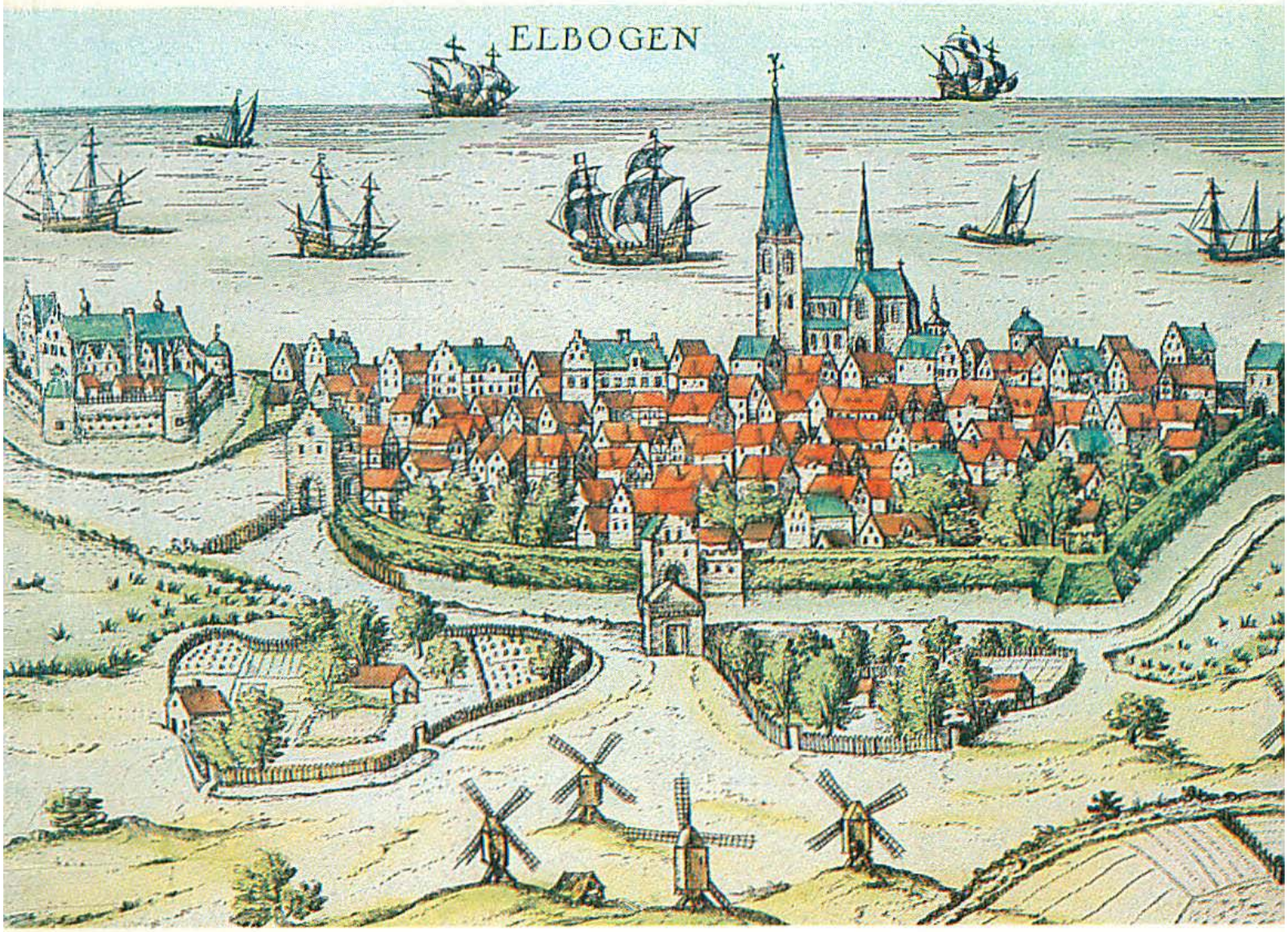
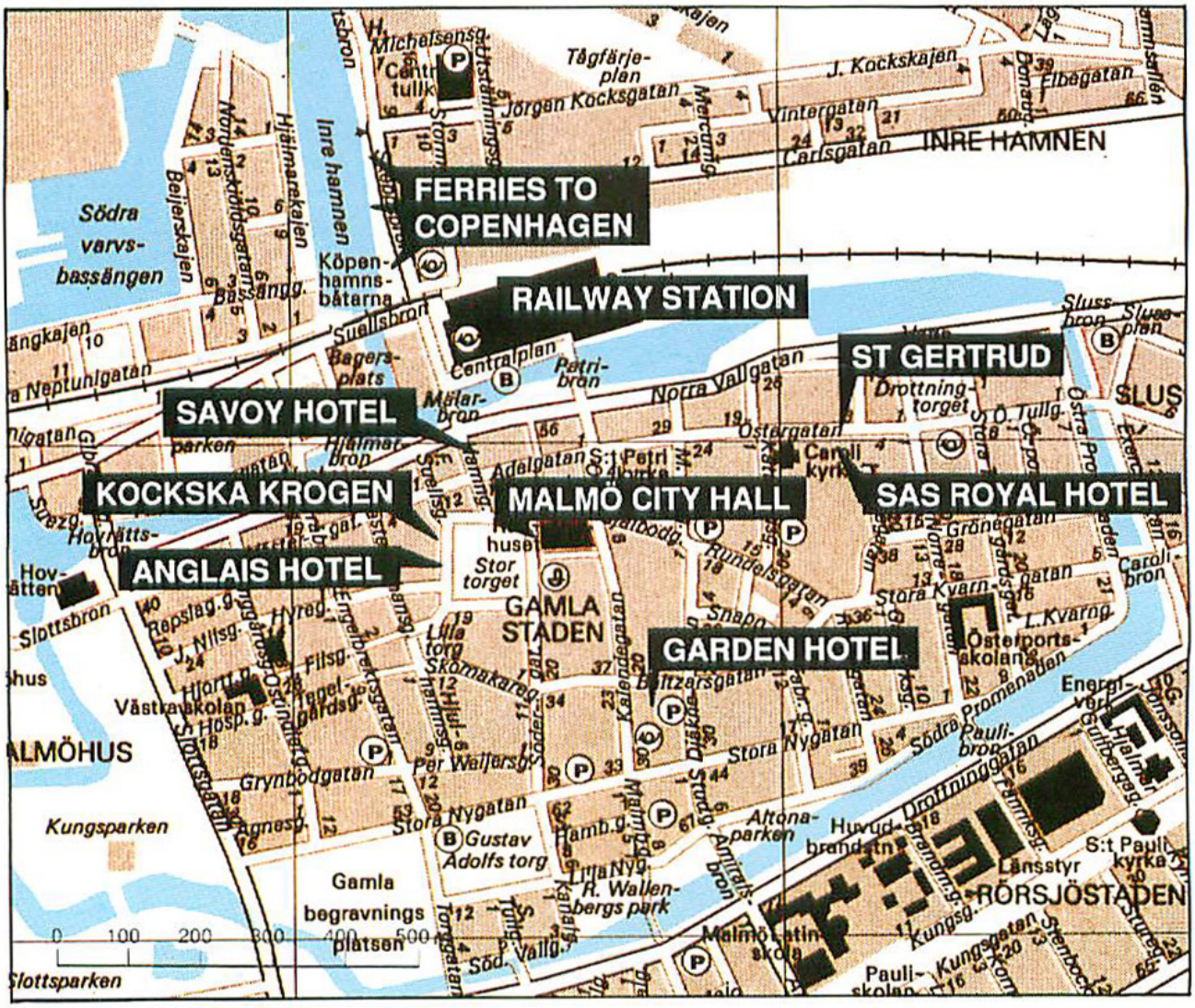
PROGRAMME



IXTH INTERNATIONAL PERIMETRIC SOCIETY MEETING

MALMÖ, SWEDEN JUNE 17 - JUNE 20, 1990



Part of Malmö City Centre

PROGRAMME

IXTH INTERNATIONAL PERIMETRIC SOCIETY MEETING

JUNE 17 - JUNE 20, 1990

THE ST GERTRUD CENTRE
ÖSTERGATAN 9
MALMÖ, SWEDEN

Sjukvården Malmö
Tryckeriet, 1990

CONTENTS

THE INTERNATIONAL PERIMETRIC SOCIETY

The International Perimetric Society (IPS) is the international organization for researchers in perimetry and visual fields. The Society was founded in 1974 and has held its international meetings every second year in the following locations:

1974	Marseilles, France
1976	Tübingen, FRG
1978	Tokyo, Japan
1980	Bristol, UK
1982	Sacramento, California
1984	Santa Margherita Ligure, Italy
1986	Amsterdam, The Netherlands
1988	Vancouver, Canada

The proceedings of the meetings are published, currently as the Perimetry Update series, by Kugler-Ghedini

The current Executive Committee of the International Perimetric Society:

President:	Dr Anders Heijl, Malmö, Sweden
Vice Presidents:	Dr Erik Greve, Amsterdam, The Netherlands
	Dr Mario Zingirian, Genova, Italy
Secretary:	Dr Richard Mills, Seattle, USA
Treasurer:	Dr Fritz Dannheim, Hamburg, FRG

Other Committee Members:

Dr Emilio Campos, Modena, Italy
Dr Jay Enoch, Berkeley, California
Dr Josef Flammer, Basel, Switzerland
Dr Fumio Furuno, Tokyo, Japan
Dr Enrico Gandolfo, Genova, Italy
Dr Egill Hansen, Oslo, Norway
Dr John Keltner, Davis, USA
Dr Kenji Kitahara, Tokyo, Japan
Dr Yoshiaki Kitazawa, Gifu, Japan

Honorary Members: Dr Elfriede Aulhorn
Dr Franz Fankhauser
Dr Hans Goldmann
Dr Heinrich Harms
Dr. Harutake Matsuo

ORGANIZERS OF THE IXth MEETING

Organizer of the Scientific Programme:
Dr Richard Mills, Honorary Secretary of the Society

Programme Committee:
Dr Richard Mills, Dr Josef Flammer, Dr Lars Frisén, Dr Anders Heijl

Organizing Host:
Dr Anders Heijl, University of Lund, Department of Ophthalmology in Malmö, S-21401 Malmö

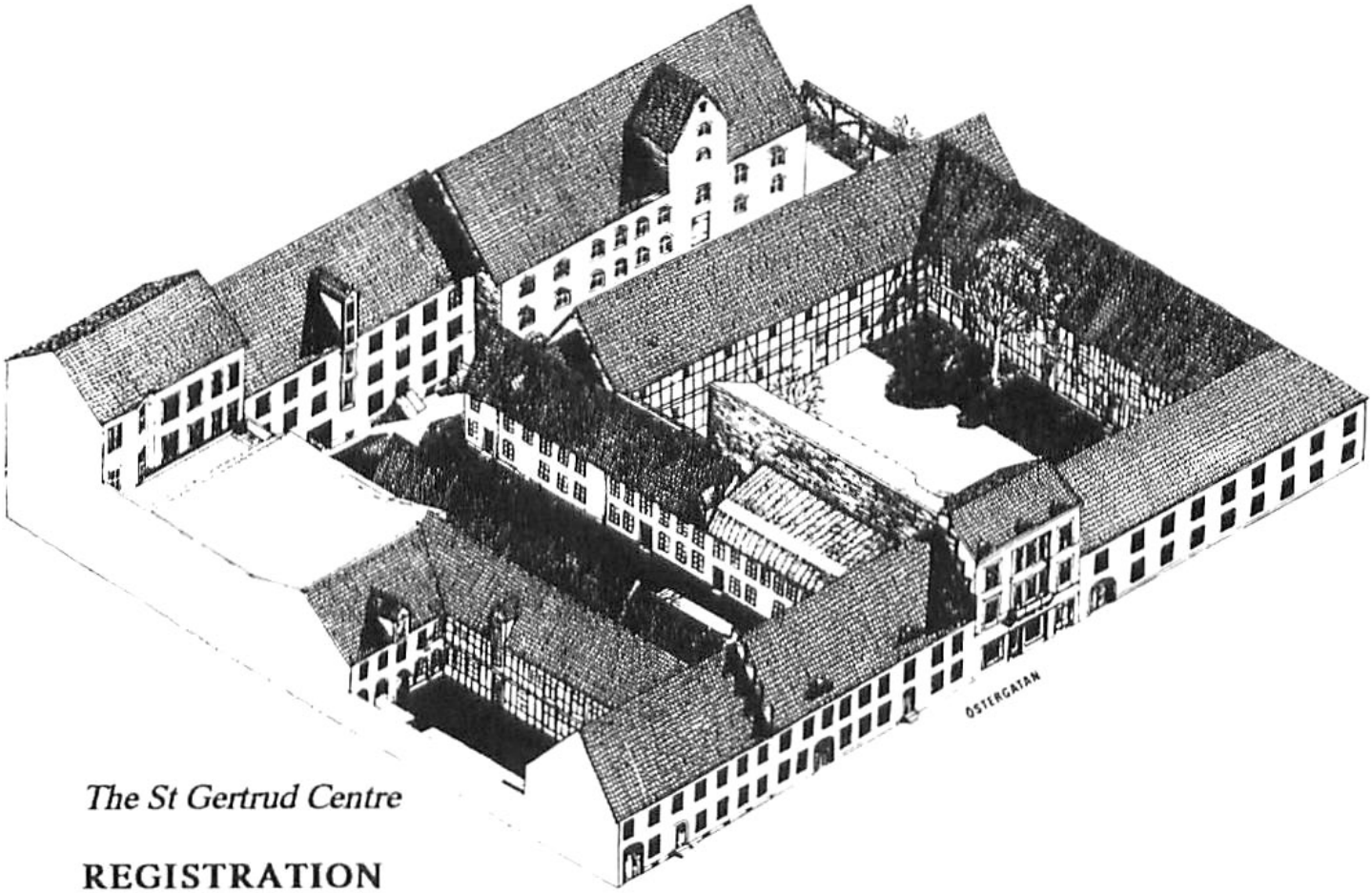
Host Committee:
Boel Bengtsson, Agneta Heijl, Dr C.E.T. Krakau, Marie-Louise Krakau, Gunilla Lundskog, Claudia Rebeggiani, Kristell Silvhed, Maj-Britt Thulin, Dr Peter Åsman

Travel Arrangements and Exhibits:
Malmö Convention Bureau, Södergatan 16, S-21134 Malmö, Sweden

MEETING VENUE: THE ST GERTRUD CONFERENCE CENTRE

The meeting will take place at the historical St Gertrud Conference Centre, Östergatan 9 in central Malmö. The scientific sessions are held in the Carolina Hall. Commercial exhibits and scientific posters are displayed in the Rasmus, Gertrud and Bager Halls and in the Carnegie room (see map below;list of poster locations and exhibitors on pages 27 and 96 respectively).

The SAS Royal Hotel is situated just across the street from St Gertrud, other conference hotels are within walking distance (see map of central Malmö on inside cover).

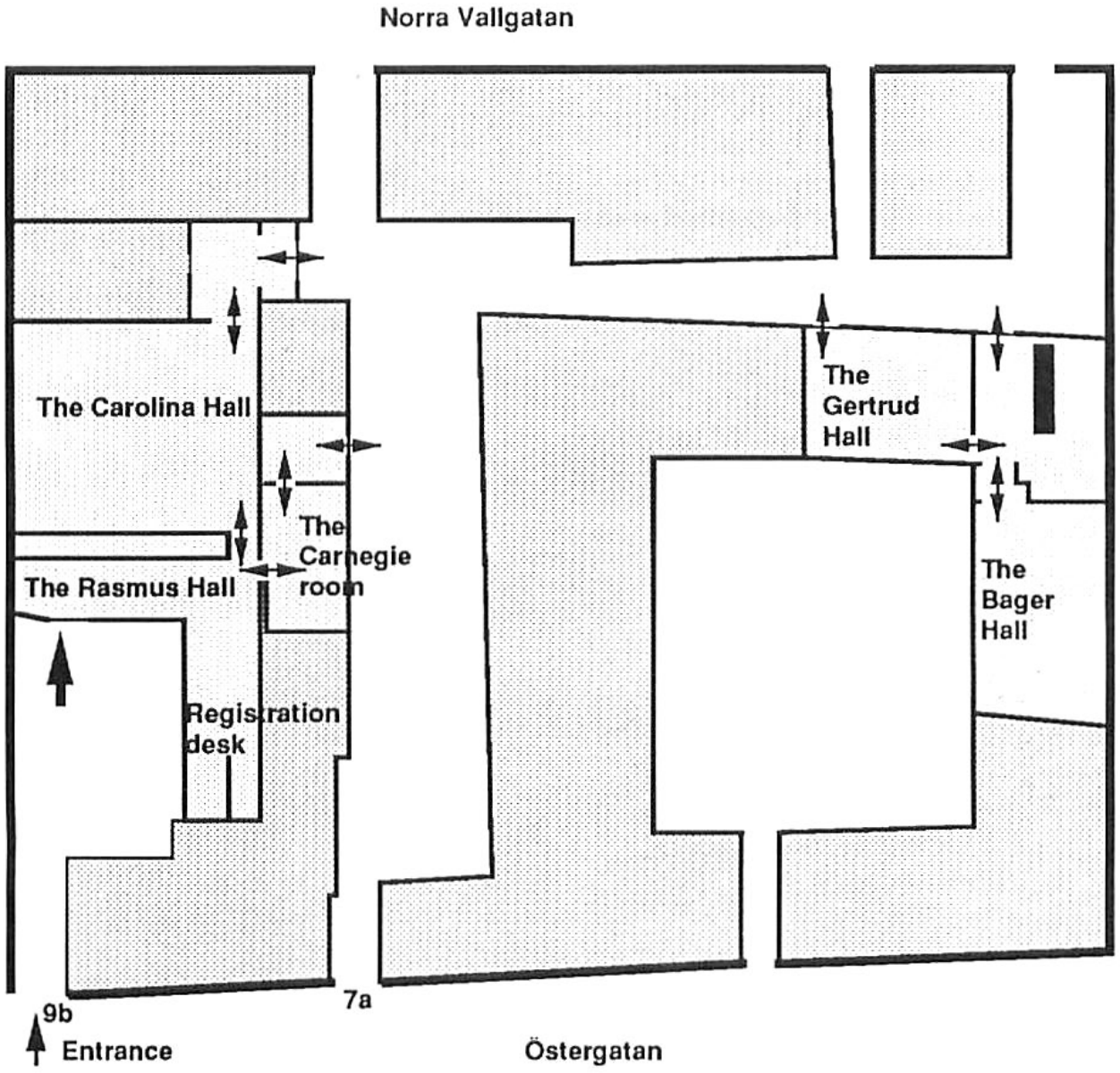


The St Gertrud Centre

REGISTRATION

Sunday	June 17	5.00 PM to 7.30 PM at the SAS Royal Hotel
Monday	June 18	8.00 AM to 4.00 PM at the St Gertrud Centre
Tuesday	June 19	8.00 AM to 12.30 PM at the St Gertrud Centre
Wednesday	June 20	8.00 AM to 12.00 noon at the St Gertrud Centre

Admittance to the Symposium, scientific sessions as well as exhibits is by badge only. A badge should also be worn during social events. Only registered participants and registered accompanying persons can participate in the Social Programme, and the Accompanying Persons' Programme.



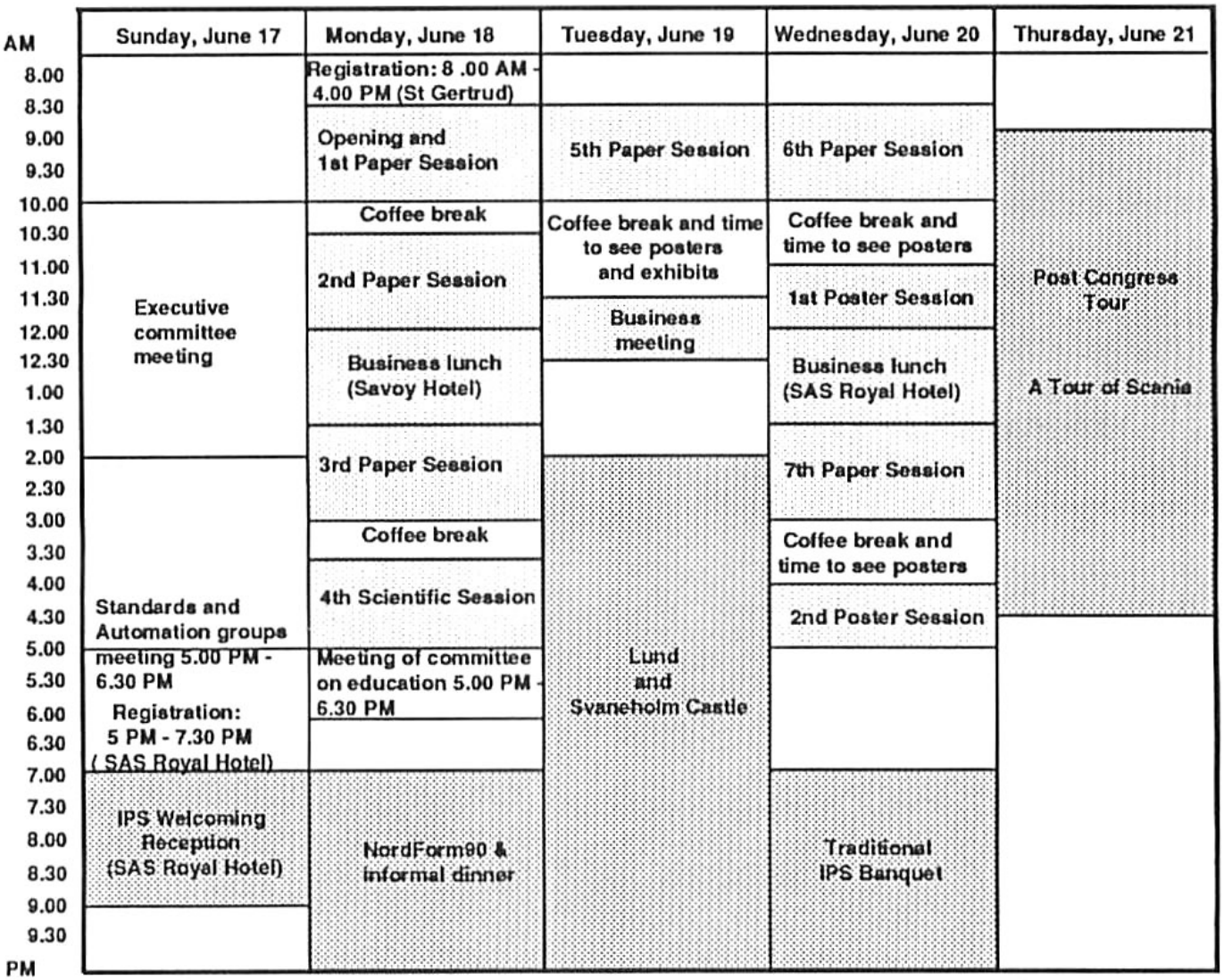
Plan of St Gertrud Centre. Scientific proceedings are held in the Carolina Hall.; commercial exhibits and scientific posters in the Rasmus, Gertrud and Bager Halls and in the Carnegie room

Full Registration entitles admission to all scientific sessions, commercial and scientific exhibits and posters, copy of final programme with abstracts, coffee breaks, Welcoming Reception, and the right to purchase tickets for social events and Post Congress Tour.

Accompanying persons' fees include Welcoming Reception, Malmö City Tour with lunch, and the right to purchase tickets for social events, Day Trip to Denmark and Post Congress Tour.

PROGRAMME-IN-BRIEF; DELEGATES

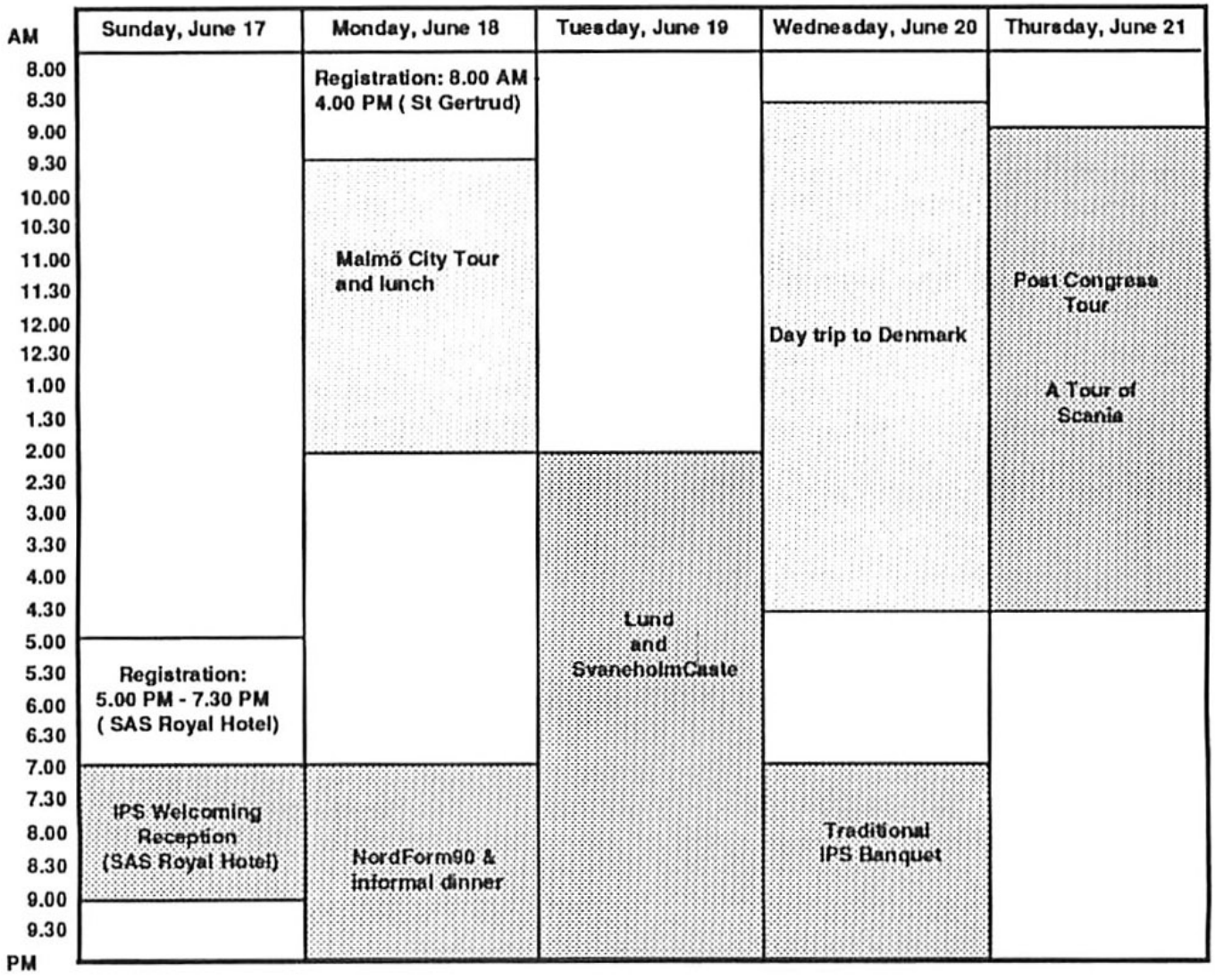
Sunday, June 17			
Executive committee meeting	10.00 AM	-	2.00 PM
Mounting of posters and exhibits (St Gertrud Centre)	12.00 PM	-	6.00 PM
Meeting of standards and automation of perimetry groups (The Carolina Hall)	5.00 PM	-	6.30 PM
Registration at the SAS Royal Hotel	5.00 PM	-	7.30 PM
IPS Welcoming Reception	7.00 PM	-	9.00 PM
Monday, June 18			
Registration at the St Gertrud Conference Centre	8.00 AM	-	4.00 PM
Opening and 1st Paper	8.30 AM	-	10.00 AM
Coffee break	10.00 AM	-	10.30 AM
2nd Paper Session	10.30 AM	-	12.00 AM
Lunch break	12.00 AM	-	1.30 PM
3rd Paper Session	1.30 PM	-	3.00 PM
Coffee break	3.00 PM	-	3.30 PM
4th Paper Session	3.30 PM	-	5.00 PM
Meeting of committee on education	5.00 PM	-	6.30 PM
NordForm90 and informal dinner	6.30 PM	-	10.00 PM
Tuesday, June 19			
5th Paper Session	8.30 AM	-	10.00 AM
Coffee break and time to see posters and exhibits	10.00 AM	-	11.30 AM
Business Meeting	11.30 AM	-	12.30 PM
Lund and Svaneholm Castle	2.00 PM	-	10.30 PM
Wednesday, June 20			
6th Scientific Session	8.30 AM	-	10.00 AM
Coffee break and time to see posters and exhibits	10.00 AM	-	11.00 AM
1st Poster Session	11.00 AM	-	12.00 AM
Lunch break	12.00 AM	-	1.30 PM
7th Scientific Session	1.30 PM	-	3.00 PM
Coffee break and time to see posters and exhibits	3.00 PM	-	4.00 PM
2nd Poster Session	4.00 PM	-	5.00 PM
Traditional IPS Banquet	7.00 PM	-	12.00 PM
Thursday, June 21			
Post-Congress Tour of Scania	9.00 AM	-	4.30 PM



Schematic diagram of Delegates' Programme

PROGRAMME-IN-BRIEF; ACCOMPANYING PERSONS

Sunday, June 17			
Registration at the SAS Royal Hotel	5.00 PM	-	7.30 PM
IPS Welcoming Reception	7.00 PM	-	9.00 PM
Monday, June 18			
Registration open at the St Gertrud Conference Centre	8.00 AM	-	4.00 PM
Malmö City Tour and lunch	9.30 AM	-	2.00 PM
NordForm90 and informal dinner	6.30 PM	-	10.00 PM
Tuesday, June 19			
Morning: free			
Lund and Svaneholm Castle	2.00 PM	-	10.30 PM
Wednesday, June 20			
Day trip to Denmark	8.30 AM	-	4.30 PM
Traditional IPS Banquet	7.00 PM	-	12.00 PM
Thursday, June 21			
Post-Congress Tour of Scania	9.00 AM	-	4.30 PM



Schematic diagram of Accompanying Persons' Programme

GENERAL SOCIAL PROGRAMME

Sunday, June 17 **IPS Welcoming Reception** 7.00 PM - 9.00 PM

A buffet will be served at the SAS Royal Hotel, which is located across the street from the St Gertrud Centre. Meeting participants may register at the SAS Hotel between 5.30 and 7.30 PM, or at St Gertrud on the following day. No transportation.

Monday, June 18 **NordForm90 & informal dinner** 6.30 PM - 10.00 PM

Buses will transport participants from SAS Royal and Savoy to NordForm 90, the largest exhibition of Scandinavian art handicrafts, industrial design and architecture which has been arranged in Scandinavia for several decades. After a guided tour at NordForm, buses will transport participants to "Kockska Krogen", a restaurant located in a historical building from the 16th century. A rustic, genuine regional Scania dinner will be served. "Kockska Krogen" is situated in the very heart of the city, at Stortorget, close to all meeting hotels. No transportation will therefore be provided **after** the dinner.

Tuesday, June 19 **Lund and Svaneholm Castle** 2.00 PM - 10.30 PM

Buses will pick up participants at SAS Royal and Savoy at 2.00 PM. The tour will first go to Lund. The Cathedral with its famous mediaeval clock, the open-air Museum of Cultural History and the University will all be visited. Tea and coffee will be served. The excursion will continue through charming countryside to the 16th century castle of Svaneholm. There, Midsummer celebrations will be followed by a genuine Swedish "smörgåsbord" dinner in the castle. Return by bus to meeting hotels.

Wednesday, June 20 **Traditional IPS Banquet** 7.00 PM - 12.00 PM

The IPS Banquet will be held at the Malmö City Hall at Stortorget. After cocktail reception with music in the Landstings Hall, the Society will gather for its traditional dinner and national singing in the Canute Banqueting Chamber. No transportation.

ACCOMPANYING PERSONS PROGRAMME

In addition to the General Social Programme, accompanying persons may participate in the following arrangements:

Monday, June 18 **Malmö City Tour and lunch** 9.30 AM - 2.00 PM

Guided bus tour of Malmö followed by a walk in the charming "Old town". Lunch is included and after lunch there will be opportunities for shopping.

Tuesday, June 19 **Lund and Svaneholm Castle** 2.00 PM - 10.30 PM

See General Social Program.

Wednesday, June 20 **Day trip to Denmark** 8.30 AM - 4.30 PM

Full day guided tour by ferry and bus includes visits to the city of Elsinore, the famous art museum Louisiana, lunch at an old Danish inn and a walk in Copenhagen.

POST CONGRESS TOUR

Thursday, June 21 **A Tour of Scania** 9.00 AM - 5.00 PM

A tour through the beautiful countryside of the southernmost province of Sweden: charming country villages and churches, old castles and historical sights.

The congress reserves the right to cancel tours if necessary.
All social events are available only to registrants.

INFORMATION

The information counter, situated in the Rasmus Hall of the St Gertrud Centre, will be open during the whole congress. Delegates can also be reached through this counter, telephone + 46 40 128809

Further information may be obtained from:

Malmö Convention Bureau
att: Ms Claudia Rebeggiani
Södergatan 16
S-21134 Malmö, Sweden
Telephone: +46 40 232550
Fax: + 46 40 235520

or from:

IXth IPS Meeting Secretariat
Dept. of Ophthalmology in Malmö
University of Lund
Malmö General Hospital
S-21401 Malmö, Sweden
Telephone: +46 40 332755

PAYMENT AND TICKETS FOR SOCIAL EVENTS

On-site registration is possible at the St Gertrud Centre, where it is also possible to purchase remaining tickets for social events. Payment for on-site registration and purchases may only be made in Swedish crowns or the equivalent amount in US$. Cash and travelers cheques are accepted, personal cheques and credit cards cannot be accepted.

BANKING AND FOREIGN EXCHANGE

Currencies may easily be exchanged at all banks. These are usually open from 9.30 AM to 3.00 PM Monday through Friday. One currency exchange (Forex), located in central Malmö at the intersection of Hamngatan and Norra Vallgatan (across the street from the Savoy Hotel), is open 8.00 AM to 9.00 PM every day.

LUNCHES

The business lunches for delegates are at the Savoy Hotel on Monday 18, and at the SAS Royal on Wednesday 20. These meals are available only to those participants who have purchased lunch tickets. On Tuesday participants should arrange their own lunches.

There are many restaurants in central Malmö, especially around Stortorget, Lilla Torg and in the Market Hall (see Malmö This Month or Malmö Shopping Guide).

SCIENTIFIC PROGRAMME

MONDAY JUNE 18

8.30 AM - 10.00 AM **OPENING AND 1ST PAPER SESSION**
Chairman: F. Furuno
Moderator: L. Frisén

The morphology of visual field damage in idiopathic intracranial hypertension: An anatomic region analysis
M. Wall

Atypical field defects in optic neuritis and the significance of the Tübingen Flicker Test in its diagnosis
S. Trauzettel-Klosinski, E. Aulhorn

Evaluation of visual fields in patients with clinically diagnosed TIA and minor stroke
B.M. Abela Jr., C.E.T. Krakau, P. Falke, F. Lindgärde

Statokinetic dissociation: analysis of spatial and temporal characteristics by perimetry
M. Osako, C.A. Johnson, E.J. Casson, P. Huang, J.L. Keltner

Optic neuritis treatment trial: Initial visual field defects
J.L. Keltner, C.A. Johnson, J.O. Spurr, and the Optic Neuritis Study Group

Pattern recognition in automated perimetry of patients with optic neuropathies
S.A. Newman

10.00 AM - 10.30 AM **Coffee Break**

MONDAY JUNE 18

10.30 AM - 12.00 AM **2ND PAPER SESSION**
Chairman: G. Douglas
Moderator: B. Schwartz

Correlation of the optic disk and visual field in glaucoma
F. Dannheim, T. Damms, S. Obrecht

The relationship between optic nerve and nerve fiber layer parameters and visual loss in glaucoma
J. Caprioli, M. Zulauf

Correlation of optic disc cupping pallor loss
C. O'Brien, B. Schwartz, T. Takamoto

What types of morphological changes in the optic nerve head correlate with field changes as revealed by the Octopus G-1 program
U. Flüeler, B. Gloor, J Stürmer

The correlation between retinal nerve fiber layer defect and visual field defect in glaucoma
Y. Yamazaki, T. Miyazawa, H. Yamada

Correlation of retinal nerve fiber layer loss, changes at the optic nerve head and various psychophysical criteria in glaucoma
B.J. Lachenmayr , P.J. Airaksinen, S.M. Drance, K. Wijsman

Comparison of optic disc image analysis with automated perimetry in the detection of glaucomatous progression
M.B. Sherwood, S.T. Simmons, M.F. Smith, N.J. Mehta

12.00 AM - 1.30 PM **Lunch Break**

MONDAY JUNE 18

1.30 PM - 3.00 PM **3RD PAPER SESSION**
Chairman: K. Kitahara
Moderator: P.J. Airaksinen

Computerized color analysis of the optic disc and progression of visual field defects in glaucoma
M. Ito, K. Tetsumoto, J. Kawakami, H. Miyazawa, K. Mizokami

The predictive value of computerized visual field/disc pallor as indicator of future glaucoma development
E. Linnér, B. Schwartz

Detection of chronological changes of papillary pallor using principal component analysis
Chr. Kryenbühl, R. Geschwindt, Y. Robert

Relationship between optic disc changes and visual field defects in glaucoma
K. Nanba, K. Iwata, M. Shiakashi, K. Nagata

The long-term effect of intraocular pressure reduction on the glaucomatous optic disc cupping
K. Matsubara, M. Maeda, G. Tomita, Y. Kitazawa

Improvement of visual field following IOP reduction in adult COAG patients
C.S. Tsai, D.H. Shin

Choroidal plerometry: An approach to the dynamics of choriocapillaris perfusion by digital analysis of fluorescein angiograms
G.N. Lambrou, T.J.T.P. van den Berg, F. Temporelli, W. van den Berg, H.C. Geijssen, E.L. Greve.

3.00 PM - 3.30 AM **Coffee Break**

MONDAY JUNE 18

3.30 PM - 5.00 PM

4TH PAPER SESSION
Chairman: S. Drance
Moderator: J. Wild

Psychophysical studies of the normal visual fields of monkeys
R.S. Harwerth, E.L. Smith, III, L. De Santis

A child's play version of high-pass resolution perimetry
L. Frisén

Light-sense, flicker and resolution perimetry in glaucoma: A comparative study.
B.J. Lachenmayr, S.M. Drance, G.R. Douglas, F.S. Mikelberg

Perimetry and retinal lesions: A pathophysiological study
B. Lindblom,

Visual field difference plots
L. Frisén

Blue stimuli versus white stimuli in glaucoma
A.I. Friedmann

Equiluminant blue/yellow color contrast perimetry (CCP) in high risk ocular hypertension (OHT) and glaucoma (POAG)
W.M. Hart, Jr., M.O. Gordon, S.E. Silverman and M.A. Kass

TUESDAY JUNE 19

8.30 AM - 10.00 AM **5TH PAPER SESSION**
Chairman: A. Heijl
Moderator: C. Johnson

Optic disc and RFNL imaging in screening for glaucoma
P.J. Airaksinen, A. Tuulonen, A. Montagna, H. Nieminen

Tonometry fundus photography and automated perimetry in glaucoma screening
K. Mizokami, Y. Shiose, Y. Kitazawa, S. Tsukahara, T. Akamatsu, R. Futa, H. Katsushima, H. Kosaki

Longitudinal monitoring of glaucoma suspects by means of computerized disc analysis and Octopus perimetry
J. Funk

Within and between eye learning and fatigue effects in normal perimetric sensitivity
A.E.T. Searle, D.E. Shaw, J.M. Wild, E.C. O'Neill

Computerized visual fields in congenital glaucoma and pediatric glaucomas
R. Sampaolesi, J. Casiraghi

The relationship of vasospasm, diffuse and localized visual field defects and intraocular pressure in glaucomatous eyes
J.R. Piltz, S.M. Drance, G.R. Douglas, F.S. Mikelberg, M. Schulzer,

Diagnostic value of static profile perimetry in macular pathology
E.M. Mironova, M.A. Rudneva

10.00 AM - 11.30 AM **Coffee Break and time to see posters and exhibits**

11.30 AM - 12.30 PM **Business Meeting**

WEDNESDAY JUNE 20

8.30 AM - 10.00 AM **6TH PAPER SESSION**
Chairman: F. Dannheim
Moderator: C. Langerhorst

Effect of test point location on the magnitude of long-term fluctuation in glaucoma patients undergoing automated perimetry
E.Werner, G. Ganiban

Fluctuation of perimetry in stable glaucoma patients
M. Zulauf, J. Caprioli, D. Hoffman, C. Tressler

Inter-test threshold variability in glaucoma importance of censored observations and general field status
A. Heijl, A. Lindgren, G. Lindgren, M. Patella

Pointwise analysis of serial fields in glaucoma
J.M. Wild, M.K. Hussey, J.G. Flanagan, G.E. Trope

Clinical comparisons of two estimates of short-term fluctuation
R.P. Mills, W. Lau, M. Schulzer

Statpac 2 compared to clinical evaluation of visual fields
A. Tuulonen, P.J. Airaksinen

Classification of glaucomatous visual field defects using the Humphrey Field analyzer box plots
Y. Shin, H. Suzumura, F. Furuno, K. Harasawa, N. Endo, H. Matsuo

10.00 AM - 11.00 AM **Coffee Break and time to see posters and exhibits**

WEDNESDAY JUNE 20

11.00 AM - 12.00 AM **1ST POSTER SESSION**
Chairman: Y. Kitazawa
Co-moderators: J. Keltner and J. Flammer

1. Visual field findings in depressive patients under Lithium-treatment: Preliminary results
A. Prünte, U. Heinen, A. Wirz-Justice, Chr. Remé, U. Urner

2 Graves' ophthalmopathy: Perimetric and ultrasonographic findings
S.C. Sacca, E. Gandolfo, A. Polizzi, P. Capris

3. Ring perimetry in neuro-ophthalmology
H. Bynke

4. Optic neuritis treatment trial: Visual field reading center
J.L. Keltner, C.A. Johnson, J.O. Spurr, The Optic Neuritis Study Group

5. Study of the influence of stimulus size on the pericentral visual field
C. Matsumoto, K. Uyama, S. Okuyama, Y. Nakao, T. Otori

6. Binocular interaction in normal and amblyopic patients: Comparative study with automatic perimetry and VEP
M. Fioretto, V. Brezzo, G.P. Fava, E. Gandolfo

7 Puptrak: A preliminary report
F. Fankhauser II, J. Flammer, A. Jenni

8. Perimetry and driving licences
E. Gandolfo, E. Campos, M.Facino, G.Di Lorenzo,

9. A proposal for a new classification and quantification of visual disability
E.Gandolfo, M. Zingirian

10. Relationship between visual field defects and choroidal angiographic findings in patients with open angle glaucoma
Ch. Prünte, J. Flammer

11. Scanning laser ophthalmoscope for static fundus perimetry in glaucomatous nerve-fiber-bundle defects
J. Stürmer, C. Schrödel, W. Rappl

Posters 1 - 8 The Bager Hall
Posters 9 - 11 The Gertrud Hall

11.00 AM - 12.00 AM **1st Poster Session, cont.**

12. Microperimetry with the scanning laser ophthalmoscope
F. J. Van de Velde, A.E. Jalkh, A.E. Elsner

13. Localized scotomas and vascular impairment in diabetic maculopathy
T. Bek

14. New methods of analysis of serial visual fields
M. Cyrlin, J. Rosenshein, S. Cunningham, C. Tressler, C. Czedik

15. Automated visual field management in glaucoma with the Peridata program
P. Brusini, S. Nicosia, J. Weber

16. Octosmart: A computerized aid for interpreting visual field examination results
A. Funkhouser, H-P. Hirsbrunner, F. Fankhauser, J. Flammer

17. Valuation of the diagnosis of visual fields
L. R. Shapiro, C.A. Johnson

18. A neural network can differentiate glaucoma and optic neuropathy visual fields through pattern recognition
S.E. Kelman, H.R. Perell, L. D'Autrechy, R. J. Scott

19. A computer assisted visual field diagnosis system using neural network
S. Nagata, K. Kani, A. Sugiyama

20. Computer-assisted evaluation of the results from highpass resolution perimetry: A knowledge-based system
L. Martin-Boglind, P. Wanger

21 Extended empirical statistical package for evaluation of single and multiple fields in glaucoma: Statpac 2
A. Heijl, G. Lindgren, A. Lindgren, J. Olsson, P. Åsman, S. Myers, M. Patella.

22. Spatial considerations in cluster analysis for detection of glaucomatous field loss
P. Åsman, A. Heijl

23. Symmetry analysis in pituitary adenoma
C. Papoulis, J. Weber

Posters 12 - 23 The Gertrud Hall

11.00 AM - 12.00 AM **1st Poster Session, cont.**

24. Estimating short-term fluctuation without double threshold determinations: Validation of a method
R.P. Mills, W. Lau, M. Schulzer

25. The effect of the number of sensitivity determinations on short-term fluctuation
B.C. Chauhan, R.P. LeBlanc, S.M. Drance, K. Wijsman, A. M. Cruz

26. Optimizing dot size and contrast in pattern discrimination perimetry
B. Drum, R. Bissett

27. The Octopus 1-2-3 Cupola-free perimeter
F. Jenni, A.T. Funkhouser, F. Fankhauser, J. Flammer

12.00 AM - 1.30 PM **Lunch Break**

Posters 24 - 27 The Gertrud Hall

WEDNESDAY JUNE 20

1.30 PM - 3.00 PM **7TH PAPER SESSION**
Chairman: E. Campos
Moderator: W. Hart

Improved threshold estimates using full staircase data
J. Olsson, P. Åsman, H. Rootzén, A. Heijl

Riots: A heuristic technique for automated perimetry
C.A. Johnson, L. Shapiro

Octopus program G1X
Ch. Messmer, J Flammer, H. Bebié

Threshold related suprathreshold field testing: Which is the best technique of establishing the threshold?
D.B. Henson, R. Anderson

Macular threshold testing in glaucoma: Reassessing "split fixation"
M.F. Lieberman, R.H. Ewing

Are the early visual field changes topographically different between primary open angle (high tension) and normal tension glaucoma?
A. Iwase, K. Matsubara, Y. Kitazawa.

The influence of intraocular pressure on visual field damage in normal-tension and high-tension glaucoma
B.C. Chauhan, S.M. Drance

3.00 PM - 4.00 PM **Coffee Break and time to see posters and exhibits**

4.00 PM - 5.00 PM

2ND POSTER SESSION

Chairman: M. Zingirian
Co-moderators: R. Mills and E. Greve

28. Perimetric isolation of the SWS cones in OHT and early POAG
J.G. Flanagan, G.E. Trope, W. Popick, A. Grover

29. Central differential sensitivity to blue stimuli in glaucoma and ocular hypertension
A.Garavaglia, P. Bettin, M. Buscemi, C. Capoferri, C. Nassivera

30. The vulnerability of the blue cone system in glaucoma
R. Tamaki, K. Kitahara, A. Kandatsu, Y. Nishio

31. The differential light threshold as a function of retinal adaptation - the Weber-Fechner/Rose de Vires controversy revisited
J.G. Flanagan, M. Wild

32. The frequency-of-seeing curve under perimetric conditions.
S. Rau, J. Weber

33. Effect of target size, temporal frequency and luminance on temporal resolution visual fields
J. Faubert, M. Muermans

34. Scotopic and photopic CFF following manipulation of the IOP
A.C. Kothe, J.G. Flanagan, J.V. Lovasik

35. Quantifying metamorphopsia using hyperacuity paradigms
S. Aziz, V. Lakshminarayanan, J.M. Enoch

36. Functional alterations in diabetic retinopathy: Visual field macular recovery test and chromatic sense
A. Polizzi, M. Bovero, R. Gesi, C. Orione, G. P. Camoriano, E. Gandolfo

37. Automated perimetry of photopic and mesopic adapted visual fields in the evaluation of retinitis pigmentosa
H. Suzumura, T. Nonaka, Y. Ko, S. Wakasugi, T. Ogawa, H. Matsuo

38. Contrast sensitivity measurement in detection of primary open-angle glaucoma
J.M. Wood, J.E. Lovie-Kitchin

Posters 28 - 39 The Gertrud Hall
Posters 33 - 37 The Carnegie Room
Poster 38 The Rasmus Hall

39. The concept of the new perimeter Peristar
J. Weber

40. "Lectricon PCL 90": A new automatic perimeter
M. Zingirian, E. Gandolfo, P. Capris, R. Mattioli

41. A computer program for measuring the blind spot by means of the Octopus 2000 R unit
A.B. Safran, L. Almeida, C. Mermoud, D. Desangles, C. deWeisse, R. Lang

42. Multiple stimulus bowl perimetry using a four button, quadrant-related patient response system
K.L. DePaul, W.E. Sponsel

43. Automated peripheral perimetry: Kinetic vs suprathreshold static strategies
H.S. Barnebey, R.P. Mills

44. Evaluation of automated kinetic perimetry with the Humphrey Field Analyzer
J.R. Lynn, W.H. Swanson, R.L. Fellman

45. The significance of the peripheral visual field in detecting early visual field changes in glaucoma
A.L.Haas, R.P. LeBlanc, U.C. Schneider

46. Statokinetic dissociation in glaucomatous peripheral visual field damage
N. Katsumori, J. Bun, H. Shirabe, K. Mizokami

47. Influence of learning on the peripheral field as assessed by automated perimetry
N. Guttridge, A.A Rudnicka, D.F. Edgar, A.E. Renshaw

48. Correlation of reliability indices and test-retest reproducibility in normal subjects undergoing automated perimetry on the Humphrey Field Analyzer
G.R. Bennett, E.B. Werner

49. Is the variability in glaucomatous field loss due to poor fixation control?
D.B. Henson, H. Bryson

Posters 39 - 49 The Rasmus Hall

4.00 PM - 5.00 PM **2nd Poster Session, cont.**

50. An investigation into the blackhole effect in autoperimetry
N.A. Jacobs, M.L. Harris

51. The mode of progression of isolated scotomas in glaucoma
H. Miyazawa, H. Yokogawa, K. Mizokami

52. The progression mode of visual field defects in low tension glaucoma
T. Sugiura, M. Ito, K. Mizokami

53. The Influence of Brovincamine fumarate in low tension glaucoma
F. Furuno, M. Sakai, H. Suzumura, K. Yabuki, T. Hama, H. Ohkoshi

54. The effect of head tilt on fixation monitoring of the Humphrey perimeter
S. Newman, M. Wall

55. The relationship between backward and forward intraocular light scatter
M. Dengler-Harles, J.M. Wild, M.D. Cole, E.C. O'Neill, S.J. Crews

Posters 50 - 55 The Rasmus Hall

LIST OF POSTER LOCATIONS

Posters 1 - 8:	The Bager Hall
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ABSTRACTS ORAL PAPERS

PAPER SESSION 1

CHAIRMAN: F. FURUNO
MODERATOR: L. FRISÉN

THE MORPHOLOGY OF VISUAL FIELD DAMAGE IN IDIOPATHIC INTRACRANIAL HYPERTENSION: AN ANATOMIC REGION ANALYSIS

Michael Wall
Tulane University, New Orleans, Louisiana

Fifty patients with idiopathic intracranial hypertension (pseudotumor cerebri) had automated perimetry of the central 30° and Goldmann perimetry on the same day. The right eyes of 49 of the patients with good enough vision for automated perimetry were analyzed. The visual fields were graded with a modified glaucoma system and numerical anatomic region analysis performed. Nasal step defects (usually inferior) and enlarged blind spots were better defined with Goldmann perimetry. Loss in the nasal hemifield was usually concomitant with automated perimetry. The progression of loss was from a nasal step to nasal loss to a generalized depression of the visual field with relative sparing of the cecocentral and inferior Bjerrum areas. The visual loss of idiopathic intracranial hypertension is much like that of glaucoma.

ATYPICAL FIELD DEFECTS IN OPTIC NEURITIS AND THE SIGNIFICANCE OF THE TÜBINGEN FLICKER TEST IN ITS DIAGNOSIS

S. Trauzettel-Klosinski and E. Aulhorn
Department of Pathophysiology of Vision and Neuro-Ophthalmology, University Eye Clinic, Tübingen, FRG

This report deals with 24 patients suffering from optic neuritis (ON), who do not show the typical absolute central scotomas, but atypical field defects, such as arcuate scotomas, reduction of differential light sensitivity, paracentral scotomas and other defects, when examined with the Tübingen manual perimeter.

In these cases which imply quite a few problems in differential diagnosis, the Tübingen Flicker Test is of special diagnostic value, as this test gives pathological results only in active ON and is highly specific. Using this method, a reliable diagnosis of ON can be made in most of these cases.

EVALUATION OF VISUAL FIELDS IN PATIENTS WITH CLINICALLY DIAGNOSED TIA AND MINOR STROKE

Benjamin. M. Abela[1], Jr C.E.T Krakau[1], Pia Falke[2] and Folke Lindgärde[2]
Departments of 1 Experimental Ophthalmology and 2 Internal Medicine, Malmö General Hospital, University of Lund, Sweden

Seventeen patients diagnosed to have transient ischemic attacks (TIAs) from the carotid artery territory and fifteen patients with minor strokes were evaluated for status of ocular circulation using the Langham ocular blood flow system and with perimetry on the Competer 750. All patients were referred from the Department of Internal Medicine to the Department of Experimental Ophthalmology, both at the Malmö General Hospital in Sweden, and were previously examined using the duplex ultrasound for carotid artery stenosis. Visual fields, gross visual acuity, pulse rate, intraocular pressure, and pulse amplitudes of each eye were recorded. Visual field defects were found to be present in five TIA patients and eight minor stroke patients. Subjectively, all of these patients were unaware of having defects in their fields of vision. In general, larger field defects were found among the minor stroke cases. There was no significant difference in the frequency of visual field defects between the two groups. There were also no significant correlations between the presence of visual field defects and doppler and CT-scan findings. The relevance of the ocular pulse amplitude will be discussed in detail.

STATOKINETIC DISSOCIATION: ANALYSIS OF SPATIAL AND TEMPORAL CHARACTERISTICS BY PERIMETRY

Masahiro Osako, Chris A. Johnson, E. J. Casson, Peter Huang and J. L. Keltner
Optics and Visual Assessment Laboratory, University of California, Davis, California

Statokinetic dissociation (SKD) refers to a greater reduction in sensitivity to stationary visual stimuli relative to similar targets in motion. We evaluated SKD in 9 optic neuritis (ON) patients and 9 normals by measuring the difference between static and 4°/sec kinetic thresholds for a size I target along the four oblique meridians (31.5 asb background). To assess temporal response characteristics, we used flicker perimetry to measure sensitivity to 2, 8 and 20 Hz sinusoidal flicker at 5° intervals along the same oblique meridians. The patients' flicker sensitivity to all three frequencies was reduced at all eccentricities, but individual flicker losses did not appear to be related to the size of SKD for any of the three frequencies. However, in a number of cases, flicker sensitivity was unmeasurable to one or more frequencies well within the boundary for detection of kinetic stimuli. At 20 to 25°, in half the cases there was no measurable sensitivity to a flickering target, although a moving target could be seen. These results indicate that SKD in these patients may not be due to a selective loss of sustained mechanisms with a relative sparing of transient mechanisms as has been previously suggested. We hypothesize that SKD may be due to the presence of the greater spatial redundancy for a moving target as compared to a stationary target. If this is the case we might expect ON patients to perform better for static perimetry if a larger target is used. We compared the results of standard 30-2 Humphrey perimetry for size III and size V targets for normals and ON patients. Patients showed a larger than expected improvement using the size V targets, in accordance with our predictions.

OPTIC NEURITIS TREATMENT TRIAL: INITIAL VISUAL FIELD DEFECTS

J.L. Keltner, C.A. Johnson J.O. Spurr and the Optic Neuritis Study Group
University of California, Davis, California

The Visual Field Reading Center (VFRC) at the UC Davis Department of Ophthalmology has reviewed over 5,000 Goldmann and Humphrey visual fields in the 17 months since the Optic Neuritis Treatment Trial began. We have classified the initial visual field defects in 223 ONTT tests through October 1989. The initial Goldmann peripheral fields showed 45.3% diffuse and 41.7% localized visual field loss; 13% showed no defect. The initial Humphrey visual fields showed 49.8% diffuse and 50.2 % localized visual field loss.The frequency distribution of the 112 local Humphrey defects was as follows: Altitudinal 30.4%, three quadrant 17.0%, hemianopic 10.7%, quadrant 9.8%, arcuate 8.9%, centrocecal 8.9%, peripheral rim 6.3%, central 5.4% and enlarged blind spot 2.7%. The frequency of abnormality in the fellow eye was much higher than expected. Of the 223 initial Humphrey fellow eye visual fields, 47.5% had an abnormal Mean Deviation with a P value of < 0.05.

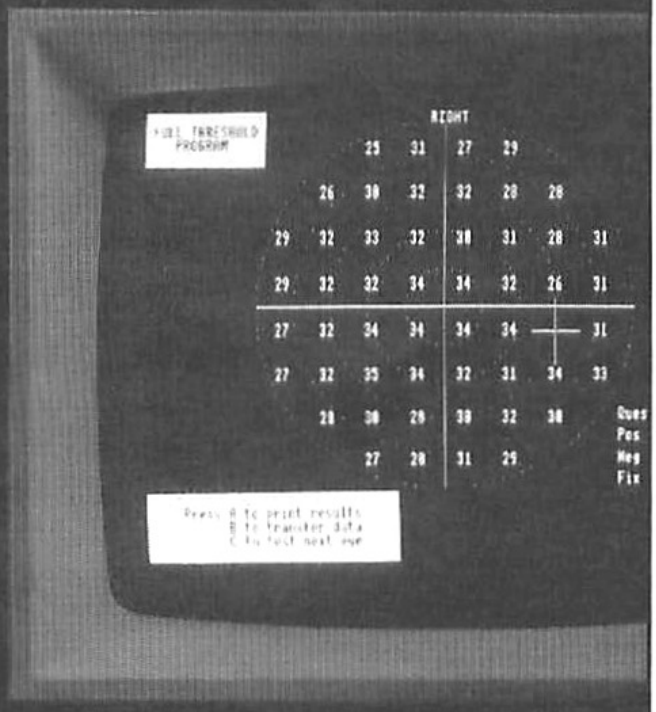
Examples of the variety of visual field defects will be presented.

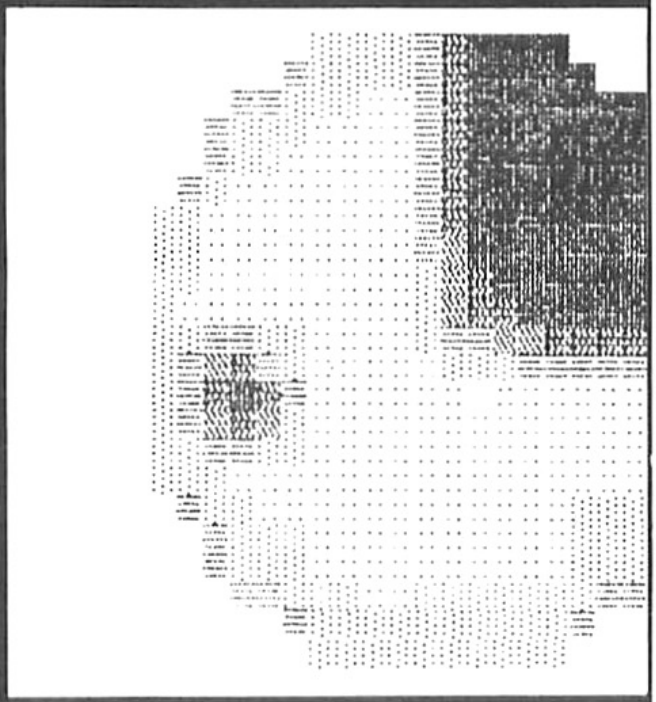
PATTERN RECOGNITION IN AUTOMATED PERIMETRY OF PATIENTS WITH OPTIC NEUROPATHIES

Steven A. Newman
University of Virginia, Charlottesville, Virginia

Automated static perimetry has been well-accepted as the standard of field analysis in patients with glaucomatous optic nerve damage as it offers sensitivity to paracentral defects and quantitation. Neuro-ophthalmologists have been slower to accept automated static perimetry. While patient compliance problems and, perhaps, reduced concern for the quantitative aspects remain an individual question with neuro-ophthalmologists, one additional problem has been the difficulty of pattern recognition. In order to analyze the patterns seen in common nonglaucomatous optic neuropathies, we undertook a review of patients seen at the University of Virginia. Automated static perimetry was performed on 44 patients with optic neuritis, 40 patients with AION, and 55 patients with compressive optic neuropathies. Fields were rejected if reliability coefficients were not within standard parameters or if a V-sized test object was utilized, leaving 27 fields of eyes with optic neuritis, 15 fields with AION, and 19 fields with compressive etiologies. The mean age was 33.3, 62.1, and 53.9. VA averaged 20/40. Mean deviation was -13.45, -14.20, and -13.02 dB. PSD averaged 7.75, 11.01, and 7.05 dB respectively. Short-term fluctuation was identical among the groups. Foveal sensitivity averaged 20.15, 27.13, and 27.47 dB. There was no significant difference in MD, SF, and VA. PSD was higher in AION than compressive or optic neuritis. Foveal sensitivity was reduced to a greater degree in optic neuritis. Pattern recognition in automated perimetry is more difficult than with Goldmann kinetic perimetry. Inflammatory, ischemic, and compressive processes may affect the optic nerve fibers in a variety of ways. History, age, and clinical setting remain essential in the differential diagnosis of a patient with optic neuropathy.

VISUAL FIELD SCREENING. VISUAL FIELD ANALYSIS IN TWO EASY LESSONS...





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PAPER SESSION 2

CHAIRMAN: G. DOUGLAS
MODERATOR: B. SCHWARTZ

CORRELATION OF THE OPTIC DISK AND VISUAL FIELD IN GLAUCOMA

F. Dannheim, T. Damms and S. Obrecht
Department of Ophthalmology, University of Hamburg, FRG

We performed computer perimetry (Octopus program G1), random masked manual planimetry, and computerized optic disk topometry (DNHA) upon 93 eyes of 53 subjects with chronic glaucoma, low tension glaucoma, ocular hypertension, suspicious-looking disks, or normal findings.

We correlated multiple disk parameters with visual field indices MD and CLV. This was lowest with computerized topometry (no correlation), better for planimetric c/d ratio, still better for planimetric rim area, and best for temporal rim planimetry (r^2=0.57 when correlated with MD within 10°). To discriminate glaucoma from normal subjects, the order of usefulness was reversed. Thus vertical c/d-ratio separated better than temporal rim area.

Computerized topometric cup volume decreased with age. It neither correlated with fields defects nor helped distinguish normal from glaucoma subjects.

THE RELATIONSHIP BETWEEN OPTIC NERVE AND NERVE FIBER LAYER PARAMETERS AND VISUAL LOSS IN GLAUCOMA

J. Caprioli and M. Zulauf
Yale University, New Haven, Connecticut

We investigated the relationship between optic nerve head and nerve fiber layer structural parameters and indices of visual field loss in normals (53), glaucoma suspects (87), and glaucoma patients (112). Structural parameters were derived from computerized digital analysis of simultaneous stereoscopic video images and included cup-disc ratio, disc rim area, cup volume, average nerve fiber layer height, and nerve fiber layer height at the superior and inferior poles (polar NFL height). The correlation coefficients between these and the visual field indices mean defect (MD) and corrected loss variance (CLV) are:

	cup-disc	rim area	cup volume	NFL height	polar NLF height
MD	0.29	0.36	0.28	0.33	0.45
CLV	0.27	0.31	0.26	0.22	0.37

The strongest correlation was between polar NFL height and visual field Mean Defect. Statistically significant correlations were also found for inferior and superior NFL height and the corresponding visual hemifield in glaucoma patients. Additional structural parameters which are independent of the underlying scleral architecture of the disc may be found which are more sensitive indicators of glaucomatous optic nerve damage.

CORRELATION OF OPTIC DISC CUPPING, PALLOR AND RETINAL NERVE FIBER LAYER THICKNESS WITH VISUAL FIELD LOSS

C. O'Brien, B. Schwartz and T. Takamoto
Tufts-New England Medical Centre, Boston, Massachusetts

We have developed quantitative methods for measurement of optic disc cup volume, depth, area at surface of retina and slope (by photogrammetry), retinal nerve fiver layer thickness (NFLT) at the disc rim (by photogrammetry) and optic disc pallor (by computerized image analysis). We correlated these measurements at present of 33 open angle glaucomas with measurements of visual field thresholds [Octopus perimeter 2000R]. For the total disc a significant Spearman correlation was obtained for cup area (r_s -0.4875; p = .004) but not for the other parameters of the cup pallor or NFLT. Quadrant analysis of the optic disc showed significant correlations for thresholds for the total visual field with cup area and NFLT for the inferior, superior and temporal quadrants. Intercorrelations between disc parameters and nerve fiber layer thickness were also significant especially for pallor and cup parameters and for NFLT and pallor. We conclude that the most significant correlation between functional visual field loss and structural damage occurs at the surface of the disc, namely cup area and NFLT.

WHAT TYPES OF MORPHOLOGICAL CHANGES IN THE OPTIC NERVE HEAD CORRELATE WITH FIELD CHANGES AS REVEALED BY THE OCTOPUS G-1 PROGRAM

U. Flüeler, B. Gloor and J. Stürmer
Universitäts-Augenklinik, Zürich, Switzerland

Photographs of papillas and nerve fiber layers of 96 glaucomatous eyes were compared with their respective visual field findings using the Octopus G-1 program. In particular, this was done not just by calculating the correlations of all eyes in the collective, but, instead, by sorting out those individual cases in which a conspicuous relationship between visual field loss and morphology was noted, in order to be able to reasonably classify such papillas in general on the basis of their morphology alone.

THE CORRELATION BETWEEN RETINAL NERVE FIBER LAYER DEFECT AND VISUAL FIELD DEFECT IN GLAUCOMA

Y. Yamazaki[1], T. Miyazawa[2] and H. Yamada[2]
1 Department of Ophthalmology and 2 Industrial Technology, Nihon University, Tokyo, Japan

The mechanism of damage to the optic nerve in normal-tension glaucoma (NTG) and high-tension glaucoma (HTG) remains unknown. There is now much evidence that NTG might be responsible for localized visual field defects (VFD). However, whether localized VFD are induced by localized retinal nerve fiber layer (RNFL) defects is not clear. We evaluated the correlation between VFD and RNFL defects using digital image analyses of red-free fundus photographs. Our system is able to convert red-free photographs into digital images, and analyze image intensity along scanning lines across the RNFL. We examined one randomly selected eye from each of 20 NTG and 20 HTG patients, matched both for age and for extent of VFD as tested with the Humphrey Field Analyzer. The image intensity decrease and the intensity variance along the scanning line were analyzed and compared with the 95% confidence interval of normal subjects.

The image intensity decrease was significantly correlated to MD, and the intensity variance to CPSD ($P<0.01$). NTG eyes showed significantly larger intensity variance in relation to the image intensity decrease than HTG eyes ($P<0.05$).

These results suggest that NTG has more localized RNFL defects as compared with HTG, and that there may be different mechanisms of damage in glaucoma.

CORRELATION OF RETINAL NERVE FIBER LAYER LOSS, CHANGES AT THE OPTIC NERVE HEAD AND VARIOUS PSYCHOPHYSICAL CRITERIA IN GLAUCOMA

B.J. Lachenmayr[1], P.J. Airaksinen[2], S.M. Drance[3], K. Wijsman
1 University Eye Hospital, Munich, West Germany, 2 Department of Ophthalmology, University of Oulu, Finland, 3 Department of Ophthalmology, University of British Columbia, Vancouver, Canada

Semiquantitative assessment of retinal nerve fiber layer loss and neuroretinal rim measurement of the optic nerve head by means of the Optic Nerve Head Analyzer were correlated to the outcome of automated light-sense, flicker and resolution perimetry and FM 100-Hue test. A significant influence of age on Total RNFL and Total Diffuse RNFL Scores was found but there was no effect of age on neuroretinal rim area. Total RNFL Score and Total Diffuse RNFL Score show a good correlation to the various visual field indices: For Total RNFL Score vs. Mean Flicker Frequency in flicker perimetry $r=-0.606$, $p<0.0001$, vs. Mean Sensitivity in light-sense perimetry $r = -0.385$, $p = 0.002$ and vs. Mean Ring Score in resolution perimetry $r = 0.341$, $p = 0.007$. There is no significant correlation between RNFL scores and FM 100-Hue score. Correlation between neuroretinal rim area and the various psychophysical indices is poor and mostly not statistically significant. The high correlation of flicker scores with retinal nerve fiber layer loss provides interest for future applications of this perimetric technique.

COMPARISON OF OPTIC DISC IMAGE ANALYSIS WITH AUTOMATED PERIMETRY IN THE DETECTION OF GLAUCOMATOUS PROGRESSION

M.B. Sherwood, S.T. Simmons, M.F. Smith and N.J. Mehta
University of Florida, Gainesville, Florida, Glaucoma Service, Albany Medical Center, Albany, New York, and Lions Eye Institute, Albany, New York

The Topcon Imagenet 100 system optic disc change program was evaluated in 50 eyes of patients with questionable control of their glaucoma. These results were compared to the visual field change program of the Humphrey or Octopus 2000 visual field analyzer in these patients over the same time periods. The visual fields were assessed in a masked fashion by two observers for evidence of progression. The optic disc analysis was performed at one center, by one observer, using slide input.

Progressive loss of neural tissue both by disc change analysis and visual field was found in 30%; the area of progressive visual field loss corresponded with the associated area of change in optic disc topography. Over 40% were found to have no significant change in both the change analysis and visual field. 30% of eyes demonstrated progressive change on image analysis without field loss. There were no visual fields which progressed without change in disc topography.

Optic disc image analysis using the Topcon Imagenet System change program may be more sensitive than automated visual fields in the detection of glaucomatous progression.

PAPER SESSION 3

CHAIRMAN: K. KITAHARA
MODERATOR: P.J. AIRAKSINEN

COMPUTERIZED COLOR ANALYSIS OF THE OPTIC DISC AND PROGRESSION OF VISUAL FIELD DEFECTS IN GLAUCOMA

M. Ito, K. Tetsumoto, J. Kawakami, H. Miyazawa and K. Mizokami
Department of Ophthalmology, School of Medicine, Kobe University, Kobe, Japan

The assessment of the optic disc plays an important role in the diagnosis and care of glaucoma. In this study, a modified computerized color analyzer was employed. Color changes of optic disc photographs in glaucoma were analyzed in red, green, and blue components respectively. This system showed 1.8% intraphotographic and 1.9% interphotographic coefficients of variation.

The rim color in 20 glaucoma eyes, (8 eyes in early stage and 12 eyes in middle stage disease) with progression of visual field defect was analyzed using this instrument. The visual fields which were followed with Octopus program 31 showed progression of damage with program Delta. At the same time, the cup/disc area ratio was measured and the correlation among the changes in color, visual field and the C/D ratio was also evaluated.

In 2 eyes with early stage glaucoma, rim color changed as the optic disc cupping enlarged. In 4 eyes with middle stage disease, rim color also changed; in one eye rim color changed without enlargement of cupping.

We suggest that rim color may change not only in middle stage but also in early stage glaucoma, and that in middle stages rim color may change without concomitant enlargement of optic disc cupping.

THE PREDICTIVE VALUE OF COMPUTERIZED VISUAL FIELD/DISC PALLOR AS INDICATOR OF FUTURE GLAUCOMA DEVELOPMENT

E. Linnér[1] and B.Schwartz[2]
1 University of Gothenburg, Gothenburg, Sweden, 2 Tufts University, Boston, Massachusetts

Optic disc pallor and computerized visual field were followed during at least 1000 days in untreated, hypertensive eyes. In 94 non-exfoliative eyes the initial disc pallor was significantly larger in those 9 eyes developing glaucomatous lesions than in the remaining 85 eyes, whereas neither IOP, nor visual field showed significant differences between the two groups. In 17 exfoliative eyes 6 developed glaucomatous lesions. No significant differences were found between the two groups.

The predictive value as indicator of future glaucoma development will be discussed.

DETECTION OF CHRONOLOGICAL CHANGES OF PAPILLARY PALLOR USING PRINCIPAL COMPONENT ANALYSIS

Chr. Kryenbühl[1], R. Geschwindt[1] and Y.Robert[2]
1 Department of Physical Chemistry, Basel University and 2 Department of Ophthalmology, Zürich University, Switzerland

Taking photographs of a glaucoma patient's retina repeatedly during a certain span of time allows detection of chronological changes of pallor. The pictures (usually transparencies) are digitized and subsequently brought into register with one another. Such digitized images can be considered as a multi temporal database. The data are subjected to principal component analysis (PCA), producing corresponding principal component images. This method has two particular advantages: (a) interpreting the PCA, chronological changes can be detected; (b) variations in picture-taking conditions can to a large extent be eliminated by PCA. As an example, a patient is described whose retina was photographed several times over a five-year period.

RELATIONSHIP BETWEEN OPTIC DISC CHANGES AND VISUAL FIELD DEFECTS IN GLAUCOMA

Katsuhiko Nanba, Kazuo Iwata, Motohiro Shiakashi and Kyoko Nagata
Department of Ophthalmology, Niigata University, Niigata, Japan

To find how quantitatively optic disc changes may precede visual field defects twenty-five patients with open-angle glaucoma were selected who had almost the same optic disc size in both eyes, but showed different optic disc cupping with a visual field defect in one eye and disc rim area equal to or larger than 1.0 mm^2, and a normal visual field in the fellow eye. The differences in optic disc parameters (rim area, cup area, cup volume) between paired eyes of each patient were compared to the visual field differences between eyes. Computerized image analysis was used to measure optic disc parameters. Visual field defects were estimated by global indices (MD, PSD, CPSD).

Differences in cup area and cup volume between paired eyes were significantly correlated to differences in MD. Differences in rim area showed border-line significance. The results indicated that changes of 0.3-0.4 mm^2 in cup area and rim area, and of 0.1 mm^3 cup volume had occurred before visual field defects were detected.

THE LONG-TERM EFFECT OF INTRAOCULAR PRESSURE REDUCTION ON GLAUCOMATOUS OPTIC DISC CUPPING

K. Matsubara, M. Maeda, G. Tomita and Y. Kitazawa
Department of Ophthalmology, Gifu University School of Medicine, Gifu, Japan

We prospectively studied topographic changes induced by intraocular pressure (IOP) reduction in 10 primary open-angle glaucoma eyes that had trabeculectomy. Topographic parameters including C/D ratio, rim area and cup volume were determined using the Optic Nerve Head Analyzer (Rodenstock) before and after surgery at intervals of 3 to 6 months for at least one year. 30-2 central threshold fields were obtained with a Humphrey perimeter at the same time.

Significant reduction of cup volume was noted at the first, postoperative measurements, 3 months after surgery (0.73 ± 0.40 mm^3 vs 0.58 ± 0.35 mm^3, $P<0.05$) with significant IOP reduction (24.6 ± 5.9 mmHg vs 10.3 ± 4.3 mmHg, $P<0.01$). Cup volume was noted to further decrease as compared to the first, postoperative measurement when IOP was maintained at the same or lower level than the mean IOP during the first 3-month postoperative period. Cup volume remained significantly reduced in all eyes with persistent IOP lowering throughout the observation period.

IMPROVEMENT OF VISUAL FIELD FOLLOWING IOP REDUCTION IN ADULT COAG PATIENTS

Clark S. Tsai and Dong H. Shin
Kresge Eye Institute, Wayne State University, Detroit, Michigan

Visual field global indices, before and after IOP reduction from a mean ± SD initial IOP of 30.4 ± 7.6 mm Hg to a final IOP of 18.9 ± 4.5 mm Hg for a duration of 30.4 ± 23.0 weeks, were compared in adult COAG patients with videographic evidence of reversal of glaucomatous cupping.

The 3 global indices (MD, PSD and CPSD) were not significantly different between 10 patients without and 13 with previous perimetric experience ($P > 0.1$). All of the 3 global indices (MD, PSD, and CPSD) improved in direct proportion to IOP reduction and percent IOP reduction:

	IOP Reduction		% IOP Reduction	
	r	P	r	P
ΔMD	0.701	0.0002	0.559	0.0055
ΔPSD	-0.538	0.0081	-0.472	0.0229
ΔCPSD	-0.514	0.0122	-0.366	0.0858

Patients with IOP reduction > 40% had improvement in the mean global indices, in statistically significant contrast to patients with an IOP reduction < 40%, who showed either no improvement or deterioration of the mean indices ($P < 0.05$ for all 3 indices). There appears to be a critical magnitude of IOP reduction, above which the visual field global indices are more likely to improve and below which the indices are less likely to improve or more likely to deteriorate.

CHOROIDAL PLEROMETRY: AN APPROACH TO THE DYNAMICS OF CHORIOCAPILLARIS PERFUSION BY DIGITAL ANALYSIS OF FLUORESCEIN ANGIOGRAMS

G.N. Lambrou, T.J.T.P. van den Berg, F. Temporelli, W. van den Berg, H.C. Geijssen and E.L. Greve
Academic Medical Center, Amsterdam, The Netherlands

A computer-based system has been designed for the time analysis of fast fluorescein angiograms or of video angiograms, which are assessed, to this day, subjectively. There are many advantages of such an automatic system, namely that the results are not examiner-dependent, and that they have a higher accuracy and reproducibility. Moreover, new aspects of the angiogram can be studied: it is possible to compute dye-appearence times for every point of the choroid (instead of a global figure for the entire fundus) and to analyse the dynamics of the local filling process so as to obtain an estimate of the perfusion rate of the choriocapillaris. Using this system we analysed the peripapillary perfusion of 50 patients from the glaucoma outpatient clinic, with particular emphasis on low tension glaucoma. The angiograms were also assessed subjectively by three examiners. The correlations between computer-calculated and subjectively estimated parameters and clinical data (IOP, perimetric defects, cupping, progression) are discussed and sample cases are presented.

PAPER SESSION 4

CHAIRMAN: S.M. DRANCE
MODERATOR: J. WILD

PSYCHOPHYSICAL STUDIES OF THE NORMAL VISUAL FIELDS OF MONKEYS

R. S. Harwerth[1], E.L.Smith III [1], and L. De Santis[2]
1 University of Houston, Houston, Texas and 2 Alcon Laboratories, Inc., Fort Worth, Texas

Psychophysical studies of the visual fields of three normal rhesus monkeys were conducted using the Humphrey Field Analyzer Central 24-1 and 24-2 Threshold Programs. With operant control of the position of the animal's eye and behavioural responses, the visual field data were obtained using the Field Analyzer's standard threshold programs. For each of the monkeys, the perimetric reliability tests were well within acceptable limits with mean values of 8% for False-Positive responses, 1% for False-Negative responses, and 1.1 dB for Short-term Fluctuation. Preliminary assessments indicate that the variance of thresholds at each eccentricity was approximately constant but increased systematically with field eccentricity. The Statpac global indices suggested that the monkeys' visual field data were generally consistent with those of standard normal human subjects. Although the Mean Deviation (MD) indices for the monkeys were invariably negative when compared to humans of the same chronological age, the residual MD values were small after compensation for developmental age differences in humans and monkeys.

Therefore, the results demonstrate that the thresholding strategies and data analysis protocols of computerized perimetry, which were developed to evaluate visual fields of humans, can also be used to study normal visual fields and the functional alterations produced by experimental models of retinal disease in macaque monkeys.

A CHILD'S PLAY VERSION OF HIGH-PASS RESOLUTION PERIMETRY

Lars Frisén
Department of Ophthalmology, University of Göteborg, Sweden

The computer graphics environment of high-pass resolution perimetry offers many possibilities to secure good cooperation, even in subjects with fixation difficulties. The test strategy introduced here involves flashing one out of several distinctive symbols (drawn at random) in the test display's center, and, simultaneously, a regular ring target in some other location. Presentation time is 165 milliseconds, which frustrates refixation attempts. Each presentation is **triggered by the subject,** who has to (1) identify the central symbol and (2) point to the location of any seen ring target. The examiner records the subject's responses on the computer's keyboard or by means of a mouse.

There are three sets of central fixation targets. A symbolic set is meant for non-reading subjects. Another set uses the HOTV letter, and the third the full alphabet. If the latter set is selected. the subject has to name the letter display. Both visual and auditory feedback is provided.

Except for the manual triggering and recording routines, the test is closely similar to the regular Ophthimus Ring Visual Field Test. There are no blindspot tests. The same pattern is used for right and left eyes. The test can be aborted at any stage, without loss of partial results. Preliminary experience is encouraging.

LIGHT-SENSE, FLICKER AND RESOLUTION PERIMETRY IN GLAUCOMA: A COMPARATIVE STUDY

B.J. Lachenmayr[1], S.M. Drance[2], G.R. Douglas[2] and F.S. Mikelberg[2]
1 University Eye Hospital, Munich, West Germany, 2 Department of Ophthalmology, University of British Columbia, Vancouver, Canada

106 eyes of 106 patients with different types of glaucoma were examined by automated light-sense, flicker and resolution perimetry (Humphrey Field-Analyzer, flicker perimeter as described by Lachenmayr, resolution perimeter devised by Frisén). The fields were classified in masked fashion as being normal or having purely diffuse loss, purely localized loss or diffuse as well as localized loss. Resolution perimetry shows a markedly lower sensitivity in the detection of glaucomatous damage compared with both light-sense and flicker perimetry (77% and 75%), but a high specificity (93% and 85%). When flicker perimetry is compared to light-sense perimetry and vice versa the sensitivity is high (95% and 94%), but the specificity is low (57% and 62%). The prevalence of detection of diffuse loss for both light-sense and resolution perimetry is related to visual acuity whereas flicker perimetry does not show such a relationship.

PERIMETRY AND RETINAL LESIONS: A PATHO-PHYSIOLOGICAL STUDY

Bertil Lindblom
Department of Ophthalmology, University of Göteborg, Sweden

Perimetric thresholds were measured in subjects with proliferative diabetic retinopathy before and after pan-retinal green-only argon laser photocoagulation. Two perimetric techniques were used: Ordinary perimetry determining differential light sensitivity, and high-pass resolution perimetry. Thresholds were measured in a defined retinal area using a test grid with 4° mesh size. The extent of photocoagulation was measured on fundus photographs two months after treatment. Knowing the treated area, a relative space-average ganglion cell separation could be calculated.

Resolution theory states that resolution is directly proportional to ganglion cell separation. This theory found substantial support in this study: The change in resolution threshold showed a perfectly linear relation through the origin with the change in average ganglion cell separation. For differential light sensitivity, on the other hand, a theoretical basis is lacking for the relation between perimetric sensitivity and the anatomical state of the visual system. Here, it was empirically found that the difference between pre- and post- treatment thresholds expressed in dB appeared to be linearly related to ganglion cell separation. Destruction of 20 % of the retinal area resulted in a mean threshold rise of about 5 dB.

VISUAL FIELD DIFFERENCE PLOTS

Lars Frisén
Department of Ophthalmology, University of Göteborg, Sweden

Optimum graphic formats for static perimetry results remain to be defined. Charts graphically depicting the **magnitude of difference** between observed and normal references results seem advantageous. Here, four examiners independently evaluated masked high-pass resolution perimetry "ring" plots and difference plots from the same subjects.

Sensitivity was estimated from 24 subjects who had made a good recovery after retrobulbar optic neuritis. The examiners on average identified 91% ± 7 (SD) of these as abnormal with the regular plot but full agreement was reached in only 75% of cases. None was unanimously judged normal. With the difference plot, there was full agreement in all cases, 70% being unanimously classified as abnormal and 21% as normal. The change in sensitivity was statistically significant ($p=0.016$). For comparison, objective field indices identified 79% abnormal results, the form index giving the greatest yield. 24 age-matched normal controls illuminated specificity. This was estimated to 79% ± 3 with the regular plot and 83 ± 4 with the difference plot ($p=0.16$). Again, full agreement was more common with the new chart (82 vs 61%). Indices identified 23 normal results, giving a specificity of 96%.

In categorizing field defects, uniformity was much better with difference plots. It is concluded that these to a great extent can facilitate subjective visual field evaluation.

BLUE STIMULI VERSUS WHITE STIMULI IN GLAUCOMA

A.I. Friedmann
London, UK

There is increasing evidence that chromatic (coloured) stimuli are more sensitive than white stimuli especially in the detection of early glaucoma Interestingly this applies not only to extra-foveal but also to foveal malfunction. Basically modern concepts of the functioning and pathways of the retinal cones differentiate sharply between the short-wave cones (blue cones) and the medium-wave (green) and the long-wave (red) cones where the differentiation is not quite clear. Short wave cones contribute much less to movement detection.The blue cones connect to their own bipolar, horizontal and ganglion cells which are larger, have larger receptive fields, larger nerve fibres, and appear to be more vulnerable to raised IOP.

The evidence is reviewed and instructive cases described.

EQUILUMINANT BLUE/YELLOW COLOR CONTRAST PERIMETRY (CCP) IN HIGH RISK OCULAR HYPERTENSION (OHT) AND GLAUCOMA (POAG)

William M. Hart, Jr., Mae O. Gordon, Scott E. Silverman and Michael A. Kass
Department of Ophthalmology and Visual Sciences, Washington University School of Medicine, St. Louis, Missouri

We designed a cross-sectional study to determine if threshold static CCP of the central 30° of the visual field improved detection of glaucomatous damage. A masked reading committee independently graded age-corrected gray-scale plots for CCP to Statpac plots for the 30-2 program of the Humphrey perimeter (HP). Readers estimated global (generalized) and focal depression for CCP and HP. Initial data are available for 63 age-matched normals, 49 OHT's and 14 POAG's. Age-corrected FM 100-Hue data is also available for these patients. For the entire central 30° of the visual field, CCP significantly differentiated POAG from normal (Fisher's exact test $p<.006$) but not OHT from normal ($p=1.0$). For the central 5° of the visual field, CCP significantly differentiated POAG from normal ($p < .0003$) and OHT from normal ($p <.0003$). False positives were very low for central 30° and central 5° (4% and 11% respectively). False negatives were high, 42% and 56% respectively. In the future we intend to increase the sensitivity of the criteria used by readers.

PAPER SESSION 5

CHAIRMAN: A. HEIJL
MODERATOR: C. JOHNSON

OPTIC DISC AND RNFL IMAGING IN SCREENING FOR GLAUCOMA

P. J. Airaksinen, A. Tuulonen, A. Montagna and H. Nieminen
Department of Ophthalmology, University of Oulu, Finland

The purpose of this study was to evaluate the usefulness of wide angle fundus photographs in screening for glaucomatous changes at the optic disc and retinal nerve fiber layer (RNFL) when photographs were taken by a technician with a non-mydriatic fundus camera.

183 first degree relatives of known glaucoma patients were photographed. Based on the findings in the photographs, 31 subjects (17%) were referred to the eye clinic for ophthalmological examination and visual field (VF) testing.

In 19 subjects abnormal finding(s) were confirmed: 6 (3%) new glaucomas were found with optic disc and VF abnormalities, 9 eyes (5%) had RNFL abnormalities with normal or suspicious disc, 5 eyes (3%) had a disc hemorrhage and 2 eyes (1%) asymptomatic venous stasis changes at the optic disc.

The results of this study with a 92% success rate of photography indicates that a non-mydriatic retinal camera with a 45° picture angle is a useful tool in screening for glaucoma.

TONOMETRY, FUNDUS PHOTOGRAPHY AND AUTOMATED PERIMETRY IN GLAUCOMA SCREENING

K. Mizokami, Y. Shiose, Y. Kitazawa, S. Tsukahara, T. Akamatsu, R. Futa, H. Katsushima and H. Kosaki
Japan Glaucoma Society, Kobe, Japan

A population based collaborative glaucoma survey was conducted in seven different districts across Japan. A total number of 12,370 eyes were examined by two stage screening; tonometry and fundus photography as the first stage, and automated perimetry as the second stage. In the first stage, an abnormal IOP (over 21 mmHg) and an abnormal disc cupping and RNFLD were detected. Visual fields were examined in a second stage screening of 1,157 eyes using the Humphrey Field Analyzer. A suprathreshold screening program, the Armaly Central 3 zone test, was employed. Further, abnormal points in this screening were reconfirmed by custom testing (4 degrees). In this way 271 eyes were diagnosed as glaucomatous with visual field defects.

From these results we will discuss the sensitivity and specificity of screening processes for detection of various types of glaucomatous visual field defects including paracentral scotomas, nasal steps and Bjerrum scotomas.

LONGITUDINAL MONITORING OF GLAUCOMA SUSPECTS BY MEANS OF COMPUTERIZED DISC ANALYSIS AND OCTOPUS PERIMETRY

J. Funk
Universitäts-Augenklinik, Freiburg, FRG

We used Octopus perimetry (G1-Program) and computerized disc analysis (Optic Nerve Head Analyzer, Rodenstock) to monitor 47 eyes of 25 glaucoma suspects. The mean follow-up time was 17.9 months (range: 12 - 30 months), the average number of disc examinations per eye was 4.4 (range: 3 - 7).

A continuous deterioration of neuroretinal rim area was found in 8 out of 47 eyes. No changes were found in 19 eyes. Discontinuous deterioration and/or larger fluctuations were found in 20 eyes.

The decrease of neuroretinal rim area apparently preceded visual field defects. All parameters of visual field testing were still normal in these cases. The finding confirms previous results of cross-sectional studies concerning the correlation between neuroretinal rim area and visual field.

WITHIN AND BETWEEN EYE LEARNING AND FATIGUE EFFECTS IN NORMAL PERIMETRIC SENSITIVITY

A.E.T. Searle[1] D E Shaw[1], J.M. Wild[2] and E.C. O'Neill[1]
Universities of 1 Birmingham and 2 Aston, Birmingham, UK

Prolonged perimetry in single eyes of normal subjects and of glaucoma patients results in decreased sensitivity with increased test duration. This can be attributed to fatigue effects and thus mitigates against the use of an extended examination, In addition, improvement in sensitivity due to learning effects has also been documented. The inter-eye relationship of both effects at a given visit are unknown. The purpose of the study was to document the within and between eye changes in normal perimetric sensitivity as a function of stimulus duration. Thirty-five normal volunteers, naive to perimetry, were examined with a customized threshold program of the Humphrey Field Analyzer 640. The program comprised 30 points out to an eccentricity of 30°. Subjects were randomized with reference to order of eye examined and to stimulus duration of 105 ms (n=17; mean age 46.2, SD 9.7 years) or 200 ms (n=18; mean age 44.6, SD 5.0 years). Each eye underwent the customized program three times separated by one minute between each test and by a rest period of approximately five minutes between each eye. The procedure was repeated for each patient on average 2 weeks later.

ANOVA was used with repeated measures over tests, eyes and visits; stimulus duration was a between subjects factor and age a covariate. Mean sensitivity (MS) decreased over the first three programs of the first eye by 0.9 dB and the first three programs of the second eye by 2.6 dB. The corresponding decrease at the second visit were 2.6 and 2.4 dB respectively ($p<0.001$). These differences were not consistent over stimulus duration ($p=0.11$). MS was significantly related to eye ($p=0.001$), visit ($p=0.018$) and stimulus duration ($p=0.019$). This study questions the accuracy with which perimetric data can be collected.

COMPUTERIZED VISUAL FIELDS IN CONGENITAL GLAUCOMA AND PEDIATRIC GLAUCOMAS

R. Sampaolesi and J. Casiraghi
Department of Ophthalmology, University of Buenos Aires, Argentina

The visual field was studied in 41 cases belonging to one of four groups: primary congenital glaucoma, congenital glaucoma associated with congenital anomalies of the eye, late congenital glaucoma and two cases of simple glaucoma in children. The first group were children operated before the second year of age, who had to be reoperated. The visual field in all groups was performed between the 6th and 22nd year of age. The study was performed with Octopus 2000 program G1, and was analyzed with Octosmart.

The visual field defects were only diffuse loss of sensitivity. Probably, this kind of defect was caused by the action of the intraocular pressure on axoplasmic flow.

THE RELATIONSHIP OF VASOSPASM, DIFFUSE AND LOCALIZED VISUAL FIELD DEFECTS, AND INTRAOCULAR PRESSURE IN GLAUCOMATOUS EYES

J.R. Piltz, S.M. Drance, G.R. Douglas, F.S. .Mikelberg and M. Schulzer
The University of British Columbia, Vancouver, British Columbia, Canada

Vasospasm is now recognized to be a risk factor in the development of glaucomatous optic nerve damage. This study examines the relationship of vasospasm and intraocular pressure with regard to diffuse and localized damage of the visual field

The maximum recorded intraocular pressure was noted for one eye of each of 102 patients with chronic open angle glaucoma. Automated visual fields using Humphrey program 30-2 or Octopus program G1 were analyzed for each patient to determine the presence of localized defects. Bebié curves were plotted for each field to identify diffuse visual field loss. All abnormal visual fields were identified as having either localized defects or diffuse and localized defects. Patients were then classified as being vasospastic or non-vasospastic based on measurements of fingertip blood flow. If the ratio of the maximum blood flow after immersion in 40° water to the minimum flow after immersion in cold water exceeded 7, patients were labeled vasospastic.

In non-vasospastic patients, IOP was significantly higher in eyes with diffuse and localized field defects compared to eyes with localized defects. In vasospastic patients, there was no significant difference in IOP in eyes with diffuse and localized defects compared to eyes with localized defects. The mean IOP of eyes with localized field loss was similar in both vasospastic and non-vasospastic patients, while the mean IOP of eyes with diffuse and localized defects was higher in non-vasospastic patients. The significance of the above findings will be discussed.

DIAGNOSTIC VALUE OF STATIC PROFILE PERIMETRY IN MACULAR PATHOLOGY

E.M. Mironova and M.A. Rudneva
Research and Technology Eye Microsurgery Complex, Moscow, USSR

72 patients with dry form maculopathy (DFM) of myopic and vascular genesis and 34 patients with macular edema (ME) were examined on the Humphrey Field Analyzer using the profile programme along 0-180° meridian. At the earliest stages of the disease general decrease of central light sensitivity was observed, which was more significant in cases of ME (27±2,1 dB). The "foveal peak" was present in 50% of cases. Far-advanced stages of the disease were characterized by progressive decrease of central light sensitivity to 24±2,9 dB in DFM and 16±3,2 dB in ME. The "foveal peak" was absent in the majority of cases, and in 48% of patients with ME the central scotoma was absolute. Treatment was more effective at earlier stages of the diseases and resulted in significant increase of light sensitivity and other visual functions.

CHAIRMAN: F. DANNHEIM
MODERATOR: C. LANGERHORST

EFFECT OF TEST POINT LOCATION ON THE MAGNITUDE OF LONG-TERM FLUCTUATION IN GLAUCOMA PATIENTS UNDERGOING AUTOMATED PERIMETRY

Elliot Werner[1], Gary Ganiban[1] and Gordon Balazsi[2]
1 Hahnemann University, Philadelphia, Pennsylvania, 2 McGill University, Montreal, Canada

Long-term Fluctuation (LF) of visual thresholds for each of the 59 test locations on the Octopus G1 program was measured in 67 patients with chronic open-angle glaucoma by retrospective analysis of visual field data obtained with the Octopus 500 automated perimeter. LF was determined by calculating the root mean square of the residuals after performing linear regression analysis of each test location over time for the four most recent visual fields on each subject.

The mean LF for the entire sample was 2.8 dB $\pm$1.1 LF for individual test locations generally increased with distance from fixation. LF for peripheral test locations was significantly higher than for central locations (3.2 dB vs. 2.2 dB, $p<0.0001$) LF was slightly higher in the superior hemifield (2.9 dB) than in the inferior hemifield (2.5 dB).

FLUCTUATION OF PERIMETRY IN STABLE GLAUCOMA PATIENTS

M. Zulauf, J. Caprioli, D. Hoffman and C. Tressler
Yale University, New Haven, Connecticut

A better knowledge of the long-term fluctuation (LF) of the differential light sensitive threshold (DLS) would improve the clinical evaluation of glaucoma patients. We report on a study of 135 visual fields (Octopus 201, program 32) of 36 clinically stable eyes of 36 glaucoma patients followed for at least 18 months to evaluate the relationship of LF with the depth of visual field defect and eccentricity of the test location. There was a correlation between the LF and the DLS ($r=0.44$, $p<0.001$). The mean (±SEM) LF for all test locations was 4.1 $\pm$ 0.3 dB. The difference between the mean LF of normal (3.6 $\pm$ 0.1 dB) and moderately (5.0 ± 0.2 dB) depressed test locations was significant ($p<0.001$). The LF of more severely (7.0 ± 0.4 dB) depressed test locations was significantly higher than in normal or moderately depressed test locations ($p<0.001$). LF was significantly less within 5° (3.1± 0.2 dB) from fixation than at test locations located more than 20° (3.1 ± 0.2 dB) from fixation. The clinical importance of these findings will be discussed.

INTER-TEST THRESHOLD VARIABILITY IN GLAUCOMA: IMPORTANCE OF CENSORED OBSERVATIONS AND GENERAL FIELD STATUS

Anders Heijl[1], Anna Lindgren[2], Georg Lindgren[2] and Michael Patella[3]
1 Department of Ophthalmology in Malmö, and 2 Department of Mathematical Statistics, University of Lund, Sweden and 3 Allergan Humphrey, San Leandro, California

We tested 51 glaucomatous eyes of 51 patients four times each over a one month period using the 30-2 program of the Humphrey perimeter. Analyses of those data reported at the 1988 IPS meeting, showed that the observed threshold variability was small at points with normal sensitivity, became relatively large at moderate defect depths, became again smaller in severely depressed points, and depended on point location.

While these results were entirely correct, they were not at all optimal for use in a statistical analysis package for judging longitudinal changes in glaucomatous visual fields. The utility of prediction limits was improved considerably by taking into account the problem of censored data introduced by the limited maximum stimulus luminosity of the perimeter, and the effect of the general status of the field, as expressed by MD.

The paper will demonstrate the importance of these two factors for the calculation of significance limits for changes in individual threshold values.

POINTWISE ANALYSIS OF SERIAL FIELDS IN GLAUCOMA

J.M.Wild[1], M.K. Hussey[1] J.G. Flanagan[2] and G.E. Trope[3]
1 Aston University, Birmingham, UK, 2 University of Waterloo, Ontario, Canada, 3 University of Toronto, Ontario, Canada

The current visual field indices provide summary measures of the data derived from all test locations within the visual field and as a result information may be unavailable concerning the pointwise contribution of sensitivity. Such indices therefore may not be sufficiently sensitive for the detection of the earliest change in the glaucomatous visual field.

The aim of the study was to document the pointwise distribution of sensitivity between serial fields for a given patient. By comparing the predicted pointwise sensitivity values at any given examination. T_p, with the measured outcome, T_m, an index of change might be derived. The sample comprised 534 fields (Humphrey Field Analyzer programs 24-2 and 30-2) carried out over a mean period of 35.3 months (SD 8.74) from 36 glaucoma patients (72 eyes). The mean number of examinations was 7.94 per subject (SD 2.32). The pointwise distribution of sensitivity for any given single glaucomatous field at any time period, k, was fitted in terms of a polynomial regression approach. The relationship between serial fields for each patient was then further fitted using polynomial regression and multiple regression to incorporate a serial component for the trend between tests.

The goodness of fit of the different components of the composite model was found to vary between and within individuals and was correlated with the clinical profile.

CLINICAL COMPARISONS OF TWO ESTIMATES OF SHORT-TERM FLUCTUATION

Richard P. Mills, Wing Lau and Michael Schulzer
Seattle, Washington and Vancouver, Canada

The short-term fluctuation (SF) in threshold static fields can be estimated using a root mean square (RMS) calculation on double threshold determinations at multiple test locations, or using the residuals from a polynomial trend surface based on single determinations of threshold at each point.

We calculated SF using both methods on Humphrey 24-2 test data from one eye of 173 patients, each of whom performed 3 replications of the test in one session. Multiple regression and covariance analyses were performed, relating the two estimates of SF to a number of explanatory variables including the Mean Deviation, reliability indices, and eye examination results.

The RMS estimate of SF was more strongly correlated with patient unreliability and less correlated with Mean Deviation than the trend surface analysis estimate of SF.

STATPAC 2 COMPARED TO CLINICAL EVALUATION OF VISUAL FIELDS

A. Tuulonen and P. J. Airaksinen
Department of Ophthalmology, University of Oulu, Finland

The purpose of this study was to evaluate how Statpac 2 Change Probability Analysis correlates to "Cerebropac", i.e. routine clinical interpretation of visual field progression.

We included in the study 20 consecutive patients with glaucoma or ocular hypertension who had five Humphrey 30-2 visual fields taken during 2 to 4 (mean 3) years. Using Statpac 1 the authors evaluated independently the progression of 38 visual fields without any knowledge of the patients' clinical data or optic disc changes. A score of the number significant points in the Statpac 2 follow-up fields was used to describe progression or non-progression of visual field changes. The agreement between Statpac 2 and one observer was 87% (AT) and the other 76% (PJA), respectively. The observers interpreted 7 eyes (18%) stable where Statpac 2 indicated deterioration 4 of these 7 eyes showed progression of disc abnormalities.

The results of this study indicate that Statpac 2 Change Probability Analysis correlates well with routine clinical evaluation of progression of visual field changes.

CLASSIFICATION OF GLAUCOMATOUS VISUAL FIELD DEFECTS USING THE HUMPHREY FIELD ANALYZER BOX PLOTS

Y. Shin, H. Suzumura, F. Furuno, K. Harasawa, N. Endo and H. Matsuo
Tokyo, Medical College, Tokyo, Japan

We have reported several methods for evaluation of glaucomatous visual field defects and have developed a system of classifying glaucomatous visual field defects by numerical values. Approximately 1300 eyes with POAG were examined by the Humphrey Field Analyzer and the visual fields were investigated by box plots. The series of box plots related to impairment of the visual field were placed in order. Using this system, it was possible to classify the glacomatous visual field defects into three groups and eight subgroups. This method permits an objective, analog representation of the extent of visual field defect that can be rapidly and accurately grasped.

CHAIRMAN: E. CAMPOS
MODERATOR: W. HART

IMPROVED THRESHOLD ESTIMATES USING FULL STAIRCASE DATA

Jonny Olsson[1], Peter Åsman[2] , Holger Rootzén[1] and Anders Heijl[2]
1 Department of Mathematical Statistics and 2 Department of Ophthalmology in Malmö, University of Lund, Sweden

In 1988 we described a method for estimation of reliability parameters based on maximum likelihood analysis. We have now developed a new algorithm for threshold estimation based on the same concept. The method uses all patient responses and also to some extent spatial dependence of thresholds.

The accuracy of the new method was studied in 20 eyes of 10 normal subjects and 24 eyes of 15 patients with glaucomatous field loss. All subjects were tested with the 30–2 threshold program of the Humphrey perimeter at least four times within a short period of time. Pointwise inter-test threshold variances were calculated and averaged for each eye. The new method decreased these variances significantly in both groups ($p<0.001$); to 73% in the normal fields (range: 57% - 93%) and to 93% in the glaucoma group (range: 61% - 104 %). Improvement of threshold estimates in glaucoma subjects was seen mainly in fields with mild field loss.

Thus the accuracy of threshold estimates may be significantly improved without any increase in test time, if all patient responses are utilized.

RIOTS: A HEURISTIC TECHNIQUE FOR AUTOMATED PERIMETRY

Chris A. Johnson[1] and Lionel Shapiro[1,2]
1 Optics & Visual Assessment Laboratory, Department of Ophthalmology, University of California, Davis 2 Department of Cognitive Science, University of California, Irvine, California

RIOTS (Real-time Interactive Optimized Test Sequence) is a two phase heuristic test strategy for automated perimetry that provides substantial reductions in test time and slightly better test-retest reliability than conventional staircase procedures. The first phase uses a modified MOBS procedure (Tyrell and Owens, 1988; Johnson and Shapiro, 1989) to establish highly reliable thresholds for a low resolution partitioning of the visual field. The second phase provides threshold estimates based upon the first phase results and a sequence of passes, each incorporating stimulus presentations based upon an alternating spatial pattern (expected seen/not seen). After each pass a rule set is applied to alter the estimates and confidence measures. The results of simulation experiments and preliminary clinical trials will be presented.

In addition to providing information about visual field sensitivity, an important part of current automated perimetric test procedures is an analysis of the patient's response reliability as the test is being conducted. We have developed an analysis technique for RIOTS that provides an assessment of the patient's response reliability during the test without the use of additional "catch" trials.

OCTOPUS PROGRAM G1X

Ch. Messmer[1], J. Flammer[2] and H Bebié[3]
1· Augenklinik , Kantonspital, Luzern, 2 Universitäts Augenklinik, Basel, 3 Institut für teoretische Physik, Bern, Switzerland

The glaucoma program G1 is widely employed by Octopus users. Beside a specific distribution of the locations its main advantages is the quick comparison of results with normal values as well as an easy follow-up. The program, however, is relatively time-consuming and therefore for some patients tiring, For this reason, the program was modified to "G1X". This program is interruptible at any time and provides the information including statistical analyses based on the available data. The test sequence is rearranged in accordance to the importance of the information. The available information, including their confidential limits are continuously calculated and presented on the screen during the test procedure. This provides the possibility to adapt the measurement to the patients and their diseases. This principal feature as well as clinical applications will be described.

THRESHOLD RELATED SUPRATHRESHOLD FIELD TESTING: WHICH IS THE BEST TECHNIQUE OF ESTABLISHING THE THRESHOLD?

D.B. Henson and R. Anderson
University of Wales, Cardiff, UK.

Suprathreshold testing is recognized as one of the best techniques of detecting visual field loss. One particular form of suprathreshold testing (threshold related) involves estimating the threshold at the onset of the test.

The authors present data from 70 normal patients and 18 glaucoma patients who have been examined with a series of different threshold estimating techniques. The accuracy of each technique and the time taken to establish the threshold have been calculated. All techniques used a semiautomated multiple stimulus instrument (modified Henson CFS2000).

The results reveal a roughly exponential relationship between accuracy and time and that a reliable estimate can be obtained with a stimulus which steps down (1 db steps) from seeing to non-seeing.

MACULAR THRESHOLD TESTING IN GLAUCOMA: REASSESSING "SPLIT FIXATION"

Marc F. Lieberman and Robert H. Ewing,
Pacific Presbyterian Medical Center, San Francisco, California

This is a prospective study begun in 1984, whereby every glaucoma patient who has undergone a Humphrey Threshold Test (30-2 and 24-2 tests) and who has shown an abnormality in one of the four most central test points has then been tested with the Macular Threshold Test (MTT). Customized software has been developed to translate the Humphrey format into Macintosh-compatible information, and to evaluate the macular data on over 1500 fields, including multiple tests over several years.

Evaluation of this data has focused on several discrete areas: (1) the appearance of consistently higher threshold values and improved reliability factors with the MTT, despite its being performed after the exhaustive tests of the central 24 or 30 degrees; (2) the relationship of the MTT values and the Foveal Threshold values obtained at the same sitting; (3) the stability, fluctuation and deterioration behavior seen at each of the sixteen test points when plotted over time and in relation to intraocular pressure control; (4) the prognostic significance of loss of the central test points, both in cases of advanced field loss and in rarer cases of discrete early central involvement. Reference is made to Kolker's retrospective evaluation of "split fixation" when performed by Goldmann perimetry.

ARE THE EARLY VISUAL FIELD CHANGES TOPOGRAPHICALLY DIFFERENT BETWEEN PRIMARY OPEN-ANGLE (HIGH TENSION) AND NORMAL TENSION GLAUCOMA?

A. Iwase, K. Matsubara and Y. Kitazawa
Department of Ophthalmology, Gifu University School of Medicine, Gifu, Japan

We studied the 30-2 threshold visual fields obtained with a Humphrey perimeter in 19 POAG and 33 NTG patients with early field changes. Each field was evaluated using a prototype version of the Glaucoma Hemifield Test (GHT) of Statpac 2. Fourteen eyes of 14 POAG patients and 20 eyes of 20 NTG patients were judged abnormal by the GHT. The location of the defects in abnormal fields was classified as to whether the upper or lower hemisphere was most affected and as to the eccentricity of the primary field defect from fixation.

In NTG the decrease in sensitivity was noted to be closer to fixation as compared to POAG, and the superior area was more commonly affected as compared to the inferior area ($P< 0.05$). In POAG the sensitivity decrease was significantly more frequent inferiorly than superiorly (< 0.01).

Our findings seem to suggest the possibility that early axonal damage may be topographically different between POAG and NTG.

THE INFLUENCE OF INTRAOCULAR PRESSURE ON VISUAL FIELD DAMAGE IN NORMAL-TENSION AND HIGH-TENSION GLAUCOMA

Balwantray C. Chauhan and Stephen M. Drance
University of British Columbia, Vancouver, Canada

We undertook this study to determine the extent to which patients with normal-tension glaucoma (NTG) and high-tension glaucoma (HTG) could be differentiated on the basis of their visual fields. Forty pairs of NTG and HTG patients were matched very closely for the extent of field damage, pupil size and visual acuity. Using this pooled material, we increased the IOP difference between the two groups in either direction, i.e. by lowering stepwise the highest recorded IOP allowed for inclusion in the NTG group and by increasing stepwise that required for inclusion in the HTG group. At each step we compared the normal areas of their visual fields with simple indices designed to quantify the undisturbed field. Using ROC analysis we showed that changing the inclusion criterion in the NTG group did lead to a better separation between the groups, however, when the inclusion criterion was changed in the HTG group, the two groups became more separable. In this case, the degree of separation appeared to be related to the group difference in the highest recorded IOP ($p < 0.025$). These findings show that pressure has a greater influence on the type of field damage at the higher end of the IOP spectrum and suggest that there is no common single pathophysiological mechanism in glaucoma.

ABSTRACTS POSTERS

POSTER SESSION 1

CHAIRMAN: Y. KITAZAWA
CO-MODERATORS: J. KELTNER AND J. FLAMMER

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1. VISUAL FIELD FINDINGS IN DEPRESSIVE PATIENTS UNDER LITHIUM-TREATMENT - PRELIMINARY RESULTS

A. Prünte [1], U. Heinen[1], A. Wirz-Justice[2], Chr. Remé[3] and U. Urner[3]
1 University Eye Clinic, Basel, 2 Psychiatric University Clinic, Basel, 3 University Eye Clinic, Zürich, Switzerland

Avissar found in 1988 that lithium acted on G-proteins of cell membranes in the brain; furthermore he described a reaction of lithium with transducin having a blocking effect on light dependent processes in outer rod-segments. It was the aim of this study to evaluate if these effects cause a decrease of the differential light sensitivity in lithium-treated patients. Visual field examinations with Octopus, program G 1, electroretinograms, electrooculograms and tests for dark adaptation, which are already known to be pathological in these cases, were performed on 30 lithium-treated depressive patients. We found a diffuse decrease of the differential light sensitivity without correlation with the duration of lithium-treatment. Our data do not allow a differentiation between possible retinal damage from eventual cognitive difficulties.

2. GRAVES' OPHTHALMOPATHY: PERIMETRIC AND ULTRASONOGRAPHIC FINDINGS.

S.C. Sacca, E. Gandolfo, A. Polizzi and P.Capris
University Eye Clinic, Genova, Italy

The authors utilized computerized perimetry (Peritest and Perikon) in order to detect early visual field changes in 35 patients suffering from Graves' ophthalmopathy.

Visual field defects similar to those found in open angle glaucoma were present in 12.5% of the cases. In addition, the short-term kinetic threshold fluctuation was significantly greater in the patients with Graves' ophthalmopathy than in a normal control group. In 20% of the patients tonometry in the eccentric gaze showed a significant IOP increase.

The authors interpret these results as a consequence of the hormonal state, as well as muscle enlargement and other orbital alterations detectable by means of ultrasonography.

3. RING PERIMETRY IN NEURO-OPHTHALMOLOGY

H. Bynke
Department of Ophthalmology, Lund, Sweden

Twenty-two visual fields of 14 patients with CNS disorders were tested with the Ring perimeter (R) and with the threshold program of Competer 750(C). Seventeen visual fields were pathological and five were normal.

Although the majority of the patients had been tested with C on previous occasions, only two preferred that method. Eleven patients preferred R, mainly because of its feed-back system, and one patient gave no preference to any of the methods.

The mean test time, which was 5.42 min with R and 7.20 min with C, was approximately proportional to the mean numbers of points tested (45.8 with R and 60 with C). As calculated on the mean threshold values (scores) of the total central area and of the quadrants tested with R and C, respectively, the correlation coefficients ranged between -0.84 and -0.64. Consistently, R detected and localized all major defects but missed some minor defects, which were identified with C. The statistical analysis did not support the statement that R measures other visual qualities than C, which is a conventional automated perimeter, but this could not be excluded.

To sum up, the Ring perimeter was found to be a handy and reliable screening instrument for clinical neuro-ophthalmological examinations.

4. OPTIC NEURITIS TREATMENT TRIAL: VISUAL FIELD READING CENTER

J.L. Keltner, *C.A. Johnson, J.O. Spurr, and the Optic Neuritis Study Group*
University of California, Davis, California

The Visual Field Reading Center (VFRC) at the UC Davis Department of Ophthalmology was established to provide high quality and reliable visual field data for the Optic Neuritis Treatment Trial (ONTT). Its major functions include technician training and certification, quality control of ONTT visual field tests, data compression and analysis, and transmission of visual field data to the ONTT Coordinating Center. The VFRC has processed data from over 5,000 Goldmann and Humphrey visual fields in the 18 months since the ONTT began.

The VFRC quality control measures provide important feedback to the ONTT clinics and visual field technicians on their performance in both Goldmann and Humphrey visual field testing. This feedback has produced improvement in the quality and reliability of the ONTT visual fields. The average Goldmann quality control score has improved from 2.42 for the first three months of the ONTT to 0.78 for the last three months (where zero is a perfect score on a 0-9 scale), and the average Humphrey score has improved from 1.49 to 0.56. The quality control also ensures that the entrance visual field criteria have been followed and that the uniform testing standards are employed by all ONTT clinics. This is the first visual field reading center of this type for clinical trials in ophthalmology.

5. STUDY OF THE INFLUENCE OF STIMULUS SIZE ON THE PERICENTRAL VISUAL FIELD

C. Matsumoto, K. Uyama, S. Okuyama, Y. Nakao and T. Otori
Department of Ophthalmology, Kinki University School of Medicine, Osaka-Sayama, Japan

The pathophysiology of the pericentral visual field within 10° is not so well understood. We studied the influence of stimulus size on the sensitivity of this area in normal subjects and patients with several eye diseases. Using the SARGON program of the automated perimeter Octopus 201, we examined 49 (7x7) test points on a 2° grid in the pericentral area using stimulus sizes 1, 3 and 5.

In many of the patients with optic neuritis and chiasmal syndrome, stimulus size 1 was more sensitive in detecting pericentral scotoma and hemianoptic changes than the standard stimulus size 3.

The present result seems to suggest that the small target such as stimulus size 1 should be used to examine the pericentral visual field abnormalities in neuro-ophthalmological cases.

6. BINOCULAR INTERACTION IN NORMAL AND AMBLYOPIC PATIENTS: COMPARATIVE STUDY WITH AUTOMATIC PERIMETRY AND VEP

M. Fioretto, V. Brezzo, G.P. Fava and E. Gandolfo
University Eye Clinic, Genova, Italy

The authors examined the central threshold tested by means of automatic static perimetry in normal and amblyopic patients in both monocular and binocular vision. The patients then underwent pattern VEP examination with stimulation of monocular and binocular vision.

In normal subjects the static threshold and the P 100 wave amplitude were significantly greater in binocular than in monocular vision. In amblyopic patients a similar behavior was observed, thus demonstrating the persistence of a certain degree of binocular interaction even in the presence of a central scotoma.

7. PUPTRAK: A PRELIMINARY REPORT

F. Fankhauser II, J. Flammer and A. Jenni
University Eye Clinics, Bern and Basel, Switzerland

A provisional, semiautomated version of a system for automated testing of the afferent pupillary reflex with perimetric methods under controlled conditions is described. A target projected onto a perimeter cupola is used as the stimulus for triggering the pupillary response. In a modification to the Octopus 201 automated perimeter, the pupil is illuminated by two IR LED diodes, while the pupillary responses are recorded by the onboard IR sensitive TV camera built into the perimetric unit. Measurements of the pupillary area as a function of time and stimulus luminance have been performed and have resulted in consistent results. Here, one perimetric program, working with stimuli above the threshold for the afferent pupillary light reflex is described. The present setup works with system-specific software and standard hardware, the central data processing unit being a desk-top computer (IBM PC AT-03).

8. PERIMETRY AND DRIVING LICENCES

E. Gandolfo, E. Campos, M. Facino and G. Di Lorenzo,
University Eye Clinic, Genova, Italy

A "questionnaire" about the rules concerning the perimetric capabilities necessary for obtaining a driving licence in different countries was sent to all members of the IPS Standards and Ergoperimetry groups, as well as to the Secretaries of the National Ophthalmological Societies. A personal opinion was also requested.

Of 120 questionnaires distributed 31 answers were received from 20 countries. Fifteen of these 20 countries had specific rules concerning perimetric damage and driving licences, in the USA the law varies according to the State. Many colleagues recommended standardization of the perimetric performance necessary for a driving licence. Most suggest a threshold-related screening test of the entire visual field (e.g. Octopus 07, Humphrey 120 point). The authors suggest suitable criteria for the final decision about perimetric driving fitness.

9. A PROPOSAL FOR A NEW CLASSIFICATION AND QUANTIFICATION OF VISUAL DISABILITY

E. Gandolfo and M. Zingirian
University Eye Clinic, Genova, Italy

The visual disability classification is nowadays based mainly on a well standardized quantitative evaluation of visual acuity. The quantification of visual field damage is, on the contrary, often based on empirical criteria. We have therefore attempted to create a new classification of perimetric disability parallel to that of visual acuity, in order to obtain an overall disability index based on both visual acuity and visual field function.

Visual fields were obtained with a computerized perimeter. A binocular suprathreshold strategy testing 100 points and stressing perimetric areas relevant for functional assessment was used. The perimetric results were converted to percentile scores quantifying the residual visual field. Combining visual acuity and visual field scores, we obtained a decimal index of the overall visual disability, useful not for legal but only for rehabilitation purposes.

10. RELATIONSHIP BETWEEN VISUAL FIELD DEFECTS AND CHOROIDAL ANGIOGRAPHIC FINDINGS IN PATIENTS WITH OPEN ANGLE GLAUCOMA

Ch. Prünte and J. Flammer
University Eye Clinic, Basel, Switzerland

The topography of visual field defects in patients with chronic open angle glaucoma was compared with the findings of Indocyanine green video-fluorescence angiography of the area around the optic nerve head. In some patients with localized visual field defects a corresponding local delay in choroidal arterial filling and a rarefication of choroidal capillaries could be observed. Examples of these findings will be demonstrated and discussed.

11. SCANNING LASER OPHTHALMOSCOPE FOR STATIC FUNDUS PERIMETRY IN GLAUCOMATOUS NERVEFIBERBUNDLE DEFECTS

Jörg Stürmer[1], *Carsten Schrödel*[2], *and Wolfgang* Rappl[2]
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2 G. Rodenstock Instruments Ltd., FRG

The advantage of fundus perimetry is an exact correspondence between fundus image and simultaneous perimetric result.

For static fundus perimetry we modified the tightly confocal Rodenstock Scanning Laser Ophthalmoscope by installing an infrared diode laser for fundus imaging, providing a background brightness at the same level (4–31 asb) as that of conventional hemispheric perimeters. The originally installed HeNe–laser is still used for generating the stimuli and background by computer controlled acousto–optic modulation. Software was developed to change stimulus size and intensity as well as to place the stimulus to any desired position in the 18 x 13° field. For correction of fixation shifts, manual fundus tracking was incorporated. The first clinical experience in 30 glaucoma patients with nerve–fiber bundle defects is reported. Fundus perimetry was seen to provide a more exact description of scotomata relative to their morphological location, facilitating evaluation of such cases.

12. MICROPERIMETRY WITH THE SCANNING LASER OPHTHALMOSCOPY

Frans J. Van de Velde, Alex E. Jalkh and Ann E. Elsner
Eye Research Institute, Boston, Massachusetts

Computer controlled acousto-optic modulation of the laser beam in scanning laser ophthalmoscopy allows for the creation of psychophysical stimuli while visualizing the retina on a monitor. Perimetry is performed using 255 potential stimulus intensity levels and a combination of 633 nm and 780 nm background illumination. Linear or logarithmic interval, incremental or decremental stimuli relative to a mesopic, low or high photopic background are thus possible.

A fundamental advantage for the examiner is the ability to see psychophysical stimuli presented on the retina in real-time. Accurate monitoring of fixation and localization of the stimulus are therefore possible. A static technique eliminates reaction time artifacts. The term microperimetry refers to the high resolution typically obtained (< 1°) in the posterior pole. Three psychophysical techniques are illustrated: (1) Automated microperimetry with a precise user pre-defined configuration of test locations on the retina and a new reliability index, the bivariate area of fixation. (2) Manual microperimetry, in which the static stimulus is placed on the retina under visual feedback by the examiner during testing. (3) Threshold microperimetry using staircase procedures to measure the retinal sensitivity at a single locus on the retina.

Microperimetry with the SLO is quite different from conventional field testing (potential light scatter, Stiles-Crawford, bleaching). To demonstrate the reliability of quantitative perimetry, we evaluated the Weber-Fechner relationship under various testing conditions.

13. LOCALIZED SCOTOMAS AND VASCULAR IMPAIRMENT IN DIABETIC MACULOPATHY

Toke Bek
Department of Ophthalmology, Gentofte Hospital, Denmark

Computerized perimetry is a technique which allows the study of retinal light sensitivity in well-defined localized areas. The correlation of localized visual field data to corresponding fundus morphology can be expected to produce deeper insight into the pathophysiology of diseases where localized lesions is a prominent sign, as e.g. in diabetic retinopathy. Therefore, an optical technique for accurate superimposition of computerized perimetry data onto corresponding fundus morphology seen on fundus photographs and fluorescein angiograms was developed, and a systematic study of diabetic retinopathy was undertaken employing this technique. It was found that localized scotomata occurred which could be correlated to retinal areas of non-perfusion, and to retinal areas peripheral to occluded retinal arterioles. Other scotomata occurred, however, which could not be correlated to areas of distribution from the central retinal artery. Retinal areas which displayed breakdown of the blood-retina barrier as assessed on fluorescein angiograms had normal light sensitivity in most cases. Where scotomata occurred, however, there was no correlation between barrier leakage and decreased retinal light sensitivity.

On the basis of these findings it is concluded that other mechanisms than disturbances of retinal vascular supply probably are involved in causing sensory cell damage in diabetic maculopathy.

14. NEW METHODS OF ANALYSIS OF SERIAL VISUAL FIELDS

Marshall Cyrlin, Joseph Rosenshein, Steven Cunningham Charles Tressler and Christine Czedik
Sinai Hospital Detroit, Michigan S. University,Oakland University

We have developed new methods for displaying and analyzing serial automated field data. Using a computer graphic display, field losses at all 76 points of the Octopus 32 field can be seen for up to 16 different exams on a single map of the field. This view allows trends in local and diffuse field loss to be rapidly identified as well as sequelae of treatment. We then consider the threshold sensitivity at each test point to represent a vector lying along one dimension in n-dimensional space, where n equals the total number of points tested in the field. We calculate the total field vector (TFV) which is representative of the overall state of the field. Diffuse loss (or gain) in sensitivity is seen as a difference in magnitude between the TFV and the calculated normal field vector (NFV). The distribution of the threshold sensitivities is represented by the vector angle (VA) between the linearized TFV and the linearized NFV. An increasing VA corresponds to a focal change in sensitivity. A change in the TFV length without a change in the VA corresponds to a diffuse change. Analysis of a series of fields using this method yields a "trajectory" of the visual field in vector space which can be used to characterize the localization and magnitudes of field changes. We will present the strengths and weaknesses of this approach as compared with standard global indices and the Delta program to evaluate a series of Octopus 32 visual fields in patients with unstable glaucoma.

15. AUTOMATED VISUAL FIELD MANAGEMENT IN GLAUCOMA WITH THE PERIDATA PROGRAM

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Peridata is a new program created for storage and graphical and statistical processing of perimetric data from the Octopus and Humphrey automated perimeters. Some features (i.e. its statistical functions) make it useful in visual field management of patients with chronic glaucoma, both for diagnostic and follow-up purposes.

The authors' experience with this program is presented.

16. OCTOSMART: A COMPUTERIZED AID FOR INTERPRETING VISUAL FIELD EXAMINATION RESULTS

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University Eye Clinics, Bern and Basel, Switzerland

Octosmart is a new computer program running on an IBM PC or compatible which is able to take G1 examination results and evaluate them. Goldmann was able to standardize examination conditions for obtaining visual fields. With automation, artifacts due to subjective judgements of the perimetrist were largely eliminated. As a further step in this evolution, Octosmart seeks to make visual field evaluation clearer, easier and more standardized in that it offers commentary about the examination results based on the accumulated experience of several visual field experts. We describe program operation and present the results of a study in which Octosmart evaluations of a number of visual fields were compared with those of human interpreters.

17. EVALUATION OF THE DIAGNOSIS OF VISUAL FIELDS

L. R. Shapiro[1,2] and C.A. Johnson[1]
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The use of expert systems and artificial intelligence techniques have been useful in the study of diagnostic decision making and judgement in, for example: radiology, cardiology, and internal medicine. Clinical diagnosis of visual fields may be seen as a similar problem of agreement among experts. Previous studies of clinical decision making and judgement support this characterization (e.g., Feinstein, 1967; Lesgold, 1984). The present study uses established techniques in Cognitive Science (i.e., protocol analysis: Ericsson and Simon, 1984) to specify the diagnostic knowledge for a group of experts and novices using a given set of normal and pathologic visual fields. Clinician's verbal reports are analyzed using variables: classification features, subsequent diagnosis, as well as time into the report for features and diagnosis. The results form preliminary experiments as well as examples of their application will be presented. These data may be used to further study diagnostic decision making as well as establish a basis for an expert system in clinical perimetric diagnosis. This approach goes beyond traditional techniques by exploiting non-verbal classifications extracted from the data and visual field set. The ultimate goal of this research is to build an expert system for the diagnosis and evaluation of visual fields.

18. A NEURAL NETWORK CAN DIFFERENTIATE GLAUCOMA AND OPTIC NEUROPATHY VISUAL FIELDS THROUGH PATTERN RECOGNITION

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Using a neural network for pattern recognition, we tested the hypothesis that glaucoma visual fields could be differentiated from non-glaucoma optic neuropathy visual fields on the basis of pattern differences. A training set of Humphrey 30-2 visual fields was obtained on 50 patients with primary open angle glaucoma and 37 patients with optic neuropathy due to either ischemic optic neuropathy, optic neuritis or compressive optic neuropathy. A three layer neural network with one hidden layer was trained with back propagation learning to classify the visual fields into glaucoma and on-glaucoma groups. The network was implemented on an IBM ATY computer using Neural Ware software. The network achieved 100 % classification accuracy on the training set. After training, the network correctly classified 82 % (n= 23) of glaucoma and 80% (n = 10) of non-glaucoma visual fields on data not included in the training set. Analysis of the hidden units revealed that relative preservation of temporal field sensitivity was one of several features detected by the network in glaucoma visual fields.

We conclude that a neural network can learn to differentiate glaucoma and optic neuropathy visual fields and generalize what it has learned to allow classification of new visual fields. To our knowledge, this is the first time an attempt has been made to separate glaucoma and optic neuropathy automated fields on the basis of pattern differences. Accurate classification of abnormal visual fields can aid in guiding the diagnostic work up of patients.

19. A COMPUTER-ASSISTED VISUAL FIELD DIAGNOSIS SYSTEM USING NEURAL NETWORK

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A system was developed enabling the Topcon SBP1000 perimeter to assist in the diagnosis of ophthalmologic disorders. The system utilizes the computer's neural network, which is taught through repetition to recognize various pathologic condition through analysis of visual field disturbances.

The network composed of 3 layers of cells,was educated using the back propagation method. In 3 days of learning with a 32 bit computer, our system memorized 40 types of visual field patterns, enabling it to classify 13 types of illness. The computer-generated classifications showed an 80% rate of concurrence with diagnosis arrived at by the attending physicians.

20. COMPUTER-ASSISTED EVALUATION OF THE RESULTS FROM HIGH-PASS RESOLUTION PERIMETRY: A KNOWLEDGE-BASED SYSTEM

Lene Martin-Boglind[1] and Peter Wanger[1] and Klas Orsvärn[2]
1 Department of Ophthalmology, Sabbatsberg Hospital,2 Swedish Institute of Computer Science, Stockholm, Sweden

Computerized perimetry generates a sometimes large number of data to be considered when the examination results are evaluated. The aim of the present study was to develop a computer program for at least a preliminary evaluation of the visual fields. Program prototypes were produced, using three different techniques; an expert system shell, Prolog and CLIPS (tm Cosmos Inc.). Testing was performed by feeding the programs with visual fields from normal subjects and patients with known disorders.The best program prototype has so far reached an agreement of at least 80%, when compared to a trained human observer. Computerized evaluation of the results from high-pass resolution perimetry may lend a considerable support to the final diagnostic decision.

21. EXTENDED EMPIRICAL STATISTICAL PACKAGE FOR EVALUATION OF SINGLE AND MULTIPLE FIELDS IN GLAUCOMA: STATPAC 2

Anders Heijl[1], Georg Lindgren[2], Anna Lindgren[2], Jonny Olsson[2], Peter Åsman[1], Steve Myers[3] and Michael Patella[3]

1 Department of Ophthalmology in Malmö, and 2 Department of Mathematical Statistics, University of Lund, Sweden and 3 Allergan Humphrey, San Leandro, California

A statistical package, based on empirically determined normative physiologic data has been available for the Humphrey perimeter since 1986. We have now developed an extension to that package, providing analyses for change in glaucomatous visual fields, and a new routine for recognition of glaucomatous field loss in single fields.

Data from repeated testing of 51 patients with glaucoma over a month period were used to establish empirical significance limits for change in glaucomatous fields. Significance limits depend on test point location, initial defect depth, number of tests available, and global sensitivity as measured by Mean Deviation (MD). These limits are used to calculate Change Probability Maps showing the significance of deteriorations or improvements on a point by point basis. Significance limits for change in MD are also incorporated into the package. Linear regression analysis for change in MD ignores the first test in case of significant learning.

The extended package provides a Glaucoma Heimifield Test with plain text analysis of single fields. The analysis is based on comparisons of probability scores in 5 sectors in the superior field with mirror-image sectors in the inferior field. The text indicates if these up-down differences exceed or fall within the limits of normal variability. Generalized shifts in sensitivity are also recognized and flagged.

The rationale for the different methods of the package will be presented together with clinical applications.

22. SPATIAL CONSIDERATIONS IN CLUSTER ANALYSIS FOR DETECTION OF GLAUCOMATOUS FIELD LOSS

Peter Åsman and Anders Heijl
Department of Ophthalmology in Malmö, University of Lund, Sweden

We have devised a new method for the detection of arcuate clusters which takes into account retinal nerve fibre layer anatomy as well as cluster location. Our algorithm identifies clusters of significant points in the Statpac Pattern Deviation Probability Map; only points located along predefined paths corresponding to the direction of the normal retinal nerve fibre layer are taken into consideration. Cluster volume is defined as the sum of probability scores within the cluster. Significance limits for cluster volumes depend on location, and are generally higher in the mid-periphery.

Humphrey 30-2 fields from 177 eyes of 177 normal subjects and 58 eyes of 46 patients with glaucomatous discs were analyzed for localized loss with the new method. Results were compared with those obtained with a traditional method looking for clustered neighbouring points in all directions. At the 90% level of specificity, sensitivity was 78% with the new method and 57% with the traditional. In the glaucoma group highly significant clusters were most common in the nasal and central areas. In contrast, in the normal group highly significant clusters occurred most frequently in the temporal and lower periphery.

Interpretation of clusters of significantly depressed points is facilitated if their location and shape is taken into account.

23. SYMMETRY ANALYSIS IN PITUITARY ADENOMA

C. Papoulis and J. Weber
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Indices developed to be a strong instrument for the evaluation of visual fields. We examined the power of a symmetry index for the detection of pituitary adenoma in 38 clinical cases compared to 28 normals. Sensitivity and specificity crossed over at the high level of 80%.

We tested also two other ways of analysis, a quadrant index and a point-by-point comparison. Compared to the hemifield symmetry index, they furnished better results in cases of incomplete hemianopic defects, but were more difficult to interpret.

24. ESTIMATING SHORT-TERM FLUCTUATION WITHOUT DOUBLE THRESHOLD DETERMINATIONS; VALIDATION OF A METHOD

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We have previously reported a method for estimating Short-term Fluctuation (SF) from a single determination of threshold at each test location in regular grid visual field examinations. Using a technique of trend-surface analysis, the residual variances after detrending the surface correlated very well with the conventional estimates of SF made according to root mean square (RMS) calculations. However, since we developed our modification of the trend-surface analysis on the original sample of 62 eyes, we wished to validate the method on a larger independent sample.

In 106 eyes of 106 patients, excellent correlation (coefficients of log–transforms of 0.8 and better) of the trend surface method with the conventional RMS method was found. Since good estimates of SF can be obtained from visual field data using only single threshold determinations, the time-efficiency of double determinations should be reconsidered.

25. THE EFFECT OF THE NUMBER OF SENSITIVITY DETERMINATIONS ON SHORT-TERM FLUCTUATION

Balwantray C. Chauhan[1], Raymond P. LeBlanc[1], Stephen M. Drance[2], Kees Wijsman[2] and Arturo M. Cruz[1]
Departments of Ophthalmology, 1 Dalhousie University, Halifax and 2 University of British Columbia, Vancouver, Canada

We wanted to assess whether the number of multiple sensitivity determinations in automated perimetry had a significant effect on the local and global (RMS) Short-term Fluctuation. Our sample contained 26 subjects (8 normals, 8 glaucoma suspects and 10 glaucoma patients) whose mean age was 57 years. One eye of each subject was first tested with both the standard Octopus programs G1 and 31, followed by 5 custom (Sargon) programs. The latter were designed to test 15 locations twice, 10 locations thrice, 6 locations 5 times, 3 locations 10 times and 2 locations 15 times respectively. There were 2 principal locations [(0,12) and (0,-12)] where all five sets of replications were carried out. The order of the standard and custom programs was randomised. Our results show that local fluctuation increased sharply when calculated from 2 to 3 determinations after which it remained virtually constant. On the other hand, the number of determinations did not have a significant effect on RMS fluctuation. A comparison of the RMS obtained from the standard and custom programs indicate no significant differences ($p>0.05$). Our results suggest that the current standard programs which do only double determinations may be underestimating local fluctuation. Furthermore, local fluctuation is de-emphasized by a 'watering-down' effect of calculating RMS fluctuation.

26. OPTIMIZING DOT SIZE AND CONTRAST IN PATTERN DISCRIMINATION PERIMETRY

Bruce Drum and Regina Bissett
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Pattern discrimination perimetry assesses the visual field with stimuli consisting of patches of nonrandom dots embedded in a surround field of dynamic random dots. The threshold variable is usually the coherence, or degree of nonrandomness, of the stimulus dots. Coherence (and visibility) is reduced by reversing the contrast of a known percentage of dots at random locations within the stimulus, keeping the ratio of light to dark dots constant. Previous studies were carried out with a prototype instrument that was limited to high-contrast stimuli with a fixed pixel size of about 15' of arc. These studies suggested that pattern discrimination perimetry may be a sensitive technique for detecting early optic nerve damage in open-angle glaucoma. A second-generation instrument has now been developed, with a more powerful computer and a high-resolution (1024x1280) CRT with 256 grey levels. These features permit separate adjustments of the dot size and contrast of the stimulus display at each eccentricity, to more effectively optimize the sensitivity and specificity of the test, not only to early glaucomatous damage, but also to visual field loss arising from other visual disorders.

To a first approximation, M-scaling dot size with eccentricity in normal subjects produces flat contrast threshold profiles for fully coherent stimuli and flat coherence threshold profiles for high-contrast stimuli. M-scaling of the stimulus pattern thus may simplify the interpretation of pattern discrimination data by providing a single characteristic coherence threshold for an entire visual field, as well as by making the size relationship between the stimuli and the underlying retinal receptive fields the same for all eccentricities. In addition, coherence thresholds for normal subjects remain nearly unchanged down to near-threshold contrasts. This finding suggests that it will be possible to increase the sensitivity of pattern discrimination testing to disorders with reduced contrast sensitivity; a contrast that is just high enough to leave the normal coherence threshold unaffected may raise the coherence threshold substantially for a patient with reduced contrast sensitivity.

27. THE OCTOPUS 1-2-3 CUPOLA-FREE PERIMETER

F. Jenni, A.T. Funkhouser, F. Fankhauser and J. Flammer
University Eye Clinics, Bern and Basel, Switzerland

A new automated perimeter of the Octopus series, model 1-2-3, which works without a cupola, will be described. It is a small, compact instrument which measures out to an eccentricity of 30°. It has been designed and constructed with knowledge gained from experience with previous perimeter models but is based on completely new technology. The stimulus, for instance, is generated by a light emitting diode. Some other parameters have also been changed. Altogether, the alteration of the instrumental characteristics and parameters have been made in such a way that the results obtained from the various Octopus perimeters are similar and can be readily compared. Based on results from measurements of 56 normal and several pathological visual fields, it has been possible to compare the new approach with conventional Octopus perimetry. The results of this comparison will be presented. By means of parameter adjustment it is shown that the new apparatus performs like the other Octopus models and that the results are directly comparable.

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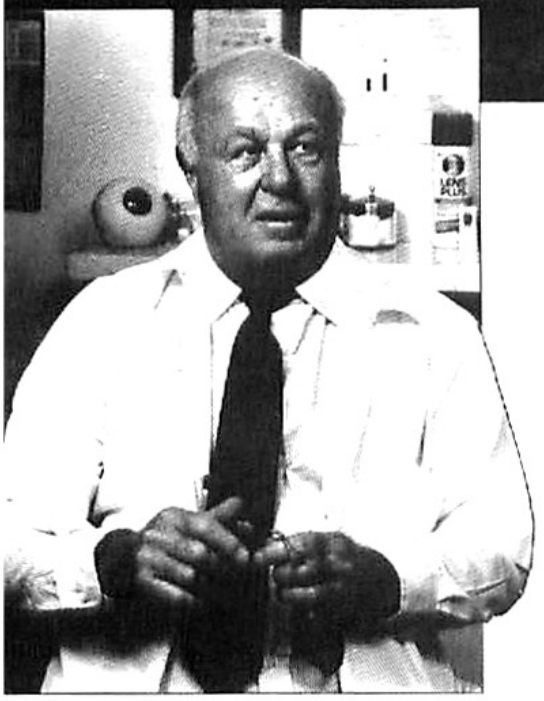

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28. PERIMETRIC ISOLATION OF THE SWS CONES IN OHT AND EARLY POAG

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Recent psychophysical and histopathological evidence has demonstrated that the larger diameter optic nerve axons are selectively damaged in early glaucoma. Thus psychophysical isolation of mechanisms most prone to the large axon nerve fibre damage should enable early diagnosis of glaucoma. The aim of this study was to perimetrically isolate the short wavelength sensitive (SWS) cones, the largest of the parvocellular projecting, ganglion cells. Various studies have measured the foveal SWS function but only two have investigated the entire central visual field. The results were conflicting with one study finding both diffuse and localised reduction in SWS function and selective loss in some OHT and early POAG patients. The other study found the technique less useful than standard perimetry on a small group of established glaucoma patients. We investigated 50 normals, 18 OHTs and 25 early POAG subjects. All were between the ages of 45 and 60 years with clear optical media to reduce the effect of differential ocular media absorption. Pupils were larger than 2 mm and acuity greater than 6/15. A routine 24-2 or 30-2 programme was conducted for each subject on a HFA 630 using a white, 0.431° target. The same target locations were also examined using a blue (OCLI, 500 nm cutoff filter), 0.431°, target against a yellow background (Schott OG530, 530 nm cutoff filter) of 300 Cd/m^2. Results were analysed on a point-by-point basis by establishing normal 95% confidence limits for every target location for each test condition. 10 out of 26 early POAG subjects and 3 out of 18 OHT subjects demonstrated a selective loss to the blue on yellow target. The early POAG subjects gave a cumulative abnormal score double that of standard testing when SWS function was determined. The results confirm that testing SWS function is of potential clinical value in patients with early POAG and OHT.

29. CENTRAL DIFFERENTIAL SENSITIVITY TO BLUE STIMULI IN GLAUCOMA AND OCULAR HYPERTENSION

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The aim of this study has been to verify whether testing differential sensitivity in the macula area with the Humphrey automated perimeter could detect early damage from glaucoma.

We selected 39 eyes with primary open angle glaucoma, free from defects within the central 4° of the field. We also included 49 eyes with ocular hypertension and 48 eyes of normal age-matched subjects. They underwent the Macula Threshold Test of a Humphrey Perimeter, using white and blue targets.

Statistical analysis showed that (1) differential sensitivities to blue were significantly depressed in the eyes with glaucoma and ocular hypertension, and (2) those of glaucomatous eyes distributed in a distinct domain as compared to normal eyes. (3) Within the glaucoma group, sensitivities to blue were related to the severity of glaucoma and poorly influenced by other variables. (4) Within the control group they were instead related to subjects age. Differential sensitivities to white stimuli were not significantly different in glaucomatous and normal eyes.

These results suggests the possibility of detecting early glaucomatous alterations of central visual function using an automated perimeter and its built-in color filters.

30. THE VULNERABILITY OF THE BLUE CONE SYSTEM IN GLAUCOMA

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Previously, we reported that there was a definite lack of a peak in the short wavelength region in most optic nerve diseases when spectral sensitivity measurements were performed on an intense white background. Using the same method we investigated the characteristics of the opponent channel damage in patients with glaucoma by measuring the spectral sensitivity at the fovea and the extrafovea. We found that there was a loss of sensitivity for both the blue cone system and the red and green cone systems at both the fovea and the extrafovea. Even though the blue cone system was slightly more vulnerable than the red and green cone system, particularly at the extrafovea, there still remained a more prominent peak than in optic nerve diseases.

31. THE DIFFERENTIAL LIGHT THRESHOLD AS A FUNCTION OF RETINAL ADAPTATION - THE WEBER-FECHNER/ROSE-DE-VRIES CONTROVERSY REVISITED

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The relationship between L, the adaptation or background luminance, and ΔL, the minimum detectable stimulus luminance, varies as a function of L. In the photopic range of L, the Weber-Fechner Law, ΔL/ L = constant, is generally considered to be the most appropriate. In the low scotopic range of L, ΔL becomes a constant, independent of L. In the low photopic and mesopic range of L, that most commonly used in perimetry, the Rose-de-Vries Law, ΔL/ L = constant, is more appropriate. The format of this relationship is uncertain in clinical perimetry; therefore the aim of this study was to assess the interaction of stimulus size and background luminance on the sensitivity and variability across the visual field. In so doing, it should be possible to establish the suitability of the Weber-Fechner or Rose-de-Vries Laws for automated perimetry from dark adapted to photopic levels of adaptation. The differential light threshold for the right eye of 10 clinically normal age matched emmetropes was determined using a Humphrey Field Analyzer 630. Stimuli were presented along the 15°-195° meridian for 3 stimulus sizes (0.108°, 0.431°, and 1.724°) over a range of background luminances (0 to 1000 Cd/m^2). Stimulus luminance and retinal illuminance were calculated for each condition and the values were corrected for the Stiles-Crawford effect. The Rose-De-Vries Law was found to be most applicable for luminances up to 10 Cd/m^2. The Weber-Fechner Law described the relationship for 10 Cd/m^2 and higher. The value of the constant was dependent upon stimulus size and the entire distribution can be described as a logarithmic function.

32. THE FREQUENCY-OF-SEEING CURVE UNDER PERIMETRIC CONDITIONS

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Conventional perimetry is the determination of the absolute threshold of perception of a light stimulus. This threshold is a psychometric function called the frequency-of-seeing curve. We measured this curve in 13 normals and 7 glaucoma patients. 4 to 8 points were measured at 12 contrast levels 25 times. The curve had a cumulative Gaussian distribution. The sigma of the curve ranged from 1.5 dB to 10 dB. It showed a highly negative correlation with the threshold level. The increase of sigma in points with low dB values was similar in pathological depressed points of glaucoma patients and in peripheral points of normals. Thus, the threshold level can serve as a pre-knowledge for optimized threshold determination strategies.

33. EFFECT OF TARGET SIZE, TEMPORAL FREQUENCY AND LUMINANCE ON TEMPORAL RESOLUTION VISUAL FIELDS

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We have previously reported that temporal resolution visual fields are affected early in glaucoma (IPS 86,88). The present study examines the effects of several parameters on temporal sensitivity to sinusoidal flicker (depth of modulation) throughout the visual field. In the first experiment 10 eyes of 10 normal observers were assessed using five target sizes (.125, .25, .50, 1.0, 2.0 degrees of visual angle) roughly similar to Goldmann sizes I to V, and four temporal rates (1, 5, 10, and 15Hz). Five retinal eccentricities were used (1.25, 2.5, 5, 10, and 20°) and the background was maintained at a mean luminance of 3.4 Cd/m^2. Eight hundred data points for each observer were assessed in two one-hour sessions on two consecutive days. In the second experiment all the conditions were the same, except that a mean luminance of 10 Cd/m^2 was used. The results show that 5Hz produces the optimal sensitivity for all target sizes and luminance levels. The increase in luminance levels especially facilitates detection for the targets presented at the most distant eccentricities (10 and 20°) and at higher temporal rates (10 and 15 Hz). There is little benefit when the targets are presented in the more central eccentricities at 1 and 5Hz. If one were to assess temporal resolution for targets presented at high rates, targets of one or two degrees in diameter should be used to maintain relatively good sensitivity.

34. SCOTOPIC AND PHOTOPIC CFF FOLLOWING MANIPULATION OF THE IOP

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A differential susceptibility of human scotopic and photopic function to an experimentally induced, transient elevation of IOP has been identified using electrophysiological techniques. The present study attempted to reproduce those results psychophysically using CFF. Two visually-trained, clinically normal observers were extensively investigated using a modified Rodenstock Goldmann perimeter. A 5° diameter target was positioned at 15° eccentricity in each quadrant, with an additional central target under photopic viewing conditions. For scotopic CFF experiments, blue and neutral density Wratten filters were used to generate a dim target which could not be detected centrally. Three CFF determinations were recorded at one minute intervals throughout the experiment. Baseline data was derived for an initial 5 minute period. Thereafter, CFF was recorded for a minimum of 20 minutes to track the recovery of flicker sensitivity. Control data was established over a 30 minute period with no manipulation of the IOP and RVPP. Results indicated that the CFF was immediately reduced following an increase in IOP. The reduction was sustained until suction or inversion was stopped, and the measurements returned to baseline values. Results were similar for each quadrant and confirmed the greater vulnerability of the dark- versus light-adapted retina to manipulations of the IOP and RVPP.

35. QUANTIFYING METAMORPHOPSIA USING HYPERACUITY PARADIGMS

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Hyperacuity, the ability to perceive a difference in relative spatial localization of the order of seconds of arc is clinically important as a test of visual function in patients with opaque media. This is because hyper-acuity stimuli are resistant to optical image degradation. Here, we present further studies on a modified vernier gap test and a bisection task test to detect and quantify metamorphopsia (retinal image distortion due to underlying retinal anomaly). The usual Amsler grid test, used to detect metamorphopsia is qualitative and does not allow the clinician to assess fine changes in retinal status. Our PC-based test is based on the fact that the directional bias found in psychophysical hyperacuity testing is a sensitive indicator of metamorphopsia.

This procedure allows for precise quantification of metamorphopsia to the order of seconds of arc and can be used even in cases where due to ocular opacities the routine Amsler test is of limited value. The experimental procedure and results of these tests from both normals and patients will be presented.

36. FUNCTIONAL ALTERATIONS IN DIABETIC RETINOPATHY: VISUAL FIELD MACULAR RECOVERY TEST AND CHROMATIC SENSE

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Long term evaluation of the visual field (Perikon, Octopus 2000^{R}, Humphrey 630) macular recovery after photo-stress (Goldmann - Weekers Adaptometer) and chromatic sense (Farnsworth 100 Hue and Lanthony - Munsell New Color Test) was performed in diabetic patients without ophthalmoscopic or fluoreangiographic evidence of retinopathy.

After a five year follow-up it was found that these patients who from the beginning had had alterations, even non-significant ones, of all three tests were more likely to develop retinopathy than those who had alterations in none or only one and two of the tests.

37. AUTOMATED PERIMETRY OF PHOTOPIC AND MESOPIC ADAPTED VISUAL FIELDS IN THE EVALUATION OF RETINITIS PIGMENTOSA

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The nocturnal activity of patients with retinitis pigmentosa (RP) is restricted by visual field defects and nyctalopia. The relation between differences of the photopic and the mesopic adapted visual fields and the dark-adapted threshold was analyzed in 12 RP patients with clear media. The visual fields were measured with a Humphrey Field Analyzer under photopic and mesopic conditions. Dark adaptation was measured with the Goldmann-Weekers adaptometer. RP patients with an increased mean sensitivity of more than 10dB in the mesopic adapted visual field showed less than 10^{-3} in dark adapted threshold and those with an increased mean sensitivity of less than 5 dB in the mesopic adapted visual field showed more than 10^{-3} in dark-adapted threshold. However, there was a less significant relation between increased retinal sensitivity in the mesopic condition and dark-adapted threshold. Thus, the visual fields of RP patients should be individually analyzed and, when measured under photopic and mesopic conditions, can yield useful information regarding degree of nyctalopia. This is useful for assessment of visual disability in RP patients.

38. CONTRAST SENSITIVITY MEASUREMENT IN DETECTION OF PRIMARY OPEN-ANGLE GLAUCOMA

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Contrast sensitivity is a well established psychophysical technique for identification and monitoring of visual dysfunction. Traditional methods of contrast sensitivity measurement using oscilloscope-based techniques are too time-consuming and expensive to be clinically viable. A number of chart-based tests have been introduced to simplify measurement. These employ either grating or letter targets and incorporate criteria-free psychophysical strategies such as 2 alternate forced choice to reduce measurement error. The aim of the study was to determine the potential of such tests in the detection of primary open-angle glaucoma.

Twenty primary open-angle glaucoma, 20 ocular hypertensive patients and 20 normal control subjects were investigated using the following chart-based contrast sensitivity tests: Cambridge Gratings, Pelli-Robson Letter Charts, High and Low Contrast Letter Charts and Melbourne Edge Test. The validity and diagnostic capability of each was evaluated with respect to oscilloscope-based contrast sensitivity and to Humphrey Field Analyzer central visual fields assessment (program 24-2), disc photographs and intraocular pressures.

The validity of each of the chart-based tests relative to the oscilloscope-based standard was poor ($r<0.70$). ROC curves demonstrate low sensitivity and specificity (poor diagnostic capacity) at the recommended cut-off levels for all of the contrast sensitivity tests. Alternative criteria will be suggested to improve diagnostic capacity.

39. THE CONCEPT OF THE NEW PERIMETER PERISTAR

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The new perimeter Peristar has only one flexible program. A basic test point pattern is chosen from several standard patterns. Combinations of patterns and user-defined patterns are also possible. Moreover, a basic accuracy level can be chosen from 3 levels. At any moment of the test or after the test, points can be added and/or the accuracy level can be elevated. Using all information of the prior testing, no time is lost by a late decision.

The measurement procedure is a full threshold bracketing using the very quick "dynamic strategy". Thus, a glaucoma test with 81 points lasts only 7 minutes.

40. "LECTRIKON PCL 90": A NEW AUTOMATIC PERIMETER

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A new automated perimeter has been recently developed by the "Lectrikon" firm under the supervision of the perimetric study group of the Genova University Eye Clinic. The perimeter, called "PCL 90", has the following main characteristics: projected stimuli (with optimized calibration of surface and shape); static, kinetic and mixed strategies; great possibilities for adopting standard and non-standard parameters for stimuli, background and strategies (photopic and mesopic tests, color perimetry, flicker, etc.); large menu of screening and diagnostic programs; hard disk memory for storage and comparison of results; automated fixation control based on an optimized television system.

Preliminary remarks on the clinical use of the "PCL 90" are reported and discussed in comparison with the other main automated perimeters.

41. A COMPUTER PROGRAM FOR MEASURING THE BLIND SPOT BY MEANS OF THE OCTOPUS 2000 R UNIT

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An attempt is made to develop a computer program for assessing the blind spot boundary. A single-level strategy is used, and the intensity of light stimuli is set at 12 dB below mean normal age-corrected values of the threshold in locations surrounding the blind spot area. This intensity was chosen in order to (1) avoid angioscotomas, (2) prevent falsifying effects of stray light, and (3) be sensitive to slight changes in blind spot surface. A regular grid constant of 1° horizontally and 1.5° vertically was selected. Before elaborating a spatially adaptive strategy to further shorten duration of the examination, the clinical value of the chosen light stimuli and location grid was evaluated on 20 normal subjects (40 eyes), and in 1 case of mild papilledema. In normals, reproducibility of surface measurement was found to be satisfactory. Mean surface difference between two successive examinations of the same eye was 13.43% of the mean blind spot surface, in spite of the fact that an important fluctuation in differential light threshold could be observed. Interindividual variability also proved minimal, more than 98% of normal average blind spot diameter ranging from 3.32° to 5.94°. This did not prevent the procedure from being sensitive enough to detect relevant visual field changes resulting from mild papilledema,

42. MULTIPLE STIMULUS BOWL PERIMETRY USING A FOUR BUTTON, QUADRANT-RELATED PATIENT RESPONSE SYSTEM

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Traditional 30° static full-thresholding perimetry (eg. Humphrey, Octopus) is frequently confounded by false-positive and -negative responses which can obscure pathology or produce pseudoscotomata. Such methods allow only a +/- response to a single stimulus and can take 15 minutes per eye in normal subjects. Multiple-stimulus perimetry (MSP) reduces testing time and encourages central fixation by presenting patterns of 2 to 4 concentrically arranged stimuli. Since the subject response is a forced choice, false responses occur infrequently. Existing MSP devices (eg. Henson CFS3000 and Vismed Dicon TKS 4000) use a verbal response method. Missed stimuli are identified by a process of elimination, which can add substantially to testing time. This problem can be eliminated by allowing the patient to electronically designate which points are seen in each pattern. A new automated MSP system has been developed for the Marco MT336 LED bowl perimeter using a four button response system, one button for each of 4 quadrants delineated by fine lines on the perimeter face. An audible warning before presentation of each pattern maximizes patient attention level. The average mid-field threshold is established at 15° eccentricity. Then, assuming a slope of 1 dB per 5° to the hill of vision, thresholds are automatically calculated for all locations. A 73 point field within 30° is tested at 3 incremental light intensities (4, 8 and 12 dB) suprathreshold. Background illumination is 31.5 asb. Mean testing time for normal subjects is 4 min/eye. Data comparing the Humphrey 30-2 and Marco MT336 fields will be presented.

43. AUTOMATED PERIPHERAL PERIMETRY: KINETIC VS SUPRATHRESHOLD STATIC STRATEGIES

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One-hundred consecutive glaucoma suspect or glaucoma patients were tested in one eye with the Humphrey Field Analyzer using the suprathreshold peripheral 68 screening program, a peripheral custom kinetic program, and central 30-2 threshold program.

Each set of peripheral tests was graded separately by the two authors using previously assigned criteria for visual field defects which incorporated two levels of diagnostic confidence. Next, the paired tests were compared to one another and evaluated for concordance or discordance. Finally, the peripheral tests were compared to the central 30° threshold test looking for peripheral confirmation of defects on central testing.

Both peripheral strategies appeared to be comparable in demonstrating peripheral defects. Less time was required to perform the suprathreshold screen than to complete two kinetic isopters. Isopters created with the I-2-e target were too variable to be of diagnostic usefulness in this patient population; however, a single I-4-e kinetic isopter proved to be a quick and useful screen of the peripheral field.

44. EVALUATION OF AUTOMATED KINETIC PERIMETRY WITH THE HUMPHREY FIELD ANALYZER

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1 Glaucoma Associates of Texas, 2 Retina Foundation of the Southwest Dallas, Texas, USA

Kinetic visual field testing typically requires an experienced kinetic perimetrist. Recently, Allergan Humphrey has provided software which allows the Humphrey Field Analyzer to perform kinetic perimetry.

We compared visual fields obtained by inexperienced kinetic technicians with the Humphrey Field Analyzer and visual fields obtained by a highly experienced kinetic perimetrist with a Goldmann perimeter. Patients with glaucoma or suspected glaucoma were tested on both systems, with no more than 1 month between fields. Optimization methods were used for automated perimetry, including use of static visual field data for determining stimulus intensity and placement in plotting kinetic scotomas.

Differences in location of isopters as well as areas and shapes of scotomas were noted and quantified. We will discuss strengths and weaknesses of the Humphrey kinetic testing system, as employed by inexperienced kinetic technicians, and will provide recommendations for improving the system.

45. THE SIGNIFICANCE OF THE PERIPHERAL VISUAL FIELD IN DETECTING EARLY VISUAL FIELD CHANGES IN GLAUCOMA

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Program G1 has become the most frequently used program on the Octopus automated perimeter. It only measurers within 26 degrees. We wanted to know whether you do not miss peripheral defects of glaucoma patients with program G1.

We tested 77 patients with either glaucoma or ocular hypertension with program G1 and a Sargon Program designed for the quantitative testing of the peripheral visual field. We found that 12 % of the patients tested had an abnormal peripheral visual field but a normal G1. On the other hand, only 1 % had an abnormal G1 but a normal periphery. Most frequently defects were located in the superior and nasal periphery. We believe that it is necessary to test the peripheral visual field in patients having ocular hypertension and a normal G1.

46. STATOKINETIC DISSOCIATION IN GLAUCOMATOUS PERIPHERAL VISUAL FIELD DAMAGE

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In this study, we tested the peripheral nasal visual field of 20 eyes with early glaucoma by static and kinetic perimetry. Octopus program 41 was employed for static perimetry and the Goldmann perimeter for kinetic testing. Goldmann isopters were expressed in decibels. Difference of sensitivity between two test points across the horizontal median was calculated and the Octopus and Goldmann results were compared in each eye.

Octopus static perimetry was more sensitive in detecting early damage. However, in some cases with more advanced damage, Goldmann kinetic perimetry demonstrated field defects more clearly. From these results, the usefulness of static and kinetic perimetry and the presence of statokinetic dissociations in testing glaucomatous peripheral visual field will be discussed.

47. INFLUENCE OF LEARNING ON THE PERIPHERAL FIELD AS ASSESSED BY AUTOMATED PERIMETRY

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The effect of learning on the peripheral field following repeated automated perimetry was investigated in 12 eyes of 12 normal subjects with no previous experience of automated perimetry. Peripheral full threshold fields were obtained using the peripheral 30/60-2 program of the Humphrey Field Analyzer. Each subject attended for five sessions, at least one week apart and one field was plotted at each session.

Following a division of the field into sectors analysis will be presented using a three way crossed layout with factors of time, sector and eye under test.

48. CORRELATION OF RELIABILITY INDICES AND TEST-RETEST REPRODUCIBILITY IN NORMAL SUBJECTS UNDERGOING AUTOMATED PERIMETRY ON THE HUMPHREY VISUAL FIELD ANALYZER

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Thirty-five ocularly normal subjects ranging in age from 24 to 65 were tested using program 24-2 on the Humphrey Field Analyzer. Each subject underwent three examinations within six weeks. The proportion of fixation losses, false positive responses and false negative responses on the first examination were each correlated with the variation of the Mean Deviation over the three examinations.

The large majority of the subjects had very good reliability indices. There was no correlation demonstrated in this sample between any of the reliability indices on the first examination and the test-retest reproducibility.

49. IS THE VARIABILITY IN GLAUCOMATOUS FIELD LOSS DUE TO POOR FIXATION CONTROL?

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It is well established that glaucomatous eyes have large amounts of variability in their visual field defects. A typical glaucomatous defect has steep threshold gradients which, in the presence of fixation errors, will produce highly variable threshold measures. A similar effect will be apparent at the blind spot of normal patients.

An analysis of glaucomatous fields reveals a linear relationship between scotoma variability and the number of steep threshold gradients. An analysis of blind spot variability in normal patients gives a similar relationship.

These findings are consistent with the hypothesis that variability is largely the result of fixation errors and that the apparent increase in glaucomatous eyes is the result of an increase in the number of steep threshold gradients within the visual field.

50. AN INVESTIGATION INTO THE BLACKHOLE EFFECT IN AUTOPERIMETRY

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In this study we compared the Dicon AP2000 with the Topcon SBP1000 autoperimeters. The Goldmann was used as a control. The Dicon uses uncovered LEDs which are not illuminated between stimulus presentations. The Topcon differs in that all LEDs are illuminated at background intensity.

Twenty normal subjects were assessed. The increment threshold values were standardised for comparison. Although a blackhole effect in the order of 0.2 LU was found with the Dicon, there was a 0.7 LU discrepancy detected on the Topcon. These somewhat unexpected findings are discussed with reference to retinal adaptation phenomena.

51. THE MODE OF PROGRESSION OF ISOLATED SCOTOMAS IN GLAUCOMA

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We studied the mode of progression of isolated scotomas in 32 eyes with early glaucoma. Isolated scotomas in Octopus program 31 were divided into two groups according to the location and distance relative to the course of the retinal nerve fiber layer. During followup these cases with scotomas were defined as progressive by the Octopus Delta program. The direction of the progression in the nerve fiber pathway was determined by analyzing statistically the 8 points in the program 31 test point grid, which surrounded the isolated scotoma.

Isolated scotomas located in the nasal visual field tended to progress towards the blind spot.

On the basis of these results the mode of progression of isolated scotomas in glaucoma will be discussed.

52. THE PROGRESSION MODE OF VISUAL FIELD DEFECTS IN LOW-TENSION GLAUCOMA

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Several authors have reported statistically significant differences in the visual field defects of low-tension glaucoma (LTG) and primary open-angle glaucoma (POAG). Progression of visual field defects in LTG over long periods of time has not been well described.

The authors assessed the progression of visual field defects by retrospective case review of 106 eyes of 61 patients with LTG. Visual fields were tested with an Octopus 201 perimeter and/or a Goldmann perimeter.Patients were divided into two groups: 43 eyes (41%) with progression at 3 years, and 63 eyes (59%) without progression.

In the group which showed progression, a dense scotoma close to fixation up to 10° was more common ($p<0.05$), and level of change in IOP and maximum of IOP were significantly higher ($p<0.01$).

The authors suspect that in the progression of LTG, some etiologic factors may differ from those of POAG.

53. THE INFLUENCE OF BROVINCAMINE FUMARATE IN LOW TENSION GLAUCOMA

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The authors reported that based on studies of the three dimensional visual field, the visual field defect in LTG differs from that in POAG, which agrees with results of studies investigating other parameters. If the etiology of the visual function loss in LTG is due to poor circulation in the optic disc, drugs improving circulation would theoretically prevent the impairment of the visual field. Brovincamine fumarate (Sabromine® 60 mg/day), which is a calcium antagonist and an inhibitor of platelet aggregation, was given to LTG patients. The effects were analyzed based on visual field, fluorescein angiography, platelet aggregation, blood pressure, pulse rate and IOP. The platelet aggregation was inhibited in all cases, and the circulation of the optic disc improved in some cases. The fact that almost no further deterioration of the visual field was observed suggested that long-term medication of Brovincamine fumarate might play a role in halting visual field deterioration in LTG.

54. THE EFFECT OF HEAD TILT ON FIXATION MONITORING OF THE HUMPHREY PERIMETER

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Fixation losses, assumed to represent interruption in normal fixation pattern, are accepted as a reliability criterion for the standard quantitative automated static perimetry on the Humphrey apparatus. Significant numbers of fixation losses may occur in the absence of eye movements (technician monitoring). Attempting to assess possible contribution of mild head tilt to generation of fixation losses, ten normal volunteers were tested with a custom-designed two-degree grid program extending from 10-20° temporally and from 4° above to 6° below the temporal horizontal midline. All subjects' baselines were established allowing for true location of blind spot. Subjects were retested with moderate left and right head tilt. Left tilt averaged 11.5°·, ranging between 6 and 16°; right tilt averaged 12.5°, ranging between 10 and 15°. Subjects were retested with milder degrees of right (averaging 6.8°) and left (averaging 5.2°) tilt. Initially, the perimeter identified the blind spot once before the tilted position was assumed. All subjects demonstrated fixation losses of < 20% during their baseline run. With moderate right head tilt 6 of 10 subjects developed fixation losses of >33%; to the left only 3 of 10 maintained reasonable fixation losses. With mild right head tilt 4 of 10 developed unacceptable fixation losses, but with mild left head tilt only 1 of 10 subjects developed fixation losses out of the acceptable range. The difference between left and right probably relates to the default position of fixation monitoring (1° below, 15° temporally). Small to moderate degrees of head tilt may be responsible for high fixation losses in the presence of excellently maintained fixation and otherwise good reliability criteria. An automatic interrupt or message mode to recheck head position or replot the blind spot should prevent this from potentially questioning field reliability.

55. THE RELATIONSHIP BETWEEN BACKWARD AND FORWARD INTRAOCULAR LIGHT SCATTER

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The effect of media opacities on the outcome of automated perimetry has been evaluated in various studies. It is generally accepted that cataract leads to an increase in intra-ocular light scatter (I.O.L.S.), with forward I.O.L.S. causing image degradation. Both backward and forward I.O.L.S. assessments have been correlated with the deleterious effects of cataract on the visual field and the assumption made that backward and forward I.O.L.S. are directly related. We assessed the relationship on a sample of 33 patients (mean age 63.8 yrs: SD 19.1 yrs) with varying degrees of media opacification. Backward light scatter was assessed using the Opacity Lensmeter 701, and forward light scatter by measuring the depression of contrast sensitivity under conditions of both narrow and wide angle glare light. A good correlation was found between backward and forward I.O.L.S., except in cases of posterior sub-capsular opacities, where assessment of backward I.O.L.S. underestimated the disability experienced by the patient as assessed by forward I.O.L.S. measurements. The relationship was less precise in cases of nuclear opacities due to the greater effects of absorption.

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Please, load your slides at least 30 minutes before the start of your session. A speaker ready room is situated close to the projectionist room on the second floor

INSTRUCTIONS FOR POSTERS

There will be two poster discussion sessions on Wednesday June 20. A 5 x 5 cm slide with title and author should be prepared for the left projector, and a summary slide of the main point(s) for the right projector. A maximum of 30 seconds for author comment has been allotted; the rest of the time is for audience discussion.

The poster mounting boards measure 88 cm wide by 118 cm high. Authors should bring push-pins or thumb tacks for mounting of the poster. The top of the poster should indicate title and authors. The lettering of this section should not be less than 2.0 cm in height for title and 1.0 cm for authors. Illustrations and text should be readable at a distance of 1 meter or more.

Posters should be mounted on Sunday June 17th between 12.00 noon and 6.00 PM and stay up during the whole meeting. The location for each poster is clear from the list of poster locations on page 27. Each poster and poster board is numbered; see poster sessions and poster abstracts for the number of your poster.

LIST OF EXHIBITORS

Alcon International
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Allergan Humphrey
3081 Teagarden Street
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INDEX OF AUTHORS

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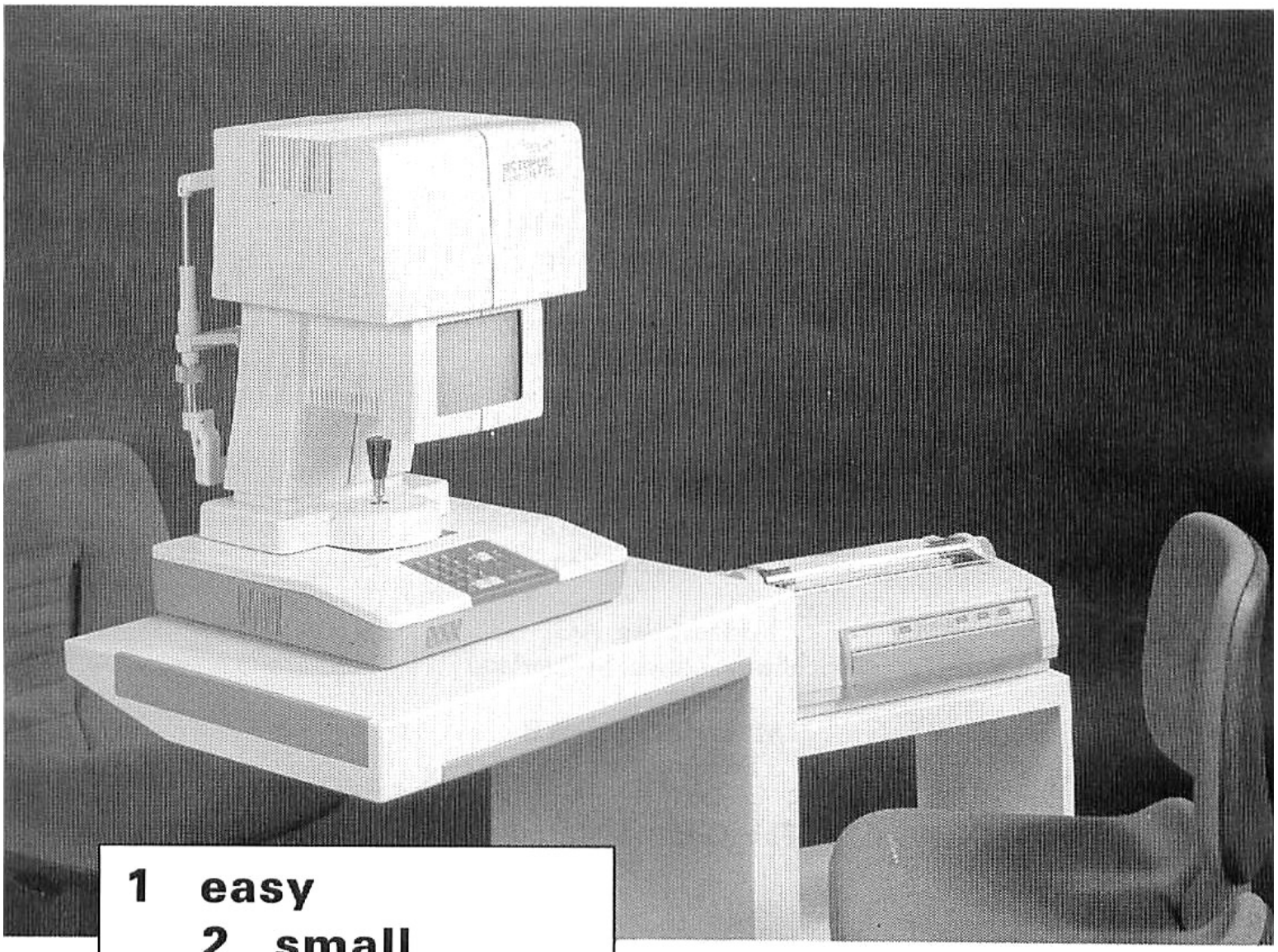

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