter 201.

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18 Eyes with LTG, 17 eyes with POAG with max. IOP of 22-29 mmHg, 16 eyes with POAG (IOP <30 mmHg), 9 eyes with pigmentary glaucoma, and as controls 6 normal eyes and 8 with ocular hypertension were examined under controlled conditions with reproducible results, using program 31 of the Octopus Perimeter 201 and the ONHA of Rodenstock (74 eyes in 74 patients). Total visual field loss (TL) was calculated with program Delta of the Octopus.
1. TL for a given amount of optic nerve disk cupping (CDR) was less in LTG and higher in POAG with high IOP.
2. In all IOP groups excavation volumes of 1-2 mm were associated with large field defects. Smaller excavation volumes up to 1 mm did not allow any conclusion as to scotoma size.
3. A multivariate analysis of the 3 disk parameters used in our study and the maximum IOP proved that the neuroretinal rim area is the most reliable parameter for predicting visual field loss.
4. TL for a given amount of rim area was less in LTG and higher in POAG and pigmentary glaucoma. Markedly different results in TL were found in LTG and POAG if the neuroretinal rim area covered more than 1 mm . Eyes with high IOP and only slightly reduced rim area and only small CDR showed relatively big defects while in LTG we had only relatively small scotomas in eyes with heavily reduced rim area and big CDR. There must be a larger number of intact nerve fibers and/or less glial cells in eyes with LTG per square unit of rim area. It seems probable that there are at least two different factors (vascular and mechanical) involved in causing disk changes and field defects.

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GLAUCOMATOUS FIELD CHANGES RELATED TO THE METHOD AND DEGREE OF INTRAOCULAR PRESSURE CONTROL.

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In a prospective study, comparing primary medical, surgical or laser treatment for chronic open angle glaucoma it was noted that those patients in the surgical group had consistently lower intraocular pressures. The differences in I.O.P. were noted both at the time of routine measurement in the clinic, but also in flatter diurnal pressure curves ($P<0.001$). Visual field changes over 1 to 4 years in those patients whose intraocular pressures were <22mm.Hg were significantly less in the surgery group than the other two groups ($P<0.004$) suggesting : 1) that the concept of "control" of I.O.P. based on a pressure <22 may be insufficient and, 2) peak I.O.P's identified on diurnal pressure curves may be necessary to identify the patient at risk of (further) visual loss.

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CORRELATION OF INTRAOCULAR PRESSURE (IOP) AND VISUAL FIELD FOLLOWING ARGON LASER TRABECULOPLASTY (ALT).

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ALT was performed on 85 eyes of 70 patients with uncontrolled primary open angle glaucoma from March 1981 to March 1983. Clinically, all eyes were considered to have progressive visual field loss prior to laser intervention. Each patient had a minimum of one Octopus program 31 or 32 just prior to ALT and two similar Octopus programs following ALT. A repeated analysis of varience was used to determine statitical significance of chanbes in the mean sensitivity of the effects were negligible. The longterm effect in eyes with moderate glaucomatous damage was that field improvement correlated with reduction in IOP. In eyes with advanced damage, visual field deterioration could occur, despite reductions in IOP. The ability of ALT to lower IOP is well documented, however, the goal of glaucoma management is stabilization of visual function.

It is the purpose of this study to report on the longterm visual field results in this select group of patients and show its correlation to change in IOP.

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PERIMETRIC CHANGES INDUCED BY ARTIFICIAL HYPOTENSION AS AN ATTEMPT TOWARDS DETERMINATION OF RISK IOP IN EARLY OPEN-ANGLE GLAUCOMA

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Computerized video-screen perimetry[1] has been used in order to evaluate sensitivity in the central visual field (20 degrees) of 70 patients whose IOP was higher than 28 mm Hg. With this technique visual field deficits were found even in patients in which no changes were detected with the Goldmann perimeter. After initial testing and tonometry all patients received orally glycerol (1 gr/Kg bw). Retesting was performed 30 minutes after administration of glycerol. In 61% of the patients there was an improvement in the visual field, concomitant to an IOP decrease (8 mm Hg as a mean). In the remaining patients the IOP decrease was not accompanied by visual field changes.

These results indicate the existence of reversible visual function changes responding to treatment.

Reference:

1. Accornero N., Berardelli A., Cruccu G., Manfredi M.: Computerized video-screen perimetry. Arch. Ophthalmol. 102, 40-41, 1984.

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VISUAL FIELD DEFECTS CAUSED BY THE VASOSPASTIC SYNDROME

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In previous papers we reported on the influence of the vasospastic syndrome on the visual function. Some of the patients with vasospastic syndrome showed a clinical appearance resembling low-tension glaucoma. We suggest, therefore, that the vasospastic syndrome may be one of several factors producing low-tension glaucoma. A number of cases will be presented. Diagnostic tests for vasospastic syndrome will be shown and the treatment with calcium entry blockers will be discussed.

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ON THE PROVOCATION OF VISUAL FIELD DEFECTS IN GLAUCOMA CASES

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An astonishing discrepancy is sometimes found between the appearance of the optic nerve head and the outcome of visual field testing. To the trained ophthalmologist the disc may appear truly pathological with signs of tissue destruction, whereas the routine automatic perimetry test may be practically normal.

One may suspect that the spare capacity of the visual function is not completely taken into account under the routine testing conditions. However, there are means of provoking increased and variable thresholds by laying strain on the test, such as shorter exposure time for the test objects or exhausting the capacity by a long session testing. These factors have been shown to influence glaucomatous visual fields.

The aim of the present contribution is to demonstrate the results of some experiments where these factors have been used to provoke defects or to enlarge defect areas.

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GLAUCOMA FOLLOW-UP BY MEANS OF THE CENTRAL DIFFERENTIAL THRESHOLD.

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The aim of antiglaucoma therapy is the preservation of the visual field. It is our clinical experience and it has also been reported in the literature that maintenance of the visual field is not always the consequence of medical or surgical reduction of intra ocular pressure (IOP).

Due to its peculiar characteristic of sensitivity to glaucomatous damage, study of the variations of the differential threshold in the central 20° can be useful for a close follow-up of the disease.

Forty-two eyes of 24 subjects affected by primary open angle glaucoma were studied. For each eye the following parameters were evaluated: - Global retinal threshold with the Peritest automatic perimeter. - Central (20°) retinal threshold profiles with the Perikon automatic perimeter. Their variations were correlated to the IOP changes and to the type of medical therapy.

Our preliminary results indicated a better correlation of the central differential threshold, than the global differential thresholds in a way unrelated to IOP.

ABSTRACTS POSTERS

1

INFLUENCE OF OCULAR MEDIA ON PERIMETRIC RESULTS: 2. EFFECT OF SIMULATED CATARACT
Eichenberger, D; Hendrickson, Ph; Robert, Y; Gloor, B

The influence of changes of the ocular media, in the form of both image degradation and light intensity reduction, on the results of perimetric examination was investigated in normal subjects on whom the OCTOPUS G1 program was applied. Degradation of the image was accomplished by means of diffusors standardized for various visual acuities. Loss of sensitivity in examinations performed through the diffusors was correlated to visual acuity.

The effect of light intensity reduction, as seen clinically e.g. in cataracta brunescens, was simulated by performing further G1 examinations through selected Kodak neutral density filters.

Both forms of ocular media changes were subsequently investigated by measuring the contrast transfer (Pap/Mac) ratio with the photopapillometer. This examination incorporated the same diffusors and neutral density filters used for the perimetric examinations. The clinical implications of the findings are discussed.

2

SIMULATION OF THE INFLUENCE OF LENS OPACITIES ON THE PERIMETRIC RESULTS, INVESTIGATED WITH ORTHOPTIC OCCLUDERS.

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The development of cataract during a perimetric follow up of glaucoma patients is a difficult, but also frequent problem in the daily practice of the ophthalmologist.

By simulating media opacities with orthoptic occluders on the corrective glass their influence on the perimetric results (on the OCTOPUS 500E, programme G) was studied on a group of normal persons and a group of patients with pathological fields.

3

DOES HIGHER BACKGROUND ILLUMINATION LESSEN THE EFFECT OF DECREASED RETINAL ILLUMINATION IN AUTOMATIC PERIMETRY?

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The perception of a perimeter stimulus is a complex phenomenon depending on the relationship of target intensity, background illumination, and the state of retinal adaptation. Only under photopic conditions is the ratio of stimulus intensity to background (I/I) relatively constant over a range of background illuminations. The high mesopic background illlumination of 31.5 asb chosen by Goldmann for his perimeter is used in many automated perimeters such as the Humphrey. Fankhauser, however, used 4 asb in the development of the Octopus system because of the increase in the dynamic range at this intensity level. It has been argued that the 31.5 asb backgrouynd may be more appropriate, as decreased retinal illumination (e.g. due to pilocarpine induced miosis or media opacity) can lead to greater diminution of the field at the lower background.

We tested the right eyes of appropriately adapted normal subjects at both 31.5 and 3.15 asb background on the Digilab 350 automated perimeter using 0.5, 1.0, and 2.0 log unit neutral density filters to simulate the reduced retinal illumination which may occur clinically. Preliminary results show that the fields obtained with both background illuminations are significantly affected by the neutral density filters. Furthermore, the effect appeared to be more pronounced at the lower background. The significance of this for the choice of background illumination in clinical perimetry will be discussed.

4

A SYSTEM FOR THE ANALYSIS OF AUTOMATED VISUAL FIELDS

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Raw data from the Humphrey Visual Field Analyser is transfered to a micro-computer making these records available for statistical analysis.

The system produces summary reports for individual fields and for the data base as a whole. Subpopulations of patients meeting specified search criteria can be extracted for detailed statistical analysis using SAS and BMDP programs.

The parameters of 1) volume, 2) standard deviation, 3) number of points deviating from previous field by a specified amount, and 4) mean defect were evaluated by quadrant and full field in all patients who had at least 3 visual fields performed sequentially. An analysis of the data was done to determine which changes of these parameters would most reliably predict actual change in visual field as confirmed by subsequent testing.

5

A PACKAGE FOR THE STATISTICAL ANALYSIS OF COMPUTERIZED VISUAL FIELDS.

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We have devised a package for the statistical analysis of computerized visual fields which will be available in the Humphrey Field Analyzer. It is based on a new mathematical model of the normal visual field and intended to facilitate interpretation of single fields and to illustrate changes over time in consecutive threshold fields. Methods used for display of analysed fields include:

a. Maps showing total deviation and deviation of shape of measured fields from the age-corrected normal field. These are expressed both numerically (in DB) and as non-interpolated greyscaled probability maps illustrating the statistical significance of measured deviations.

b. Weighted visual field indices.

c. Boxplots

Changes over time are illustrated without any reduction of data (a above) with intermediate reduction of data (b) and with a high degree of data reduction (c). The paper will describe the principles of the analyses and be illustrated with several examples.

6

ARTIFICIAL INTELLIGENCE IN COMPUTERIZED PERIMETRY

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The highly actual, but fuzzily defined discipline called artificial intelligence includes a.o. pattern recognition and expert system construction, both of relevance to ophthalmology. Expert systems make use of expert knowledge for interpretations and decisions in various situations. An interesting and challenging and also conveniently restricted application domain is found in computerized perimetry.

An expert system for visual field analysis has been constructed. At present the system is capable of descriminating between
a) reliable and unreliable fields
b) fields with and without defects
c) fields with and without lowering of the general sensitivity level
d) In case of pathological findings and a series of visual field recordings, it is also able to trace the trend of development in background and in defect separately.

As a further development one can foresee subprogrammes using some form of pattern recognition and being capable of evaluating prognosis of the field defects and the likely etiology of the defects (glaucoma, neurological disorder etc).

The performance of the system will be discussed.

7

TREND ANALYSES OF AUTOMATED VISUAL FIELDS

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The accumulation of data from automated visual fields presents a problem for the clinician in determining whether there is a significant change in visual fields with time. We have developed a software package with appropriate graphic displays for determining the trends of mean visual field thresholds with time.

We have created and actively maintain a database of OCTOPUS 31 program fields. In addition to the threshold measurements for program 31 data, several other variables are entered, including visual acuity for near, pupil size, RMS error, and diagnostic code. Whenever five or more visual fields are available, our software performs trend analysis (1) on the mean threshold values of visual fields vs. time, (2) on each of the 73 test locations vs. time, and (3) on the mean threshold values of seven selected regions in the visual field vs. time. This approach obviates the problems of evaluating the effect of short and long term fluctuations The trends are analyzed statistically and provide an easily interpretable presentation for clinical diagnosis and management of glaucoma patients.

The usefulness of this approach will be presented for three clinical situations first, for detection of significant trends in the visual field that could not be determined by visual inspection of grey scales or comparison of differences; second, for following ocular hypertensive patients to detect the earliest loss of visual fields; and third, for determining the effect of a change in treatment in the trend of the visual field.

8

QUANTIFICATION OF THE VISUAL FIELD IN COMPUTER ASSISTED THRESHOLD PERIMETRY

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The variation in sensitivity with eccentricity across the visual field can be represented orthogonally as in for example the Octopus automated perimeter or by polar representation as in the Dicon Autoperimeter. The opportunity for mathematically integrating the sensitivity values at each eccentricity across the field for programs 21 and 31 of the Octopus (target size 3) and for the numeric threshold program of the Dicon (background luminance 10 asb) was investigated as a means of obtaining an aggregate flux sensitivity score through the response plane. The values at each eccentricity were weighted with respect to ganglion cell density and spatial summation characteristics. The ganglion cell data was based upon the work of Drasdo (1977) whilst the summation coefficients were derived from samples of age-matched normal observers. Two statistical sampling methods (Monte Carlo techniques) were used to provide a measure of the volume underneath the weighted sensitivity gradients. The relationship between the calculated volume, based upon the weighting function and also upon some of its various mathematical transformations, and the corresponding qualitative clinical assessment are described for varying types of field loss determined by the two instruments.

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BEHAVIOR OF VISUAL FIELD INDICES WITH A GRADIENT ADAPTIVE METHOD.

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For the judgement of a visual field examination the use of a reference field is required . This reference field is often based on population means. In a normal control population we encountered however large interindividual differences in shape and central value of the field. For this reason we developed a method that determines the reference field from the field under investigation itself.

Since normal fields are more or less cone shaped, our model for the reference field is a cone. The reference field of a pathological field is found by linear regression of a selection of the threshold values. Defects are now defined relative to this cone.

To evaluate this method and the behaviour of different statistical indices we have developed a program that generates visual fields. Computer simulations were also used to study the behaviour of spatial autocorrelation coefficients for different defects.

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COMPUTER-ASSISTED VISUAL FIELD ASSESSMENT : QUANTIFICATION, THREE- AND FOUR- DIMENSIONAL REPRESENTATIONS

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During the last two decades progressive technical sophistication has transformed perimetry from an essentialy qualitative to a highly quantitative examination. As a result, the display of visual field data tends to become overloaded with -often numerical- information, certainly useful but hard to assess rapidly, and of uneasy intuitive approach. Those problems can partly be solved through a convenient, perimeter-independant and highly evocative three-dimensional or even four-dimensional representation of the "isle of vision".

As far as the quantitative aspect of the assessment is concerned, it is possible to evaluate the isle or its defects-in terms of mass instead of volume-after applying a weighting method. This method need not be unique but based on either functional or anatomical criteria and adapted to the goal of the examination.

The authors describe an application of these concepts which permits, through high-performance computer processing, to produce a 3-D or 4-D representation and a quantification of the central visual field, according to various weighting methods from any balanced set of threshold measures. One of the weighting methods, developped permits an estimation of the amount of functional optic nerve fibers.

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SHORTTERM AND LONGTERM FLUCTUATION OF THRESHOLDS IN AUTOMATED PERIMETRY AND THE INFLUENCE ON THE DEFECT VOLUME.

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Of 30 glaucoma patients and ocular hypertensives and 9 normal elderly controls we repeatedly measured the differential light thresholds of the 25^0 visual field with our experimental automated perimeter Scoperimeter. The patient group included primary open angle glaucoma, high tension glaucoma and low tension glaucoma. The frequency of testing was once every 3 to 6 months for 1 to 2 years. The normal group was tested every 6 weeks.

Each examination consisted of 2 threshold measurements in each of the 60 locations within the field. Shortterm fluctuation (SF), within one examination, and longterm fluctuation (LF) between examinations were computed and analysed. We studied the influence of SF and particularly LF on the Defect Volume which we use as a measure for progression of visual field defects. This poster will also elucidate the statistical relationships between the fluctuations and the size of the defect, the position of the defect, the slope of the visual field, etc. We aim to investigate the importance of each of those factors for the Defect Volume.

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RELIABILITY PARAMETERS IN COMPUTERIZED PERIMETRY

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Several computerized perimeters display the results of various reliability tests (false positive and false negative answers, fixation losses and short-term fluctuation) in their printouts. These are helpful when results of computerized perimetry are interpreted.

The present study describes the influence of perimetric reliability on the result of threshold-measuring perimetry in a normal healthy population and in patients with glaucoma. Frequency distributions and correlations of results of reliability tests are given.

The variation between test results from normals can be considerably reduced if taking into account only tests where the results of reliability tests indicate good cooperation. At the same time the number of tests meeting these criteria will decrease, making the model of the normal visual field thus created less generally applicable. A decision on limits for acceptable results of reliability tests should give reasonably narrow confidence limits for normal threshold values without excluding a large part of normal and pathological fields from analysis.

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EXPERIENCE WITH THE RELIABILITY PARAMETER OF THE OCTOPUS AUTOMATED PERIMETER

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To evaluate the reliability of the outcome of automated perimetry, the calculation of the fluctuation is the most important factor. This fluctuation is, however, influenced not only by the cooperation of the patient but also by the disease state and the depth of the defects. To estimate the cooperation of the patient, an additional parameter is thus necessary. In Octopus perimetry, this has always been performed with the so-called catch trials. In a large series of visual fields, we analyzed the rate of false responses in catch trials and the factors influencing the rate of false responses.

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EXCESSIVE VARIABILITY OF RESULTS OF COMPUTERIZED PERIMETRY.

E.L. Greve., Z.N. Zeilstra., M.A.C.R. Raakman and D. Bakker.

A number of glaucoma patients does not interact with computerized perimeters as well as we would desire. This may cause large differences between successive examinations. These differences by far exceed longterm fluctuation.
We have collected twenty examples of extreme differences. Most of these visual fields show an atypical central island on first examinations that gradually "improves" or even disappears on successive examination. The cause of these defects will be discussed. It is emphasized that such pseudodefects should be recognized if wrong therapeutic decisions are to be avoided. Less extreme differences are even more frequent.

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Quantitative Suprathreshold Static Perimetry; The Value of Field Score and Asymmetry Analysis in the Early Detection of Chronic Open Angle Glaucoma

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Visual fields and intraocular pressures of 107 glaucoma suspects were compared with those of 115 healthy volunteers of comparable age. Of the 107 referral patients, 50 were deemed glaucomatous on normal clinical grounds. Using field scoring algorithms designed to recognise early glaucomatous defects the diagnosis of glaucoma in 43 (86%) of these patients was readily confirmed; the remaining 7 showed little evidence of field deficiency but had high intraocular pressures.

Of the 57 referral patients for whom no clinical diagnosis of glaucoma had been made, 27 (47%) showed evidence of highly significant glaucomatous defects when perimetric data was analysed by microcomputer. On follow-up one to two years later this untreated subgroup of 57 referral patients showed an increase in their visual defect scores by a factor of three ($p < 0.003$).

Intraocular pressures showed no correlation whatever with the visual prognosis of these untreated patients; indeed, IOP levels were significantly lower at follow-up in the most progressively afflicted eyes ($p < 0.05$). In contrast to the IOP findings, the computerised field score/asymmetry analysis achieved a wide bimodal separation of normal from glaucomatous suspects. The diagnostic false positive rate of this technique was 3%. These findings suggest that novel scoring techniques can detect glaucomatous pathology at a subclinical level.

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THE EFFECT OF PUPIL DIAMETER ON VISUAL FIELD INDICES

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Pupil size may be important to the measurement of the differential light threshhold. With manual perimetry contraction of the isopters can be seen with miosis. In automated perimetry short term fluctuation is elevated in individuals with miotic pupils. The effect of pupil diameter on mean sensitivity, mean defect, and corrected loss variance is unknown. 20 volunteers underwent visual field examination with Octopus Program G1. On separate days they were tested after instillation of Thymoxamine eye drops and placebo eye drops. The order of testing was determined at random. Pupil diameter was measured. The relationship between visual field indices and pupil diameter was evaluated.

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VISUAL FIELD SCREENING BY A SYMMETRICAL METHOD -- PROTOTYPE OF A NEW AUTOMATIC PERIMETER --

Hiroshi KOSAKI, Hajime NAKATANI (Osaka City)

The patients who need visual field screening are those suffering from glaucoma and hemianopsia which cannot be found by a funduscope. For the visual field screening of these two disease, we have designed a method of diagnosis using the difference in the two symmetrical thresholds. For glaucoma, we use one point above and one point below the horizontal meridian on the temporal side, and points above and below the 15° circle. For hemianopsia, the two points are on the right and left of the vertical meridian. We present here a prototype of an automatic screening perimeter which incorporates this symmetrical method, and we would welcome comments.

The specifications of the new automatic perimeter are as follows :-

Diameter of dome	:	60 cm
Area of measurement	:	30° central visual field
Stimulus	:	Red LED, 132 points, 1.3 to 1,000 Asb
Fixing monitor	:	Checked by an automatic infrared light point with a TV monitor
Programs	:	8 programs

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A NEW COMPUTERIZED PERIMETER ('COMPETER 750') FOR EXAMINATION OF NEURO-OPHTHALMIC PATIENTS

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The original model of the 'Competer' was of the 'tangent screen' type and intended for analysis of the central VF only. Examination of the area outside 35 deg. was not possible. In the 'Competer 750' the flat board has been replaced by a half-sphere, thus permitting examination of the area out to 75 deg. This extension was motivated mainly by the fact that analysis of the periphery proved to be essential for topical diagnosis of CNS disorders. As a rule, the area inside 20 deg. is examined with a detailed threshold programme, and, as a second, optional step, the area outside 20 deg. with a simplified test programme. The perimeter is controlled by a personal computer (Epson 16 or of a similar IBM compatible type). The proceeding of the test is followed on the monitor. Other improvements include the introduction of an automatic fixation test, changed positions of the test lights (LEDs), and modifications of the statistical parameters (P-values, etc). The test results can be stored for later comparisons. The 'Competer 750' has been found to be superior to the original model for examinations of patients with CNS disorders.

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CLINICAL RESULTS WITH A NEW VISUAL FIELD SCREENER 'HENSON CFS2000'.

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The Henson CFS2000 is a computerized multiple stimulus screener with 132 LED stimuli. The gradient adapted stimulus luminances are initially presented at 5dB above threshold. Missed stimuli are represented at 8 and then 12 dB above threshold. The screener incorporates a 26 stimulus programme for rapid screening of large patient populations and a quantification system which calculates the probability that a given visual field result comes from a patient with a normal; visual field. The detection rate of the screening programme and the value of the quantification system are evaluated on a clinical population.

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SAPPAR: AN AUXILLIARY PROGRAM FOR SAPRO.

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The SAPRO spatially-adaptive program for the OCTOPUS automated perimeter uses various parameters in order to specify its operating environment. Collections of 22 such parameters, which comprise the so-called subprograms, control program functions such as intergrid relationships as well as upper and lower limits of grid measurement activity. With the new SAPRO parameter program SAPPAR, the user is enabled to modify one (or more) of the ten subprograms and thus customize it for his own requirements. SAPPAR usage and operation will be described and examples of how the alteration of selected parameters affect SAPRO results will be presented.

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DYNAMIC REPRESENTATION OF THE VISUAL FIELD

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Computerized perimetry has not eliminated the need for operator's intervention throughout the examination. We have developped a dynamic representation of the visual field which provides the information necessary for a precise follow-up of the examination.

It includes a graphic representation of the estimated map of sensitivity thresholds which is updated according to the patient's response after each stimulus presentation.

An interpolated map is computed from the measured data and displayed in real time, allowing for an immediate perception of suspected deficits location, shape and depth.

Color marks indicate whether the threshold in each location has been validated by the examination program. They allow a direct evaluation of the examination advancement and of the reliability of displayed data.

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STAIRCASE SCORING PROCEDURES FOR AUTOMATED PERIMETRY

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Conventional psychophysical studies have used a variety of methods for determining visual thresholds from staircase procedures (average of all presentations, median value, modal value, average of all reversals, etc.). Under most circumstances, these scoring procedures exhibit very good agreement in their threshold estimates, since large numbers of stimulus presentations are employed (typically 50-200 trials). Staircases in automated perimetry usually employ between 4 and 12 stimulus presentations to make threshold estimates. Thus, the method of scoring staircases in automated perimetry could have a significant effect on the outcome of visual field test results.

In this study, the influence of different staircase scoring procedures on automated perimetric test results was evaluated. Twenty normal eyes and 30 eyes with glaucomatous visual field loss were tested on two separate occasions (test-retest) using a 6-3-3 staircase procedure for the central 30 degree test program (86 test points) of the Digilab 750 automated perimeter. All staircases were analyzed according to 5 scoring procedures (average of all presentations, median value, modal value, average of last two reversals, value of "last seen" target). The results indicate that both the visual sensitivity estimates and test-retest reliability are affected by the method of scoring staircases. Implications for standard staircase scoring procedures for automated perimetry will be discussed.

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A NEW CONTINGENT ALGORITHM FOR STATIC AUTOMATIC PERIMETRY BASED UPON CHAIN PATTERN ANALYSIS

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Given the specific starting intensity and knowledge of the logic used, the number of members in each chain of sequentially seen and unseen test presentations constitutes a pattern which finally determines the individual threshold in static automatic perimetry. More than 100 unique chain patterns have been identified on the Squid Programmable Perimeter at 10,000 locations in 105 glaucomatous eyes. These patterns were analysed in order to quantitate the accuracies and efficiencies of the 4-2 and 4-2-2 algorithms currently used on most of the available instruments. A new algorithm which is contingent upon earlier responses at the same location uses the 4-2 where appropriate, the 4-2-2 where needed, and other decisional processes when neither of these algorithms is proving efficient. This contingent algorithm has been programmed into the Digilab 750 perimeter for comparisons of speed and accuracy with several of the available algorithms.

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COMPUTER-AIDED ANALYSIS IN AUTOMATED DARK-ADAPTED STATIC PERIMETRY

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Dark-adapted two-color perimetry is useful for evaluating and subtyping patients with retinitis pigmentosa (RP). We automated this technique by modifying the Humphrey Field Analyzer (HFA) to permit measurements of absolute thresholds for red (650 nm) and blue-green (500 nm) stimuli throughout the visual field. Further analyses of the data were accomplished on a computer external to the HFA.

Data were transmitted to a microcomputer via the HFA's RS-232 port and decoded. Computer programs were developed: 1) to determine whether rods, cones, or both photoreceptors mediated function at each test location; 2) to calculate rod and/or cone threshold elevations at these loci; and 3) to display the threshold elevations for rods and cones in grey scale, contour, and/or perspective form.

These analyses and resultant maps of data from dark-adapted two-color perimetry provide a means to view the variations in rod- and cone-mediated function across the visual field of RP patients.

We thank the RP Foundation Fighting Blindness (Baltimore, MD) for support.

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MULTI-FLASH CAMPIMETRY AND OTHER PSYCHO-PHYSICAL TESTS IN GLAUCOMA

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Multi-Flash Campimetry (MFC) is a computer implemented perimetric technique developed in our laboratory which rapidly measures temporal resolving power over the central 40 degrees. The recent litterature indicates that a loss of temporal resolution may be an early psycho-physical finding in chronic open angle glaucoma. Our study group comprised 30 eyes with suspected or confirmed early chronic open angle glaucoma. All were tested with MFC and Octopus static perimetry. MFC was frequently abnormal in the face of normal visual fields. Central contrast sensitivity using the "anticipated threshold technique" and the Farnsworth-Munsell 100 hue test were also determined.

The significance of this loss of temporal resolution in early glaucoma will be discussed with respect to the patho-physiology of the disease. Its ability to predict glaucomatous optic atrophy is as yet undetermined.

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PHERIPHERAL DISPLACEMENT THRESHOLDS IN NORMALS, OCULAR HYPERTENSIVES, AND GLAUCOMA.

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Displacement thresholds may depend on processing by ganglion cells and, like contrast sensitivity and colour vision, may therefore be affected in glaucoma. However, unlike contrast sensitivity and colour vision, human sensitivity to motion is relatively retained outside the fovea so that displacement thresholds may provide a sensitive measure of ganglion cell mediated function throughout the visual field. We have investigated displacement thresholds to a 2 minute by 2 degree vertical line generated by computer on a background on a green phosphor video display unit. Frequency of seeing curves were constructed for 10 presentations each at 0-18 minutes of arc at 2 minute intervals. Measurements were made at 15 degrees in the temporal field just above and just below the blind spot. The data were fit by probit analysis to provide a 50% point in 38 eyes of age matched normals of 3.23 $\pm$ 1.9 minutes of arc. 45 Ocular hypertensive eyes values of 5.49 $\pm$ 3.14 and 16 glaucoma eyes gave 9.73 $\pm$ 4.93. The Newman-Keuls test showed the groups to be significantly different at the 0.01 level. We are currently investigating the effects of spatial frequency, contrast, colour, and temporal frequency on perimetric displacement thresholds with the goal of finding a more sensitive and specific measure of loss of vision in glaucoma and ocular hypertension than conventional perimetric measures.

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CHARACTERISTICS OF TWO SYSTEMS OF HUMAN VISION USING FUNDUS PERIMETRY

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Electrophysiological studies confirmed two different systems, X- and Y-systems, underlying visual system in primates. Futhermore, psychophysical studies suggest existence of these two systems in human vision. In this study we applied the fundus perimeter to examine the spatial and temporal properties of the two different visual systems.

The results were as follows:

1) The diameter of the receptive field increased as the eccentricities in both two visual systems.
2) The diameter of the receptive field in Y-system is always about three times in X-system on various retinal loci.

These results may be of coincidence in the properties of the receptive field in primate's vision reported from electrophysiological studies.

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THE MEASUREMENT OF NORMAL RETINAL SENSITIVITY IN THE CENTRAL QUANTITATIVE VISUAL FIELD USING FUNDUS PHOTO-PERIMETER

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We previously reported the clinical application of the fundus photo-perimeter (Cannon CPP-1) developed by our department. However, the normal retinal sensitivity in the quantitative visual field and changes in the sensitivity by age measured using this fundus photo-perimeter remained to be determined.

In this study, using normal subjects (age ranging from 18 to 59), the quantitative kinetic visual field was measured in 33 eyes of the 33 subjects; the quantitative static visual field was measured in 45 eyes of the 45 subjects.

The isopter at 20, 10, 6.3 and 3.2 asb of the quantitative kinetic visual field was found to be 20°, 18°, 13° and 8° from the center, respectively.

For the determination of the quantitative static visual field, the peak of retinal sensitivity threshold was calculated at the apex of 1.0 asb of the mean macular threshold using white 10-minute test targets determined by Tübinger perimeter. As a result, the peak was about 0.5 - 0.6 log unit higher than the threshold of the normal static visual field.

There were no statistically significant differences in changes in the visual field by age.

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TOPOGRAPHY AND PROGRESSION OF VISUAL FIELD DAMAGE IN OPEN ANGLE GLAUCOMA (POAG), LOW TENSION GLAUCOMA (LTG) AND PIGMENTARY GLAUCOMA WITH PROGRAM DELTA OF OCTOPUS PERIMETER 201.

E. Gramer, G. Althaus, W. Leydhecker

316 patients with POAG, 83 with LTG, 52 with pigmentary glaucoma (451 eyes with visual field defects) were examined with program 31/33 under controlled conditions. With program Delta (mode series) the total loss, the total loss per testpoint, the total loss per testpoint with pathologic results (average scotoma depth) were calculated. Four stages of visual field loss (0-100 dB; 101-400 dB; 401-800 dB; 801-1600 dB) were compared for 3 different glaucoma types: 1. In POAG visual damage was more frequent in the upper half. 2. In LTG the scotomas were more frequent in the lower half. 3. In pigmentary glaucoma, upper and lower half were affected to almost equal extent. 4. In POAG and in LTG the scotomas were most frequent in the nasal upper quadrant, and rare in the temporal lower quadrant. 5. LTG showed the deepest scotomas, pigmentary glaucoma the least deepest. 6. The defects in LTG were more often in the nasal than in the temporal half, compared to POAG and pigmentary glaucoma. 7. Higher IOP causes diffuse large defects of lesser depth compared to those in LTG with deep localized defects. 8. In all glaucoma types, scotomas were most frequent for 10o-20o eccentricity.
Considering the 4 stages of field loss, POAG and pigmentary glaucoma seem to develop in the beginning less deep, but wide-spread scotomas, which later deepen. In LTG, initial scotomas are very deep and localized;in the further course, depth and width of scotomas increase in a constant proportion, but increase of width is predominant. These quantitative differences in topography and progression of visual field damage may be caused by different extents of vascular pathology in the different glaucoma types.

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A LONGTITUDINAL STUDY OF SCOTOMA VARIATION IN GLAUCOMA

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Variation in the intensity of scotoma may be observed in individuals between different examinations. These may be accompanied by variations in threshold level. Numerical classification of the visual field to permit accurate statistical evaluation of the changes taking place is important. A method for achieving this end is presented with the results from fifty patients followed up over a five year period.

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BLIND SPOTS OF NORMAL AND HIGH MYOPIC EYES MEASURED BY FUNDUS PHOTO-PERIMETRY.

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We measured sensitivity of the retina around the optic disc of 60 normal and 15 high myopic eyes by fundus photo-perimetry period. The method is to perform kinetic perimetry while observing the fundus of the eye.

In the normal eyes, we found absolute scotomas in an area slightly larger than that of the optic disc period.
The scotomata were largest in the juxta papillary area inferiorly and nasally period.
Angioscotomata were most frequently seen at the upper and lower boarders of the optic disc. No change of the scotomata or the angioscotomata with age was observed.

In the high myopic eyes we found enlarged scotomata in the nasal inferior and temporal juxta papillary retina.

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THE COMPARISON OF KINETIC AND STATIC PERIMETRY BY MEANS OF ARDEN TEST, GLARE TEST, COLOUR VISION TEST, PERG AND PEV IN PATIENTS WITH GLAUCOMA AND OCULAR HYPERTENSION.

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Patients affected with glaucoma or ocular hypertension underwent kinetic and static perimetry, Arden test, Glare test, Farnsworth 100 Hue test, PERG and PEV. Our aim was to compare possible perimetric defects with alterations of other functional tests, in order to estimate the diagnostic value of each during the course of the disease.

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EARLY VISUAL FIELD CHANGES IN DEVELOPING OCULAR HYPERTENSION.

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We evaluated the screening ability of 72 points central screening program on Competer 350 in 60 patients (120 eyes) with ocular hypertension (OH) and 40 patients (70 eyes) with primary open angle glaucoma (POAG) in various stages of development. A control group of 40 normal subjects (80 eyes) was also taken into consideration.
14% of eyes with ocular hypertension were found to be abnormal by automated static perimetry. Sensitivity and specificity of Competer 350 was evaluated as about 90% and 96% respectively.
Frequency distribution of glaucomatous scotomas found according to their respective stages of development will be illustrated.

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COMPARATIVE EVALUATION OF THE HUMPHREY FIELD ANALYSER, PERITEST & SCOPERIMETER.

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Twenty glaucoma patients with visual field stage II and III were twice examined with the Humphrey F.A. programmes "120", 'Central 30-2" and Profiles".
The "120" programme results were compared with double examinations using the Peritest suprathreshold threshold-related technique. Meridional static perimetry was compared with a similar programme of the Scoperimeter.
The "Central 30-2" and "Profiles" programme results were compared with the double threshold programme and the "meridian" programme of the Scoperimeter.
Individual defect depth, defect volume and reproducibility were studied.
Mechanical construction, operation, examinationstrategies, print-out will be discussed.

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THE MACULAR THRESHOLD: DETERMINATION OF POPULATION NORMAL VALUES.

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While it is accepted that the macula represents a peak of sensitivity, normal population values and ranges are poorly defined. Now that the assessment of macular sensitivity with automated perimetry is being performed clinically to monitor conditions such as senile macular degeneration and cystoid macular oedema following cataract surgery, a better definition is desirable.

The horizontal macular threshold was measured on the Dicon AP2000 perimeter for 160 normal subjects. All cases were autorefracted using the Nidec 3000 model, and corrected fully taking presbyopia into account. Threshold values were measured at seven points spanning the central eight degrees of field. Determination was made by a semibracketing technique employed by the Dicon.

Our results demonstrate a significant relationship between peak sensitivity and age group. The degree of fall in sensitivity taken at two degrees' eccentricity is firmly governed by the height of the peak.

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SELECTIVE RETESTS IN AUTOMATED PERIMETRY. AN EXPERIMENTAL STUDY FOR THE EVALUATION OF THE EFFECT OF THE REGRESSION TO THE MEAN

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Many automated perimeters have in their software built-in selective retests at the disturbed test locations. The goal of this study is to evaluate how far such selective retests may influence the outcome of automated perimetry. In a large pool of data based on Octopus J0 measurements we compared information based on one- and two-phase measurements with measurements carried out with selective retests. The influence on the visual field indices and on the number of pathological test locations is shown.

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BINOCULAR THRESHOLD CAMPIMETRY IN THE AMBLYOPIC SYNDROME.

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The Authors report on the possibility of studying the effect of binocular vision in normal and amblyopic subjects by means of static binocular campimetry, trying to eliminate any "dissociating" factors.

A giant projection campimeter with typological features equivalent to Goldmann's standards was utilized to assure the accuracy of the examination.
Thirty subjects aged between 7 and 14 years (10 normal, 10 affected by anisometric amblyopia and 10 by strabismic amblyopia) underwent static threshold examination every 3 degrees along the 0 - 180° and 0 - 90° hemimeridians, by means of the traditional method of limits, first in monocular and then in binocular vision.

In both normal and amblyopic subjects an increased light sensitivity in binocular conditions was found. This increase was also present in areas where an amblyopic scotoma was present.

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CENTRO-COECAL FIELD EXAMINATION IN CHRONIC ALCOHOLISM.

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The Humphrey Field Analyzer automatic perimeter was employed for centro-coecal field examination in 50 alcholics with normal visual acuity. A threshold grid custom test was specifically designed for this purpose.
The results were compared with values found in a control group of normal subjects.

In a significant number of cases it was possible to show a fall in sensitivity in the examined area, probably due to sub-clinical optic nerve damage.

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STATIC AND KINETIC PERIMETRY RESULTS OF RED KRYPTON LASER TREATMENT FOR MACULAR EDEMA COMPLICATING BRANCH VEIN OCCLUSION.

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Twenty patients with clinical and angiographic evidence of branch vein occlusion complicated by macular edema were assigned to Krypton laser treatment if their symptoms lasted no more than three months.
Each patient underwent visual acuity testing, static and kinetic perimetry, fundus photography and fluorescein angiography before treatment and at one-to three month intervals thereafter. The visual acuity in addition to static and kinetic perimetry results are presented and the correlation between them is being discussed.

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OCTOPUS PERIMETRY IN DEVELOPING COUNTRIES.
AN APPRAISAL OF PATIENT PERFORMANCE.

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Computerized perimetry is more effective than manual perimetry for the detection and assessment of visual field defects. Despite the availability of reasonably priced models which are simple to operate and with minimal maintenance, computerized perimeters are not commonly used in developing and industrializing countries. This may be due to the misconception that patients belonging to cultures with less exposure to technology should have poorer understanding of the tests and are thus intimidated by the hardware. The purpose of our study is to verify the feasibility of Octopus visual field testing in our patient population. A total of 120 consecutive Octopus visual field tests using the programs 31 or 32, were analyzed. All cases were exposed for their first time to computerized perimetry. Patients with normal central 30° visual fields required 432 (±123) stimulus presentations; 550 or more stimuli were necessary in 9% of them. A mean of 13 (±20) stimuli were repeated; 15 or more repetitions of stimuli were recorded in 29% of the cases. The false positive and false negative answer rates were 5.5% and 1.7%, respectively. The mean RMS value was 1.9 (±0.8) dB. Among the patients with abnormal visual fields, 29% required 550 or more stimulus presentations. More false negatives (6%) and less false positives (2%) than in normals were observed. RMS fluctuations were 3.4 (±1.8) dB. The remaining parameters were the same as in normals. Patient acceptance and understanding of the test as quantifiable by standard reliability parameters in our sample was comparable to what is commonly observed in western patients.

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SPATIAL SUMMATION AND DYNAMIC RANGE

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Enlarging the stimulus size of the OCTOPUS automated perimeter from 3 to 5 increases the differential light sensitivity (dls). Such an increase of the dls may be necessary to enhance visual field remnants. This increase of the dls is due to spatial summation. Spatial summation in normals at different eccentricities are presented. Spatial summation in normal areas are compared with those occurring in moderatly disturbed areas. Furthermore stimulus size 3 and 5 are compared in terms of scatter, tiring effect etc.

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SPECTRAL SENSITIVITIES ON A WHITE BACKGROUND AS A FUNCTION OF RETINAL ECCENTRICITY

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It has been found that the spectral sensitivity curve on an intense white background shows three peaks which are at about 440nm, 530nm and 610nm. In this experiment the test sensitivities on a white background with a luminance of 1000 photopic trolands were studied for up to 15° from the fovea along the horizontal meridian using a Maxwellian view optical system for the groundwork for color perimetry. A 1° diameter circular test field was superimposed in the center of a 8° circular background. This test field was exposed for 200msec every two seconds. The results showed the usual three maxima of sensitivities, about 440nm, 530nm and 610nm, at the fovea. However, the two maxima in the long wavelength region gradually decreased with retinal eccentricity. The characteristics of test sensitivities on a white background as a function of retinal eccentricity will be discussed.

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POPULATION STUDY OF LOCAL FATIGUE WITH PROLONGED THRESHOLD TESTING IN AUTOMATED PERIMETRY.

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In the literature several reports have indicated that there is deterioration of the differential light threshold in prolonged visual field testing, more so in glaucoma patients than in normals. It is speculated that this so-called fatigue phenomenon might be of help in detecting early glaucomatous damage. In order to investigate the factors influencing fatigue we studied 46 normals, 32 ocular hypertensives, 38 other glaucoma suspects, and 37 glaucoma patients. Fatigue was defined by the increase of threshold value in dB/hour.

We determined "global" fatigue (whole field repeatedly tested) and "local" fatigue (4 selected points repeatedly tested) by continuous testing over 20-30 minutes. We found that local fatigue was larger than global fatigue by a factor of about 2, for all groups. There was no significant difference in the frequency distribution between groups, except for the glaucoma group. We found a slight age-dependency which was not different between groups.

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THE NORMAL OPTIC DISC

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The area of the optic nervehead was measured in 120 normals by means of the computerized planimetric technique with correction for the magnification factors of the eye. The blind spot was manually delineated on the Oculus Perimeter, mangnified and planimetrized. The correlation between the area of the blind spot and the significance of any deviations from a linear relationship will be discussed.

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ANOMALOUS VISUAL RESPONSE IN TOURETTE'S SYNDROME: A PRELIMINARY STUDY

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Because haloperidol is often successfully used in treating Tourette's syndrome, this condition is commonly thought to involve an anomaly of dopamine neurotransmission. It is also believed that the human retina contains dopaminergic amacrine, interamacrine and interplexiform cells. Since these retinal cells could represent the neural substrate of the psychophysical transient-like response characterized by Enoch and collaborators, at the suggestion of Dowling we conducted a detailed visual study of a Tourette's patient. Our subject is a 25 year old male who has been on haloperidol medication since being diagnosed as having Tourette's syndrome at age 10. His eyes appeared within normal limits in a conventional eye examination except for a slight enlargement of the blind spot in OS found by kinetic Goldmann perimetry.

Quantitative layer-by-layer perimetric testing, as evolved in this laboratory, was performed at fixation and different parafoveal eccentricities. All loci tested revealed normal sustained-like response. The transient-like response, thought to be mediated by cells bordering the inner plexiform layer, was often 50% (or less) of normal at 10 degrees eccentricity for random, noncongruous loci in each eye. During a brief gastrointestinal illness which caused interruption of his haloperidol medication, the patient's transient-like response became normal to supra-normal at affected test sites. These same data points became subnormal responses after the patient resumed therapy. We hope to test additional Tourette's patients. Possible implications of these findings will be discussed.

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APPLICATION OF THE TROXLER EFFECT IN CAMPIMETRY IN GLAUCOMA SUSPECTS.

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A trial campimeter observed at 30 cm. distance is used. It has 80 target holes within the 25° circles, arranged 16 holes by every 5° , and 3 illuminating systems, which are:
a) for the target holes as 500 asbs by each,
b) for the screen surface diffusely as 16 asbs, and
c) changeable from 1 to 15 asbs, used for off-response diffusely on the screen surface by a switch with a time-device.

A person is asked to sit before the lightened campimeter and to stare the fixation without blinking. After 2 seconds the witch of the c) light is turned off. If there is any slight depression (of the third neuron) in the person's field, the Troxler effect excited by the off-response may show the existence of field defects as "vanishing out" of the target lights.
In early glaucomas this effect occurs in the Bjerrum area: in suspected glaucomas it can be seen often even when the Goldmann perimeter shows no defect. By changing the brightness of the c) light we can get a new sort of static quantitative perimetry.