CJO 48(1) 1-64, 1986
ISSN 0045-5075

The Canadian Journal of Optometry

La Revue Canadienne d'Optométrie

VOL. 48 NO. 1

MARCH/MARS 1986

PLASTIC UPDATE

SUPERCOTE 99

The Space-Age, No-Glare Lens Coating

Now, even with the strongest prescription, your customers will have a choice of fashionable, attractive eyewear that simply wasn't available before.

SUPERCOTE 99 is a broadband multi-layer coating with four layers on each side of the lens, unlike many competitors which only use two. SUPERCOTE 99 is guaranteed for life and its lab turn around time is fast.

There is no longer a reason for any glass lens to be sold without SUPERCOTE 99. Your customers will feel they have their prescription without a lens. Once your customers have had their glasses coated with SUPERCOTE 99, they will just not be satisfied with regular lenses when the time comes to purchase again.

Fashion eyewear, Better eyecare
and in the final analysis that's what will really sell.

IMPERIAL OPTICAL CANADA

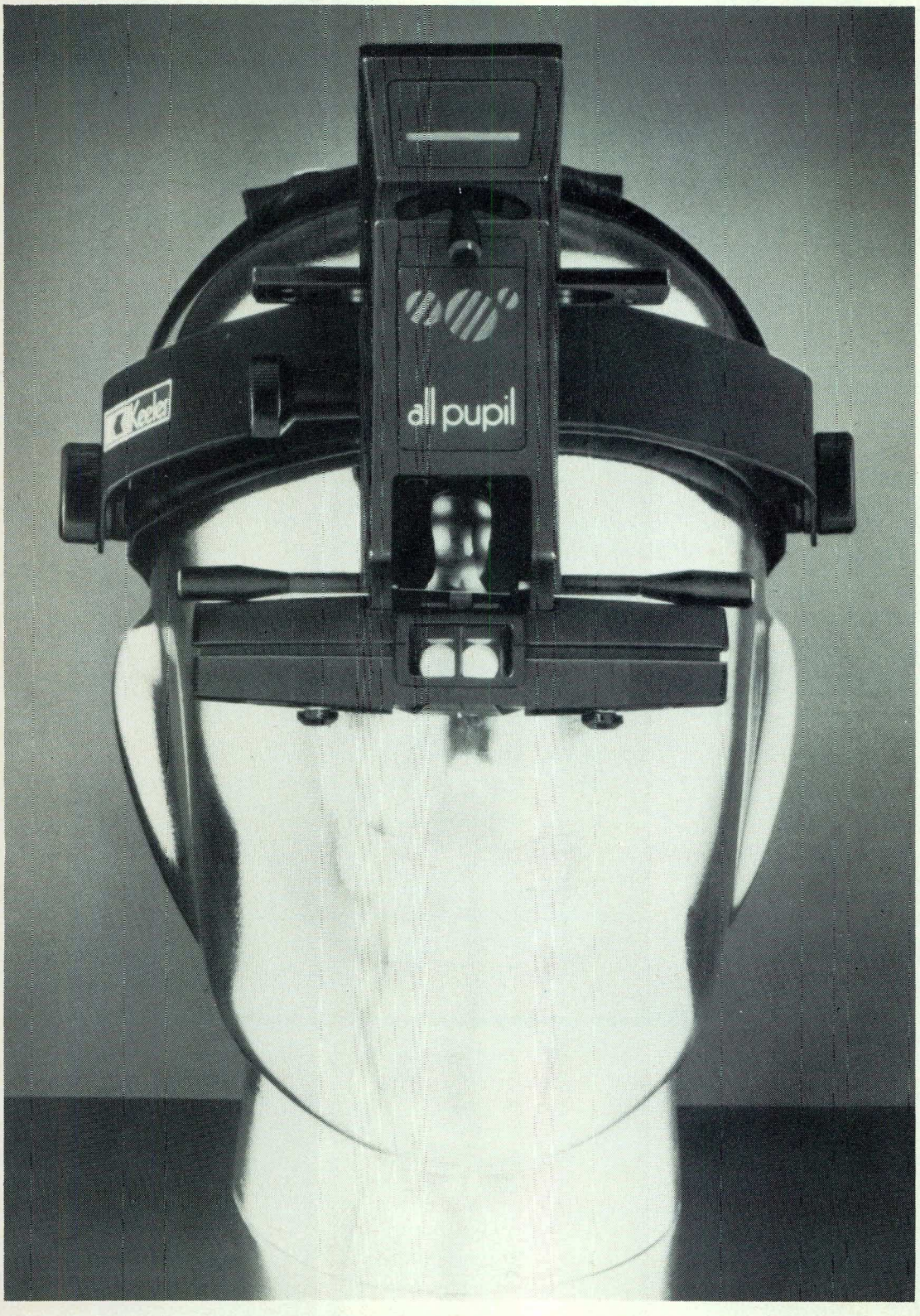
SUPERCOTE 99
For Plastic Lenses
Available Summer 1986

UNCOATED LENS

SUPERCOTE 99 LENS

IMPERIAL OPTICAL CANADA
introduces

The Keeler All Pupil Indirect...



Any Pupil Anywhere Everytime!

Keeler's lightest, coolest headband indirect ever! Keeler Instruments has combined new technology and innovative design to bring you an indirect which is lighter and more comfortable.

ANY PUPIL!
A single action lever lets you view the retina clearly and easily through any pupil down to 1mm diameter. More importantly the retinal image is not compromised by a small pupil! You get the same clear detailed image you have come to expect from a dilated pupil with ANY PUPIL!

ANYWHERE!
Take the All Pupil to the patient. An optional battery pack clips to your belt and you can perform indirect ophthalmoscopy in the office, clinic or hospital.
ANYWHERE!

EVERYTIME!
Every indirect ophthalmic exam is easier. Halogen illumination provides you with a briliant round homogeneous patch of light with no annoying artifacts! Every exam! Every diagnosis is easier.
EVERYTIME!

IMPERIAL OPTICAL CANADA

CONTENTS

Canada Post Postage paid / Postes Canada Port payé
Second Class Mail Registration Number 5807 / Courrier de deuxième classe
Return Postage Guaranteed

Canadian Journal of Optometry

Editor in Chief
Dr. G.M. Belanger

Managing Editor
Dr. Roland des Groseilliers

Business Manager
Mr. Michael J. DiCola

The CJO is a quarterly publication with offices in Ottawa at the Canadian Association of Optometrists, Ste. 207-77 Metcalfe St., Ottawa, Ontario K1P 5L6. Telephone (613) 238-2006.

Layout, Design,
Typesetting and Printing:
Love Printing Service Ltd.

COVER

Cover photograph reprinted by permission and courtesy of Carl Zeiss (Canada) Ltd.

Special Features

Articles

Features

SPECIAL INTRODUCTORY OFFER
from L. & R. MEDICAL INC.

Canon

puts you into the 21st century

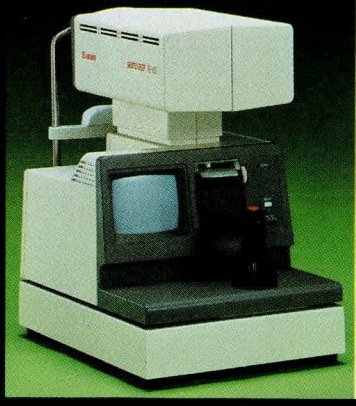
SPECIAL $1,550 REBATE

New! The Canon CR3-45 NM Nonmydriatic Retinal Camera

- ☑ Monitor display of retina
- ☑ 45° Retinal imaging
- ☑ Unique "blink-sensor" detector
- ☑ Easy focusing and alignment
- ☑ High resolution photography

AFTER REBATE **$14,950**

SPECIAL $1,000 REBATE



The Canon High Performance Refractometer

- ☑ Instantaneous measurement 0.05 sec
- ☑ High Accuracy ±0.25D
- ☑ Reliability
- ☑ Over refraction

AFTER REBATE **$11,200**

SPECIAL $1,000 REBATE

Introducing The Auto Keratometer K1 The Ultimate in Keratometers

- ☑ Accurate and immediate measurements
- ☑ Contact lens holder
- ☑ Peripheral measurements
- ☑ Mire image display

AFTER REBATE **$11,200**

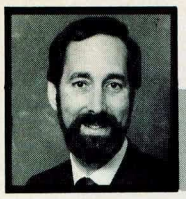
Limited offer only
All items carry a one year warranty
Prices include F.S.T.

For further information call collect

MEDICAL

L. & R. MEDICAL INC.

2888 Bathurst Street • Toronto, Ontario, Canada M6B 4H6
Telephone: (416) 789-9366 Telex: 06-986766TOR



PRESIDENT'S PODIUM

Total Vision Care?

The issue of total vision care is being addressed by many groups across Canada. I feel it's time some of the misconceptions about this unique optometric service were clarified.

First, what is it? "Total vision care" is a comprehensive examination, a visual needs assessment, therapy modality assessment and, finally, treatment and follow-up procedures.

Each part of this total vision care package is dependent on the others for the maximum effectiveness in meeting the vision care needs of the public. Only one profession — Optometry — has the education and expertise to carry out this complete program effectively.

An eye examination is a very broad procedure. It encompasses an oculo-visual assessment whereby not only the patient's eye health is examined, but also the systemic health since the eye is "the window to the body". When pathology is detected, as it is in under 5 percent of cases, then, only at this point will the patient be referred to the appropriate medical practitioner for treatment before optometric care can resume. In the majority of cases, specific tests are then conducted to determine refractive error, muscle balance, focussing ability, visual perceptual abilities, visual acuity, etc.

Taking into account the optometric findings and relating them to the patient's visual environmental needs, the various treatment possibilities are then discussed. Spectacles, contact lenses, low vision aids, environmental adjustments and vision training are just some of the modalities that are considered. To be able to do this most effectively, it is extremely important that the practitioner be well trained, not only in the health sciences, but also that he/she have a good working knowledge of ophthalmic and physiological optics, optical materials, ergonomics and environmental specifications. This has the effect of taking vision and eye care out of the Doctor's examining room and into the outside visual world. Thus, the optometrist is not only an eye specialist, but also (and more importantly) a functional vision specialist.

The consideration of "total vision care" does not end here. In fact, this is but a turning point. The most extensive eye examination in the world is wasted if the treatment is not executed properly and if there is no follow-up to assess effectiveness. Here again, the optometrist excels. In the optometric practice, spectacles and contact lenses are considered treatment modalities, not highly commercialized consumer products. There is, however, cause for concern that commercialized pressure on the "prices" of ophthalmic products will lead to a compromise in the quality of the product and, as a result, the quality of care. Spectacles, contact lenses and other prescription products are only means to the end and it is the manner in which the product is chosen, managed, delivered and serviced which will determine the effectiveness of proper vision care.

Which system, then, "delivers the goods" — that of the optometrist, the total care practitioner, or the ophthalmologist/dispensing optician divided system?

Ophthalmologists spend some 85 percent of their extensive training on diagnosis and treatment — whether it be surgical or pharmacological — of eye diseases. Within this narrow scope, they are unquestionably the specialists. Ethics and quality care are stressed in their training and practice. A breakdown, however, occurs when the ophthalmologist writes a prescription.

For diseased eyes, the prescription goes to a university-trained pharmacist and the patient returns to the Doctor for final assessment of the effectiveness and management of the prescribed treatment. But, for healthy eyes, which need neutralizing lenses, the prescription goes to the dispensing optician (ophthalmic dispenser) who likely has a training background based around a two-year correspondence course

Les soins complets de la vue

Plusieurs groupes, partout au Canada, parlent des soins complets de la vue. Je crois qu'il est temps d'écarter certaines fausses notions au sujet de ce service optométrique unique.

D'abord, de quoi s'agit-il? "Les soins complets de la vue" consistent en un examen complet, une évaluation des besoins visuels, une évaluation des modalités thérapeutiques et enfin, le traitement et le suivi.

Les éléments de cet ensemble de soins de la vision sont interdépendants, de sorte qu'il soit possible de satisfaire aux besoins de soins de la vision du public de la manière la plus efficace possible. Une seule profession, l'optométrie, possède les qualifications et l'expertise nécessaire pour réaliser ce programme global de manière efficace.

L'examen des yeux constitue une démarche très élaborée. Cela comprend l'évaluation oculaire et visuelle, où l'on examine non seulement la santé de l'oeil du patient, mais aussi son état de santé général, étant donné que l'oeil est une fenêtre ouverte sur le corps. Ce n'est que lorsqu'une maladie est décelée, c'est-à-dire dans moins de 5 % des cas, que le patient est acheminé au spécialiste médical approprié, de sorte qu'il puisse être traité avant que ne reprennent les soins optométriques. Dans la plupart des cas, on procède à des tests précis pour déterminer l'erreur de refraction, l'équilibre musculaire, le potentiel d'accomodation, l'aptitude à la perception visuelle, l'acuité visuelle etc.

On peut ensuite aborder les différentes possibilités de traitement, compte tenu des constatations de l'examen optométrique, mises en rapport avec les besoins visuels imposés par l'environnement du patient. Parmi ces possibilités de traitement, il faut compter les lunettes, les verres de contact, les aides à la basse vision, l'adaptation environnementale et la thérapie oculaire. Pour que cette phase des soins soit efficace, il est extrêmement important que le praticien soit non seulement bien formé en sciences de la santé, mais qu'il ait une bonne connaissance pratique de l'ophtalmique, de l'optique physiologique, des matériaux optiques, de l'ergonomie et des spécifications environnementales. C'est ainsi que les soins de la vision et des yeux quittent la salle d'examen du médecin et entrent dans le domaine visuel extérieur. L'optométriste n'est donc pas seulement un spécialiste des yeux, mais aussi (et c'est plus important) un spécialiste fonctionnel de la vision.

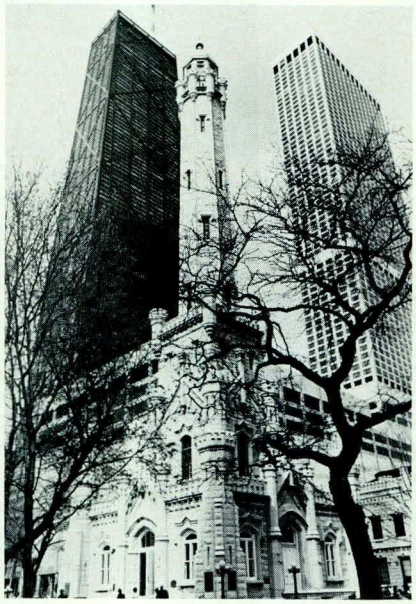
La question des soins complets de la vision ne se termine pas ici. En réalité, il ne s'agit que d'un point tournant. L'examen optométrique le plus complet sera inutile si le traitement n'est pas effectué correctement et s'il n'y a pas de suivi pour détermier son efficacité. Voilà encore un domaine où excelle l'optométriste. Dans la pratique de l'optométrie, les lunettes et verres de contact sont considérés comme des modes de traitement, non pas comme des produits de consommation hautement commercialisés. Il y a cependant lieu de s'inquiéter du fait que les pressions commerciales exercées sur les "prix" des produits ophtalmiques finiront pas compromettre la qualité du produit et, partant, celle des soins. Les lunettes, les verres de contact et les autres produits obtenus par ordonnance sont un moyen d'atteindre un but : c'est la manière dont le produit est choisi, administré, livré et entretenu qui déterminera l'efficacité d'un bon programme de soin de la vision.

Quel programme, donc, "donnera le meilleur service" — Celui de l'optométriste, le practicien des soins des soins complets, ou le système combiné ophtalmologiste/opticien d'ordonnance?

Les ophtalmologistes passent environ 85 % de leur formation fort élaborée à étudier le diagnostic et le traitement des maladies des yeux — que ce soit le traitement chirurgical ou

Plan Now for Midwest!

OptiFair® Midwest 86



Seminars: June 12-15, 1986
Exhibits: June 13-15, 1986
O'Hare Expo Center
Chicago

Seminar program expands
Choose from 250 seminars offering 380 practice-enhancing hours. Over 30 courses offer transcript quality credit.

Exhibition expands
This year's exhibit hall is 33% larger — bringing you almost 75,000 square feet of exciting, educational exhibits.

New special events
The International Society of Holistic Optometry is sponsoring a nutrition group gathering, and Insight is hosting a special meeting for vision assistants.

OptiFair Midwest '86 is sponsored by Advisory Enterprises, publishers of Insight, Ophthalmology Management, Contact Lens Forum and Optometric Management, and professionally managed by CMC (Conference Management Corporation).

For more information, call Georgene at (203) 852-0500, or telex 284997.

OptiFair® Midwest 86

Seminars: June 12-15, 1986
Exhibits: June 13-15, 1986
O'Hare Expo Center
Chicago

☐ Yes, please send me a free copy of *OptiFair News*, containing complete information on OptiFair Midwest '86 seminars, exhibits and special events.

☐ Please send me _____ free exhibition admission tickets. (quantity)

NAME _____

TITLE _____

COMPANY _____

STREET ADDRESS _____

CITY/STATE/ZIP _____

PHONE _____

OCJ6

Mail to: OptiFair Midwest '86
17 Washington Street, Box 4990
Norwalk CT 06856-4990

emanating from a trade school. The course, and apprenticeship program, may be heavily controlled by large, commercialized corporations. The prescription, whether for spectacles or contact lenses, is then filled and the patient is *not* returned to the prescribing ophthalmologist for a final assessment. Imagine. A contact lens or spectacle lens is matched directly to one of the body's most sensitive and important structures *without the direct supervision* of the Doctor who arranged the "match" in the first place!

This is where a breakdown of the total vision care system occurs.

Doctors of Optometry, with professional, university based training in anatomy, physiology and pathology, combined with a strong base in ophthalmic optics, materials and functional vision, bring a truly unique and comprehensive service to the public. The joining of all these services into one profession, Optometry, which takes the patient from eye examination through dispensing of the final optical aid to follow-up and assessment is definitely in the patient's best interests. This is total vision care.

Bruce N. Rosner, OD
President, CAO

pharmacologique. Ce sont eux qui, sans conteste, sont les spécialistes à l'intérieur de cet étroit domaine. Dans leur formation et dans leur pratique, ils portent l'accent sur l'éthique et la qualité des soins. Les problèmes commencent lorsque l'ophtalmologiste prépare une ordonnance.

Dans le cas des maladies des yeux, l'ordonnance est acheminé à un pharmacien diplômé de l'université et le patient revient chez le docteur pour une dernière évaluation de l'efficacité et de l'administration du traitement prescrit. Cependant, dans le cas des yeux en santé pour lesquels un verre correcteur est indiqué, l'ordonnance est envoyée à un opticien d'ordonnance, (fournisseur ophtalmique) dont la formation est axée sur un cours de correspondance de deux ans dispensé par une école technique. Le cours et le programme d'apprentissage peuvent être largement contrôlés par de grandes sociétés commerciales. L'ordonnance, qu'il s'agisse de lunettes ou de verres de retourner est alors remplie et le patient n'est *pas* tenu de contact, chez l'ophtalmologiste ayant établi cette ordonnance pour une évaluation finale. Quelle histoire! On adapte une lentille cornéenne ou une lunette directement à l'un des organes les plus directe du médecin qui l'a prescrite!

Et c'est la faiblesse du système des soins complets de a vision.

Les docteurs en optométrie, qui ont une formation professionnelle et universitaire en anatomie, en physiologie et en pathologie, ainsi qu'une excellente base dans le domaine de l'optique opthalmique, des matériaux et de la vision fonctionnelle, sont en mesure d'assurer au public un service unique et complet. La conjugaison de tous ces services à l'intérieur d'une même profession, l'optométrie, qui traite le patient à partir de l'examen de la vision jusqu'au suivi et à l'évaluation, en passant par la prestation de l'aide optique, est définitivement au grand avantage du patient. Voilà ce que sont les soins complets de la vision.

Bruce Rosner, OD
Président, ACO

CAO COMMUNIQUÉ

Editor's Note

This section of *The Canadian Journal of Optometry* is a selection of exerpts, highlights and précis of material which has appeared in *The CAO Communiqué.*

***Communiqué* is a national Bulletin issued by the Ottawa administrative office of the Canadian Association of Optometrists. It is circulated, approximately once every two months, to current members of provincial optometric Association and Society Councils, both Canadian Schools of Optometry and the past national Presidents of CAO.**

The opinions quoted in the items which appear here are not necessarily those of either the Canadian Journal of Optometry or the Canadian Association of Optometrists.

CAO members interested in following up on any of the items which appear in this section are invited to contact directly their provincial CAO Councillor.

Cette section de la *Revue Canadienne d'Optométrie* est consacrée à une sélection d'extraits, de points saillants et de résumés des titres ayant paru dans le *Communiqué.*

Le *Communiqué* est un bulletin national provenant du bureau national de l'Association canadienne des optométristes à Ottawa. Il est diffusé, environ tous les deux mois, aux personnes couramment membres des conseils des associations et sociétés d'optométrie des provinces, aux deux écoles d'optométrie du Canada et aux anciens présidents nationaux de l'ACO.

Les opinions exprimées dans les articles reproduits ici ne sont pas nécessairement partagées par la Revue Canadienne d'Optométrie, ni par l'Association canadienne des optométristes.

Les membres de l'ACO qui désirent approfondir les sujets traités dans cette section sont priés de communiquer directement avec leur conseiller provincial de l'ACO.

AOA Publishes Position on Vision Therapy

The American Optometric Association has published its official position on vision therapy. In a statement released to their members in October of last year via the *Journal of the AOA*, the Association affirmed "its long standing position that vision therapy is an effective therapeutic modality in the treatment of physiological dysfunctions of the vision system."

The two-page statement, a complete copy of which ran in the December *Communiqué*, goes on to define vision and VT (vision therapy/visual training); addresses the question, "Who can benefit?"; describes the relationship between vision and learning; outlines the education of the optometrist and the ongoing optometric research program and, finally, summarises the AOA's position as follows:

"The American Optometric Association continues to support quality optometric care, education and research in the area of vision therapy. AOA also will continue to cooperate with all disciplines involved in helping individuals attain the highest quality of life in which vision plays such an important part."

US OD Finds No Evidence Linking VDTs, Radiation Harm

"There is no evidence that harmful radiation is emitted by Video Display Terminals."

That is the central finding of a paper by Dr. James P. Comerford (PhD, OD), Associate Professor of Physiological Optics at the New England College of Optometry.

Entitled "Environmental Sources of Patient Problems with Video Display Terminals", Dr. Comerford's paper theorizes that patient complaints about VDTs may be visual in origin, but very often are caused by poor workplace design and related ergonomic factors.

"An optometrist," concludes Dr. Comerford, "has a dual role in managing the patient with problems working with video display terminals. One role is correcting the refractive, binocular and optical sources of the patient's problems. The other role is to advise the patient and where possible the patient's employee regarding the environmental influences that will result in discomfort."

Dr. Comerford's paper appears in Vol. 35, No. 6 of *The New England Journal of Optometry*.

We're Number Five!

A survey published recently by the Economic Council of Canada (ECC) ranks optometrists fifth out of 500 occupations in terms of social standing.

Canadians surveyed were given 88 general occupations to rank. In analysing the data, two York University sociologists were able to extrapolate a list totalling 500 occupations in Canada.

The survey's "prestige ranking" perception among Canadians was produced based largely on income and the educational qualifications of the people in the occupation. In general, the higher the income and the higher the educational attainment, the more prestigious the occupation was perceived to be.

The top ten, according to the ECC? (1) Administrators in teaching and related fields; (2) Nuclear Engineers; (3) Dentists; (4) Managers in Science and Engineering; (5) Optometrists; (6) Physicians; (7) Veterinarians; (8) Meteorologists; (9) Lawyers and Notaries and (10) University teachers. The list continues all the way to (500) Hunters and trappers.

At Least "Doctor", "OD" and "Optometrist" are Equally Applicable to Male or Female

In a recent report entitled *The Economic Needs of Women in the Labour Market*, the Economic Council of Canada (ECC) recommends, among other things, closing the pay gap between men and women for the same work; full tax deductions for child

care expenses (to replace the process of direct government aid for daycare centres) and making mathematics and the sciences compulsory courses through high school to enable more women to move into post-secondary fields traditionally dominated by men.

An examination of the current enrollment statistics at both Canadian Schools of Optometry reveals that, given that more than half the new students of Optometry are women, in a few years it may well be the *male* applicants who are demanding equal consideration for the places in the program.

Information, or a copy of the Report, is available from the ECC, Publications Section, Information Division, PO Box 527, Ottawa, Ontario, K1P 5V6.

Information "BOUM" at Montreal School

"BOUM", the Bulletin d'Optométrie de l'Université de Montréal, is a thoroughly informative newsletter put out by the AEOUM (Association des Etudiants en Optométrie de l'Université de Montréal).

As part of a renewed program of liaison with the Student Associations at both Canadian Schools of Optometry, CAO recently advised the respective Presidents that the *Canadian Journal of Optometry* will now be sent on a complimentary basis to all students registered in Optometry in Canada.

As a result, the AEOUM responded by including CAO on its list of recipients for BOUM. An extremely well-written publication, BOUM deals with optometric student politics, clinical studies and vision and eye care research, all from the perspective of the optometric student. Although presented in a photocopied, rather than a press, format, BOUM's research-oriented content is excellent and well-referenced.

In addition, the publication is punctuated with articles and cartoons whose humour points out that Optometry is not only the serious application of vision and eye care. BOUM is also good enough to have attracted the support of several advertisers in the Quebec ophthalmic community and, for our part, we congratulate the AEOUM on their excellent publication.

Quebec Health Professional/Population Ratio Changes

In 1971, Quebec had 1 GP per 1,737 inhabitants; 1 "specialist" per 1,458 inhabitants; 1 optometrist for every 12,471 inhabitants. Dentists were 1 per 3,767 and oral surgeons, 1 per 299,898.

According to a recent issue of the Bulletin of the Quebec Health Insurance Commission, the "Régie de l'assurance-maladie du Québec", the same professionals, in 1985, are to be found now in the following ratios: GP's are 1 per 1,041; "specialists" 1/1,109; optometrists, 1 per 7,958; dentists, 1 per 2,818 and oral surgeons, 1 per 5,384.

Some Thoughts on Lobbying . . .

"If you really want to be most effective, you want to get in on the ground floor so you need a day-to-day or week-to-week relationship with the key people in the federal bureaucracy.

"You don't lobby, in my opinion, strictly for your own vested interests because if you do you aren't going to get very far.

"When it comes to lobbying, probably one of the most important levels, if not *the* most important level, is the local level."
— Doug Geekie, Communications Director, CMA
as quoted in *The Medical Post*

What Makes a Successful Lobbying Program?

According to an article in the November 1980 *Financial Post Magazine*, the answer is just plain hard work. And whose hard work does the FP Magazine cite as a prime example?

"One of the most memorable grassroots campaigns in the annals of lobbying history was when the Canadian Association of Optometrists (CAO), way back in the '60s, wanted optometrists' services covered under Medicare. Among the CAO's more brilliant ploys was to get a copy of Allan MacEachen's travel itinerary (he was then Minister of Health and Welfare) and to make sure there was a Liberal optometrist in every welcoming party throughout his trip. In fact, the CAO made its presence so well known that when the Medicare issue finally was debated in the House, to the background noise of construction blasting on Parliament Hill, MacEachen was heard to remark, 'It's Jim Gilmore (then CAO Executive Director) trying to get in.' "

GUEST EDITORIAL

The Coming Age of the Referral Clinic

Have you encountered a situation in which, having completed an oculovisual assessment and reviewed the case, you are left uncomfortable and unsure of your diagnosis? Sooner or later all practitioners are presented with certain cases which pose questions and raise concerns. In a predicament such as this, would it not be advantageous to confirm your diagnosis by special testing? Unfortunately, many practitioners do not have the sophisticated instrumentation or perhaps the expertise to clarify these patient problems.

Ideally, would it not be preferable to refer such patients to an Optometric Centre for special testing procedures or a second opinion? After receiving a comprehensive evaluation and report of your case from this centre, you may now have a better understanding of the most appropriate management of your patient's problem.

Optometry is on the verge of a new beginning, incorporating the idea of the referral clinic. The concept of an independent intra-professional referral centre will improve the quality of vision care delivery to our patients. It also will have far-reaching effects upon the evolution of our profession.

One such centre is currently in operation in Toronto. A group of dedicated optometrists worked diligently toward the inauguration of a clinic to provide diagnostic services, clinical research, and a professional meeting place for practitioners. On November 9, 1983, the Optometric Institute was officially opened.

The Optometric Institute, a non-profit charitable organization, received initial funding from the Ontario Association of Optometrists and the College of Optometrists of Ontario. Funding for its continuing operation is achieved through donations, grants, continuing education, research contracts, and provision of clinical services. Additional operational support has been provided by the School of Optometry, University of Waterloo, and ophthalmic supply companies which have given equipment, materials and funds.

The care provided within the Institute does not replace the services available at a practitioner's office. Rather, the Institute offers specialized diagnostic and treatment procedures not normally available to private practitioners. These vision care services should therefore not be thought of as competitive with private practice, but rather as complementary. The Institute should be viewed as a hospital or outpatient facility in which the patient receives care unavailable in the private office.

The framework of services offered by the Institute was chosen to satisfy the following objectives:

1) To assist in the improvement of the standard of vision care services in the community;
2) To promote, encourage, and participate in the advancement of vision care research and preventive optometry;
3) To provide programs and facilities for the continuing education of optometrists and other health professionals;
4) To foster interprofessional cooperation;
5) To educate the public about vision.

1. Improvement of the standard of vision care services:

This objective is fulfilled through the creation of the primary care and specialty service clinics. Referrals to the Institute are accepted both intra- and extra-professionally. All patients referred, regardless of the problem, initially undergo a complete oculovisual assessment in the primary care service. After the preliminary data is gathered and a tentative diagnosis is made, referral to one or more of the specialty clinic services is possible. The primary and specialty service clinicians review the case and prepare a letter reporting all findings of tests that relate to the diagnosis and prognosis of the patient.

At present the Institute has six specialty areas that provide advanced diagnostic and therapeutic services. The electro-diagnostic clinic offers practitioners many sophisticated procedures, including visually evoked response (VER), electroretinography (ERG), electrooculography (EOG), contrast sensitivity function (CSF), and objective automated computerized visual field assessments. The electrodiagnostic clinic has been the fastest-growing specialty service offered at the Institute.

The photodocumentation service allows optometrists and physicians to obtain a permanent pictorial record of an active or passive ocular pathology. Photodocumentation allows the practitioner to monitor the efficacy of a treatment, such as the effect of a contact lens on the cornea, or to observe the ocular side effects of certain systemic drugs.

The low vision service provides sophisticated methods of diagnosing and treating the visually impaired. Patients have been referred to the Institute for low vision services both nationally and internationally. Currently the Institute is having discussions with the Low Vision Association of Ontario regarding a jointly sponsored diagnostic/rehabilitation service.

Practitioners having difficulties with a contact lens patient may refer to the contact lens service for a second opinion. Advanced fitting techniques and specialized lenses are utilized by experienced clinicians.

The binocular vision service was established to assist practitioners to diagnose and treat binocular visual anomalies. After the binocular vision assessment, the clinician and the referring optometrist together develop an effective treatment regimen which may be initiated and monitored at the Institute or in the office of the practitioner.

Children and infants who may be suspected of having a visual, binocular, or perceptual problem are examined in the pediatric unit. The Institute offers a wide range of services to study and evaluate the development of the visual system. For infants who are "visually at risk," the pediatric service uses a preferential looking test which provides an assessment of the visual acuity of infants. These results can be compared with cortical potentials if necessary to cross-validate findings.

2) Promotion of and Participation in Research.

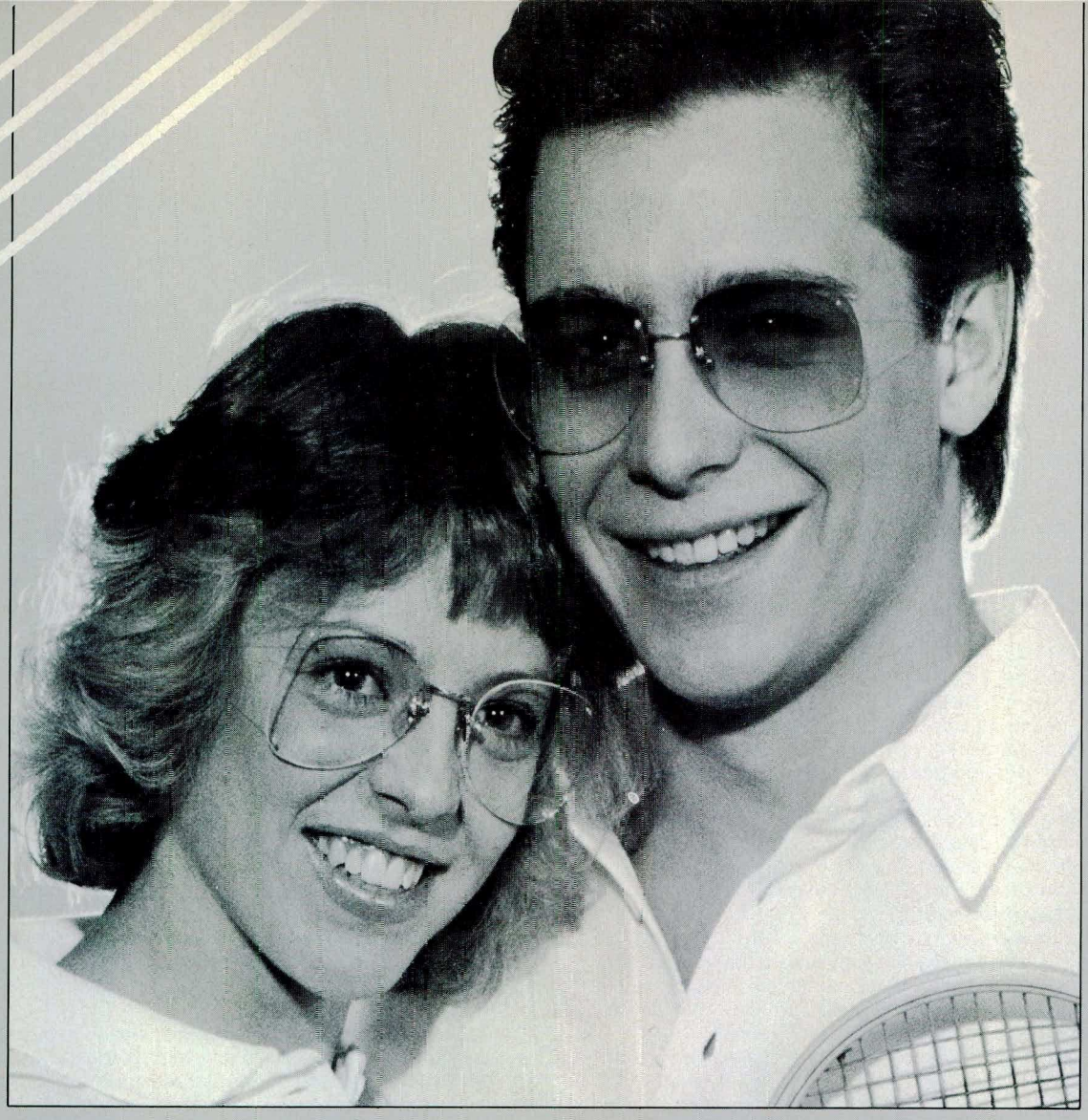
Vision care research is essential for the academic growth of the profession and the improvement of vision care delivery. As a clinical facility, the Institute utilizes data obtained from the primary and specialty care clinics, where the application of biostatistics and epidemiological data permits the identification of population groups who may be "visually at risk." The Institute is actively participating with private corporations and government agencies in research that has a clinical and practical application.

The facilitation of an effective research program requires the establishment of a library resource centre. In addition to an extensive collection of books, journals and publications pertinent to the practice of optometry, an on-line computer obtains information from databases world-wide. The library resource centre will not only support research, but will make available to all optometrists resources which they can use to expand the scope of their practices. This library resource centre is funded by a trust account established by the College of Optometrists of Ontario and the Ontario Association of Optometrists.

3) Provision for Continuing Education

Being a clinically oriented facility, the Institute provides continuing education programs directly relevant to the needs of practitioners. Courses offered include the evaluation of

Continued on p. 57

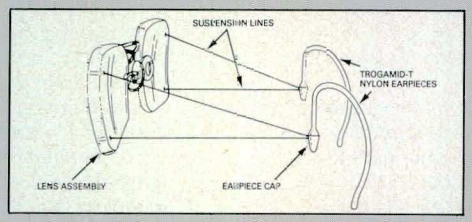


Canadian Patent No. 1135543

Suspension Eyewear

More secure, comfortable and stylish.

- Lenses are held securely in place by a nearly invisible, weightless suspension system.
- No "sliding down", no irritated nose or ears.
- No peripheral obstruction to impair vision.
- Fits problem-patients and reduces frame inventory.



- Unique styling will attract new patients by referral.
- Unlimited control of PANTO-TILT and SEG PLACEMENT.
- Any style of rimless lenses by most labs.
- Suspension system guaranteed against breakage.

CALL FOR INFORMATION PACKAGE AND FREE SUSPENSION EYEWEAR SYSTEMS FOR DOCTOR AND STAFF.

CANSEE
SUSPENSION EYEWEAR ENTERPRISES (CANADA) LTD.
1-800-661-1165 (CANADA WIDE)

POUR DE PLUS AMPLES RENSEIGNEMENTS AINSI QUE DES SYSTÈMES DE SUSPENSION GRATUITS POUR L'OPTOMÉTRISTE ET LE PERSONNEL, APPELEZ.

CANSEE
ENTREPRISES DE LUNETTES SUSPENDUES (CANADA) LTÉE 1-800-567-1288
(CODES RÉGIONAUX 418, 514, 613, 819)

OPINION

Views from the University of Waterloo School of Optometry on Meeting with the Manpower Needs of the Future**

A.P. Cullen*

The University of Waterloo continues to be the major source of optometrists for all provinces in Canada except Quebec and the student body is recruited from all provinces including Quebec. The pool of candidates for admittance remains high (300-400) and of an academic calibre that is increasing annually. Up to half the incoming students have B.Sc. or higher degrees and this year only two candidates with a single year of University have been offered positions, reflecting the trend in recent years. We continue to seek academically well qualified students with broad interests and excellent interpersonal skills. With such a large pool it is possible to select these and attrition has been low with the loss or failure of only a handful of students. Unfortunately many well qualified candidates are not admitted indicating that there will be no shortage of students for a third Canadian school.

Why does Waterloo not increase its class size? The major reason is that the facility was designed for 50 incoming students a year and with an intake of 60 our resources are already strained. In addition, there is the possibility that an increased class size would dilute the quality of education and clinical experience provided to the professional student.

Following their recent accreditation site visit the Council on Optometric Education of the American Academy of Optometry were most complimentary of all of the School's programmes, and renewed the School's accreditation. Also both the M.Sc. and Ph.D. programmes received the highest rating from the Ontario Council on Graduate Affairs and the maximum (7 years) accreditation was granted this year. In other fields the school has been most successful and the faculty are engaged in a whole host of activities which in turn reflects the overall quality of the optometric education provided.

In addition to 172 Doctor of Optometry degrees, in the past three years the University has awarded 8 M.Sc. (Physiological Optics), 2 Ph.D. (Physiological Optics), and 1 two year Residency Certificate; of the recipients of these degrees three remain on our full time faculty and three were not O.D.'s.

A number of modifications and expansions are apparent in the clinics. The Government of Ontario (through several Ministries and Agencies) has assisted in the establishment of the Centre of Sight Enhancement at the School; this incorporates the former Low Vision Clinic and the expansion includes the services of allied health professionals such as social work, technologists and public health nurses in addition to optometrists with specialty training in low vision/rehabilitative optometry. The Ocular Health Clinic is to move into a redesigned unit in the fall with the addition of a full time clinical faculty member with residency training in the area. The clinical services in electrodiagnosis and pediatrics have increased. Outreach programmes are being expanded.

What are the manpower needs of the School? These may be divided into several main areas:

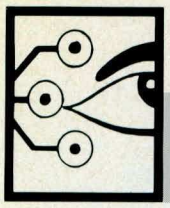
1. Academic faculty preferably with an optometric degree in addition to their graduate degrees.
2. Clinical faculty preferably with specialty residency training or graduate training.
3. Part-time clinical associates with: (a) Specialty expertise (b) Contemporary primary care skills.
4. Graduate students and residents.

The School needs a complement of approximately 20 academic faculty, 12 clinical faculty and over 30 clinical associates. At the present time these needs are not fully met and the School's academic administrators continue to carry full teaching, clinical and research loads in addition to their administrative and committee responsibilities at the School, University, provincial, national and international levels. In recent years we have been forced to recruit clinical and academic faculty from outside

Continued on p. 27

*Associate Director, School of Optometry, University of Waterloo

**Extracted from a presentation at Interaction '85 entitled *Optometric Manpower Needs in Canada*, July 2, 1985, Regina, Saskatchewan



CLINICAL RESEARCH

Comparison of the Distance and Near Vistech Vision Contrast Test Systems (VCTS)

G.C. Woo*
H. Bohnsack**

Abstract

This paper describes the essential principles associated with the clinical use of a contrast sensitivity function (CSF) test to document vision loss or improvement. Some advantages of the CSF over the more conventional visual acuity test are described as well as the type of CSF losses associated with several ocular and neurological conditions. Contrast sensitivity was measured on each of 12 normal subjects ages 21 to 27 years on two separate occasions using both the distance and near versions of the Vistech Vision Contrast Test System charts (VCTS). Analysis of the variance showed that the results obtained using the distance and near chart were not significantly different. The contrast sensitivity scores elicited on the second trial, as compared to the first, were found to be consistently higher at all frequencies. This improvement associated with repeated testing is clinically evident among a high percentage of subjects tested but not statistically significant at the .05 level.

Résumé

Ce document fait état des principes de base de l'emploi clinique du test de sensibilité au contraste (contrast sensitivity function test) pour documenter la perte ou l'amélioration de la vision. Il est question des avantages de cette méthode par rapport aux méthodes classiques d'examen de l'acuité visuelle ainsi que des types de pertes de sensibilité au contraste associés à diverses conditions oculaires et neurologiques. La sensibilité aux contrastes a été déterminée chez douze sujets normaux entre 21 et 27 ans, à deux reprises, à l'aide de la version proche et de la version éloignée de la carte VCTS (Vistech Vision Contrast Test System). L'analyse de la variation montre que les résultats issus de l'emploi de cartes à faible ou à plus grande distance ne varient pas de manière significative. Les cotes de sensibilité obtenues au deuxième essai, par rapport à celles du premier, étaient toujours plus élevées, à toutes les fréquences. Cette amélioration, associée à des essais répétés, est évidente chez un grand nombre de sujets testés, mais ne représente pas un facteur significatif au niveau de .05.

Recent advances in contrast sensitivity testing techniques are making the procedure easier to use clinically. The advantages of the CSF test over the conventional visual acuity test continue to be realized. The purposes of this study are to describe the use of contrast sensitivity testing as a measurement of visual performance and to compare results obtained using distance and near versions of the recently developed Vistech Vision Contrast Test System.[1]

Contrast sensitivity is a measurement of the patient's ability to perceive differences between the lightest and darkest areas of a given target. Usually, a sine wave grating is used. This target has uniformly alternating dark and light bands whose edges do not have sharp luminance discontinuities; rather the target luminance distribution varies as a sine function. Mathematically, contrast is defined as the difference between the highest and lowest luminance of a grating divided by their sum: C = (Lmax -Lmin)/(L max + L min).

The width of each band, or, more specifically, the number of dark and light bars per degree of visual angle determines the spatial frequency of the grating. If one dark band subtends 1 min of arc at the observer's eye, as does each stroke of a 6/6 (20/20) letter, then a cycle would subtend 2 min of visual angle at that distance. Since there are 60 min of arc per degree, 30 cycles that subtended 2 min each at the observer would be contained within 1 degree of visual angle. Therefore this spatial frequency would be specified as 30 cycles per degree (c/d). If each band were widened to 2 minutes by reducing the

*O.D., Ph.D., Professor
**3rd year Optometry student
School of Optometry, University of Waterloo

original observation distance for the same grating to half, then each cycle would subtend 4 min of arc and the resulting spatial frequency would be 15 c/d. Similarly, halving the grating band width or doubling the observation distance would double the spatial frequency to 60 c/d.

A sine wave grating is used as a test target because it is the simplest form of visual stimulus and its image when modulated through an optical system retains its sine-wave form. Optical defocus merely has the effect of increasing the image's transition zone size, which causes perception of the high frequency gratings to be impaired first.

Testing is usually done by determining the contrast of a grating of a specific spatial frequency at which the subject is at the threshold of just being able and just not being able to differentiate the sine wave grating from a uniform patch of grey. This contrast level is called the threshold contrast for that observer at that spatial frequency. The inverse of this threshold indicates the contrast sensitivity. By determining contrast sensitivity over a range of spatial frequencies (typically from about 0.5 to 20 c/d) a patient's contrast sensitivity function (CSF) can be mapped. A typical contrast sensitivity function is displayed in Fig 1.

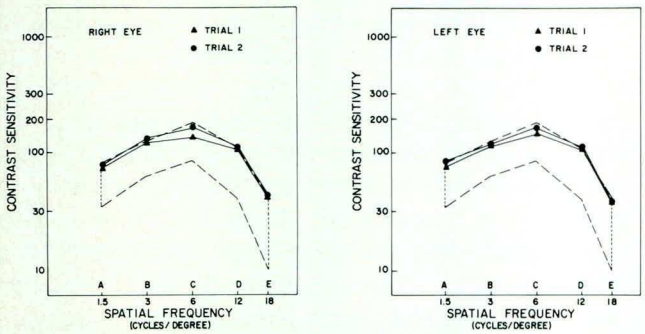


Fig. 1 Comparison of all trial 1 results with all trial 2 results of the right and left eyes respectively. Broken lines indicate the normal range of contrast sensitivity values by VISTECH.

Thus, although both letter charts and contrast sensitivity tests measure thresholds, the former represents an extensity threshold, that is, the minimum size target that can be resolved or recognized[2]. Contrast sensitivity tests measure intensity thresholds; the minimum luminance difference that can be seen. This test usually uses much larger test targets[2].

Snellen acuity can only evaluate the performance of a small part of the visual system, since only the foveal cones have a sufficiently dense mosaic to handle high frequency information. In the retinal periphery, only lower spatial frequency channels are represented[3].

For this reason, disturbances in other parts of the visual system may impair visual function without altering visual acuity. Thus, identical visual acuities may result in substantially different capabilities and conversely, contrast sensitivity function cannot be predicted from visual acuity results alone[4].

However, if CSF data points are extrapolated, the intersection at the abscissa represents the spatial frequency at which a grating can only be seen if its contrast is 100% and any grating of higher spatial frequency is indistinguishable from a uniform patch of grey[3]. This intersection, therefore, corresponds to the cut-off spatial frequency threshold or resolution capability, which is in fact visual acuity measured in cycles per degree.

Experimental research has shown contrast sensitivity to be a more complete description of different types of vision loss. An example of the value of CSF testing is found among contact lens wearers, who may have visual complaints which can be identified by measuring CSF although their visual acuity is normal[5].

Of great diagnostic importance is the fact that characteristic CSF curves are associated with such conditions as multiple sclerosis[4,6], glaucoma[3,7], cataracts[8], amblyopia[9,10], retrobulbar neuritis[10], and other specific pathway disorders[12]. This makes CSF a valuable tool for diagnosis, monitoring and assessment of several primary and secondary ocular conditions as well as evaluating improvement resulting from spectacle, surgical or vision training therapy. Routine use of CSF testing would allow the practitioner to find the first evidence of eye diseases or neurological disorders earlier than with conventional tests or procedures, and occasionally may facilitate differential diagnosis of eye problems[3,13,14].

Contrast sensitivity testing with low spatial frequency gratings has proved to be an efficient screening device for glaucoma and peripheral field losses[3,7]. Refractive blur will cause significant losses in the high spatial frequency range without affecting thresholds for lower spatial frequencies[13]. In neurological conditions such as multiple sclerosis, the mid and low frequency losses are typically as great or greater than the high frequency losses[4,6,13]. Amblyopia, cortical lesions and multiple sclerosis may also result in "notch" losses which selectively affect the intermediate spatial frequencies[13]. Cataracts can produce losses equally across all frequencies, or at high and medium spatial frequencies only[8].

Several testing systems have been utilized including oscilloscope systems, television systems, the Arden Grating Test chart system[15], the Vistest LH-5 chart test system[16] and most recently, the Vistech Vision Contrast Test System (VCTS)[1]. The first two of these are research rather than practitioner employed tools requiring careful calibration and involving test procedures generally unfamiliar to most practitioners and patients.

The Vistech Vision Contrast Test System, recently developed by Ginsburg[1] incorporates new design

features which aim to make CSF testing quick and simple. The VCTS consists of a chart of 5 rows of 9 sinusoidal grating test patches, each row having a different spatial frequency: A = 1.5, B = 3, C = 6, D = 12, and E = 19 c/d. Within each row, the contrast of successive test patches decreases from left to right in steps of approximately 0.1 log unit. The test gratings are randomly arranged in one of three orientations: vertical, 15 degrees right or 15 degrees left. A forced choice technique is used in testing such that the patient must report the orientation of each test grating or report the patch as blank if the grating cannot be perceived. If the patient thinks he sees the grating but is unsure of the orientation, he is encouraged to guess. The low contrast test patch whose orientation the subject can identify correctly is recorded and the results can be compared with a normal curve. Three-chart sets of both the distance version for use at 3.05 m (10 ft) and the near version for use at 45.6 cm (18 in) are commercially available.

The distance chart measures 94 x 67.5 cm. (37 x 27 in) with each test patch subtending 1.63 degrees. The near chart measures 17.4 x 14 cm (6.9 x 5.5 in), with each test patch subtending 1.41 degrees at the eye.

It should be noted that the near chart is used at a distance of 45.7 cm (18 in), thus acting as a stimulus to accommodation of about 2.25 D. Therefore, if a patient's accommodative range is too limited to allow him to see the chart clearly through his add, additional lenses of 2.00 to 2.25 D must be used when administering the test, especially if the patient's normal reading distance is closer than 40 cm.

Method

A total of 24 eyes were tested monocularly using first the distance chart B of the VCTS, then near chart B of the VCTS which had the same arrangement of test patches. In each instance, the right eye was tested before the left. A luminance level of 120 cd/m^2 was maintained on both charts at all times. On the second trial, use of the same chart and testing sequence was repeated. Subjects were all optometry students from the University of Waterloo School of Optometry. Their ages ranged from 21 to 27 years. All were emmetropes or ametropes corrected with spectacles.

Results and Discussion

The results of statistical analysis of the clinical data are summarized in Table 1.

Analysis of variance was applied to determine whether, among normal observers, there is a significant difference between the results obtained with the distance VCTS chart compared to the near chart. The statistical analysis shows that the average results for the two charts are not significantly different. This suggests that either chart may be used interchangeably and results of the two distances could be compared directly for these normal prepresbyopic subjects.

Table 1

Selected statistical indices from results of analysis of variance. (* - Values for P of less than 0.05 indicate that the variable has a significant effect)

	Right Eye		Left Eye	
Source	F	P	F	P
Subject	2.50	0.0076*	3.39	0.0004*
Test Dist	0.80	0.3718	0.00	0.9751
Frequency	187.75	0.0001	171.23	0.0001
Trial	10.96	0.0011*	5.41	0.0210*
Trial*Freq	3.16	0.0152*	0.91	0.4601
Test*Dis*Freq	0.94	0.4422	2.28	0.0627
Trial*Test*Dist	0.00	0.9873	0.89	0.3478
Trial*Dist*Freq	0.95	0.4368	0.37	0.8333

The interaction between test distance and each of the following: trial, frequency and both frequency and trial together were also studied. In each case these interactions were found to be insignificant, further supporting the conclusion that the distance chart and the near chart will give the same CSF findings.

The Student-Newman-Keuls test was also applied to determine whether there was a difference in CSF results with repeated trials. Results for the right and left eyes were analyzed separately. Comparison of the averages of all trial 1 results with all trial 2 results showed the two trials to be significantly different at the .05 level, with the averaged results for all subjects being consistently higher on the second trial than the first at all frequencies for both the right and left eye samples, as shown in Figure 1. This improvement on trial 2 is most likely due to a learning effect which arises on the second trial as the subject becomes more familiar with the test and begins to make judgements more easily about gratings which are near his threshold sensitivity. Analysis of the trial frequency interaction showed that for at least one frequency, a strongly significant increase in CSF was found to occur on the second trial, in addition to the possible learning effect found for the average of the results for all frequencies. The large increase in CSF from 136 to 165 at frequency C is the most likely cause of this additional effect. Other than this, however, analysis of results for each frequency separated did not show the learning effect to be significant. Both the limited number of observations at each frequency as well as the relatively coarse gradations of possible CSF values are likely to have contributed to this finding. It would be interesting to test the significance of the learning effect at each spatial frequency using a larger subject population or a number of repetitions of the same test on the same subjects.

When comparing averaged results for the right and left eye samples, it is noted that the right eyes had slightly higher contrast sensitivity on both trials.

However, the improvement of CSF over the two trials appears to be smaller for the left eye sample. This may be because the subject gained familiarity with the test when his first eye, always the right, was being tested. Consequently, the first test for the left eye would yield a higher contrast sensitivity than if the left eye had been tested first. This would leave less room for improvement on the second trial since it is predicted that this apparent learning effect decreases with successive trials. This would explain why a significant increase was found at frequency C for the right eye but not for the left.

Because the VCTS chart measures contrast sensitivity in discrete steps of 0.1 log unit, any increases in the overall average on the second trial would suggest that a proportional portion of the population tested had a significant increase in CSF. For example, the improvement in contrast sensitivity from 136 to 165 represents close to a 0.1 log unit increase. This would suggest that a large proportion of the sample population had shown a clinically significant increase of one 0.1 log unit step or more at frequency C. Table 2 summarizes the performance at each frequency of all subjects on trial 2 as compared to trial 1. At frequencies A through D, it was found that between 32 and 59% of the subjects had improved CSF scores on the second trial, compared to the 9 - 32% of the subjects whose contrast sensitivity decreased on the second trial at the same four frequencies. Greater variability was found at frequency B, where 37 and 46% of the subjects had increased contrast sensitivity, while the proportion experiencing a decrease was nearly equal to 36 and 41%. This result confirms the expectation that measurements at the highest spatial frequency are subject to the greatest fluctuations, as well as intersubject variability since no steps were taken to improve each subject's more recent spectacle correction.

Table 2

Spatial frequencies: This table summarizes the percentage of the subjects who were found to show increases or decreases in CSF results of one test patch or more on the VCTS charts, as compared to trial 1.

Percentage of subjects showing:	A		B		C		D		E	
	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS
increase	32	41	41	41	59	45	41	55	46	37
decrease	19	14	14	18	9	9	28	32	36	41
no change	50	45	45	41	32	45	32	14	18	23

Analysis of the interaction between chart version (distance or near) and spatial frequency and their combined effect on CSF revealed a consistent, though not statistically significant trend. Among both right and left eye samples, high spatial frequencies were seen slightly more easily with the distance chart.

Higgins et al[17] have shown the "criterion-free" forced choice method of CSF testing to be superior to the method of adjustment when 50 trials at each of 9 spatial frequencies are used, having "excellent long-term stability". The forced choice method was shown to be less subject to fluctuations of criterion over time and is also easier for patients to understand. Although the Vistech chart uses a variation of the forced choice technique, only one trial is made at the "threshold patch" at each spatial frequency, and all possible contrast threshold values are spaced apart in discrete steps of 0.1 log unit. These factors may put limits on the precision of the Vistech system not found with the more thorough technique described by Higgins. The long-term stability of the VCTS results following the possible initial learning effect has yet to be investigated.

Comparison of the typical contrast sensitivity function with the function obtained using the VCTS showed the two to be dissimilar both in terms of the actual contrast threshold values as well as the spatial frequency giving the peak sensitivity. Most test systems show the peak sensitivity to be at approximately 3c/d while the VCTS consistently finds it to be at 6 c/d. This disparity could be due to different luminance levels and different field sizes.

In summary, it was concluded that for normal subjects of the age range tested (21 to 27 years), there is no difference between results obtained with the near chart and those found using the distance chart. It was shown that an improvement in contrast sensitivity associated with repeated trials was found and between 32 and 59% of subjects may be expected to show an increase in contrast sensitivity of 0.1 log unit or more at various spatial frequencies on their second test trial. This improvement, however, was found to be statistically insignificant at the .05 level. It would be interesting to test this "improvement" in contrast sensitivity function by using a larger number of subjects and a number of trials of the same test on the same subjects in a further study on the clinical use of the Vistech system.

Acknowledgements

We thank Vistech Consultants Inc. for providing us with the distance VCTS chart. This work was supported in part by NSERC research grant #A3449 to Dr. G.C. Woo as well as an NSERC research assistant grant to Harry Bohnsack.

References

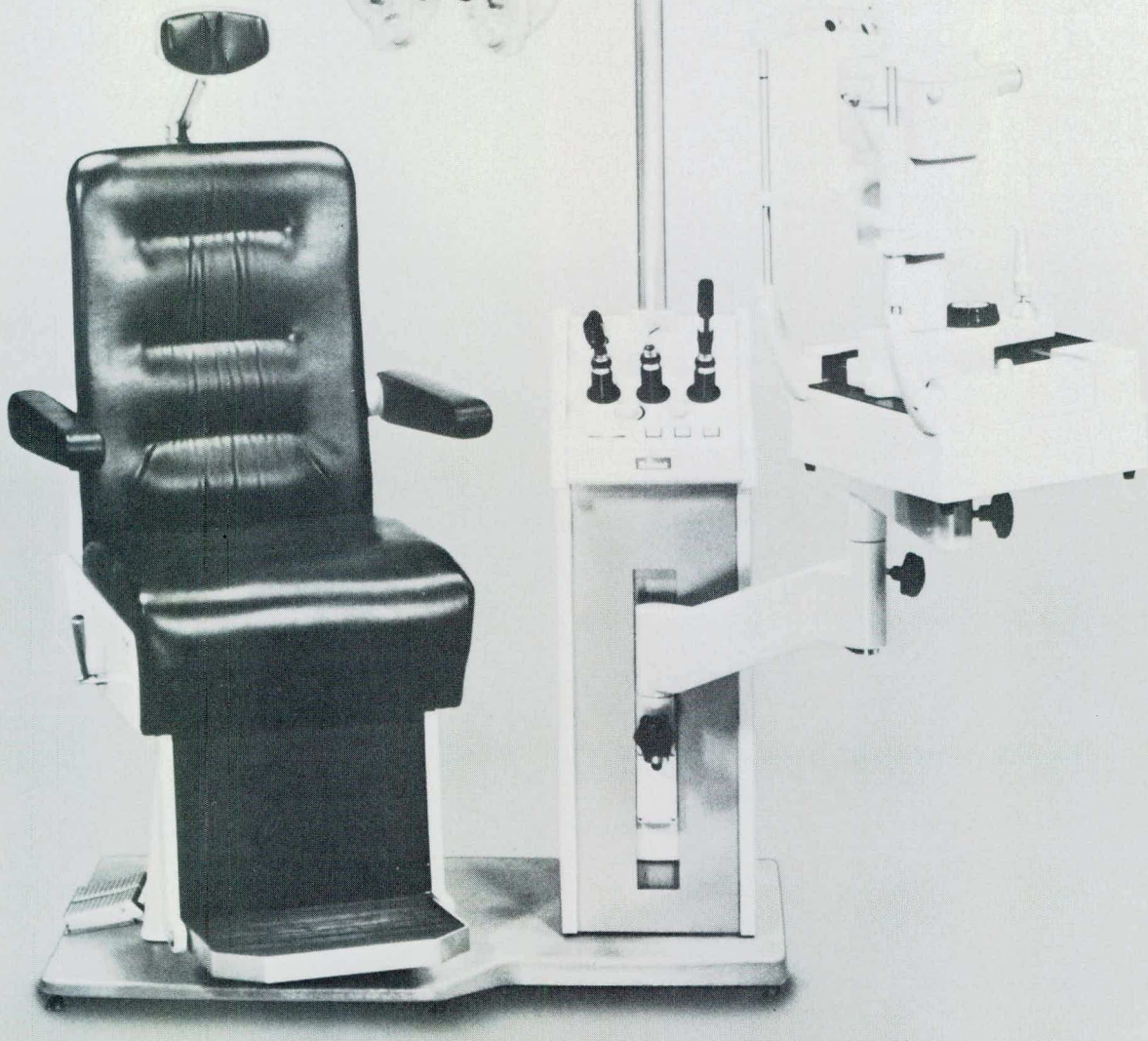
1. Ginsburg AP. A new contrast sensitivity vision test chart. *American Journal of Optometry and Physiological Optics*. 6: 403 - 407, 1984.
2. Sekuler R, Mulvanny P. Correspondence: Acuity and contrast sensitivity. *British Journal of Ophthalmology*. 67: 134, 1983.
3. Arden GB. The importance of measuring contrast sensitivity in cases of visual disturbance. *British Journal of Ophthalmology*. 62 (4): 198 - 209, 1978.

Continued on p. 54

Reichert

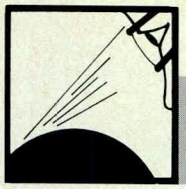
The Standard Chair and Stand: Excellence Made Standard

The Standard Chair and Stand provides upscale performance at a popular price. Call your Authorized Reichert Instrument Distributor. See for yourself how the Reichert Standard Chair and Stand meets the standards of your practice.



Reichert

For more information contact your local distributor or call us
REICHERT OPHTHALMIC INSTRUMENTS
P.O. Box 39, Belleville, Ont. K8N 4Z9 **(613) 966-8210**



Optical Radiation Protection by Non-Prescription Sunglasses

B.R. Chou*
A.P. Cullen**

Abstract

We present spectral transmittance curves over the waveband 200 to 2500 nm for 47 non-prescription sunglass lenses. All appear to provide adequate protection from ultraviolet radiation, especially those which have been advertised as such. Other criteria for choosing the "right" sunglass are discussed briefly.

Résumé

Le document présente des courbes de transmission spectrale sur la gamme d'ondes 200-2 500 nm pour 47 lunettes de soleil non correctrices. Toutes semblent assurer une protection adéquate contre les rayons ultraviolets, particulièrement celles dont les fabricants annoncent qu'elles offrent cette protection. Il est brièvement question d'autres critères de sélection d'un verre fumé.

Introduction

The most widely used non-industrial non-prescription tinted lenses sold in the world are sunglasses. Ideally sunglasses should be used to provide ocular protection from hazardous levels of ultraviolet (UV), visible and infrared (IR) radiation. They are often used to improve visual perception in certain activities in brightly illuminated environments (e.g. shooting glasses) and to reduce glare (e.g. polarising lenses for driving). Sunglasses are often used to increase comfort under bright illumination. However, cosmesis is probably the most important consideration of the average purchaser of sunglasses.

The variety of sunglasses available to the public has increased greatly in recent years. They have a wide range of price, quality and style. Some types are prominently identified with a logo or brand name to enhance the status of the wearer who follows the latest fad of fashion. The average purchaser decides arbitrarily what sunglasses to buy with the main source of information being manufacturers' advertising.

We have previously reported on tinted prescription lenses,[1] and special non-prescription tints for occupational and sports use.[2] Recent queries to our laboratory from practitioners, industry, labour, the media and the general public have indicated that there is also a need for independent evaluation of the spectral transmittance characteristics of non-prescription cosmetic shades and sunglasses.

*M.Sc., O.D., FAAO, Lecturer

**O.D., Ph.D., FBCO, FAAO, Professor
Optical Radiation Laboratory
School of Optometry, University of Waterloo

General Considerations of Sunglass Quality

Lenses

Sunglass lenses are either glass or some form of plastic. Glass lenses are either optically surfaced in the same way as prescription lenses, or made by the faster inexpensive coquille process. In the latter, a bubble of glass is blown to approximately the radius of curvature of a 6D-base lens, and allowed to cool. Once hard, the glass can be broken into pieces which are of approximately plano power and can be shaped and edged to fit into a frame. As is the case of prescription lenses, such glass may be tinted either by mixing colorants into the molten glass, or by vacuum-coating the white lens with either a colorant or mirror coating. Photochromic lenses may be made either by generating optical-quality surfaces, or by the coquille process.

Plastic lenses may be cast, pressed from sheet, injection molded or optically worked. A wide variety of plastics is used, including CR-39, PVC, poly-

carbonate and polystyrene. The lenses are tinted by mixing colorants with the plastic prior to polymerisation, or by dyeing. Vacuum coated tints are rare.

Polarising lenses can be obtained most often as plastic membranes (Polaroid^{R} material) or (rarely) as laminated glass lenses or bonded plastic lenses.

In evaluating the lenses, it is necessary to consider colour, uniformity and density of the tint, as well as the optical quality of the lens.

The density of the tint chosen is a matter of arbitrary choice by the purchaser. In general, cosmetic shades and sunglasses are made in the following categories: light (transmittance up to 80%), medium (up to 40%) and dark (less than 20%). Tints of more than 40% transmittance should be regarded as "fun tints", i.e. cosmetic or fashion shades, rather than sunglasses, especially if violet or pink in colour. These may be placed on a UV-absorbing substrate such as polycarbonate or similar plastics. It is generally regarded, on psychophysical grounds, that in order to reduce glare effectively a tint which transmits less than 60% should be used.[3] We have discussed the choice of colour of the tinted lens in a previous paper.[1]

The impact resistance provisions of the U.S. Food and Drug Administrator's Statement on General Policy "Use of Impact-Resistant Lenses in Eyeglasses and Sunglasses"[4] are usually followed by the makers of non-prescription sunglasses in order to gain access to the huge American market. Lenses must withstand the impact of a 16mm (5/8-inch) steel ball weighing 15.9gm (0.56 ounce) dropped from a height of 1.27m (50 inches) onto the circular area 16mm (5/8-inch) in diameter located at the geometric centre of the lens. The lenses must also meet standards of the American National Standards Institute (ANSI)Z5[5]. No analogous standard exists in Canada at this time.

Frames

Frames used in non-prescription sunglasses are made in a wide variety of styles in both plastic and metal. Most are inferior in quality and robustness when compared to most frames intended for use with prescription lenses.

Lenses are often roughly shaped and edged, then wedged into the eyewire. It is not uncommon for the lens to be of incorrect size or shape, making dislodgement of the lens highly probable. If the lens is slightly oversize and forced into the eyewire, it will be warped, inducing some cylinder power, and may be stressed at certain points along the edge, making the lens more vulnerable to breakage. Some of these problems are reduced in plastic frames by cementing the lenses in place. Metal eyewires are generally closed by either rivets or solder, as the lenses are not expected to be removed. With few exceptions, lenses are edged with little or no bevel to enhance lens retention in the frame.

As a rule, sunglasses are made so that "one size fits all". This is especially true of the high fashion frames. The frame materials generally do not lend themselves well to easy adjustment by the consumer. The wearer of a poorly fitting frame will experience all the physical discomforts which result from such a situation. The fit and quality of the frame are as important as the quality of the lenses if the sunglasses are to be useful to the wearer.

Materials and Methods

Randomly selected samples of non prescription sunglasses were obtained from manufacturers or distributors of various brands. We also obtained samples of plano uncut finished sunglass lenses from two wholesale optical laboratories.

Lenses were removed from their mountings and thoroughly cleaned. The spectral transmittance curve of each lens was recorded with a Zeiss DMR21 dual-beam recording spectrophotometer following the procedure described elsewhere[1,2].

Gradient lenses were tested at the areas of most dense and least dense tint. Photochromic lenses were tested in the clear state, then exposed to bright sunlight for 5 minutes, and immediately re-tested. (For such lenses we did not control ambient temperature, previous light exposure history or hardening process).

Table 1 is an alphabetical list of the 47 lenses studied, with descriptions and corresponding figure number to locate the spectral transmittance curve.

Results

Spectral transmittance curves of tinted lenses are shown in Figures 1 to 24.

In general, lenses which were claimed to block ultraviolet radiation were found to do so, with shortwave cut offs in the range of approximately 370 to 400 nm; the Bollé Irex curve agrees well with the advertised claims, having a cut off for our sample lenses of approximately 475nm. The curves for other glass and plastic lenses are similar in their shortwave cut offs to other tinted lenses which we have examined previously[1,2].

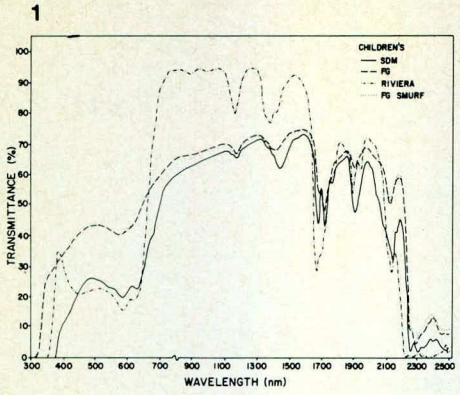
Discussion

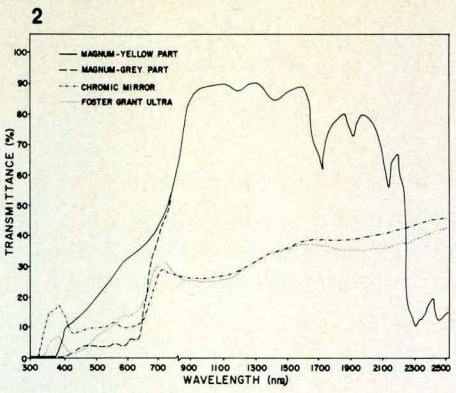
It is often stated that the price of a given item is directly related to its quality. In the optical industry, inexpensive sunglasses have often been condemned as inferior products which can give rise to patient complaints of headache and/or eyestrain. We are unaware of any epidemiological support for such claims; indeed the majority of users of inexpensive sunglasses do not appear to have these complaints. There is no evidence of damage to the eyes from the use of inferior quality sunglasses.

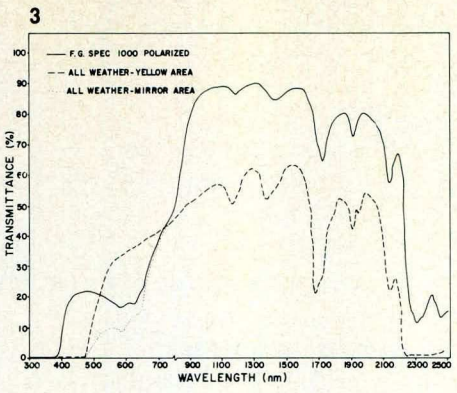
Table 1
Lenses Tested

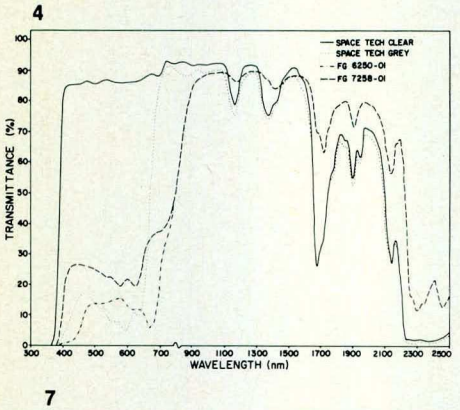
Lens	Description	Figure
Children's sunglasses		
Foster Grant (FG)	Grey plastic sheet	1
FG Smurf	Grey plastic sheet	1
Riviera (R)	Blue-grey molded plastic	1
Shoppers Drug Mart (SDM)	Grey-green plastic sheet	1
Adults' sunglasses		
FG 1242-01 Magnum*	gradient grey on yellow polarized plastic	2
FG 1264-01 Chromic mirror*	semi-mirror coat on grey coquille glass	2
FG 1636-01 All Weather Spec 1000*	Gradient grey on yellow plastic	3
FG 1658-01 Spec 1000*	Grey polarized plastic	3
FG 1802-01 Photochromic*	Photochromic coquille glass	5
FG 1866-01 Ultralens*	Mirror coat on coquille glass	2
FG 6250-01 Clip-ons*	Green polarized plastic	4
FG 7358-01 Opti-clips*	Grey polarized plastic	4
FG Space Tech*	Gradient blue-grey plastic	4
Pirate	Grey-green plastic	6
Solaire	Gradient green plastic	7
Tropical	Grey glass	6
R All Weather	Semi-mirror coat on amber plastic	8
R Mirror	Mirror coat on coquille glass	9
R Slalom	Blue polarized plastic	9
R Titan	Green glass (ground)	8
R Violet	Gradient tinted plastic	10
R Amber Polarized	Plastic sheet	8
R Brown Polarized	Plastic sheet	9
Bolle Irex 100*	Mirror coat on brown plastic	11
Plano sunglass lenses (finished uncuts)		
C-15 with Televis	Yellow coat on grey glass	12
Nitesite	Yellow glass	12
Rayban 3	Green glass	13
Sun-sensor	Brown glass	13
Televis	Yellow coat on glass	12
Varigray	Photochromic grey glass	22
Varigray Extra	Denser photochromic grey glass	23
XDF	Light grey glass	14
CR39 Grey Solid	Dyed CR39	14
CR39 Grey gradient	Dyed CR39	15
CR39 Brown gradient	Dyed CR39	16
Photolite	Photochromic plastic	21
Plastic polarized (71)	Polaroid bonded to CR39	17
PLS polarized (65)	Polaroid bonded to green glass	17
Glass polarized	Polaroid bonded to grey glass	17
Clarlet brown gradient 85%	Dyed CR39	18
Clarlet gray gradient 65%	Dyed CR39	18
Clarlet nr 07	Dyed green-grey CR39	19
Clarlet brown 65%	Dyed CR39	19
Zeiss Umbral 65	Brown glass	20
Zeiss Umbral 75	Brown glass	20
Zeiss Umbral 85	Brown glass	20
Zeiss Umbramatic 35SR	Brown photochromic glass	24

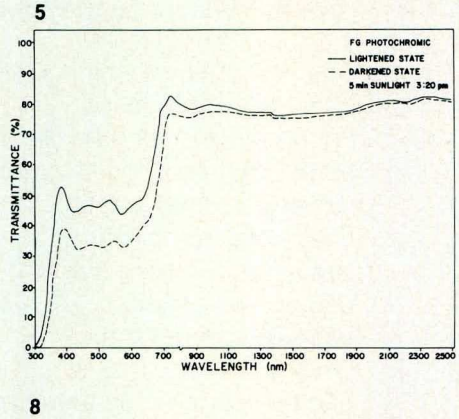
*Labelled or advertised as a UV-blocking lens.

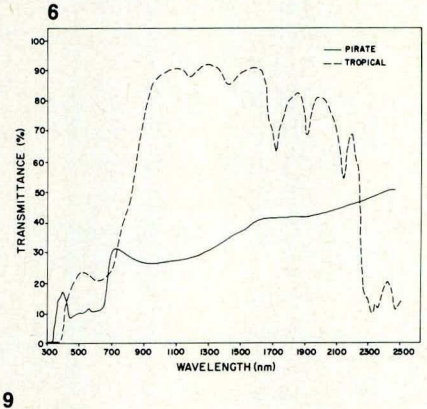

1
CHILDREN'S
SDM
FG
RIVIERA
FG SMURF
TRANSMITTANCE (%)
WAVELENGTH (nm)

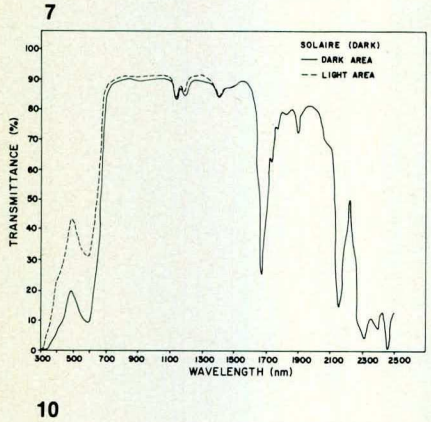

2
MAGNUM-YELLOW PART
MAGNUM-GREY PART
CHROMIC MIRROR
FOSTER GRANT ULTRA
TRANSMITTANCE (%)
WAVELENGTH (nm)

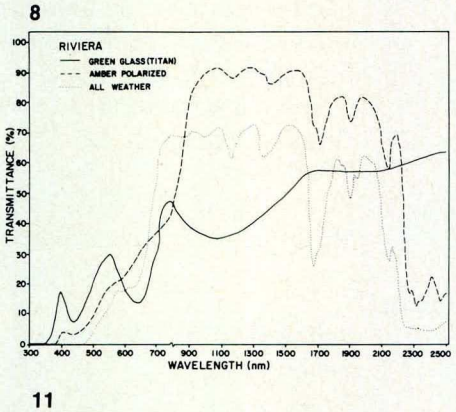

3
F.G. SPEC 1000 POLARIZED
ALL WEATHER-YELLOW AREA
ALL WEATHER-MIRROR AREA
TRANSMITTANCE (%)
WAVELENGTH (nm)

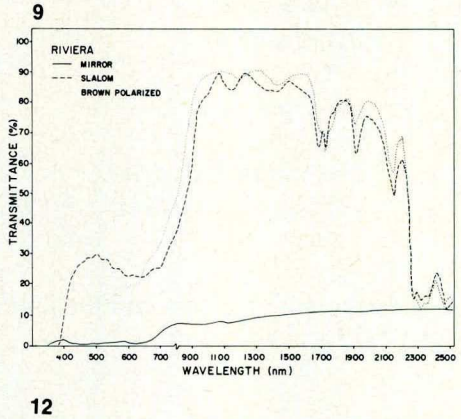

4
SPACE TECH CLEAR
SPACE TECH GREY
FG 6250-01
FG 7258-01
TRANSMITTANCE (%)
WAVELENGTH (nm)

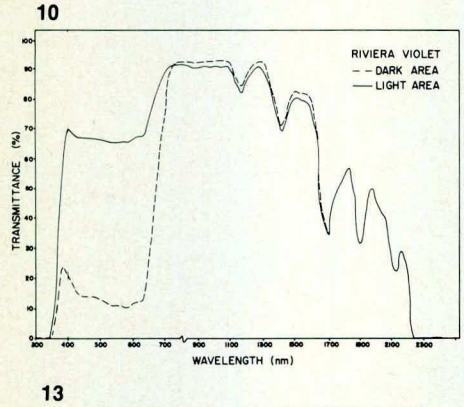

5
FG PHOTOCHROMIC
LIGHTENED STATE
DARKENED STATE
5 min SUNLIGHT 3:20 pm
TRANSMITTANCE (%)
WAVELENGTH (nm)

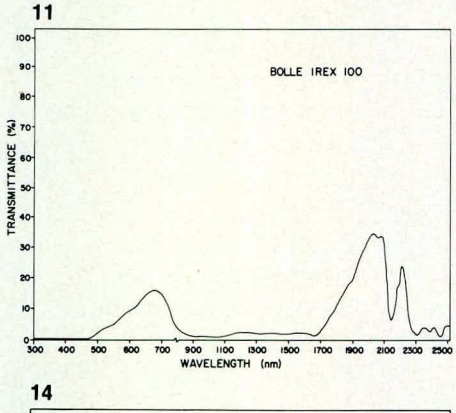

6
PIRATE
TROPICAL
TRANSMITTANCE (%)
WAVELENGTH (nm)

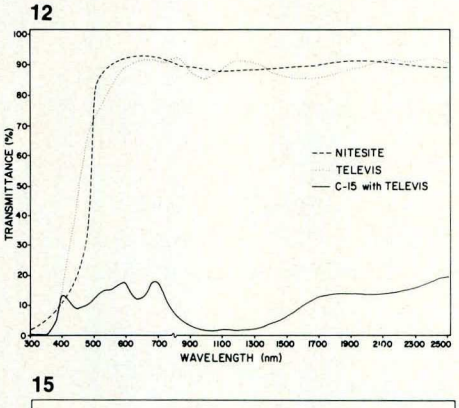

7
SOLAIRE (DARK)
DARK AREA
LIGHT AREA
TRANSMITTANCE (%)
WAVELENGTH (nm)

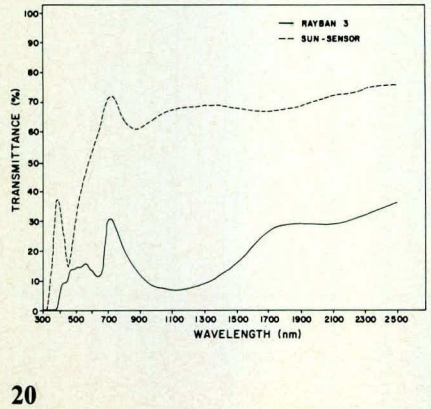

8
RIVIERA
GREEN GLASS (TITAN)
AMBER POLARIZED
ALL WEATHER
TRANSMITTANCE (%)
WAVELENGTH (nm)

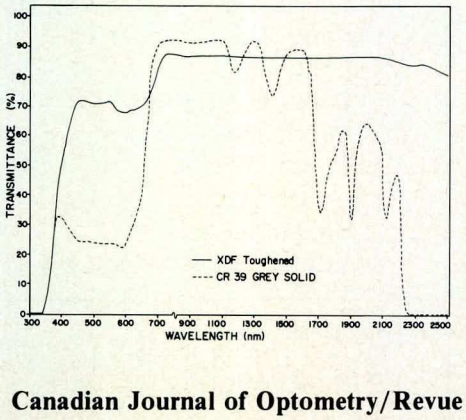

9
RIVIERA
MIRROR
SLALOM
BROWN POLARIZED
TRANSMITTANCE (%)
WAVELENGTH (nm)

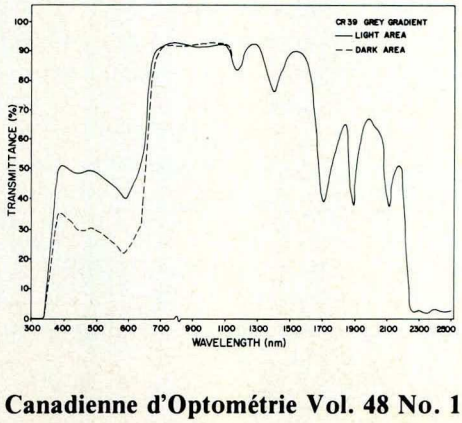

10
RIVIERA VIOLET
DARK AREA
LIGHT AREA
TRANSMITTANCE (%)
WAVELENGTH (nm)


11
BOLLE IREX 100
TRANSMITTANCE (%)
WAVELENGTH (nm)


12
NITESITE
TELEVIS
C-15 with TELEVIS
TRANSMITTANCE (%)
WAVELENGTH (nm)


13
RAYBAN 3
SUN-SENSOR
TRANSMITTANCE (%)
WAVELENGTH (nm)


14
XDF Toughened
CR 39 GREY SOLID
TRANSMITTANCE (%)
WAVELENGTH (nm)


15
CR 39 GREY GRADIENT
LIGHT AREA
DARK AREA
TRANSMITTANCE (%)
WAVELENGTH (nm)

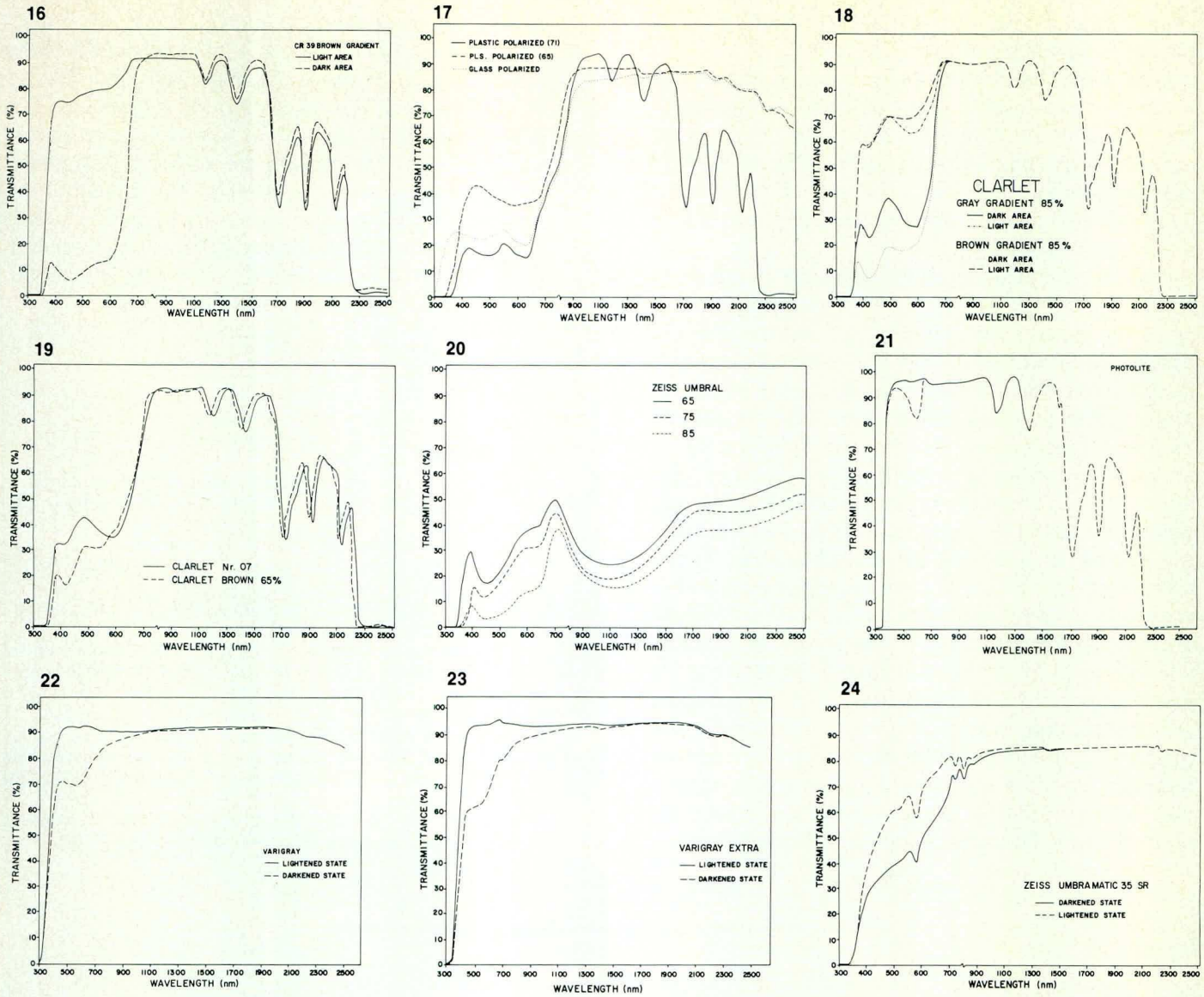


Fig. 1 **Spectral transmittance curves of children's sunglasses. There are significant differences in ultraviolet transmittance.**

Figs. 2-5 **Transmittance curves of Foster Grant sunglasses.**

Fig. 6 **Transmittance curves of Pirate (glass) and Tropical (plastic) lenses show the different infrared transmittance properties which we have demonstrated with tinted prescription lenses.[1]**

Fig. 7 **The transmittance data of the Solaire lens show how plastic gradient tints affect only the UV and visible regions of the spectrum.**

Figs. 8-10 **Transmittance curves of Riviera sunglass lenses.**

Fig. 11 **The Bollé Irex 100 lens has excellent protective qualities over the entire optical waveband.**

Figs. 12-20 **Transmittance curves of sunglass lenses supplied by wholesale optical laboratories.**

Figs. 21-24 **Transmittance curves of photochromic sunglass lens materials.**

The purpose of the present study was to determine whether the spectral transmittance characteristics of non prescription sunglass tints met advertised claims of protection from optical radiation. The figures show that in almost all cases these lenses provide a level of radiation protection which is comparable to or greater than that afforded by prescription lens tints.[1] This was irrespective of the suggested price of the sunglasses, which ranged from 65¢ to over $100.

This last point begs the question, how does one differentiate between a good and poor quality sunglass? Price is not a good indicator, as some "designer" sunglasses are priced according to fashion considerations, rather than quality of the frame and lenses. This is *not* to imply, however, that *all* expensive sunglasses are poor. Many such sunglasses are indeed of quality comparable to prescription spectacles. It is therefore necessary to educate the patient on how to inspect frames and lenses. While this is relatively simple for the trained

professional, it may not be quite so apparent to the casual sunglass purchaser.

Lens surfaces should be well polished with no visible surface defects such as ripples, scratches or pits. As with ophthalmic lenses, the presence of inclusions or other foreign matter within the lens substance is reason to reject the lens. Lenses should be mounted snugly with no gaps or tight spots around the eyewire.

Frames should be carefully inspected for cracks at solder points. Hinges should turn smoothly and be securely joined with screws (not rivets) and the moving parts should be metal. Nosepads should fit flush on the sides of the nose, without pinching or digging into the flesh. There should be no weight-bearing edges. Unless they are cable-type, temples should be long enough for the bend to begin just above the ear, but short enough that the ends are not below the earlobe. Temples, hinges and nosepad guardarms (if any) should be adjustable. These criteria are no different from those for acceptable prescription spectacle frames.[6] Comfort and safety are as important considerations as fashion. Mechanical soundness of the frame and ease of adjustment are just as important in choosing the "right" sunglasses.

In conclusion, most non-prescription sunglasses offer an acceptable level of protection from optical radiation from the ultraviolet through visible light to the near infrared, especially those advertised as blocking specific parts of the optical spectrum.

Acknowledgements

We thank Belvedere & Associates, Carl Zeiss Canada Ltd., Imperial Optical Ltd. and Morlee Distributors Inc. for supplying the sunglasses and lenses used in this study; N. Ahmedbhai, M.G. Hall and S.E. Jany for making the spectrophotometric measurements; and A. Weber for drawing the figures. This study was supported in part by grants from the Natural Sciences and Engineering Research Council of Canada (APC) and the Canadian Optometric Education Trust Fund (BRC).

References

1. Chou BR, Cullen AP (1983). Spectral transmittance of selected tinted ophthalmic lenses. *Can J Optom* 45(4): 192-198.
2. Chou BR, Cullen AP (1985). Spectral characteristics of sports and occupational tinted lenses. *Can J Optom* 47(2): 77-83, 88.
3. Borish IM (1970). Clinical Refraction 3rd Ed. Chicago: Professional Press. p. 1127.
4. US Food and Drug Administration. (1971) Statement of General Policy 21 C.F.R. 3.84. Use of impact-resistant lenses in eyeglasses and sunglasses. *Federal Register* 36 F.R. 8939. 15 May 1971.
5. American National Standards Institute (1977). American National Standard Requirements for Non-prescription Sunglasses and Fashion Eyewear. ANSI Z80.3-1977. New York: ANSI.
6. Brooks CW, Borish IM (1979) System for Ophthalmic Dispensing. Chicago: Professional Press, pp. 41-64.

Supplemental Note

New Instrument
"UV-Protec" Meter

Introduction

Although the evaluation of the spectral transmittance of prescription and nonprescription lenses may be made in the laboratory using sophisticated and expensive spectrophotometers, such instruments are neither readily available nor practical as in-office instrumentation. However practitioners often wish or are frequently asked to evaluate the protection afforded by sunglasses presented by patients. These are commonly of unknown origin and as we have mentioned earlier (1-4) it is usually not possible to deduce the degree of UV protection from the transmittance characteristics in the visible spectrum. In addition it is difficult to confirm the protective efficacy of UV-absorbing prescription lenses.

Evaluation

The OMS UV-Protec meter[1] (Figure 1) is designed for in-office use with the intent of measuring UV transmittance of a lens at 400 nm. The basic design of the UV-Protec meter (Figure 2) is a UV-A source and a photocell isolated by a long wavelength UV transmitting filter. The lens to be tested is placed over an aperture above the UV source and the movable photocell is placed in line as indicated. The top of the instrument is closed to prevent stray light effects and the reading is provided directly on a digital readout. The instrument is adjusted to a 100% without the test lens in position prior to taking the

[1] **Manufactured by: Optical Moulding Systems, 5120 de Courtrai, Montréal, Québec, H3W 1A7. Cost with only the UV photocell $475.00.**

reading. The digital readout suggests a precision of 0.1% although the manufacturer admits an error of ± 1.9% at 400 nm.

We compared the transmittance reading given by the UV-Protec meter with the transmittance recorded on the Zeiss DM 21 spectrophotometer at 390 nm and 400 nm, and the integrated UV-A (320-400 nm) transmittance of 20 different tinted lens samples used in our earlier studies published in the Canadian Journal of Optometry and elsewhere (1-4). The results indicated considerable variability, with the

Fig. 1 Prototype UV-PROTEC meter. The current production model does not use the separate sensing unit illustrated to the right of the meter.

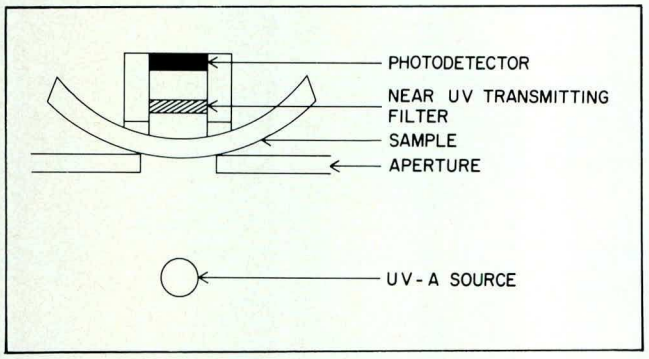


Fig. 2 Schematic design of the radiometric system.

UV-Protec meter measurements more closely corresponding to the spectrophotometric readings at 390 nm in many cases and the total UV-A transmittance in others.

Using UV interference filters as lens samples we found that the instrument is "blind" to UV-B (290-320 nm) but is still sensitive to the mid UV-A (365 nm).

Positive Features

The meter is easy to use without removing lenses from the frame. We found it to be most accurate for assessing UV protection afforded by lenses such as the UV-400, or CR-39 lenses treated with UV-Protec Dye. In addition, the UV reading is clearly demonstrable to the patient.

Negative Features

The reading is not accurate to 0.1% as suggested by the digital readout. The reading varies with the spectral transmittance characteristics of the sample lens in the UV-A. "Windows" in a lens in the UV-B band would not be detected, however we have detected no such windows in lenses specifically designed for UV and blue light protection.

Additional Features

Because of its modular design visible light and infrared radiation attachments will be available in the near future.

Conclusion

This instrument provides a simple method of evaluating near ultraviolet transmittance of spectacle lenses and sunglass lenses without the necessity of removing them from the frame. It functions within the limits of a simple radiometric system with a tendency to over estimate UV-A transmittance. From the practical viewpoint of whether a filter absorbs UV, the answer is readily provided by the UV-Protec meter.

References

1. Chou, B.R., Cullen, A.P. Spectral transmittance of selected tinted ophthalmic lenses. *Can. J. Optom.* (1983) 45(4):192-198.
2. Chou, B.R., Cullen, A.P., Egan, D.J. Spectral transmittance of contact lens materials. *Int. Contact Lens Clin.* (1984) 11(2):106-114.
3. Chou, B.R., Cullen, A.P. Spectral characteristics of sports and occupational tinted lenses. *Can. J. Optom.* (1985) 47(2):77-83, 88.
4. Chou, B.R., Cullen, A.P. Optical radiation protection by non-prescription sunglasses. *Can. J. Optom.* (1986) 48(1): in press.

University of Waterloo
School of Optometry Centre for Sight Enhancement
International Symposium on Low Vision
June 25 - 27, 1986

A three day Symposium devoted to clinical and research issues in low vision, with presentations from the field of optometry, ophthalmology, vision science and rehabilitation. Eighteen continuing education credit hours will be given for the three day event in the areas of optometric optics, paediatrics, low vision/geriatrics, optometric health assessment, epidemiology, environmental/occupational vision, patient management, physiological optics (areas 1, 2, 3, 6, 7, 8, 9, 10).

Among the participating lecturers are:

- Ian Bailey, O.D., California
- Jocelyn Faubert, M.A., Canada
- Eleanor Faye, M.D., New York
- Gerald Fonda, M.D., New Jersey
- Jacques Gresset, O.D., Canada
- Euclid Herie, L.LD., Canada
- Robert Hess, Ph.D., United Kingdom
- Adrian Hill, Ph.D., United Kingdom
- Jennifer Hill, Ed.D., Canada
- Lea Hyvarinen, M.D., Finland
- Jan Lovie-Kitchin, M.Sc. (Optom), Australia
- Teri Lawton, Ph.D., California
- Gordon Legge, Ph.D., Minnesota
- Eva Lindstedt, M.D., Sweden
- Shelly Marmion, Ph.D., Mississippi
- Sunanda Mitra, Ph.D., Texas
- Cathy Mullen, Ph.D., United Kingdom
- Margaret Paetkau, M.D., Canada
- S.J. Rog, Ph.D., Canada
- Janet Silver, M.Phil., United Kingdom
- Robert Weale, D.Sc., United Kingdom
- Stephen Whittaker, Ph.D., Philadelphia
- Peter Wong, M.D., Canada

Representative topics:

— Visual impairment and disability: enhancement and substitution
— Localization of defect in cortical visual impairment using topographic mapping
— The clinical profile of a young visually handicapped population
— Senile macular degeneration of the eye and Parkinson's disease
— A hierarchy of perceptual training in low vision
— Visual acuity deficits and chromatic aberration in pseudophakia
— Eye movement considerations in the assessment of retinal function in patients with maculopathy
— Differential retinal structural damage exhibited by image enhancement of fundus photographs
— Low vision performance as a function of task characteristics
— Pathology characteristics and optical correction of 900 low vision patients
— Rights of low vision children and their parents

Full registration fee is $350 Canadian, or $125/day for partial registration. Enrollment is limited; preregistration is strongly advised.

Symposium Secretariat

Dr. G.C. Woo
Chairman

Dr. R. Pace
Secretary General

Ms. L.M. Hanna
Coordinator

The Centre for Sight Enhancement
School of Optometry
University of Waterloo
Waterloo, Ontario N2L 3G1

For further details, please clip and send the form below:

International Symposium on Low Vision

University of Waterloo — June 25 - 27, 1986

Please forward details about the Symposium to me as indicated:

Mr. ____ Mrs. ____ Ms. ____ Dr. ____ _____ _____
Surname — Given name

_____
Street Address

_____ _____ _____
City — Province — Postal Code

Mail to: Lynne Hanna, Coordinator
International Symposium on Low Vision
School of Optometry
University of Waterloo
Waterloo, Ontario N2L 3G1

WHEN WE FIRST INTRODUCED TRUVISION PROGRESSIVE POWER LENSES, WE NEVER DREAMED WE'D ATTRACT SO MUCH COMPETITION.

Other companies have tried to copy the American Optical TruVision™ progressive power lens. But when it comes to technical superiority, nothing else comes close. TruVision lenses have less aberration than any other progressive lens on the market today. This means TruVision lenses are easier to fit, and most important, easier for your patients to adapt to. The intermediate corridor is wide and useable. The reading segment provides the utility of a 28mm reading portion. So if you want the progressive power lenses that outperform all the others, you want the original that can't be duplicated. The TruVision progressive power lens. A tough act to follow.

AO®

American Optical® TRUVISION™ PROGRESSIVE LENSES

AOCO LIMITED/LIMITÉE 60 Mobile Drive, Toronto, Ontario M4A 3R7 SUBSIDIARY OF AMERICAN OPTICAL CORPORATION

CASE REPORT

Traumatic Retinal Detachment

T.D. Williams*

History

At age 19, while playing tennis, the patient was struck in the right temple by a tennis ball. She contacted several eye care practitioners during the month following the accident, but no retinal problems were detected at any of these visits. Her first visit was sought primarily because of the recent eye injury: she had no symptoms at that time. A week later, the patient noted some flashing lights and arranged another consultation. No significant retinal problems were found at that time.

Two months later, she became aware of vision losses in the right eye. A superior temporal retinal detachment was detected at that time, and was successfully treated. A scleral buckle was put in place as part of the retinal detachment surgery. This is seen in Fig. 1.

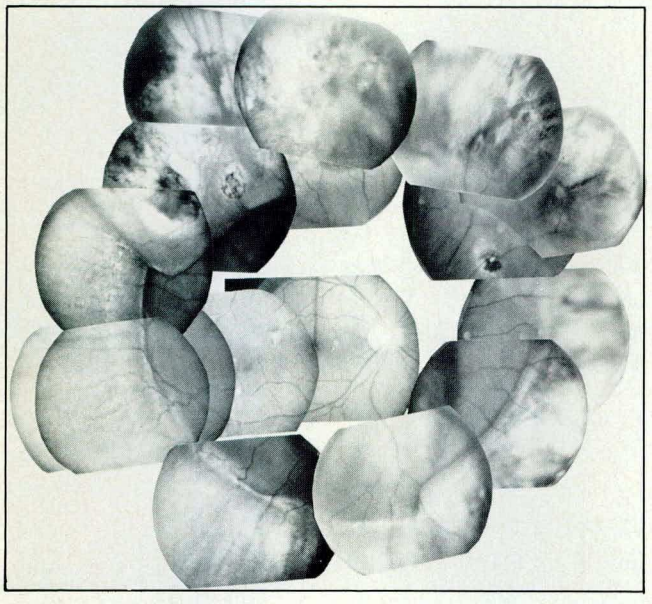


Fig. 1

Her visual fields are shown in Fig. 2. She was 5 D myopic in the right eye following surgery. Both eyes had been essentially emmetropic prior to the surgery.

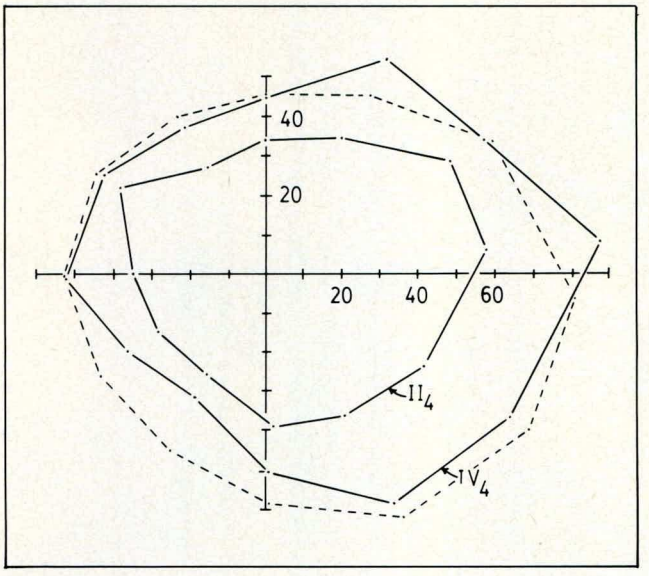


Fig. 2

Comments

In the scleral buckling procedure, a silicone rubber band is permanently placed around the eyeball (close to the equator), converting its roughly spherical shape to an hourglass shape. The indentation of the retina due to the rubber band is readily seen in Fig. 1. Scleral buckling usually results in an increase in axial length, which explains the myopia found in this case. One of the major aims of scleral buckling is to release vitreous tension on the retina; otherwise, this tension could lead to further detachments. In this case, the surgeon elected to produce a higher buckle by placing two pieces of silicone rubber underneath the band: one of these is seen starting at 10:00 and the other is seen ending at 5:00 along the buckle.

The scarring seen around the periphery indicates areas where the surgeon used either heat (diathermy) or cold (cryopexy) to induce an inflammation which caused the detached retina to adhere to the outer layers of the eye. Cryopexy was used in this case.

While the shapes of the patient's visual fields are reasonably normal, the fields are considerably constricted when compared to normal fields for her age group. The broken lines in Fig. 2 show a normal

*O.D., M.S., Ph.D., Professor
School of Optometry, University of Waterloo

I-4 isopter for a 25 year old age group. The area of the patient's II-4 isopter (which should be larger than a normal I-4 isopter) is only 47% of the area of the normal I-4 isopter shown in Fig. 2. The cause for this field reduction is not clear, although it could be related to the severe changes in receptor direction caused by the scleral buckle.

Regarding the two-month delay in the detection of the patient's retinal problem, it should in fairness be pointed out that retinal detachments due to blunt injury frequently follow an insidious course[1]. The blow causes a peripheral hole which allows a slow entry of fluid into the subretinal space. A large, billowing retinal detachment is uncommon in such cases. In fact, such retinal holes may cause visual disturbances more suggestive of central serous retinopathy than retinal detachment. Thus many retinal detachments due to blunt injury are not detected until the macula becomes involved. Field testing could certainly give a much earlier warning of the need for retinal detachment surgery in such cases.

References:

1. Cox, M.S., Schepens, C.L., and Freeman, H.M., Retinal detachment due to ocular contusion, *Arch Ophthalmol* 1966; 76:678-685.

Continued from p. 11

of Canada. This is because there is a shortage of Canadian optometrists with post O.D. training; a number of those with such qualifications prefer the rewards of practice to those of academia. The number of University of Waterloo School of Optometry graduates entering graduate or residency programmes remains small. A new graduate can command much higher remuneration than a new assistant professor with four or five years more training.

It is our opinion that most manpower studies tend to generate more optimistic pictures than actually exist. Trends that have already occurred in the United States and the United Kingdom are beginning here, with O.D.'s working in administrative or clinical positions in community clinics, hospitals or as full time consultants/researchers in industry including those producing contact lenses and pharmaceuticals.

The aggregate optometric student body in Canada is more than 50% female. The long term effects, with regard to manpower needs, of an optometric work force which is increasingly female has not been addressed satisfactorily. A number of our students are considering residency programmes in the United States, others write the American National Board Examinations. Since only a few Canadian optometrists find their way to other countries we feel that this number is not significant at this time. We note that there are only one or two full time public service optometrists (compared with numerous physicians and dentists) and that there are no military optometrists (compared with over 600 in the United States). Should there be changes in policies, which would encourage optometrists into such positions, the overall effect on the manpower needs might well be considerable.

Much energy has been expended over many years in attempts to develop a second optometry school in English Canada. We would welcome and support such a development. Although initially this would strain the limited optometric educator resources of Canada, the long term effects of reducing the shortage of practitioners and increasing the competition for well qualified educators would enhance the attractions of a university career. Based on our experiences at the School we wish to offer the following suggestions with regard to any new school in Canada. It must be located in a prestigious university which has full academic resources and graduate facilities. Preferably it should also be located at an institution with one or more other *primary* health care programmes. The latter eliminates the need to educate the university's administration as to the special needs of a clinical programme, the relevance of clinical duties and the need for differential salary scales. The university should be located within a large enough patient drawing area for the clinics to operate at an optimum level. Factors which have aided in recruiting faculty at Waterloo include the impression that Southern Ontario offers a good quality of life, the close proximity of Toronto with its many attractions including easy air travel to anywhere in the world, and the international reputation enjoyed by the University of Waterloo as a whole. We often hear it stated that the manpower needs of optometry schools can be relieved by having certain courses taught by professors from other departments. Even within a university well experienced with optometric education frequently such courses are unsatisfactory.

Continued support of COETF is vital since this fund provides a prime source of direct and indirect funding for Canadian optometrists seeking post professional education. The funds generated by WATFUND are used principally to modify, develop and re-equip our clinical facilities. In addition to support received from the optometric profession we are also indebted to funding received from Federal and Provincial government agencies, other agencies, the University of Waterloo, the corporate sector and private individuals. The profession continues to do an excellent job in recruiting outstanding young men and women for the School. We would urge you to pay particular attention to those who show potential for a career in optometric education.

The Pattern Evoked Electroretinogram: Origin, Characteristics and Clinical Usage

J.V. Lovasik*
A.C. Kothe**

Abstract

This paper consists of a literature review of the clinical observations of the pattern electroretinogram (pERG) and theories concerning its origin. Normative data are presented for subjects aged 20 to 29 years to document variations in pERG response characteristics as a function of selected stimulus parameters. Clinical cases of visual neural dysfunction are also presented to illustrate the usage of pERGs in the realm of electrodiagnostic testing. Emphasis is placed on new or complimentary information provided by these retinal potentials.

Résumé

Ce document consiste en une revue de la documentation relative aux observations cliniques des électrorétinogrammes de grille et aux théories sur leur origine. Il présente des données normatives sur des sujets de 20 à 29 ans afin de documenter les variations de réponse électrorétinographique en fonction de certains paramètres d'excitation. On y présente aussi des cas cliniques de dysfonction nerveuse visuelle pour illustrer l'emploi des ERG de grille dans le domaine électrodiagnostique. L'accent est porté sur l'information nouvelle complémentaire générée par ces potentiels rétiniens.

Introduction

The clinical electroretinogram (ERG) can be elicited in the human eye by a diffuse flash of light. It is now widely accepted that the flash ERG (fERG) originates in the outer and middle third of the sensory retina (Brunette, 1982, Norden, 1979): the outer retina containing the photoreceptors and the middle third consisting of bipolar, Mueller, horizontal, and amacrine cells. Each of these layers contribute to a separate component of the biphasic fERG; the electronegative a-wave originates in the receptors while the electropositive b-wave originates in the middle retinal layer.

Recently the ERG has also been investigated in response to the use of patterned visual stimuli such as checkerboards or bar gratings reversed in counterphase. Figure 1 illustrates the difference in stimuli used for flash and pattern ERGs. In comparison to the diffuse fERG, which is universally accepted as a luminance-evoked response, general agreement does not exist as to whether the pattern ERG (pERG) is exclusively a pattern-evoked response, a luminance-evoked response, or whether both components occur. Furthermore, there are some conflicting reports concerning the site of generation of the pERG in man, and the degree and nature of changes in the pERG in various ocular disorders and systemic diseases affecting vision. Some of the discrepancies in vision literature undoubtedly arise from the technical difficulties in recording the pERG which is a very low amplitude signal (0 to 4 microvolts) and the variety of test conditions used to elicit the retinal response.

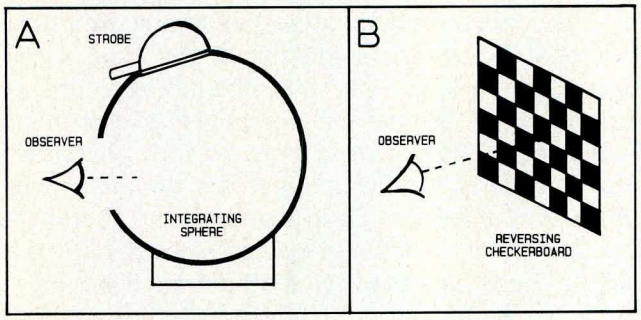


Fig. 1
Diagram illustrating the stimuli used to elicit the flash ERG (Plate A) and pattern ERG (Plate B). For the fERG, the observer receives a light flash delivered by a strobe directed into a light integrating sphere. This method of stimulation (Ganzfeld presentation) ensures a uniform distribution of light across the retina and a response from all portions of the retina. The pERG is elicited by a checkerboard target generated electronically on a television monitor. The black and white checks can be reversed in counterphase at a fixed rate, and check sizes changed to produce high to low spatial frequency stimulation.

*B.Sc., M.Sc., O.D., Ph.D., F.A.A.O.
**B.Sc., O.D.
School of Optometry, University of Waterloo

Nevertheless, based mainly on fairly extensive clinical observations of alterations in pERGs in ocular diseases of varying severity, but only one animal laboratory study, the current trend is to view the pERG as a reflection of ganglion cell activity.

This paper reviews some of the literature pertaining to the nature and origin of the pERG, and its clinical appearance in ocular disease. In addition, the recording methodology for the pERG, and clinical cases are presented to show its diagnostic utility in relation to other objective neurophysiological tests of visual function employed at the University of Waterloo, School of Optometry, Electrodiagnostic Clinic.

Pattern versus Luminance Responses

As early as 1973, Spekreijse et al (1973) proposed that the ERG in response to checkerboard pattern-reversal stimulation was the summed response of local luminance increases and decreases. This was later supported by Riemslag et al (1983) who also concluded that contrast specific components play no role in the generation of the pERG and suggested that it was due solely to local luminance distortions. In an earlier study, however, Korth (1983) had evaluated pattern- and luminance-evoked responses in the human ERG using pattern onset-offset (pattern appearance-disappearance) stimuli and determined that the pattern-onset wave exhibited spatial selectivity with a peak amplitude at 3 to 4 cycles/degree. Further studies by Korth & Rix (1984) indicated that the spatial selectivity occurred at a constant spatial frequency (maximum amplitude at 3.67 cycles/degree) but was more evident at low contrast.

Origin of Pattern Evoked ERG

Maffei & Fiorentini (1981) observed the pERG in a cat model before and after unilateral optic nerve section. Using sinusoidal gratings of varying spatial frequencies (.17 to 2.5 cycle/degree) reversed at 8 Hz, Maffei & Fiorentini demonstrated that 4 months after sectioning, no pERG could be elicited from the test eye at any spatial frequency. The control eye had pERG amplitudes similar to those obtained prior to the operation. For the test eye, the pERG responses became attenuated earlier at low spatial frequencies indicating that perhaps ganglion cells with larger receptive fields located more peripherally in the retina were impaired before those with smaller receptive fields, located in the central retina. Flash ERGs remained comparable in amplitude between the 2 eyes and comparable to that obtained prior to the optic nerve section. Histological analysis of the retinas indicated degeneration of the ganglion cell layer, more so in the periphery than in the centre of the retina.

This single laboratory study is frequently referenced as providing the strongest evidence that the pERG has its origin in the ganglion cell layer of the retina. However, the applicability of the results of this study to man has recently been questioned since the retina of the animal model used for experimentation (the domestic cat) differs both anatomically and physiologically from man (Zrenner et al, 1985). Further well-controlled studies using primate-like models are required to validate the current clinical impression concerning the nature and origin of the pERG in man.

Optic Nerve Disorders

ERGs in response to sinusoidal gratings of varying spatial frequency and fERGs have been examined in patients with unilateral retinal and optic nerve diseases (Fiorentini et al 1981, 1982). In all these patients, the fERG was normal whereas the pERG was absent or reduced in amplitude in the diseased eye. Patients examined included those with unilateral optic nerve atrophy, retrobulbar optic neuritis, temporary occlusion of the central retinal artery, monocular chronic glaucoma and unilateral section of the optic nerve. The observation that the pERG is altered in optic nerve disease led Fiorentini et al to conclude that the ERG in response to alternating gratings was correlated with the functional integrity of ganglion cells.

May et al (1982) compared the records of flash and pattern ERGs in patients with optic nerve dysfunction and noted that fERG amplitudes and latencies were normal whereas pERGs showed abnormalities. In the early stages of optic nerve disease, abnormalities in the pERG were seen when they were elicited by low spatial frequency sine-wave gratings and large check size stimuli. In more advanced optic nerve disorders, pERGs elicited by gratings of higher spatial frequencies or smaller check sizes were also affected. The observed relationship between spatial frequency requirement of the visual stimuli used to elicit the pERG and pERG alterations support the theory that the generators of pERGs are the ganglion cells which are known to have spatial requirements for optimal excitation (Davson, 1980).

Dawson et al (1982) recorded the pERG using a dot matrix phase alternating stimulus pattern from the eyes of one subject with a unilateral optic nerve section resulting from trauma. While no pattern ERG or Visually Evoked Response (VER) could be recorded from the lesioned eye, a normal flash ERG was elicited. Responses from the contralateral eye were normal for both flash and pattern evoked ERGs as well as VERs. These results led to the hypothesis that the ganglion cells and optic nerve are responsible for the ERG recorded in response to pattern stimuli.

In contrast to the above findings, Arden et al (1982) found that, in 12 patients, there was no reduction in the pERG during the acute stage of

unilateral optic neuritis although VER changes were evident and form vision was absent. As vision returned, 2 to 7 weeks after the attack, the pERG was larger in the affected eye suggesting a hypernormal phase due to hyperexcitation of the neurons at the point of degeneration. Still later, the pERG was reduced in the affected eye, an observation believed to be consistent with some retrograde degeneration of the optic nerve. The same researchers (Vaegen et al, 1982) also demonstrated that the pERG was reduced in conditions such as multiple sclerosis, trauma, and toxic optic neuritis.

In a study with results similar to those of Arden et al, Sherman (1982) reported that in 7 patients with long-standing optic nerve disease, pERGs were not grossly abnormal but VERs were extinguished. In a further study, Sherman & Richardson (1982) obtained relatively normal pERGs in both eyes to 14, 28 and 56 min. check sizes for 3 patients with unilateral optic nerve atrophy due to trauma. These results were interpreted as indicating a preganglionic source for pERGs. More recently, however, Celesia & Kaufman (1985) noted that in 7 eyes with diagnosed optic atrophy, pERGs were abnormal in 67% of cases when checkerboards with 15 min. checks were used to elicit the ERGs and 57% of cases when 31 min. checks were used, while fERGs were normal in all cases.

Multiple Sclerosis

Kirkham and Coupland (1983) examined the pERG in 28 patients with multiple sclerosis (MS) and did not find any significant differences in the pERG latency or amplitude when compared to subjects without MS. Bobak et al (1983) also found normal pERGs in 8 out of 10 patients with MS. On the other hand, Persson & Wanger (1984) reported significantly reduced pERG amplitudes in 50% of MS patients who had prolonged VER latencies. The reduction in pERG amplitude was significantly correlated with the magnitude of the delay in macular-cortical transmission. No significant difference from the normal group was noted in those patients who had normal VER latency measures. Additionally, no association was found between pERG amplitude and optic nerve appearance or history of optic neuritis. Persson & Wanger concluded that since an increased VER latency is indicative of optic nerve demyelination and the reduction in pERG amplitude is associated with prolonged VER latency, then pERGs probably reflect retinal ganglion cell activity.

In a recent study of 14 patients with MS, Celesia & Kaufman (1985) reported that pERGs were abnormal only in those who had pale optic discs or central field loss. MS patients with normal visual acuity had normal pERGs but delayed transient VERs. The discrepancy between the findings pertaining to the optic nerve head appearance and pERGs in this study and that of Persson & Wanger may be due to differences in the age of onset and duration of MS in the two test groups as well as the number of attacks of optic neuritis suffered by each patient.

Amblyopia

The pERG has also been studied in amblyopia. One study by Sokol & Nadler (1979) indicated that pERGs were more affected in amblyopia than fERGs. These findings provided the first electrophysiological evidence that amblyopia may have to be considered as a retinal phenomenon and not merely a manifestation of a cortical dysfunction. In another study, a significant reduction in waveform and amplitude was observed between normal and amblyopic eyes in patients who had no occlusion therapy or who had failed to improve with such therapy (Arden et al, 1980a). Further studies by Arden et al (1980b) and Arden & Wooding (1985) confirmed a significant reduction in pERG response from the amblyopic eye as compared to the normal eye and provided further support for the notion that amblyopia may be associated with changes in the peripheral retinal layers at the level of generation of the pERG. In their study of 62 amblyopic children, Arden & Wooding (1985) indicated that in most amblyopic children the pERG amplitude was reduced, although not absent. Reduction of the pERG associated with amblyopia was not related to the angle of deviation, poor fixation or improper optical correction. Additionally, occlusion therapy in young children reduced the pERG of the fellow eye but orthoptic training could increase the pERG. The difference in pERG amplitudes between the amblyopic and contralateral eye increased with decreasing check size (Vaegen et al, 1982). The onset and duration of visual deprivation have been shown to be positively related to the degree of disturbance of the pERG (Vaegen et al, 1982, Arden et al, 1982). This latter observation has led to the suggestion that the pERG is a direct measure of the function of cells in the inner retina, such as the amacrine or ganglion cells or the synaptic potentials feeding onto such cells.

Glaucoma

In 11 patients with unilateral glaucoma, no significant difference was observed in the amplitude of the fERG between glaucomatous and normal eyes, whereas a significant reduction in amplitude between the 2 eyes was found for the pERG. The oscillatory potentials in the flash ERG were equal in both eyes suggesting that their generators, likely the amacrine cells, are not affected in the glaucomatous process. The loss of pERG amplitude was significantly correlated with the visual field loss inferring impaired activity of the ganglion cells (Wanger & Persson, 1983a, Wanger & Persson, 1983b).

In a recent study of 28 eyes of glaucoma patients, Papst et al (1984) found normal pERG amplitudes in all glaucomatous eyes with normal optic nerve head appearance and visual field findings. Normal latencies but reduced amplitudes of the pERG were found in eyes with ophthalmoscopically detectable abnormalities in the optic nerve head and visual field defects. A functional impairment of the ganglion cell layer was tentatively identified as the cause of the reduced pattern ERG amplitude in glaucomatous eyes.

Ringens et al (1984) studied a group of 75 glaucoma patients and concluded that the pERG amplitude is reduced and the implicit time is significantly delayed. Bobak et al (1983) also reported the absence of a pERG in 3 out of 4 eyes with chronic glaucoma.

Thus, some studies point towards abnormal pERGs in patients with glaucoma while others report abnormal pERGs in glaucoma only when there are accompanying changes in the optic nerve head or measureable field changes. The difference in findings may be due to the degree and duration of glaucoma in the test groups as well as individual variations in ocular vascular perfusion pressures. The relationship of this latter factor to intraocular pressure and their combined influence on the function of retinal ganglion cells has not been examined systematically by pERGs.

Maculopathies

Support for the role of ganglion cells in the production of the pERG comes from Kirkham & Coupland (1981) who reported abnormal pERGs associated with cherry-red-spot-myoclonus syndrome. Although fERGs were normal, VERs were delayed, and pERGs were significantly reduced in amplitude. The absent pERG response was believed to reflect damage to the ganglion cells resulting from their storage of an abnormal metabolic product.

Arden et al (1984) reported reduced pERG amplitudes in 37 out of 40 patients with ocular disease restricted to the macular area. The average pERG amplitude was less than one-quarter of the normal value and was not correlated with fERG findings. A significant correlation did exist between the reduction in pERG amplitude and the reduction in visual acuity. The pERG therefore appeared to be a sensitive index of retinal abnormalities.

Celesia & Kaufman (1985) also reported abnormal or absent pERGs in 5 patients with maculopathies. Sherman (1982) found abnormal pERGs and VECPs to 14 and 28 min checks in patients with macular pathology.

Clinical Implications

Although a majority of researchers view the pERG as a pattern-evoked rather than a luminance-evoked response, vision literature contains conflicting reports as to the site of generation of the pattern ERG and the effect of various ocular disorders on the pERG response. Until this controversy is resolved and some of the factors affecting the pERG are better understood, the pERG should not be used in isolation as a procedure to arrive at a definitive differential diagnosis in the clinical environment.

Electrodes for ERG Recordings

There is a variety of electrode types available for recording the clinical ERG, in particular, the fERG. These devices consist of both corneal and non-corneal electrodes (Fig. 2-A) although recording from non-corneal sites (usually the lower lid margin) is often less than satisfactory due to variations in signal capture properties, attenuation of signal amplitude, and considerable electrical noise. Most corneal electrodes are not suitable for recording pERGs due to reduced optics resulting from the combination of the electrode and solutions used to protect the eye during testing. In addition, these electrodes require corneal anaesthesia, and are poorly tolerated by some patients, especially young children.

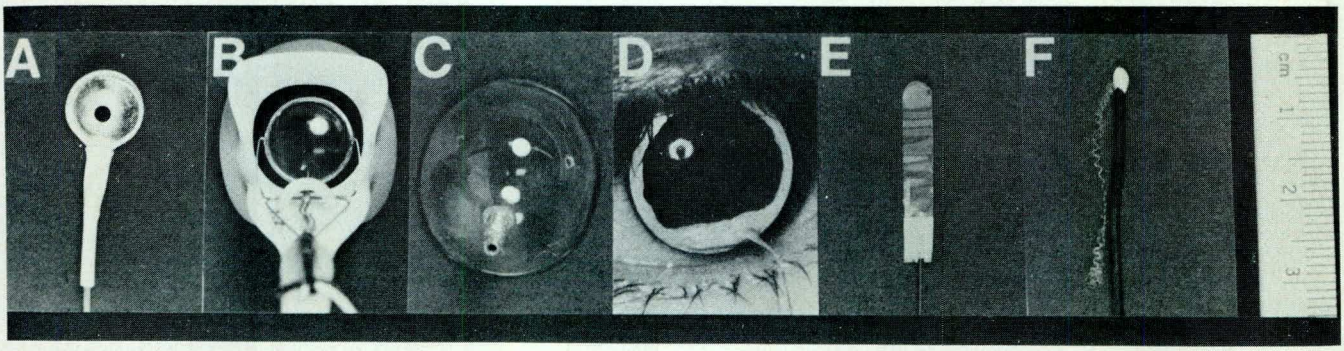


Fig. 2
A variety of electrodes used for recording the ERG, A: Surface cup electrode normally placed just below the lower lid margin. B: Burian-Allen electrode with lid speculum. C: Karpe electrode; a large haptic lens fitting under the upper and lower lids. D: A piggyback hard-soft contact lens electrode system. Electro-conductive silver paint on the rigid lens makes electrical contact with the cornea via the soft lens. (Figure adapted from Bloom & Sokol, 1977) E: Gold foil electrode. For use, the foil is shaped to vault the lid margin and touch the inferior corneo-scleral margin. F: DTL type fiber electrode. The scale on the right hand side applies to all frames but frame D.


LET'S CELEBRATE SOMETHING SPECIAL.

Allergan Inc.
SCIENCE WITH VISION

100 million Hydrocare "Fizzy" Protein Remover Tablets have been used already.

For more than ten years you've recommended Hydrocare "Fizzy" Protein Remover Tablets and with good reason.

Hydrocare "Fizzy" Protein Remover Tablets have been used successfully by over one million Canadian contact lens wearers.

Hydrocare "Fizzy" Protein Remover Tablets have proven to be effective and compatible with all soft (including extended wear) and gas permeable contact lenses.

Allergan, through its commitment to research and development, will continue to bring you the finest products in contact lens care.

HYDROCARE "FIZZY" PROTEIN REMOVER TABLETS.

NOW ONTO THE NEXT 100 MILLION.

The Burian-Allen electrode (Fig. 2-B) is possibly the most widely used electrode for recording fERGs. It consists of a silver ring embedded in a plastic contact lens, which rests on the cornea, and a speculum that keeps the lids open (Riggs, 1977). A corneal anaesthetic, as well as a cushioning agent, typically methylcellulose, is required when the Burian-Allen electrode is used to record the fERG. Other types of electrodes commonly used for fERG recording include the Karpe and Henkes electrodes (Riggs, 1977) (Fig. 2-C).

Several researchers have designed new forms of electrodes suitable for recording the pERG. Bloom & Sokol (1977) introduced a corneal electrode system consisting of a silver ring painted on a plastic contact lens which sat atop a large soft contact lens (Fig. 2-D). In this piggyback system no corneal anaesthetics or other solutions are required. The optical characteristics of this electrode sandwich were reported to be excellent (Bloom & Sokol, 1977), and pERGs were successfully recorded.

Arden et al (1979) described the use of an ERG electrode made of gold foil and Mylar film (Fig. 2-E). This electrode was reported to be inexpensive, simple to fabricate and most importantly, non-irritating since the electrode hooked over the lower lid and made electrical contact with the cornea only at the inferior limbal area. Because this electrode did not interfere with the optics of the eye, pERGs could be recorded.

Dawson et al (1979) developed a corneal electrode (DTL electrode) consisting of a low mass conductive thread made of spun nylon fibres impregnated with metallic silver (Fig. 2-F). The thread is draped on the cornea or placed into the lower conjunctival sac and electrical contact with an averaging computer is made through the cornea-tear film-nylon thread interfaces. The DTL electrode is easily made in the laboratory from commercially available nylon fibre. Preliminary testing with the DTL electrode indicated excellent patient acceptance with no reports of corneal pain. Corneal anaesthesia is not usually required, nor are additional cushioning agents needed. Since the DTL electrode does not interfere with form vision, pERGs may be recorded.

Due to its ease of production, excellent patient acceptance, and non-interference with the optics of the eye, a DTL type electrode is the electrode of choice for recording pERGs in the Electrodiagnostic Clinic at the University of Waterloo, School of Optometry.

Contrast Dependent Electrodiagnostic Tests

The two most frequently utilized non-invasive electrophysiological tests of visual function that employ patterned visual stimuli are the Visually Evoked Response (VER) and the pattern dependent ERG. Both of these diagnostic procedures generally use checkerboard targets with checks of variable spatial frequency reversed in counterphase at pre-set rates. Although the response frequency of the retinal (pERG) and macular-cortical (VER) mechanisms parallel each other, as well as the checkerboard reversal rate, the amplitude and temporal features of salient components of the response differ significantly. Important differences also exist between the response amplitude-stimulus pattern size function for the pERGs and pattern VERs. To evaluate and compare the pERG and VER waveform morphology and their amplitude and time characteristics as a function of pattern size and reversal rate we recorded the pattern ERGs and VERs from each eye of 10 payed volunteers (6 males and 4 females) aged 20 to 29 years. All subjects had good ocular health, steady centered fixation and visual acuity of at least 20/20 (6/6) in each eye.

Pattern ERGs were recorded using fiber electrodes (Fig. 3-A) similar to those described by Dawson et al (1979). The fiber portion of the electrode was moistened with physiological saline, and then positioned in the lower conjunctival sac of the test eye (Fig. 3-B). The wire portion of the electrode cemented to the fiber was taped to the skin slightly below the lateral canthus, allowing the fiber to vault the lid margin. An adult size pre-gelled Ag/AgC1 electrode normally used for electrocardiograms was positioned about 1 cm temporal to the lateral canthus and served as a reference electrode. The circular plastic adhesive collar for the Ag/AgC1 electrode was cut tangentially to eliminate lid irritation once applied to the lateral canthus. (Neonatal/pediatric monitoring electrodes made by Ferris Manufacturing Corp. Illinois offer the advantage of a soft electrode that readily conforms to facial contours and has a more easily removeable collar for pediatric testing and for patients with sensitive skin.) A similar electrode placed on the inner wrist served as the electrical ground. Skin-

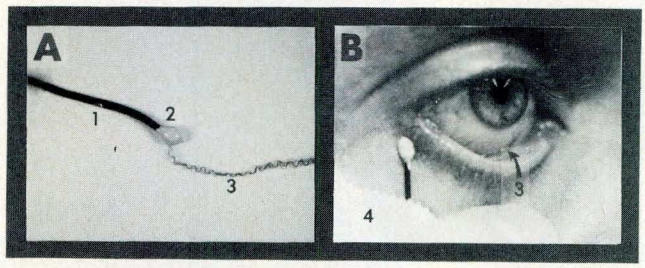


Fig. 3
A: Fiber electrode used to record pERGs. The key to the small numbers in plates A and B is as follows: 1) multi-stranded copper wire, 2) non-conductive epoxy covering the cold silver solder joint between nylon fibers and copper wire, 3) nylon thread composed of 6 to 7 silver impregnated nylon fibers, 4) surgical adhesive tape securing fiber electrode to temporal periorbital area.

B: Plate showing fiber electrode positioned in lower fornix. The lower lid is everted for illustration purposes. During testing, the lower lid covers the fiber portion of the electrode and holds the fiber in the lower cul de sac.

electrode impedance for the active electrode was in the order of 0.5 to 1.0 Kohms, and 0.5 to 2.0 Kohms for the reference and ground electrodes.

VERs were recorded using an active electrode placed approximately 2 cm above the inion with the reference electrode 6 cm higher along the mid-sagittal plane. The right ear served as the electrical ground.

The subject monocularly viewed a reversing checkerboard pattern on a Nicolet 1006 television monitor. The overall checkerboard field size for the 1 m observation distance was about 13 degrees by 17 degrees. A Spectra Pritchard photometer was used to measure the luminance of central and peripheral sectors of the checkerboard field. The space averaged luminance of the television screen was about 100 cd/sq m. Checkerboard check contrast was calculated to be about 87% by the following formula:

$$\text{contrast} = (L_{max} - L_{min}) / (L_{max} + L_{min}),$$

where Lmax was the measured luminance of a white check and Lmin was the measured luminance of a black check. Testing was performed for checks subtending 7, 14, 28, 56 and 112 min of arc at the corneal plane. All recordings were made with subjects wearing their habitual ophthalmic corrections. No cycloplegics or mydriatics were instilled into the observers' eyes.

Steady state pERGs and VERs were recorded for a checkerboard reversal rate of 7.5 Hz. An average of 100, 500 msec epochs constituted a single trial. Transient pERGs and VERs were recorded for a checkerboard reversal rate of 1.9 Hz. An average of 100, 200 msec epochs formed a single trial. Low and high bandpass input filters were set at 1 and 30 Hz, respectively.

The electrodiagnostic unit available to the investigators required that the testing sequence consist of sequential measurements of the steady state and transient pattern ERGs followed immediately by sequential recordings of the steady state and transient pattern VERs. The availability of a multi-channel averaging computer allowing independent specification of signal amplification for each channel would have made simultaneous recordings of VERs and ERGs possible, and significantly decreased the subject-investigator contact time.

ERGs and VERs were amplified (X10,000) on a Nicolet CA-1000 averager and stored on floppy diskettes for subsequent retrieval and analysis. Digitized data was down-loaded into a slave computer that had specially designed software for analysis and plotting of ERG and VER waveforms. The slave computer was programmed to search for and measure trough-to-peak amplitudes and display the averaged amplitude of salient waves in the evoked potentials.

Results

Group averaged steady state and transient ERG and VER amplitudes, as a function of checkerboard check size, are shown in Fig. 4-A and 4-B, respectively. Both steady state and transient VERs demonstrated spatial tuning properties with peak amplitudes occurring for a check size of 14 minutes of arc. The amplitudes of VERs decreased for check sizes below and above the selective maximal response tuned for 14 minute checks.

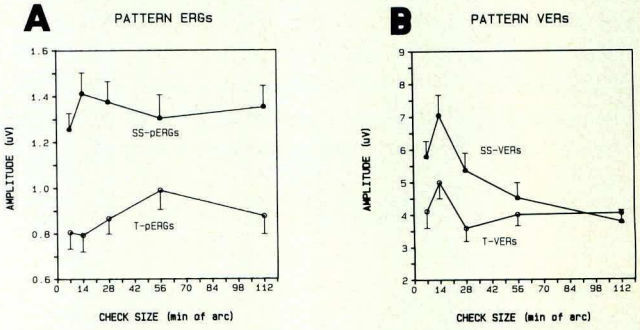


Fig. 4

A) Amplitude of the steady state pattern ERG (SS-pERG) and transient pattern ERG (T-pERG) as a function of checkerboard check size. For frames A and B each data point is the group averaged value for ERGs and VERs for 20 eyes. Vertical bars through the data points represent standard error of the mean (SEM) bars. For illustration purposes, only plus or minus SEM values are shown for each data point. The SS-pERG did not show strong spatial tuning, although there was a tendency to peak near 14 minutes of arc checks. T-pERGs showed a clear tuning for 56 minute checks.

B) Amplitude of the steady state pattern VER (SS-VER) and transient pattern VER (T-VER) as a function of checkerboard check size. Both SS-VERs and T-VERs showed clear spatial tuning for 14 minutes of arc checks.

Group averaged steady state pERGs demonstrated a trend for a peak in the response amplitude for 14 minutes of arc check sizes. This tendency for spatial frequency tuning at or close to 14 minutes of arc was also seen for a group analysis for right and left eyes. An analysis of the group averaged amplitudes of the q-wave (first major positive peak) in the transient pERG for each check size showed a strong tendency for the amplitude-check size function to peak at 56 minutes of arc. Thus, the transient pERG spatial tuning was for target sizes about four times as large as those for either the steady state pERGs and VERs or transient VERs.

The absolute amplitudes of the steady state and transient VERs and ERGs differed greatly. Group averages with standard error values are given in Table 1. On average, steady state VERs were approximately four times as large as steady state ERGs, while transient VERs were about five times larger than transient ERGs.

The implicit times (time from onset of a stimulus to the peak of the stimulus related response) of the P-1 and q waves of the transient pattern VER and ERG, respectively, varied with checkerboard check size.

Fig. 5 shows the implicit time of the P-1 and q waves as a function of check size. For the transient VER, the implicit time decreased with an increase in check size from 7 to 28 minutes of arc and then increased with a further increase in check size. The shortest implicit time was seen for the 28 minutes of arc checks. The biphasic implicit time-check size function for the transient VER was in sharp contrast to that seen for the transient pERG which showed a near linear trend. The implicit time of the q wave decreased as the checkerboard check size increased. In general, the implicit time of the P-1 component of the transient VER was much longer than the implicit time of the q wave in the transient ERG. The shortest time for P-1 (106 msec) was about twice as long as the shortest time for the q wave (54 msec).

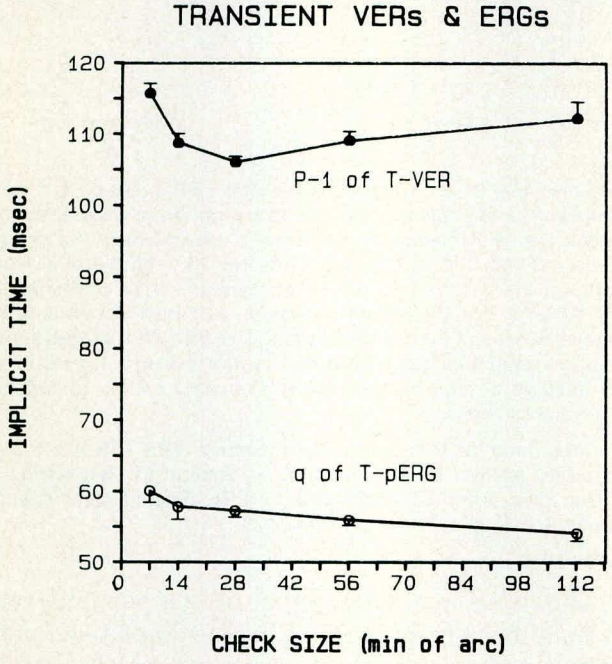


Fig. 5
The implicit time of the first major positive wave in the transient pattern VER (P-1 component) and transient pattern ERG ('q' wave component) as a function of checkerboard check size. The implicit time of P-1 decreased as check size was increased, reached a minimum value for 28 minutes of arc checks, and then increased with a further increase in check size. The implicit time of the 'q' wave varied monotonically with checksize, showing a progressive decrease with increased check size.

Sample recordings of steady state and transient pERGs and VERs for one subject are presented in Fig. 6. These records show the similarity of the waveforms elicited for each test condition and highlight the differences in amplitude and temporal aspects of retinal versus macular-cortical recordings.

Electrodiagnostic Evaluation of Visual Dysfunction

The function of the human visual system can be assessed objectively at various levels by the judicious selection and application of one or several electrodiagnostic procedures. Recently the pattern

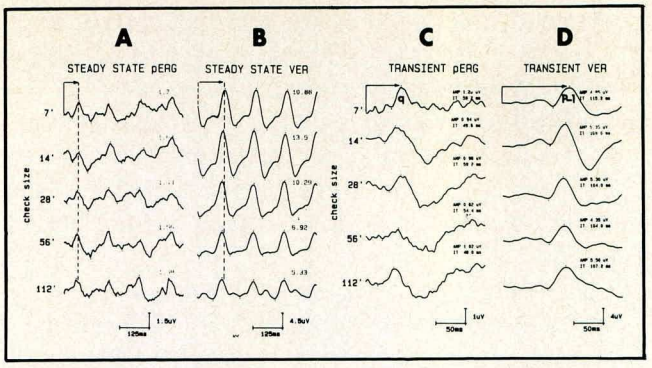


Fig. 6
Sample recordings for one subject for steady state pERGs (A), steady state VERs (B), transient pERGs (C), and transient pattern VERs (D). Each wave represents the average of 100 epochs. Note the similarity in the waveform for steady state recordings at the retinal level (A) and cortical level (B) but the very large difference in the amplitude of the response. The amplitude calibration scales at the bottom of each column of waves show that the VERs are several times larger than the ERGs. The horizontal arrows drawn above the first record in each column emphasize the difference in the time of occurrence of the first positive peak in ERG and VER samples within the steady state or transient recording mode. The longer implicit times for the VERs reflect the neural transmission time from the eyeball to the macular projection areas in the visual cortex. The small number beside each record for steady state pERGs or VERs is the computer determined average trough-to-peak amplitude of the first three consecutive positive waves. For transient recording conditions, the small numbers indicate the computer measured amplitude and implicit time of the 'q' and P-1 waves. The 'q' wave for the pERG and the P-1 wave in the VER are identified in bold print in the first record in columns C and D. The dots within each waveform identify the computer selected troughs and peaks for the 'q' and 'P-1' components.

Table 1 pERG and VER Amplitudes

	Pattern ERGs		VERs	
Check size (min of arc)	Steady State (uV)	Transient (uV)	Steady State (uV)	Transient (uV)
7	1.26 ± 0.07*	0.81 ± 0.07	5.79 ± 0.47	4.12 ± 0.52
14	1.41 ± 0.09	0.79 ± 0.07	7.05 ± 0.63	5.00 ± 0.49
28	1.38 ± 0.09	0.87 ± 0.07	5.37 ± 0.53	3.59 ± 0.40
56	1.31 ± 0.10	0.99 ± 0.09	4.51 ± 0.47	4.01 ± 0.35
112	1.38 ± 0.09	0.88 ± 0.08	3.77 ± 0.36	4.04 ±0.30

*wave amplitude ± standard error of the mean
N=20 eyes

ERG has been incorporated into the well-established range of neurophysiological tests used in the Electrodiagnostic Clinic at the University of Waterloo, School of Optometry. The scope and nature of the electrodiagnostic tests together with the specific and general levels in the visual system examined by these procedures is schematically illustrated in Fig. 7. The cases presented below will demonstrate the clinical application of these non-invasive tests towards the diagnosis of the nature and extent of visual dysfunction. Emphasis will be placed on any new or complimentary diagnostic information provided by transient or steady state pattern electroretinograms.

Case 1: Optic Neuritis

A 28 year old female, JM, with a history of retrobulbar optic neuritis and pars planitis in the left

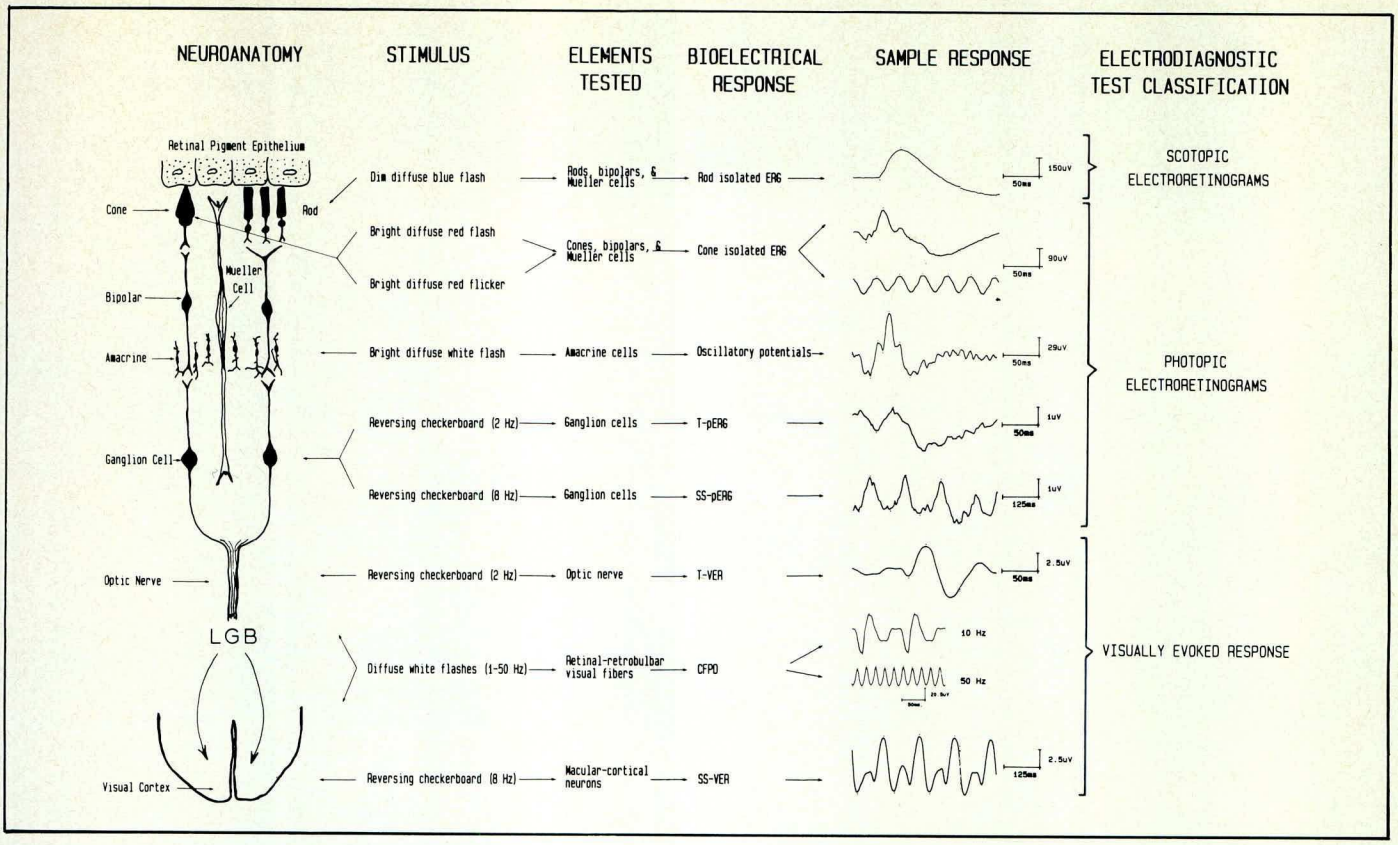


Fig. 7
Schematic representation of the test procedures used to clinically assess the functional integrity of various cellular elements within the retina and retrobulbar components of the visual system. Compare the amplitude-time characteristics for the sample waveforms provided for each test procedure. The pattern ERGs are much smaller than pattern or flash VERs. The key to some abbreviations used are as follows: T-pERG (transient pattern electroretinogram), SS-pERG (steady state pattern electroretinogram), T-VER (transient visually evoked response), CFPD (critical frequency of photic driving), SS-VER (steady state visually evoked response).

eye voiced complaints of some retrobulbar pain on movement of the eye at the time of testing. Aided visual acuities were OD, 20/20 (6/6), 0S, 20/30 -1 (6/9 -1).

An evaluation of gross cone function in each eye by photopic flash and flicker ERGs did not reveal any major dysfunction in either eye (see Fig. 8-A). The amplitudes of both flash and flicker ERGs were within normal limits, but the responses from the left eye were marginally smaller than those from the right eye. An assessment of the amacrine cell layer function by photopic oscillatory potentials did not disclose significant differences between the two eyes or deviation from normal limits, although the first oscillatory potential for the left eye was not well differentiated (see Fig. 8-B). Steady state pERGs were used to evaluate the ganglion cell layer function. The differential response to reversing checkerboards with graded check sizes revealed relative differences between the right and left eyes (see Fig. 8-C). Steady state pERGs for the right eye indicated spatial frequency tuning to 14 min checks while the left eye showed a progressive increase in response amplitude with increased check size. A significant reduction in the pERG amplitude and altered waveform for the left eye for 7 and 14 min checks inferred that the more centrally located ganglion cells with finer receptive fields were more affected than more peripheral ones which normally respond to larger check sizes. An evaluation of visual neurons within the macular-cortical tract by steady state VERs showed a significantly reduced response in the left eye for smaller check sizes (7, 14, and 28 min) (see Fig. 9-A). This indicated that the cause of the reduction in measured visual acuity for the left eye was an organic lesion. An examination of the optic nerve transmission property by transient VERs showed a significantly reduced amplitude for the left eye although implicit times were comparable for both eyes and within normal limits (see Fig. 9-B). This indicated a decreased number of responding fibers in the left eye, but no demyelination of residual visual fibers since the implicit time of P-1 was normal.

For this patient the combination of photopic ERGs and VERs localized the earliest site of the lesion to the ganglion cell layer in the left eye. This did not exclude lesions in retrobulbar visual pathways, but confirmed that the inflammatory process left sequelae within the innermost layer of the retina. The steady state pattern ERG and VER data were complimentary since very similar amplitude-check size functions were revealed within and between each eye.

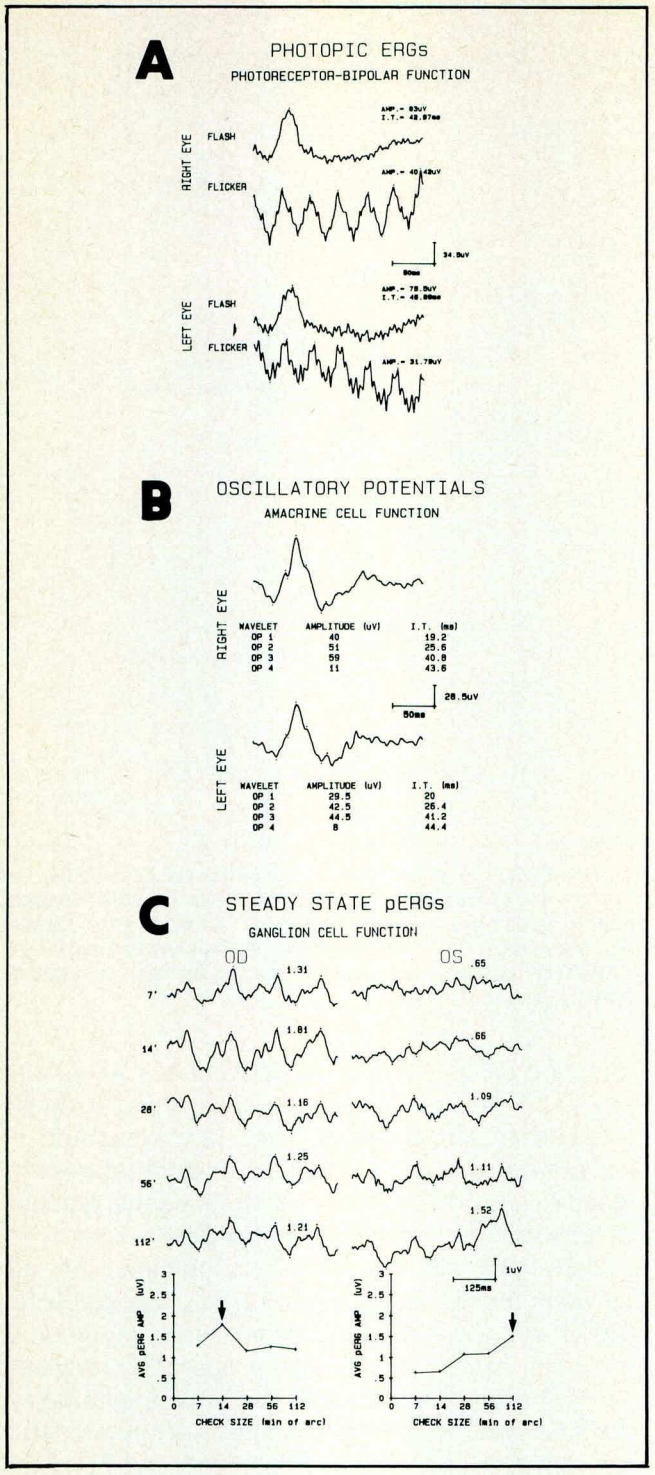


Fig. 8
Photopic ERGs (A), oscillatory potentials (B), and steady state pERGs (C) for a patient with a history of retrobulbar optic neuritis and pars planitis in the left eye. Photoreceptor and amacrine cell functions were within normal limits for both eyes. Pattern ERGs showed a loss of sensitivity to high spatial frequency stimuli in the affected eye. The small inverted arrows indicate the peak pERG response for each eye and emphasize the loss of ganglion cells responsive to fine detail in patterned stimuli.

Case 2: Multiple Sclerosis

KB, a 42 year old female, had a history of right optic neuritis and confirmed multiple sclerosis. Aided visual acuities were OD, 20/20 (6/6), OS, 20/15 -1 (6/4.5 -1).

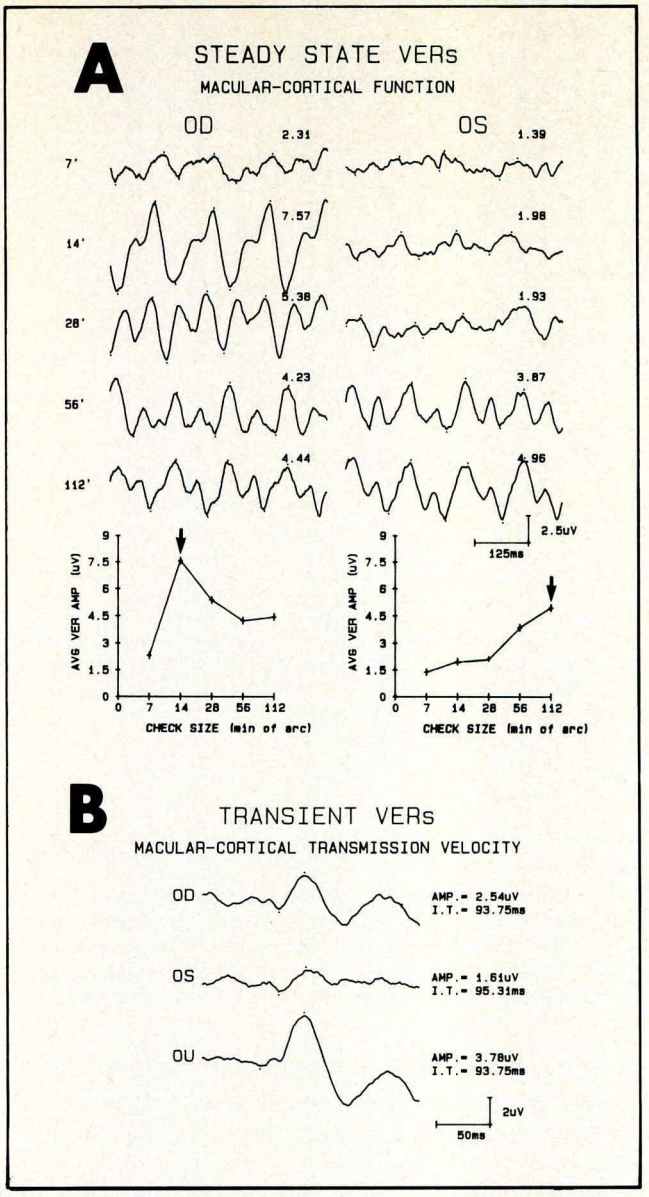


Fig. 9
Steady state and transient VERs for the same patient whose test results are shown in Figure 8. A clear reduction in the SS-VER waveform was seen in the left eye for 7 to 28 minutes of arc checks. The right eye showed a normal amplitude-check size function. The implicit time of P-1 in the transient VERs was equal and within normal limits for each eye. However, the amplitude of P-1 for the left eye was significantly reduced, indicating optic nerve damage.

Photopic flash and flicker ERGs were almost identical for the two eyes, and did not indicate any major cone dysfunction in either eye. Photopic oscillatory potentials were well formed and equal for the two eyes. Steady state pERGs revealed a similar relationship between wave amplitude and check size for the two eyes, with spatial frequency tuning to 56 min check size (Fig. 10-A). However, responses were attenuated for the right eye for all spatial frequencies inferring a reduction in the functional integrity of central and peripheral ganglion cells. Steady state VERs (Fig. 10-B) indicated normal functional integrity of macular-cortical pathways for both eyes but a considerably reduced response in the right eye for the 7 minutes of arc check size.

Transient VERs revealed a reduced amplitude for the right eye with a slightly prolonged transmission time (Fig. 10-C).

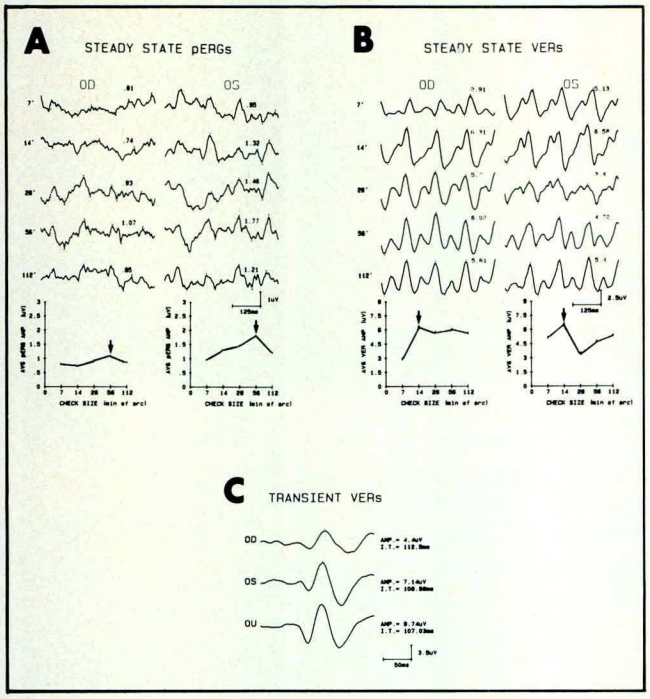


Fig. 10
Steady state pattern ERGs (A), steady state VERs (B), and transient pattern VERs for a 42 year old female with diagnosed multiple sclerosis and recurrent optic neuritis for the right eye. SS-pERGs showed spatial tuning for 56 minutes of arc checks (see inverted arrows) while the SS-VERs showed spatial tuning for 14 minutes of arc checks. The reduced responsivity to checks of all sizes for the pERGs from the right eye correlated with the patient's report of inferior vision for that eye even though she could attain 20/20 vision in both eyes. Transient VERs showed a slight delay in macular-cortical transmission time for the right eye as well as a reduced amplitude of the P-1 wave.

For this patient the electrodiagnostic test procedures implicated a lesion in the ganglion cell layer with some demyelination of the optic nerve for the right eye. These findings corroborated the patient's symptoms of inferior vision for her right eye despite a measurement of normal visual acuity.

Case 3: Glaucoma

A 70 year old male, PL, with a history of glaucoma in the right eye was assessed in the Electrodiagnostic Clinic. Prior to the therapy for glaucoma, the intraocular pressures were OD 32 mm Hg, OS 16 mm Hg. At the time of the electrodiagnostic assessment the pressures were OD 23 mm Hg, OS 17 mm Hg. Aided visual acuities were OD, 20/20 (6/6), OS, 20/25 +2 (6/7.5 +2). Superior visual fields were constricted in the right eye with some loss in the superior and inferior arcuate areas. The contrast sensitivity function, evaluated at the near point, indicated an overall depression for all spatial frequencies for the right eye.

Photopic flash and flicker ERGs were detectable but reduced in amplitude for the right eye. This finding was attributed to the inequality of pupil size (OD 2.5 mm, OS 6 mm) resulting from the use of miotics to lower the intraocular pressure in the right eye and/or a possible generalized dysfunction of the photoreceptors. Photopic oscillatory potentials did not reveal any significant differences between the two eyes. Steady state pERGs indicated spatial tuning for 28 min check size for the right eye and an increase in response amplitude with increased check size for the left eye (Fig. 11-A). A maximal response was seen for the 56 minutes of arc checks for the left eye. The differential response across spatial frequencies for the two eyes with reduced responses for higher spatial frequencies (small checks) in the left eye pointed towards a neural abnormality in the non-glaucomatous eye, probably due to non-pathological aging phenomena. The reduced pERG for the small checks likely reflects changes in ganglion cells tuned to higher spatial frequencies, and accounts for the reduction in visual acuity for that eye. Assuming an identical non-pathological selective deterioration of ganglion cells tuned for higher spatial frequencies to be present in the right glaucomatous eye, the larger response to 7 minutes of arc checks can be attributed to the optical effects of the miotic pupil which enhances retinal imagery by the associated increased depth of focus. The loss of sensitivity to lower spatial frequencies (larger checks) is consistent with the literature reports of earlier loss of more peripherally located ganglion cells in glaucoma which require larger targets for optimal excitation. Steady state VERs showed similar functional integrity of macular-cortical pathways for both eyes (Fig. 11-B). Transient VERs showed optic nerve

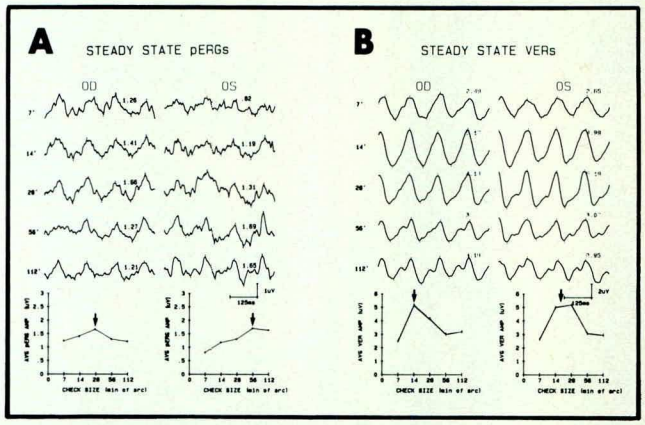


Fig. 11
Steady state pattern ERGs (A) and steady state VERs (B) for a 70 year old male with unilateral glaucoma in the right eye. VERs show similar amplitude-check size functions with maximal response amplitude centered at or close to 14 minutes of arc checks. SS-pERGs showed amplitude-check size functions that differed significantly for the two eyes. The small inverted arrows show response peaks for different check sizes for the two eyes. As well, a loss of sensitivity for lower spatial frequencies (larger checks) is seen in the glaucomatous eye. The greater response in the right eye for small checks may be due to enhanced retinal imagery resulting from the pupillary miosis caused by the pharmacological management of glaucoma.

POLYCON® II SPE* Bitoric Contact Lenses

The primary goal of contact lens fitting should be to keep the cornea healthy—Polycon II (silafocon A) SPE Toric Lenses are designed to improve the lens/cornea relationship.

Toric Cornea with Spherical Lens

Toric Cornea with SPE Bitoric Lens

POLYCON II SPE TORIC LENSES CAN PROVIDE YOU WITH THE FOLLOWING:

- Corneal Stability for the Astigmat
- Ease of Fitting
- Excellent Lens Quality
- Ability to Fit Most Difficult Patients
- Excellent Visual Acuity
- Can Provide Better Performance than Spherical Gas Permeable Lenses on Toric Corneas Over 2 Diopters
- An Alternative to Soft Toric Lenses

SOLA-SYNTEX

SOLA SYNTEX OPHTHALMICS
3287 American Drive, Suite 3
Mississauga, Ontario
L4V 1T8
TELEPHONE (416) 673-1606

*Spherical Power Effect

transmission times to be prolonged bilaterally at a rate consistent for the advanced age of the patient.

In this patient loss of functional integrity was indicated at the photoreceptor and ganglion cell layer.

Case 4: Senile Macular Degeneration

WL, a 71 year old male patient, had reduced acuity in the left eye likely attributable to incipient senile macular degeneration. Aided visual acuities were OD, 20/20+1 (6/6 +1), OS, 20/25 (6/7.5).

Photopic flash and flicker ERGs indicated similar gross cone function for the two eyes with no significant deviation from the normal. Oscillatory potentials were unremarkable. Pattern ERGs (Fig. 12-A) exhibited spatial tuning to 28 min checks for both eyes, however response amplitudes were more reduced at higher and lower check sizes for the left eye. The reduced response at high spatial frequencies (small checks) was interpreted as a neural reflection of decreased potential for high resolution. Steady state VERs (Fig. 12-B) did not indicate a significant difference between the two eyes with respect to macular-cortical function. Optic nerve transmission time was typically and equally prolonged in both eyes for the patient's age.

In this case, the pERG was the only indicator of visual acuity deficits in the left eye.

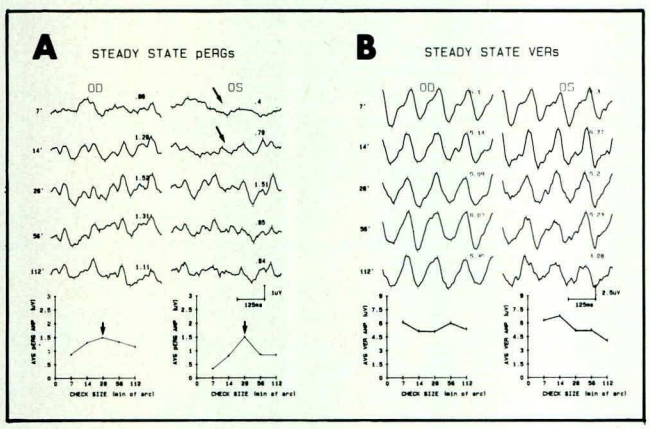


Fig. 12
Steady state pattern ERGs (A) and steady state VERs (B) for a 71 year old male with incipient senile macular degeneration in the left eye. VERs were unremarkable inasmuch as they showed similar intact macular-cortical pathways. On the other hand, while the response amplitude-check size function for the pattern ERGs peaked at 28 minutes of arc checks for both eyes, responses for high spatial frequencies (small checks) for the eye with presumed incipient macular degeneration were attenuated in comparison to the right eye. The small oblique arrows identify those records for the left eye where the waveform and signal strength were significantly reduced.

Discussion

The present investigation has shown that the two electrodiagnostic tests most commonly used to evaluate form vision, the pattern ERG and VER, can be differentially or similarly affected in ocular disease processes. Alterations in the pERG amplitude-check size function may be paralleled by similar changes in the VER (case 1), interocular differences in the overall level of the pERG sensitivity across the spatial frequency spectrum of check sizes may occur without a comparable alteration in the VER amplitude-check size function (case 2), and interocular differential loss of pERG sensitivity at specific spatial frequencies may not be accompanied by similar frequency dependent interocular differences in the VER amplitude-check size function (case 3 and 4). The fact that pERGs and VERs are similarly affected in optic nerve disease (case 1) suggests that they have a common generator, or alternatively, two distinct generators in close spatial proximity or in serial functional order. The apparent dissociation of pERGs and VERs, seen as alterations in the pERG amplitude-check size functions without changes in the same function for VERs, suggests that the pERG may be a more sensitive indicator of subtle neural dysfunction than the VERs. This may be explained on the basis of the most commonly accepted view concerning the origin of the pERGs; if pERGs reflect activity of retinal ganglion cells with representation in very large sectors of the visual field (Vaegan et al, 1982), then they may be more vulnerable to decay since disease processes affecting both central or peripheral vision would impinge on the pERG. On the other hand, pattern VERs may be less susceptible to visual neural disease than pERGs since they primarily reflect the functional integrity of neural links between retinal macular areas and their cortical projections. Thus an ocular disease such as glaucoma which clinically is diagnosed by its early preferential damage to arcuate fibers (Bjerrum's scotoma) may not be detected by the VER until extensive pressure related damage has occurred to the peripheral optic nerve fibers, or less severe damage has occurred to fibers corresponding to the macular areas.

The cases presented emphasize the value of performing both pERGs and VERs in order to identify subtle visual neural dysfunctions. For the patient with retrobulbar optic neuritis (case 1) the VERs readily identified the organic lesion causing the reduction in central vision. The pERGs were not essential for diagnostic purposes but did parallel VER results and helped to elucidate the full extent of neural damage. In the case of the patient with multiple sclerosis and right optic neuritis (case 2) the VERs detected functional loss for only high spatial frequency targets (7 min of arc checks) in the affected eye. The pERGs for that eye, however, showed a more generalized loss of sensitivity for all spatial frequencies tested. These results are reminiscent of those from contrast sensitivity testing where in spite of normal Snellen visual acuity measurements, a global decrease in contrast sensitivity is often seen for all spatial frequencies in

the presence of patient complaints of reduced visibility in the affected eye. Similarly, the detection of interocular differences in pERG amplitude-check size functions without significant differences in VER amplitude-check size functions emphasizes the necessity of employing multiple test procedures for clinical diagnostic purposes.

The discrepancies in ophthalmic literature pertaining to the effects of ocular and systemic disease on the pERG may be largely due to the restricted scope of stimuli used to evoke the retinal response. Most studies (Bobak et al, 1983, Persson & Wanger, 1984, Papst et al, 1984) have employed single check size checkerboards or bar gratings in their evaluation of retinal function. It is clear from the results of this study that testing with multiple check size checkerboards yielding a profile of the differential response across spatial frequencies (Trick & Trick, 1984) constitutes a more effective procedure for revealing neural deficits. The pERG amplitude-check size profile allows a broad spectrum interocular comparison of visual performance in cases of unilateral ocular pathology. The determination of distinctly different monocular response amplitude-stimulus size profiles or sensitivity levels for a patient is a diagnostic finding signalling the need for repeated or expanded investigation for incipient or previously undetected ocular disease. The pERG profile analysis also provides a viable method for monitoring longitudinal alterations in the physiology of ganglion cells where an assessment of interocular or intraocular changes can be made on a relative basis. Inter-trial variations in absolute pERG amplitudes due to variations in electrical resistances for the recording electrodes in situ can be ignored, thereby avoiding potential errors in diagnosis.

In summary, our examination of the relationship between pERG amplitudes and the spatial frequency of checkerboard checks in a group of subjects without ocular disease revealed a clear spatial frequency tuning for transient pERGs and a less distinct tuning for the steady state pERGs. Transient and steady state VERs showed a peak response for 14 minutes of arc checks. There were no significant interocular differences in any of these response amplitude-stimulus size functions. In contrast, subjects with diagnosed diseases showed significantly different pERG profiles. In all cases presented, the pERG duplicated VER findings or provided information not present in VER records. We conclude that the pERG is a useful clinical diagnostic procedure when used in conjunction with other well established electrophysiological tests. Care must be exercised in the use of pERGs for they can be difficult to record and show considerable variability in even normal subjects. Failure to record pERGs should not be considered diagnostic until repeated attempts with different electrodes and stimulus parameters have confirmed their extinction.

Acknowledgements

This study was funded in part by NSERC and MRC grants to Dr. J.V. Lovasik. The authors gratefully acknowledge the participation of the subjects in this study, and excellent research assistance by C. Gauthier and A. McMechan who held NSERC summer studentships throughout this study. The expert services of the departmental computer technologist, Mr. J. Cassidy, are also gratefully acknowledged.

References

Brunette JR. Clinical electroretinography. Part 1: Foundations. *Can J Ophthalmol* 1982;17:143-9

Norden LC. The electroretinogram: concepts and clinical applications. *J Am Optom Assoc* 1979;50:81-7.

Spekreijse H, Estevez O, van der Tweel LH. Luminance responses to pattern reversal. *Docum Ophthalmol Proc Ser* 1973;2:205-11.

Riemslag FCC, Ringo JL, Spekreijse H, Verduyn Lunel H. The distinction between luminance and spatial contrast components in the pattern ERG. *Docum Ophthalmol Proc Ser* 1983;37:255-264.

Korth M. Pattern-evoked responses and luminance-evoked responses in the human electroretinogram. *J Physiol* 1983;337:451-469.

Korth M, Rix R. Effect of stimulus intensity and contrast on the pattern ERG. Ophthalmic Res 1984;16:60-6.

Maffei L, Fiorentini A. Electroretinographic responses to alternating gratings before and after section of the optic nerve. *Sci* 1981;211:953-5.

Zrenner E, Hess RF, Baker CL, Schwarzer J. Fundamental differences between pattern electroretinograms of cat and man. *Invest Ophthalmol Vis Sci* 1985;Suppl:112.

Fiorentini A, Maffei L, Pirchio M, Spinelli D, Porciatti V. The ERG in response to alternating gratings in patients with diseases of the peripheral visual pathway. *Invest Ophthalmol Vis Sci* 1981;21:490-3.

Fiorentini A, Maffei L, Pirchio M, Porciatti V, Spinelli D. Pattern ERG in patients with unilateral alterations of the retinal ganglion cells. *Docum Ophthalmol Proc Ser* 1982;31:131-3.

May JG, Ralston JV, Reed JL, Van Dyk HJL. Loss in pattern-elicited electroretinograms in optic nerve dysfunction. *Am J Ophthalmol* 1982;93:418-22.

Davson H. Physiology of the eye. New York: Academic Press, 1980:290.

Dawson WW, Maida TM, Rubin ML. Human pattern-evoked retinal responses are altered by optic atrophy. *Invest Ophthalmol Vis Sci* 1982;22:796-803.

Arden GB, Vaegan, Hogg CR. Clinical and experimental evidence that the pattern electroretinogram (pERG) is generated in more proximal retinal layers than the focal electroretinogram (fERG). *Ann NY Acad Sci* 1982;388:580-601.

Vaegan, Arden GB, Hogg CR. Properties of normal electro-retinograms evoked by patterned stimuli in man. *Docum Ophthalmol Proc Ser* 1982;31:111-29.

Sherman J. Simultaneous pattern-reversal electroretinograms and visual evoked potentials in diseases of the macula and optic nerve. *Ann NY Acad Sci* 1982;388:214-26.

Sherman J, Richardson V. What is the origin of the pattern reversal electroretinogram in humans? *Invest Opthalmol Vis Sci* 1982;Suppl:138.

Celesia GG, Kaufman D. Pattern ERGs and visual evoked potentials in maculopathies and optic nerve diseases. *Invest Opthalmol Vis Sci* 1985;26:726-35.

Kirkham TH, Coupland SG. The pattern electroretinogram in optic nerve demyelination. *Can J Neurol Sci* 1983;10:256-60.

Bobak P, Bodis-Wollner I, Harnois C, Maffei L, Mylin L, Podos S, Thronton J. Pattern electroretinograms and visual-evoked potentials in glaucoma and multiple sclerosis. *Am J Opthalmol* 1983;96:72-83.

Persson HE, Wanger P. Pattern-reversal electroretinograms and visual evoked cortical potentials in multiple sclerosis. *Brit J Ophthalmol* 1984;68:760-4.

Sokol S, Nadler D. Simultaneous electroretinograms and visually evoked potentials from adult amblyopes in response to a pattern stimulus. *Invest Ophthalmol Vis Sci* 1979;18:848-55.

Continued on p. 46

RESEARCH

Asteroid Bodies in the Vitreous

J.W. Potter*
W.L. Jones**
M. Crutchfield***

Abstract

Asteroid bodies are frequently observed in the vitreous but there are many clinicians who confuse asteroid bodies with synchysis scintillans. This review attempts to clarify the differential diagnosis of these disorders. However, there remains some uncertainty regarding the association of asteroid bodies with systemic disease.

Résumé

On observe souvent des corps astéroïdes dans le vitré de l'oeil, mais de nombreux cliniciens confondent les corps astéroïdes et le synchisis scintillant. L'étude tente d'éclaircir le diagnostic différentiel de ces affections. D'autre part, il demeure une certaine incertitude quant à la relation entre les corps astéroïdes et les maladies générales.

Introduction

Asteroid bodies in the vitreous were first differentiated from other disorders of the vitreous by Benson nearly a century ago[1]. He reported the case of a 62-year-old man with complaints of three or four spots before the sight of his right eye and asthenopia. The examination of the patient was unremarkable except the vitreous of the right eye was filled with innumerable fine spheres that Benson called "stars on a clear night". A typical case of asteroid bodies is shown in Figure 1. Unfortunately, Benson named this disorder "asteroid hyalitis" in spite of the fact that there were no signs of ocular inflammation. Subsequently, others criticized this terminology and, as a result, many names were advanced to describe asteroid bodies which included Benson's disease, scintillatio nivea, scintillatio albescens, asteroid hyalopathy, and asteroid hyalosis. We have chosen to use "asteroid bodies in the vitreous", which we feel represents the most descriptive terminology, in this manuscript.

Epidemiology

Although the incidence of asteroid bodies has not been reported, the prevalence (Table 1) has been documented to be from 0.01% to 0.90%[2-7].

Many of the clinical characteristics of the disorder can be tabulated from the 351 cases reported in the

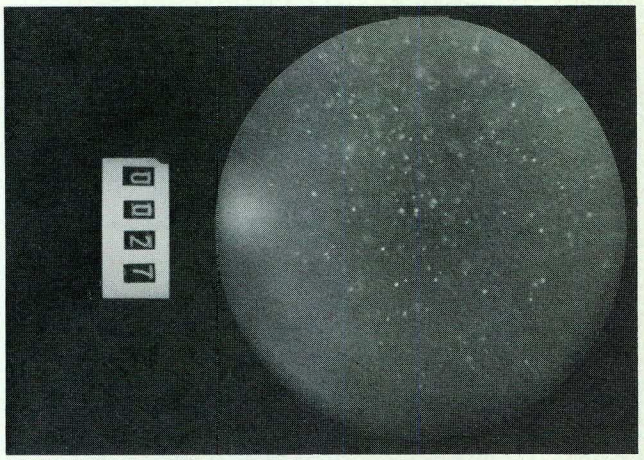


Fig. 1: Asteroid bodies in the vitreous.

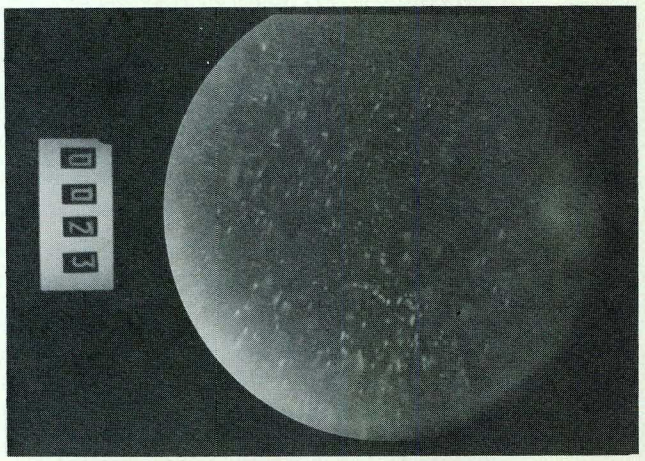


Fig. 2: Symptomatic asteroid bodies in the vitreous.

*O.D., VA Outpatient Clinic, Las Vegas, NV SCCO, Fullerton, CA
**O.D., VA Medical Centre, Albuquerque, NM Coll. of Optom., Univ. of Houston, Houston, TX
***O.D., SCCO, Fullerton, CA

Table 1
Prevalence of Asteroid Bodies

Investigator (Year)	Rate	Prevalence (%)
Webster (1884)	5/45,000	0.01%
Dor (1908)	32/82,732	0.04%
Westphal (1915)	40/65,000	0.06%
Gorduren (1948)	16/14,350	0.04%
Hatfield (1962)	32/6,346	0.50%
Potter (1980)	14/1,559	0.90%

literature[6-15]. A calculated-weighted average age was 67 years, with a range from 30 to 96 years. There were slightly more males than females. Almost 90% of the cases were unilateral. There was not adequate data available to ascertain any possible racial factors associated with the prevalence of asteroid bodies in the vitreous.

Symptoms

In spite of the fact that Benson reported a patient who had asteroid bodies with symptoms of floaters, Rutherford declared in an extensive review of the subject that asteroid bodies did not cause any symptoms or visual acuity loss[9]. However, in 1965, Cibis reported two cases that showed very poor visual acuity[16] and in 1976, Yamada and Shimizu also reported two patients with poor visual acuity attributed to asteroid bodies in the vitreous[17]. A 70-year-old woman had 20/60 distance visual acuity with her right eye through dense asteroid bodies. The other patient, a 61-year-old woman had 20/200 distance visual acuity with her right eye through dense asteroid bodies and 20/25 distance acuity through a few asteroids in the left eye. In both 1981 and 1983 there were additional reports of patients with asteroid bodies in the vitreous severely impairing vision[18-19]. These patients both had vitrectomies in an attempt to improve vision. Recently, we reported four patients who had either floaters, poor visual acuity, or both caused by asteroid bodies in the vitreous[15]. One of our patients with symptoms of floaters from that report is represented in Figure 2. Thus it would appear that contrary to many previous publications and many standard textbooks, asteroid bodies in the vitreous may infrequently cause vision symptoms of either floaters, poor visual acuity, or both.

Clinical Features

Although almost universally observable by ophthalmoscopy, the slit-lamp microscope provides the best opportunity for a comprehensive view of asteroid bodies. When they are viewed with direct focal illumination, asteroid bodies appear as smooth, white or yellow, spheres of many sizes. Occasionally, a few asteroid bodies may be pigmented[20]. They appear black by retroillumination, and often are seen to be arranged as a string of irregular spheres. Closer examination of these strings of asteroid bodies frequently will reveal that they are arranged along the course of the fibers of the vitreous. Asteroid bodies move about with eye movements, and they are most mobile in eyes with extensive vitreous liquefaction, or in posterior vitreous detachment. They may occasionally appear in the anterior chamber in aphakic eyes[21]. Regardless, asteroid bodies return to their original configuration when eye movements halt, and they do not appear in Cloquet's canal, in liquefied vitreous, or the retrovitreous space[22].

Ophthalmoscopically, asteroid bodies appear as white or yellow spheres suspended in an otherwise unremarkable vitreous. The binocular indirect ophthalmoscope can be used to categorize the severity of asteroid bodies in the vitreous[8]. Mild cases demonstrate less than five strands of asteroid bodies; moderate cases have greater than five strands, but not so many that details of the fundus are obscured; and severe cases obscure fundus details. By this taxonomy, most cases of asteroid bodies in the vitreous, in our experience, are moderate. Interestingly, fluorescein angiography of the fundus is not impaired by asteroid bodies in the vitreous because only the emitted fluorescent light is documented on the film[23,24]. However, they may obscure fundus details making the diagnosis of some fundus diseases more challenging. In fact, severe asteroid bodies in the vitreous may interfere with the visibility of retinal detachments, which may make the surgery more difficult to perform[25].

Asteroid bodies progress very slowly, if at all. Only one report has described progression of the disorder. In 1922, Weidler described a 54-year-old woman whose asteroid bodies became more numerous organizing into chain-like formations in an eight year period[26]. Also, two patients were described as having no asteroid bodies in the vitreous at initial examination, but developed mild asteroid bodies within two years[27].

Etiology

Inheritance has been suggested and three reports describing cases of affected siblings with asteroid bodies have been reported[28,29,30]. The manner of inheritance has not been accurately elucidated, but Wischer suggested that inheritance may have a role in the etiology of asteroid bodies in the vitreous[31].

Verhoeff felt that the formation of asteroid bodies might be dependent on an intraocular angiosclerosis associated with an altered condition of the blood[32]. Holloway suggested that the underlying process could be similar to that which produces gallstones[33]. Krause believed that they might originate from the lipids of leukocytes[34], and Pau felt that they might represent degenerated pigment epithelium cells[35]. Clapp suggested that syphilis,

tuberculosis and angiosclerosis might be important considerations[36]. More recently, it has been suggested that a physiochemical shift of portions of normal vitreous from liquid to solid might be responsible for the formation of asteroid bodies[37], and Streeten has emphasized that the most likely etiology was exogenous to the vitreous[38]. The pathogenesis of asteroid bodies in the vitreous has remained elusive.

Histopathology

Histologic observations of asteroid bodies were first documented by Verhoeff[32]. Asteroid bodies in the vitreous have been described as irregular spheres from 0.1 mm to 1.0 mm in diameter[39]. Inspection with polarized light has documented minute crystals surrounded and imbedded within an amorphous matrix[40], and electron diffraction has revealed the crystalline materials to be "satellites" of asteroid bodies containing oxalate monohydrate and calcium hydroxyphosphate[37]. A study utilizing roentgenographic spectroscopy has revealed sulfur and phosphorus contained in asteroid bodies[41]. Although it is often presumed that they occur in an otherwise normal vitreous, there have been a few cases of asteroid bodies reported where histologically there was a foreign body giant cell reaction[40].

Association with Systemic Diseases

Many systemic diseases and disorders have been reported to be associated with asteroid bodies in the vitreous. Most of them have been summarized by Duke-Elder, and include arteriosclerosis, nephritis, diabetes, syphilis, and tuberculosis[42]. In addition, elevated serum calcium levels have been reported in several patients with asteroid bodies[10]. The most rousing discussions have centered about the possible association of diabetes and hypercholesteremia with asteroid bodies[11,12], however, in a case-control study, such suspicions were not confirmed[8]. Recently, there has been some indication of a possible role of vascular diseases and asteroid bodies in the vitreous[7]. At present, the relationship between asteroid bodies in the vitreous and systemic disease still remains at the level of casual association[9,36].

Differential Diagnosis

Asteroid bodies in the vitreous present such a striking clinical picture that the differential diagnosis can be limited to only one other vitreous disorder, synchysis scintillans. Standard ophthalmic texts usually compare and contrast asteroid bodies in the vitreous with synchysis scintillans. To summarize these texts, synchysis scintillans is said to present bilaterally in the third decade of life as numerous flat, crystalline flakes in a liquified vitreous[19,43-47]. The composition of these flakes has been suggested to be cholesterol, whereas the major chemical composition of asteroid bodies is calcium.

Synchysis scintillans has been compared to asteroid bodies for almost a century without challenge, such that it must be considered in the differential diagnosis of asteroid bodies. Interestingly, only one report questioned synchysis scintillans as a valid clinical entity before 1975[22]. In that year, a scientific manuscript was published that reported that it had not been possible to document a single confirmed case of synchysis scintillans in this century[48]. It was suggested from this study that synchysis scintillans is an extremely rare condition that occurs in only severely damaged, blind eyes. Synchysis scintillans, as a vitreous disorder occurring in otherwise normal eyes, does not appear to exist[49,50]. Cholesterosis bulbi, a cholesterol degeneration occurring in severely damaged eyes, does exist as a well-documented clinical condition, which presents no challenge to the differential diagnosis of asteroid bodies. Many professionals may erroneously believe that a bilateral presentation of asteroid bodies in the vitreous is synchysis scintillans. However, our analysis of 335 previously reported cases of asteroid bodies suggests that 10% of cases are bilateral.

Management

Asteroid bodies in the vitreous should not cause us to suspect associated systemic disease until we have a greater knowledge base regarding these suspected associations. For those patients with vision symptoms, we found that it was not possible to diminish the floater symptoms by either dilating or constricting the pupil[15]. Thus, the management is merely to monitor the condition.

Conclusion

Asteroid bodies in the vitreous are an extraordinary clinical condition. In spite of the fact that they may be so numerous as to completely obscure the fundus, they rarely cause vision symptoms. Asteroid bodies generally occur later in life, and 90% of cases are unilateral. They are not associated with systemic disease, and it is not necessary to differentially diagnose them from synchysis scintillans. No medical treatment has been demonstrated to alter floater symptoms or poor visual acuity in the few patients with vision symptoms associated with asteroid bodies.

Acknowledgement

The preparation of this manuscript was supported by a grant from Medical Instrument Research Associates (Waltham, Massachusetts, USA), and additional support was provided by VA Training Grant #1C(76)VII-4 0499 (Southern California College of Optometry).

References

1. Benson AH. A case of 'monocular asteroid hyalitis.' *Trans Ophth Soc UK* 1894;14:101-4.
2. Webster D. Synchysis scintillans. *Arch Ophthalmol* 1883; 12:179-82.
3. Dor H. Cited by Coulter RJ. Synchisis scintillans. *Ophthalmoscope* 1910;8:40.
4. Westphal HA. Zur klinik der synchisis scintillans. *Arch Augenheilk* 1915;78:1-0.
5. Gorduren S. Six cases of scintillans albescens. *Br J Ophthalmol* 1948;32:435-9.
6. Hatfield RE, Gastineau CF, Rucker CW. Asteroid bodies in the vitreous: relationship to diabetes and hypercholesterolemia. *Proc Mayo Clin* 1962;37:513-4.
7. Potter JW, Newcomb RD. Prevalence of asteroid bodies in a VA optometry clinic. *J Am Optom Assoc* 1980;51:19-25.
8. Luxenberg M, Sime D. Relationship of asteroid hyalosis to diabetes mellitus and plasma lipid levels. *Am J Ophthalmol* 1969;67:406-13.
9. Rutherford CW. Asteroid bodies in the vitreous. *Arch Ophthalmol* 1933;9:106-17.
10. Jervey ED, Anderson WB, Jr. Asteroid hyalitis: a study of serum calcium levels in affected patients. *South Med J* 1965;58:191-4.
11. Smith JL. Asteroid hyalitis: incidence of diabetes and hypercholesteremia. *JAMA* 1958;168:891-3.
12. Bard IA. Asteroid hyalitis: relationship to diabetes and hypercholesteremia. *Am J Ophthalmol* 1964;58:239-42.
13. Argarwal IP, Mohan M, Khosla Pk, et al. Synchysis scintillans or asteroid bodies. *Orient Arch Ophthalmol* 1963;1:167-0.
14. Topilow HW, Kenyon KR, Takahashi M, et al. Asteroid hyalosis: biomicroscopy, ultrastructure, and composition. *Arch Ophthalmol* 1982;100:964-8.
15. Potter JW, Jones WL, Crutchfield M. Vision symptoms with asteroid bodies in the vitreous. *J Am Optom Assoc* 1984;55:419-22.
16. Cibis PA. Vitreoretinal pathology and surgery in retinal detachment. Saint Louis: CV Mosby, 1965:193.
17. Yamada F, Shimizu H. Asteroid hyalosis causing visual disturbance. *Jap J Clin Ophthalmol* 1976;30:787-91.
18. Miller H, Miller B, Rabinowitz H, et al. Asteroid bodies: an ultrastructural study. *Invest Ophthalmol Vis Sci* 1983; 24:133-6.
19. Renaldo DP. Pars plana vitrectomy for asteroid hyalosis. *Retina* 1981;1:252-4.
20. Pau H. Atiologische betrachtungen zur scintillatio nivea. *Ophth* 1965;150:167-74.
21. Jones WL. Asteroid hyalosis in the anterior chamber. *J Am Optom Assoc* 1980;51:66.
22. Jaffe NS. The vitreous in clinical ophthalmology. Saint Louis: CV Mosby, 1969:221-2.
23. Schatz H, Burton TC, Yanuzzi LA, et al. Interpretation of fundus fluorescein angiography. Saint Louis: CV Mosby, 1978, 84.
24. Hampton GR, Nelson PT, Hay PB. Viewing through the asteroids. *Ophthalmology* 1981;88:669-72.
25. Delany WV. Asteroid hyalitis (Benson's disease) and retinal separation. *Br J Ophthalmol* 1973;57:281-5.
26. Weilder WB. Asteroid bodies in the vitreous. *Arch Ophthalmol* 1922;51:79.
27. Potter JW, Newcomb RD, Bright DC. Asteroid bodies in the vitreous. *Optom Monthly* 1981;72:28-32.
28. Bietti G. Ueber familiares vorkommen von 'retinitis punctata albescens; (verbunden mit 'Dystrophia marginalis cristallinea corneae') glitzern des Glaskorpers und andere degenerativenAugenveranderungen. *Klin Monatsbl Augenheilk* 1937;99:737-56.
29. Belicard M. Un cas familial de scintillatio nivea. *J Genet Hum* 1960;9:113-7.
30. Titarelli R. Scintiliates nivea senile del vitres a caratene familiare. *Acta Genet Med Gemellol* 1960;9:432-7.
31. Wischer J. Kristalline Einlagerungen im Glaskorper. *Doc Ophth* 1968;24:3-40.
32. Verhoeff FH. Microscopic findings in a case of asteroid hyalitis. *Am J Ophthalmol* 1921;4:155-0.
33. Holloway TB. Snowball vitreous opacities: additional cases. *Am J Ophthalmol* 1922;5:100-5.
34. Krause AC. Chemistry of the vitreous humor. III. lipids. *Arch Ophthalmol* 1935;13:1022-5.
35. Pau H. Scintillatio nivea corporis vitrei und melanosarkom der uvea. Albrecht von Graefes. *Arch Klin Exp Ophthalmol* 1959;161:64-0.
36. Clapp CA. Crystalline deposits in the vitreous: report of two cases of calcium soaps, studied microscopically and histochemically. *Arch Ophthalmol* 1929;2:635-42.
37. March WF, Shoch D, O'Grady R. Composition of asteroid bodies. *Invest Ophthalmol* 1974;13:701-5.
38. Streeten BW. Vitreous asteroid bodies: characteristics and composition. *Arch Ophthalmol* 1982;100:969-75.
39. Hogan MJ, Zimmerman LE, eds. Ophthalmic pathology: an atlas and textbook. 2nd ed. Philadelphia: WB Saunders, 1962:651.
40. Rodman HI, Johnson FB, Zimmerman LE. New histopathological and histochemical observations concerning asteroid hyalitis. *Arch Ophthalmol* 1961;66:552-63.
41. March WF, Shoch D. Electron diffraction study of asteroid bodies. *Invest Ophthalmol* 1975;14:399-0.
42. Diseases of the vitreous body, diseases of the lens and vitreous, glaucoma and hypotony, vol II. In: Duke-Elder S, ed. System of ophthalmology. Saint Louis: CV Mosby, 1969:326-8.
43. Ballantyne AJ, Michaelson IC. Textbook of the fundus of the eye. 2nd ed. Baltimore: Williams and Wilkins, 1970:545-6.
44. Newell FW, Ernest TJ. Ophthalmology: principles and concepts. 3rd ed. Saint Louis: CV Mosby, 1974:303.
45. Scheie HG, Albert DM. Textbook of ophthalmology. 9th ed. Philadelphia: WB Saunders, 1977:463.
46. Vaughn D, Asbury T. General ophthalmology. 8th ed. Los Altos: Lange Medical Publications, 1977:150.
47. Brandreth R. Clinical slit-lamp biomicroscopy. San Leandro: Blaco Printers, 1978:261.
48. Wand M, Smith TR, Cogan DG. Cholesterosis bulbi: the ocular abnormality known as synchysis scintillans. *Am J Ophthalmol* 1975;80:177-83.
49. Potter JW. Does synchysis scintillans exist? *South J Optom* 1981;23:6-14.
50. Potter JW. Synchysis scintillans, cholesterosis bulbi, and asteroid bodies. Does synchysis scintillans exist? *Aust J Optom* 1983;66:232-8.

Continued from p. 42

Arden GB, Carter RM, Hogg CR, Powell DJ, Vaegan. Reduced pattern electroretinograms suggest a preganglionic basis for non-treatable human amblyopia. *J Physiol* 1980a;308:82P-83P.

Arden GB, Vaegan, Hogg CR, Powell DJ, Carter RM. Pattern ERGs are abnormal in many amblyopes. *Trans Ophthalmol Soc UK* 1980b;100:453-60.

Arden GB, Wooding SL. Pattern ERG in amblyopia. *Invest Ophthalmol Vis Sci* 1985;26:88-96.

Wanger P, Persson HE. Pattern-reversal electroretinograms in unilateral glaucoma. *Docum Ophthalmol Proc Ser* 1983a;37:279-85.

Wanger P, Persson HE. Pattern-reversal electroretinograms in unilateral glaucoma. *Invest Ophthalmol Vis Sci* 1983b;24:749-53.

Papst N, Bopp M, Schnaudigel OE. Pattern electroretinogram and visually evoked cortical potentials in glaucoma. *Graefe's Arch Clin Exp Ophthalmol* 1984;222:29-33.

Ringens PJ, van Lith GHM, de Heer LJ. Pattern-ERG and glaucoma. *Ophthalmologica* 1984;188:174.

Kirkham TH, Coupland SG. Abnormal pattern electroretinograms with macular cherry-red spots: Evidence for selective ganglion cell damage. *Curr Eye Res* 1981;1:367-72.

Arden GB, Carter RM, MacFarlan A. Pattern and Ganzfeld electroretinograms in macular disease. *Brit J Ophthalmol* 1984;68:878-84.

Riggs L. Electrophysiological techniques for studying visual function in man: A historical overview. *J Opt Soc Amer* 1977;67:1451-7.

Bloom BH, Sokol S. A corneal electrode for patterned stimulus electroretinography. *Amer J Ophthalmol* 1977;83:272-5.

Arden GB, Carter RM, Hogg C, Siegel IM, Margolis S. A gold foil electrode: extending the horizons for clinical electroretinography. *Invest Ophthalmol Vis Sci* 1979;18:421-6.

Continued on p. 54

Control of Glare for VDT Operators
1. Transmission of fluorescent light through UV filters and pink lenses.

G.Y. Mousa*

Introduction

Since the introduction of video display terminals (VDTs) into offices, "glare" has become a source of patient complaints and a major triggering factor of migraine attacks among VDT users. Many patients are bothered by direct glare from fluorescent lamps or reflected glare from the surface of the screen. In order to reduce the impact of glare on VDT operators, some manufacturers have installed anti-glare filters on the screen to reduce the reflective glare. Special luminaires with mirrored louvers directing the luminous flux downwards are recommended for lighting systems in VDT areas, but most offices are still illuminated by fluorescent lamp fittings not designed for this type of work.

It is likely that some of the experienced discomfort termed "glare" is caused by the short-wavelength (less than 400 nm) rays emitted by overhead fluorescent lamps. Short-wavelength rays scatter more than long-wavelength rays in the cornea, according to the formula $1/\lambda^2$ as demonstrated by Farrell et al.[1] Thus, short-wavelength rays can cause discomfort glare induced by scattered light in the cornea and crystalline lens. Hemenger[2] has demonstrated that scattered light in the lens is proportional to $1/\lambda^2$. Thus, short-wavelength radiation would scatter more in both the cornea and the lens.

For patients bothered by glare from fluorescent lights, optometrists have customarily provided pink lenses (Cruxite, Tonelite) without knowing the exact effects of these.[3] It is the objective of this paper to study the effect of two kinds of tinted lenses on the spectral distribution of fluorescent lights, comparing the traditionally used pink lenses (Cruxite, Tonelite) to the relatively new UV filters (UV400, Uni-Lite).

*M.Sc., Ph.D., O.D.
Optometric Institute of Toronto
University of Waterloo

Methods

1. Transmittance curves of tinted lenses.

Transmittance measurements of the two groups of tinted lenses used in this study have been made using a Zeiss DMR21 dual-beam recording spectrophotometer. Measurements have been made over the waveband 200 nm to 2500 nm. In the visible and infra-red regions, the monochromator of this instrument has a resolution of 1.0 nm and the accuracy of transmittance measured is 0.3%. Resolution of the spectrophotometer is 0.1 nm in the ultraviolet (Figs. 1 and 2).

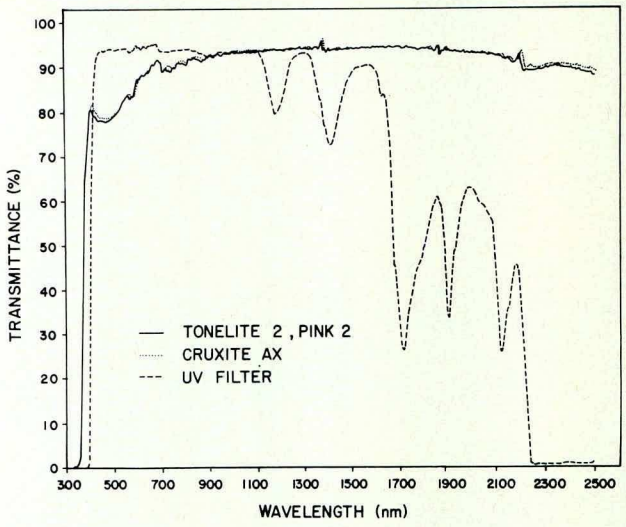


Fig. 1

2. Percentage of power transmission of fluorescent light through the optical filters.

When the spectral emittance of the fluorescent lamp was combined with the transmittance of the lenses, we found that the UV filters eliminated the four peaks of emission between 300 nm and 400 nm (Fig. 3). These peaks are the emission bands of the low-pressure mercury gas discharge, which are approximately at 312-313, 330-332, 365-366 and 404-405 nm. The continuous curve is the emission of the phosphors located inside the glass tube. The

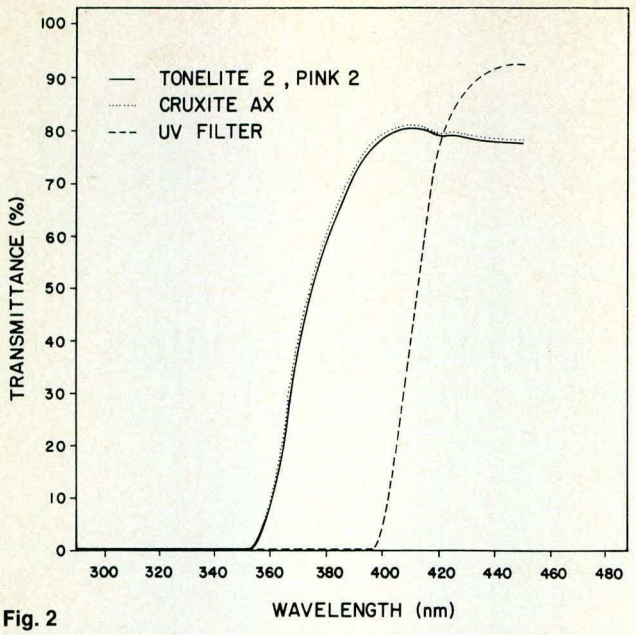


Fig. 2

pink lenses, on the other hand, reduced the overall radiant power, especially between 450 nm and 550 nm, where most of the radiant energy is produced.

In order to determine the effect of these filters on the spectral irradiance of the fluorescent light at the eye, the percentage of cool white light transmitted was calculated: Using 10 nm width increments, the area under the transmittance curve (broken line) was divided by the area under the cool white power spectrum (Figs. 3 and 4).

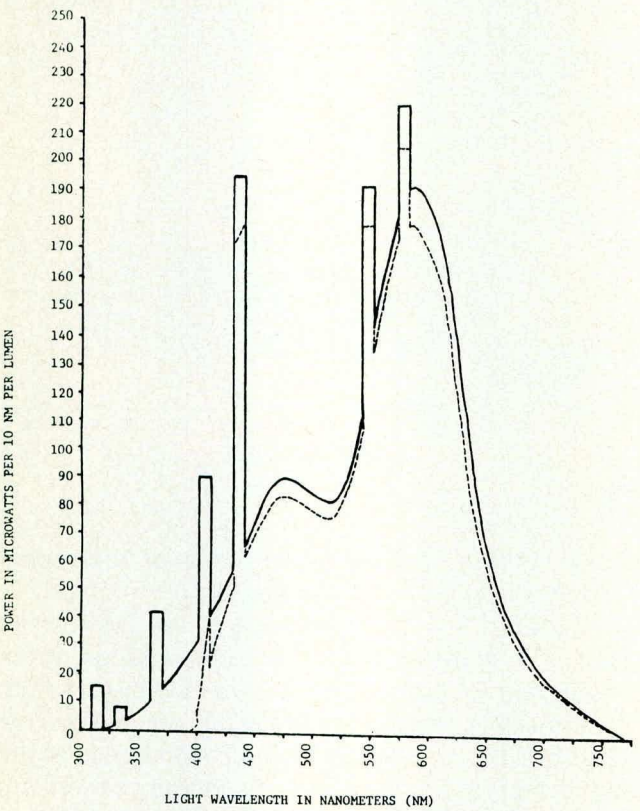


Fig. 3
(Solid Line) "COOL WHITE" Fluorescent Lamp Power Spectrum
(Broken Line) "COOL WHITE" Power Spectrum through UV Filter

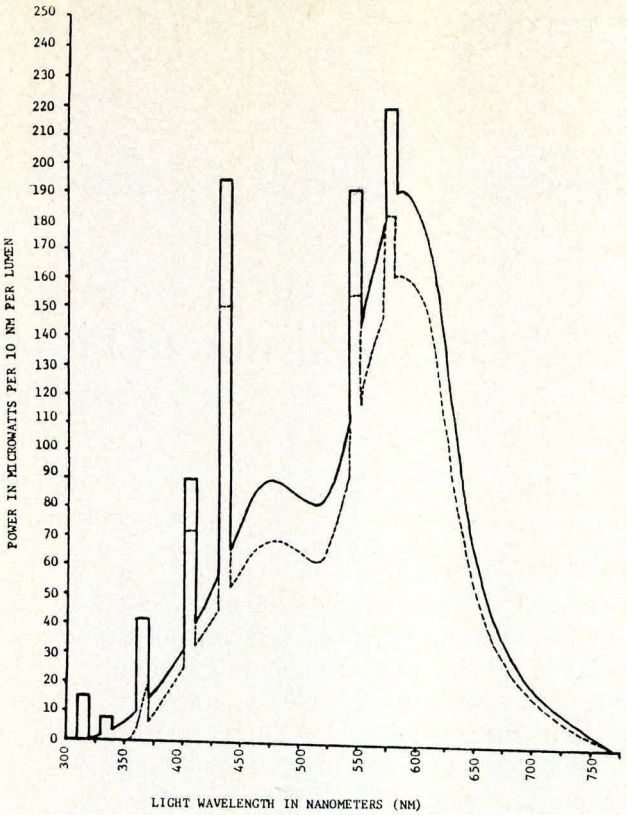


Fig. 4
(Solid Line) "COOL WHITE" Fluorescent Lamp Power Spectrum
(Broken Line) "COOL WHITE" Power Spectrum through Cruxite AX, Tonelite or Pink 2

The power distribution spectrum of a standard Cool White fluorescent lamp[4] was re-plotted in terms of percentage of its peak output at 575 nm. The filtered Cool White was plotted for each lens, its value at a given wavelength λ being $P\lambda\ t\lambda$ where $P\lambda$ is the percentage of peak power of the lamp at that wavelength and $t\lambda$ is the transmittance of the lens material at the same wavelength.

It was desired to find what percentage of the lamp's ultra-violet radiation was being transmitted between 300 and 400 nm as compared to its transmission in the visible band (400 to 770 nm) through the lenses used in this investigation.

The equation for percent transmission over a waveband between λ_1 and λ_2 is:

$$\%T_{(\lambda_1 \rightarrow \lambda_2)} = 100 \times \frac{\sum_{\lambda_1}^{\lambda_2} P_\lambda\ t_\lambda\ \Delta\lambda}{\sum_{\lambda_1}^{\lambda_2} P_\lambda\ \Delta\lambda} \qquad (1)$$

Results and Discussion

The transmission curves of the two types of lenses showed that UV filters eliminated radiation shorter than 400 nm, while the pink lenses reduced the overall transmission of light between 400 and 700 nm (Fig. 1). When the shorter-wavelength portion in

Fig. 1 was expanded, it showed that the UV filters transmitted only 3.2% of radiation at 400 nm, while the pink lenses transmitted 78% of radiation at 400 nm (Fig. 2). On the other hand, in the longer-wavelength portion the UV filters transmitted more infra-red radiation than did the pink lenses (Fig. 1). These findings are in agreement with Chou and Cullen.[5] When the emittance of the fluorescent lamp was combined with the transmittance curves of the two groups of tinted lenses, the following values of % transmittance (Table 1) were obtained for UV filter (Fig. 3) and pink lenses (Fig. 4):

Table 1
Percentage of Cool White Transmittance Through Tinted Lenses

	UV (300 - 400 nm)	Visible (400 - 700 nm)
UV filter	0.2%	90.4%
Pink Lenses (Cruxite AX, Tonelite 2, Pink 2)	36.4%	82.9%

These results indicate that UV filters do not reduce the visible light significantly, but they eliminate UV radiation between 300 - 400 nm. On the other hand, pink lenses reduce UV radiation between 300 - 400 nm by 63.6% and eliminate UV radiation below 350 nm. However, pink lenses are more effective in reducing visible light by 17.1%. These transmission curves (Figs. 3 and 4) suggest that UV filters and pink lenses reduce the discomfort possibly caused by stray light by different means: UV filters eliminate UV radiation which is scattered in the cornea and the lens more than the long-wavelength rays[1] and UV induces fluorescence of tyrosine and other molecules in the lens[6], whereas pink lenses reduce the overall illumination. This in itself could be effective, since most offices are over-illuminated for VDT operation. Ostberg[7] suggested that lower illumination is required for offices with VDT terminals, because the contrast between the high ambient illumination and the dark screen can cause problems in transient adaptation when the eyes have to change frequently between the very high luminance of the paper on the desk and the low luminance of the screen.

Acknowledgement

This research was supported by a grant from COETF to Dr. G.Y. Mousa. Thanks are due to Drs. B. R. Chou and W. K. Adrian for their help in the measurements of the transmittance curves of the tinted lenses and for their critical reading of the manuscript.

Editor's Note: Next Issue: Part II — Evaluation of Different Lenses by Subjects

References

1. Farrell, R.A., McCally, R.L., and Tatham, P.E.R. "Wavelength dependencies of light scattering in normal and cold swollen rabbit corneas and their structural implications." *J. Physiol.* 233 (1973), 589-612.
2. Hemenger, R.P. "Optical density of the crystalline lens." *AmJOpt& Physiol Optics* 59 (1982), 34-42.
3. Epting, J.B., Morgret, F.C. Jr. Ophthalmic Mechanics and Dispensing. Radnor, Penn. (Chilton), 1964: pp. 238-244.
4. Kaufman, J.E. and Christensen, J.F. IES Lighting Handbook, 5th Ed. Baltimore, Md. (Waverly Press), 1972: pp. 8.17 - 8.20.
5. Chou, B.R. and Cullen, A.P. "Spectral transmittance of selected tinted ophthalmic lenses," *Canadian J. Optom.* 45 (1983), 192-198.
6. Lerman, S. and Borkman, R. "Ultraviolet radiation in the aging and cataractous lens: A survey," *Acta Ophthalmologica* 56 (1978), 139-149.
7. Ostberg, O. "Accommodation and visual fatigue in display work," in Ergonomic Aspects of Visual Display Terminals, ed. E. Grandjean, London, England (Taylor and Francis Ltd.) 1980, pp. 41-52.

The Canadian Optometric Education Trust Fund

Purpose of the COETF

Recognizing the need to support the continuing growth and development of the profession of Optometry, the COETF is prepared to financially assist the educational, research and manpower programs deemed by the Trustees to be more important to achieving these goals.

Suitably trained optometric personnel, and the profession's continued access to these professionals is vital to our academic evolution. *The COETF supports* faculty development in our schools of optometry, graduate students in specialized educational programs and investigative research by undergraduate students.

Ongoing research undertaken by the optometrist in private practice is just one type of professional development program which optometry must continue to initiate. *The COETF supports* projects established in a clinical environment to assist the visually handicapped and to assist other optometrists through preparation and publication of the details of these clinical research studies.

A third Canadian school of optometry is of vital concern to the profession. The ongoing activities of our two existing schools are just as important. *The COETF supports* needed alterations and renovations at both schools presently operating and stands ready to assist substantially in the operating cost support of a new school of optometry in Canada.

Continuing education in the 80s must be regular and structured as technology sweeps the profession forward into new methods and discoveries in the delivery of complete vision care. *The COETF supports* the development of an academic Chair of Physiological Optics and Continuing Education to meet these ongoing needs.

The Canadian Optometric Education Trust Fund invites your support in this "Vision of the Future". If you are (or know of) an optometric practitioner, student, educational institution, service organization or member of the general public who is presently involved in, or planning a program that meets any of the goals outlined above, then assistance might be available to achieve the project's objectives.

Le Fonds de Fiducie pour les Études en Optométrie au Canada

Objet du FFEOC

Reconnaissant la nécessité de soutenir la croissance et le développement de la profession d'optométriste, le FFEOC est disposé à accorder une aide financière pour les programmes d'étude, de recherche et de main-d'oeuvre que son Conseil de fiducie juge parmi les plus importants pour l'atteinte de ces objectifs.

Il est essentiel à l'évolution de notre science de nous assurer un personnel optométrique bien formé et de faire en sorte que la profession continue d'avoir accès à ces professionnels. *Le FFEOC appuie* le perfectionnement des enseignants dans nos écoles d'optométrie, la participation d'étudiants de deuxième cycle aux programmes d'enseignement spécialisé et le travail d'investigation de la part des étudiants de premier cycle.

La recherche permanente entreprise par l'optométriste en pratique privée n'est qu'un des types de programme de perfectionnement professionnel que l'optométrie doit continuer de lancer. *Le FFEOC appuie* les projets établis en milieu clinique pour aider les handicapés visuels et pour aider les autres optométristes par la préparation et la publication des détails de ces études de recherche clinique.

La profession souhaite vivement la création d'une troisième école canadienne d'optométrie. Les activités permanentes de nos deux écoles existantes sont tout aussi importantes. *Le FFEOC appuie* les modifications et les rénovations requises aux deux écoles actuelles et est disposé à assumer une part appréciable des frais de fonctionnement d'une nouvelle école d'optométrie au Canada.

L'éducation permanente dans les années 80 doit être constante et structurée au moment où la technologie propulse la profession vers de nouvelles méthodes et de nouvelles découvertes dans la prestation des soins complets de la vue. *La FFEOC appuie* la création d'une chaire universitaire d'optique physiologique et un programme d'éducation permanente pour répondre à ces besoins permanents.

Le Fonds de fiducie pour les études en optométrie au Canada vous demande votre appui pour cette "Vision de l'avenir". Que vous soyez praticien, étudiant, établissement d'enseignement, organisme de service ou membre du grand public qui participez présentement ou projetez de participer à un programme qui répond à l'un des objectifs décrits ci-dessus, vous pourriez obtenir une aide pour atteindre les objectifs du projet.

RESEARCH

The Adhesion Syndrome

H.A. Backman*

Abstract

Rigid gas permeable contact lenses may adhere to the corneal epithelium. Reports of adhesion have been described with only one type of lens material. This report describes three types of lens materials, lens fitting characteristics and the interactions between the eyelid, cornea and contact lens. Various factors may be responsible for the adhesion phenomenon.

Résumé

Les lentilles cornéennes rigides perméables aux gaz ont la faculté d'adhérer à l'épithélium cornéen. Ce genre d'adhésion n'a été décrit que dans le cas d'un seul matériau optique. Le présent document décrit trois types de matériau, les caractéristiques d'ajustement de la lentille et l'interaction paupière-cornée-lentille. Le phénomène d'adhésion est attribuable à divers facteurs.

Introduction

Rigid gas permeable contact lenses may adhere to the corneal epithelium.[1,2,3] Most of the reports have implicated lens design, particularly edge lift as being responsible for lens-cornea adhesion. All lenses have been silicone/acrylates. Some practitioners have thought that the adhesion may be due to the hydrophobicity of silicone because silicone lenses are reported to adhere to the cornea[2].

History

The patient history (Table I) consists of the spectacle correction, keratometer measurements, duration of rigid lens wear and the eye with the adhesion problem. The lens parameters and lens care regimens are provided in Table II. Five patients with three different types of acrylic polymers, silicone/acrylate (Boston II), cellulose acetate butyrate (CAB), and styrene (Airlens) experienced lens-cornea adhesion problems. Two patients had Boston II lenses, two CAB lenses and one patient the Airlens. There was no relationship between right or left eye adhesion nor duration of lens wear and adhesion. The patients presented themselves for routine examinations and were asymptomatic.

Table I
Patient History

Patient	Eye	Spectacle Rx	Keratometer	Lens Worn (Years)	Lens Adhesion
J.B.	O.D.	-2.75/-1.50x180	43.50/45.50x90	P.M.M.A. (8)	O.D.
	O.S.	-2.50/-2.50x5	43.12/46.50x90	Boston II (1)	
Y.P.	O.D.	+3.00/-1.50x45	42.50/44.75x116	P.M.M.A. (10)	O.S.
	O.S.	+2.75/-0.50x120	42.75/45.00x66	C.A.B. (4)	
I.H.	O.U.	-5.00	43.50/45.00x90	BOSTON II (2)	O.S.
B.K.	O.D.	-5.50/-0.75x135	43.75/43.50x82	P.M.M.A. (3)	O.D.
	O.S.	-5.50/-1.25x165	43.75/44.25x90	AIRLENS (4)	
K.H.	O.D.	-4.75	45.00/46.50x90	C.A.B. (2)	O.S.
	O.S.	-4.00	45.75/46.50x90		

Table II
Lens Parameters and Care Regimen

Patient	Lens	Base Curve	Diam.	O.Z.D.	Thick.	Power	P.C.
J.B.	BOSTON II	BOSTON SOL'NS					
	O.D.	7.63	8.8	7.6	.19	-2.75	.2/9.0
	O.S.	7.63	8.8	7.6	.17	-3.00	.4/10.5
Y.P.	CAB	ALLERGAN					
	O.D.	7.96	9.5	8	.16	+3.50	.2/9.0
	O.S.	7.93/7.90	9.5	8	.24	+0.25	.4/10.5
I.H.	BOSTON II	ALLERGAN					
	O.U.	7.76	9	7.8	.11	-5.75	.2/8.5 .4/10.5
B.K.	AIRLENS	BARNES-HIND					
	O.D.	7.67	8.6	7.4	.13	-4.50	.2/8.5
	O.S.	7.67	8.6	7.4	.11	-5.50	.3/11.5
K.H.	CAB	BOSTON					
	O.D.	7.3	8.8	7.6	.15	-4.75	.2/9.5
	O.S.	7.26	8.8	7.6	.15	-4.25	.4/10.5

Methods

It has been suggested that the lens care regimen may be responsible for the adhesion problem. Two patients used Boston solutions, two Allergan solutions (Total and LC65) and one Barnes-Hind GP solutions. It appears that the solutions are unrelated to this problem.

It has also been suggested that the lenses were too thin (less than 0.13 mm) or fitted too flat. Only one patient had a lens thickness of less than 0.13 mm with an adhesion problem. Three patients were fitted

*Optometrist
Pierrefonds, Québec

on "K" and two steeper than "K". None were fitted flatter than "K". Only one patient had a hyperopic correction, one a back toric lens. The remaining patients had myopic corrections.

The edge finish on all lenses was the same in the intermediate and peripheral curve widths. The intermediate radius of curvature ranged from 8.5 to 9.0 mm and the peripheral radius of curvature from 10.5 to 11.5 mm.

All patients had histories of allergies with occasional discomfort. When the lens adhesion was noted, the patients complained of a mild sensation of dryness. The lenses, upon removal, appeared very dry.

Results

The biomicroscopic examination revealed uniocular lens adhesion to the inferior temporal quadrant of the cornea. The lens could be displaced with strong digital pressure upon which the cornea revealed multiple lesions where the intermediate and peripheral zone of the lens had adhered. With lacrimation, the lens would float and produce discomfort when centered. The upper lid hit the lens edge and displaced the lens downward and temporally until the lens adhered to the cornea and was maintained there by adhesion and blinking.

The lens was removed, cleaned and reinserted. Within seconds adhesion recurred. The lenses were blended, the edges thinned and polished. Some lenses were replaced with edge modifications. The adhesion problem improved somewhat but does recur from time to time after several weeks of wear.

Discussion

According to a recent article by E. Bennett[3] "lens desiccation with inferior positioning, a thick edge, irregular tear film and excessive edge lift may be responsible for lens-cornea adhesion". Sevigny[1] states that the "adhesion phenomenon" is produced by a negative disjoining pressure between a silicone-based lens and the corneal epithelium and creates partial or total suction. It is potentiated by tight lids and large, thin, flat-fitting lenses where the lens can flex toward the flat periphery and create minute arcuate adhesions. Sarver at the 1985 American Academy of Optometry meeting stated that adhesion occurred frequently in the morning after extended wear of the Boston IV lens. Altering the thickness and lens design produced no improvement.

The edge lift factor is responsible for creating the condition whereby the upper lid margin drives the lens to an inferior position relative to the apex of the cornea. Air is trapped between the lens and cornea, the blink does not cover the lens which creates desiccation and this creates the adhesion. Bennett[3] states that "Unfortunately, as edge lift is increased displacement of the lens inferiorally with the blink is more likely to occur, as is desiccation of the epithelium beneath the edges of the lens where tear flow is inhibited." It may be added that the patient usually blinks incompletely leaving the inferior section of the cornea dry.

Bennett[3] suggests a tetracurve lens design with steep peripheral curves and a narrow bevel. Such a lens design in a large diameter lens may sometimes resolve the adhesion problem but it is a complex problem involving the lid-lens interaction, tear film, blinking characteristics of the patient and lens design. The latter is the only controlled condition and does not always resolve the problem.

References

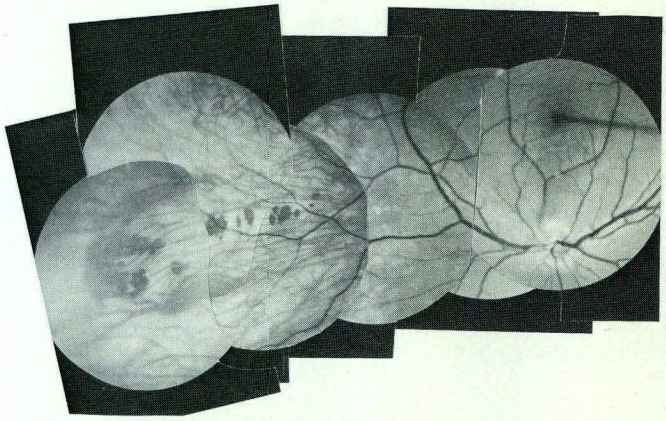
1. Sevigny, J. The Boston Lens Clinical Performance, *Int. Contact Lens Clinic*. 1983; 10(2): 73-81
2. Faat, I. Negative Pressure Under Silicone Rubber Contact Lenses. *Contacts* 1979; 23(1); 6-8
3. Bennett, E. Silicone/Acrylate Lens Design *Int. Contact Lens Clinic*. 1985; 12(1): 45-53

CASE REPORT

Grouped Pigmentation in the Peripheral Retina

J.M. Wilkinson*
T.D. Williams**

Pigment spots are frequently found during ophthalmoscopic examination. Differential diagnoses to be considered include: retinal pigment epithelium (RPE) hypertrophy, choroidal nevus, choroidal melanoma, melanocytoma, true hyperplasia of RPE, inflammatory pigmented fundus lesions, and pigmented colobomas. Table 1 summarizes methods for deciding on the possible cause for the pigmented area and its possible course.



Case Report

While scanning the peripheral retina on a routine eye examination, a colleague observed an innocent-looking pigment spot in a young male. For this patient, the pigment spot represented the "tip of the iceberg". The extent of the pigmentary irregularity was revealed during dilated direct and indirect ophthalmoscopic examination. Serial photographs

Table 1

Characteristics	Occurrence	Potential For Malignancy	Cell Primarily Involved	Colour	Uniform Pigmentation	Distinct Margin	Elevation	Visual Field Loss	Progression
Retina pigment Epithelium (RPE) Hypertrophy	1:1000[4]	-	RPE	Dark, Black	++	+++	-	-/+	-*
Choroidal Nevus	1:3[5]	+	Choroidal Melanocytes	Slate gray, greenish, bluish	+	- -	-/+	-/+	-**
Choroidal Melanoma	21 per million per year (whites over 50)[5]	++	Choroidal Melanocytes	Variable	-	- -	++	+	++
Melanocytoma	rare	-	Choroidal Melanocytes (Usually at ONH)	Black	+	+	+++	+	-/+
Hyperplasia of RPE (primary)	rare	-	RPE	Black	-/+	-	+	+	++
Inflammatory pigmented fundus lesions	3 per 100,000 per year[6]	-	RPE	Black	-	~ age	~	+	-/+t
Pigmented Colobomas	Common[4]	-	RPE	Black	-	+	~	+	-

* There are some reports of a gradual enlargement (1000 μ in 10 years)[1]
** Choroidal Nevi rarely show growth[2] after the prepubertal years
t depending on control of disease

*Student (class of 1986),
School of Optometry, University of Waterloo,
**O.D., M.S., Ph.D.
School of Optometry, University of Waterloo

across the inferior retina have been combined to show how extensive this 'grouped' or 'Bear Track' pigmentation is. The largest group lay approximately 10-12 disc diameters inferiorly to the posterior pole. The rest of the exam was unremarkable.

This type of retinal disturbance is a benign pigment epithelial hypertrophy, is well circumscribed, flat and has black uniform pigmentation. These features distinguish it from other types of pigmented areas in the retina (Table 1). Histologically, areas of grouped pigmentation are found to contain unusually large (hypertrophic) RPE cells with many pigment granules.

The disposition for this patient is to describe, sketch and/or photograph the pigment disturbance in enough detail to monitor and assist in differential diagnosis.

Patients of this kind continue to reward and encourage all of us who pick up an ophthalmoscope to explore the peripheral retina.

References

1. Norris, J.L., Cleasby, G.W., An Unusual Case of Congenital Hypertrophy of the Retinal Pigment Epithelium. *Arch Ophthalmol* 94 (11):1910-1911, Nov. 1976.
2. Gass, J. Donald M., Differential Diagnosis of Intraocular Tumors, A Stereoscopic Presentation, The C.V. Mosby Co. St. Louis, 1974.
3. Buettner, Helmut, Congenital Hypertrophy of the Retinal Pigment Epithelium, *Amer J Ophthalmol* 79 (2):177-189, Feb. 1975.
4. Duke-Elder, Sir Stewart, System of Ophthalmology, Vol. 3, Normal and Abnormal Development Part 2 Congenital Deformities, London, Henry Kimpton 1964, p. 801.
5. Yanoff, M. and Fine, B.S., Ocular Pathology, a text and atlas, 2nd ed. Harper & Row, Philadelphia, 1982.
6. Schlaegel, T.F., Essentials of Uveitis, Little, Brown & Co., Boston, 1969.

Continued from p. 15

4. Woo G, Long WF. Use of contrast sensitivity to measure visual function following a demyelinating disease. *Australian Journal of Optometry*. 62: 293 - 295, 1979.
5. Woo G, Hess R. Contrast sensitivity function and soft contact lenses. *International Contact Lense Clinic*. 16 (4): 171 - 189, 1979.
6. Regan D, Silver R, Murray TJ. Visual acuity and contrast sensitivity in multiple sclerosis — hidden visual loss: an auxiliary diagnostic test. *Brain*. 100: 563 - 579, 1977.
7. Arden GB, Jacobson JJ. A simple grating test for contrast sensitivity: preliminary results indicate value in screening for glaucoma. *Investigative Ophthalmology and Visual Science*. 17 (1): 23 - 32, 1978.
8. Hess R, Woo G. Vision through cataracts. *Investigative Ophthalmology and Visual Science*. 17 (5): 428-435, 1978.
9. Woo GC. The effect of CAM treatment and occlusion therapy on contrast sensitivity function in amblyopia. *The South African Optometrist*. 71 - 75, 1983.
10. Hess RF, Howell ER. The threshold contrast sensitivity function in strabismic amblyopia: evidence for a two type classification. *Vision Research*. 17 (9): 1049 - 1055, 1977.
11. Arden GB, Gucu koglu AG. Grating of contrast sensitivity in patients with retrobulbar neuritis. *Archives of Ophthalmology*. 96 (9): 1626 - 1629.
12. Bodis-Wollner I. Visual acuity and contrast sensitivity in patients with cerebral lesions. *Science*. 178: 769 - 771, 1972.
13. Regan D, Neima D. Low contrast letter charts as a test of visual function. *Ophthalmology*. 90 (10): 1192 - 1200, 1983.
14. Woo G. Contrast sensitivity function as a diagnostic tool in low vision. *American Journal of Optometry and Physiological Optics*. 69 (9): 648 - 651, 1985.
15. Arden GB. Measuring contrast sensitivity with gratings: a new, simple technique for the early diagnosis of retinal and neurological disease. *Journal of the American Optometric Association*. 50: 35 - 39, 1979.
16. Vistest LH-5. *Low Vision International*. 1985.
17. Higgins KE. Spatial contrast sensitivity: importance of controlling the patient's visibility criterion. *Archives of Ophthalmology*. 102: 1035 - 1041, 1984.

Continued from p. 46

Dawson WW, Trick GL, Litzkow CA. Improved electrode for electroretinography. *Invest Ophthalmol Vis Sci* 1979;18:988-91.
Trick GL, Trick LR. An evaluation of variation in pattern reversal retinal potential characteristics. *Docum Ophthalmol Proc Ser* 1984;40:57-67.

VISION CARE NEWS

American Academy of Optometry — Canada Section Highlights of the 1985 Annual Report

In December, new fellowships were awarded to Drs. J. Capell and B. Andrews of Ontario, and Dr. C. Brown of Alberta.

Ontario optometrist Dr. Brian Garnett was made a Diplomate in the Academy's Contact lens Section.

Dr. Mitchell Samek, Director of the Optometric Institute in Toronto, has been named to organize the next General Meeting of the Academy, slated for Toronto in December, 1986. Dr. Tony Cullen, of the School of Optometry, University of Waterloo, is also on the Executive Committee responsible for organizing the Toronto meeting.

The Academy, at present, consists of 3,164 Fellows, 179 of whom are from Canada.

Waterloo School Assists Optometry in Poland

As part of a program to upgrade vision and eye care services in Poland, Dr. Boleslaw Kedzia, a member of the Academy of Medicine in Poznan, Poland, visited the University of Waterloo's School of Optometry recently.

According to Dr. Kedzia, whose North American tour also took in The Optometric Institute in Toronto and Optometry Schools in Philadelphia, Chicago, Bloomington, Houston and Birmingham, vision and eye care service in Poland is, at present, the exclusive domain of ophthalmologists. Poland's 37,000,000 people are served by only 1,500 ophthalmologists (a ratio of 24,000 to 1) and most Poles, as a result, are forced into a lengthy waiting period before they can even see an eye doctor.

Dr. Kedzia's visit was prompted by a growing concern over access to service and the need for training of "more appropriate specialists".

While at Waterloo, Dr. Kedzia was hosted by the Director of the School of Optometry, Dr. Jacob Sivak and other members of the faculty. One possible long-term implication of the visit could be the participation of Polish students in the Waterloo School's graduate studies department, enabling their return to Poland as Professors of Optometry.

Correction: Canadian Contact for Optica '86

In Vision Care News (December, 1985), readers interested in information concerning Optica '86 (April 26 - 29 in Cologne, Germany) were given a German address to whom requests could be sent. We have since been advised that a Canadian source in Toronto is available for Canadian practitioners wishing information about the Cologne International Optical Trade Show.

Contact: Mrs. Edel Wichmann
Cologne International Trade Shows
480 University Avenue, Suite 1410
Toronto, Ontario
M5G 1V2
Tel. (416) 598-3343

Toronto to Host World Immunology Congress

An estimated 7,000 scientists from around the world are expected to attend the Sixth International Congress of Immunology in Toronto, July 6 - 11.

The Congress, which meets every three years, is designed to bring researchers up to date on advances which have occurred in the immunological studies of diseases like allergies, certain cancers, kidney disease, diabetes, multiple sclerosis and rheumatism.

To coincide with the Congress, the Union for Immunological Societies will hold a conference on clinical immunology July 5th and 6th. For more information about either event: Dr. Philip Halloran, Press Liaison Officer, (416) 586-5185.

Syntex Ophthalmics Sold for $60 million

Syntex Corporation announced in late December that its ophthalmics division had been acquired by Pilkington Brothers plc (London) for $60 million.

The sale results in an immediate gain to Syntex which the company announced will be reflected in its second quarter 1986 financial statement.

Syntex Corporation, parent to Syntex Ophthalmics, is an international health-care company involved in the research, development, manufacture and marketing of human pharmaceutical products, medical diagnostic systems and animal health and dental products.

Further information: Susan Neisloss
Syntex Corporation
3401 Hillview Avenue
Palo Alto, CA
94304, USA
Tel. (415) 424-1492

Polymer Introduces The Boston Equalens

Several Ontario optometrists attended a post-New Year's seminar offered by Polymer Technology to introduce the Boston Equalens. Held in Huntsville, at the Deerhurst Inn and Country Club, the seminar offered an in-depth analysis of the manufacture and fitting of the new lens.

The lens combines a newly synthesized fluoro monomer with the already-patented Boston silicone / acrylate polymer, resulting in a new fluorosilicone / acrylate copolymer (patent pending) which, according to Polymer, virtually duplicates, or has minimal impact on, the natural state of the eye.

Dk value of oxygen transmissibility is 71 x 10^{-11}, more than twice that of E-W soft lenses.

According to the manufacturer, the Equalens is biocompatible, or highly wettable in the eye, resists deposits "better" and provides "better vision than soft lenses".

For UV protection, a UV absorber is incorporated into the polymer matrix.

The lens was developed in 1985, although research was begun two years earlier by Perry Rosenthal, MD, Joseph Salamone, PhD and Edward Ellis, PhD. Polymer's V-P, R and D, Steve Kurowsky, PhD, was also instrumental in bringing the polymer to development.

Polymer recommends the lens for any individual seeking to wear CL's, particularly if previously unable to wear them; current hard lens wearers; patients with tendencies to dry eyes; lens wearers bothered by troublesome deposits; people who have had cataract surgery and people exposed regularly to sunlight or glare who are looking for UV protection.

Information in Canada (also regarding the Boston Lens IV Reconditioning Drops, as noted in Vision Care News, December, 1985) is available from:

Mr. Harve Sturges
Polymer Technology Corporation
Tel. (416) 453-1999

FDA Recommends Approval of ALGES Bifocal

The US Food and Drug Administration (FDA)'s Ophthalmic Advisory Panel has recommended approval of the ALGES (Registered tm) soft bifocal lens. The lens' design places the reading lens in the centre of the pupil and surrounds it with the wearer's distance prescription.

According to the manufacturer, the lens thus works with the eye's natural processes, based on the assumption that, when reading, a wearer's pupils shrink, increasing the percentage of light through the reading lens. At night, the enlarged pupils allow

most light to enter through the distance prescription portion of the lens. According to the manufacturer, the result is "clear vision, devoid of the halos and blurs experienced by wearers of currently available bifocal contact lenses."

ALGES derives its name from the *A*utomated *L*ens *GE*nerating *S*ystem lathe, a computer controlled lathe used in the manufacture of the lens.

Further information:

Ray J. Friant Jr.
President
University Optical Products Co.
c/o University Patents Inc.
1465 Post Road East, PO Box 901
Westport, CT
06881, USA
Tel. (203) 255-6044

Optical Radiation Corporation Expands Abrasion Resistant Lens Line

Orcolite, a division of the California based Optical Radiation Corporation, is expanding its line of abrasion resistant lenses.

The ARC-901 coating, according to the manufacturer, "resists cracking and crazing when exposed to UV light and extreme temperature variations", providing "outstanding abrasion resistance".

To the existing ARC-901 Super Flat Top 25 Bifocal, Orcolite has added the ARC-901 76mm Super Flat Top 28 and 35 Bifocals and, later in the year, will add 73mm Flat Top 7x25 and 7x28 Trifocals.

Orcolite also manufactures a wide range of single vision, multifocal and specialty lenses.

For further information:

Richard Fleming
Optical Radiation Corporation
1300 Optical Drive
Azusa, CA
91702
Tel. (818) 969-3344

Barnes-Hind Adds Thimerosal-Free Solution

The US Food and Drug Administration (FDA) has completed its evaluation and approval of the Barnes-Hind thimerosal-free Storage and Rinsing Solution for soft contact lenses.

According to a recently published company bulletin, the results of the testing show that the Barnes-Hind solution, without thimerosal, meets "in full" the FDA's published disinfection guidelines.

Further information is available from any regional Barnes-Hind representative.

Avant-Garde Begins Luxottica Distribution

Readers will note the addition of a new advertiser in both this issue, and the previous issue of the CJO — Avant-Garde Optics.

The company opened a new distribution and service facility in Mississauga last November and incorporates a computerized order processing, shipping, sales analysis and inventory system using the IBM System 38.

For information and a copy of Avant-Garde's new 36 page colour catalogue:

Mr. Jim Hughes
General Manager
Avant-Garde Optics
947 Verbena Road
Mississauga, Ontario
L5T 1T5
Tel. (416) 673-8104

CIBA Introduces Pale Blue CL Tint

CIBA Vision Care has announced the introduction of VISITINT, a light blue, one intensity handling tint designed to enable a contact lens wearer to locate a dropped lens more easily.

According to CIBA, the tint, which is no more detectable on the eye than a clear lens, is applied using a safe and effective permanent tinting process with no change in oxygen transmissibility, visual acuity or physiological response when compared to clear lenses.

Information: Roy Pullman, Marketing Manager
CIBA Vision Care Inc.
2150 Torquay Mews
Mississauga, Ontario
L5N 2M6

Zeiss Offers New Single Vision Lens

A new Zeiss lens, the PUNKTAL SL, offers "considerable advantages" over lens crown and hi-index glass, according to information released recently by Carl Zeiss Canada Ltd.

Using a newly-developed Hi-Crown 45, Zeiss claims the flatter PUNKTAL SL lens tackles head-on many of the problems associated with today's large, fashionable lenses: weight, aesthetics, magnification, extreme base curves and centre and edge thickness, enabling the wearer to enjoy "better vision *and* better looks".

Further information and a detailed description of the lens parameters is available from:

Carl Zeiss Canada Ltd
45 Valleybrook Drive
Don Mills, Ontario
M3B 2S6
Tel. (416) 449-4660

Seiko Optical Product Line Announced

The Hattori Corporation of America has announced that a new division of the Seiko Group, Seiko Optical Products, will be headquartered in Mahwah, New Jersey.

The company, whose product line includes the SVP Lens, a computer-designed Allyl Diglycol Carbonate spectacle lens and the Diacoat II single-vision, scratch resistant plastic spectacle lens will begin marketing this year through direct mail, trade advertising, exhibits and a PR campaign.

Further information is available from the company's PR firm.

Contact: Kay Darby, Public Relations
Stuart Ford Incorporated
(804) 649-9201
or Seiko Optical Products
2 Pearl Court
Allendale, NJ
07401, USA

Section Update: Children's Vision

At its Autumn, 1985 meeting, the Council of the Canadian Association of Optometrists formally approved the creation of the Children's Vision Section of CAO. Following are the terms under which the Section was constituted under CAO's By-law #52:

I — Need

The CAO Children's Vision Section should be established for the following reasons:

1) The need for definition of terminology;
2) the need for an advisory body to CAO;
3) the need for uniform standards for vision screening at preschool and school age levels;
4) the need for uniform standards for diagnosis and therapy;
5) the need for information exchange between optometrists, educators, physicians, psychologists, parents, education administrators, other disciplines and government;
6) the need to emphasize the relationship between vision and learning.

II — Scope

The broad based scope of this Section encompasses all areas of optometric diagnosis and therapy that are related to children. These include developmental vision, refractive disorders, binocular vision, amblyopia behavioral vision, learning disorders, and specifically learning disorders, in juvenile delinquency.

III — Functions

The functions of this section include:

1) Acting as an advisory body to CAO;
2) developing a CAO policy statement on children's vision;
3) developing a registry for referral purposes;
4) promoting the sharing and dissemination of information;
5) developing uniform standards for vision screening of preschool and school age children;
6) developing a description of diagnosis and therapy methods and a definition of terminology;
7) performing any other function as directed by CAO Council.

IV — RULES

1) Officers will be elected every two years at the CAO Biennial Convention by the members of the Section who are present. The Executive Committee shall consist of:
   i) Chairperson
   ii) Vice-Chairperson
   iii) Secretary-Treasurer
2) Membership is open to anyone who:
   i) is a member in good standing of CAO;
   ii) pays the annual dues of $25.
3) Activities undertaken on behalf of this section must have approval of the Executive Committee of this Section.

Council, after approving the constitution of the Children's Vision Section, extended its congratulations to Ontario Councillor Dr. Margaret Hansen des Groseilliers who, as CAO liaison for the new Section, initiated most of the groundwork in developing the approved Terms of Reference.

Section Update: Sports Vision/ Contact Lenses

In what is fast shaping up to be a draw in the process leading to the formal Council approval of Section status, organizers for a proposed Sports Vision Section, and a proposed Contact Lens Section have submitted presentations for Council's consideration at its Spring, 1986 meeting.

Representatives of the Sports Vision group, in fact, have already held a meeting in Calgary last November and elected an executive to initiate the Section's activities once it is constituted.

In the June issue of the CJO, should Council's ratification be forthcoming from its Spring meeting, we will publish the Terms of Reference, as well as any news and information, from both these Sections, as well as an update on the Children's Vision Section.

Continued from p. 9

diagnostic and therapeutic procedures and new techniques and instrumentation. They may consist of lectures, workshops, or direct involvement in a clinical setting.

Practitioners may elect to have their clinical proficiency evaluated confidentially. Strengths and weaknesses are identified, and where necessary, a program of upgrading in various areas may be established in order to assist individuals in reaching or maintaining the required level of competence for licensure.

4) Fostering Inter- and Intraprofessional Cooperation

Despite the trend toward group practice, the majority of optometrists in Ontario are solo practitioners. Having limited contact with colleagues and few opportunities for consultation, they feel isolated from their peers.

Physicians, on the other hand, communicate intraprofessionally through hospitals and clinics. These institutions allow an ongoing dialogue among medical practitioners with various areas of expertise.

An academic and clinical centre will encourage optometrists to share ideas and become aware of trends affecting private practice, thus improving intraprofessional cooperation and fostering camaraderie.

On the interprofessional level, the Institute acts as a community resource which is utilized by various health care practitioners and allied health workers. Referrals are received from local family physicians, neurologists, teachers, social workers, and rehabilitation specialists. All referrals have reports sent concerning the assessment. This helps to maintain open communication with other professions and results in improved health care delivery for the patients.

Educational presentations and joint research activities also serve to encourage interprofessional dialogue.

5) Education of the Public about Conservation of Vision

The Institute takes an active role in offering services and programs to the community through staff participation in health fairs, screening programs, and educational presentations on vision, eye health, eye protection and other areas of concern. Assistance is also offered to the disabled, the homebound, and to institutions for the mentally retarded and aged.

Although the Optometric Institute has only been in operation for a short time, its beneficial effects are quickly becoming apparent. The dedication of the Institute's board of directors, executive director, and clinical staff is reciprocated by the enthusiasm shown by the community. As an active participant at the Institute, I have come to appreciate the importance of a referral clinic. Although there is a great amount of organization and effort required to establish and maintain such a centre, the rewards to the profession, its individual members, and the community at large most definitely justify its existence.

David Ruskin, B.A., O.D.
Optometric Institute

Clean, rinse, store and disinfect soft lenses† ...the easier way.

The Two Solution Polyclens/Polyflex* System.*

Peroxide-free simplicity.

The Polyclens/Polyflex System is less complicated and easier to use than hydrogen peroxide systems. Its single step disinfection process eliminates the inconvenient waiting and risk of irritation due to inadequate peroxide neutralization.

Simplicity encourages compliance.

This simple two solution system avoids the confusion and inconvenience of three solutions. Polyclens thoroughly cleans lenses while Polyflex not only rinses, but stores and disinfects. And with only one bottle for rinsing and disinfecting there's little risk of using the wrong solution. When it comes to simplifying lens care, two solutions really are better than three.

†Recommended only for all Daily Wear Soft Contact Lenses with a 50% water content or less. Now also recommended for use with the Permaflex and Sauflon Extended Wear Lenses.

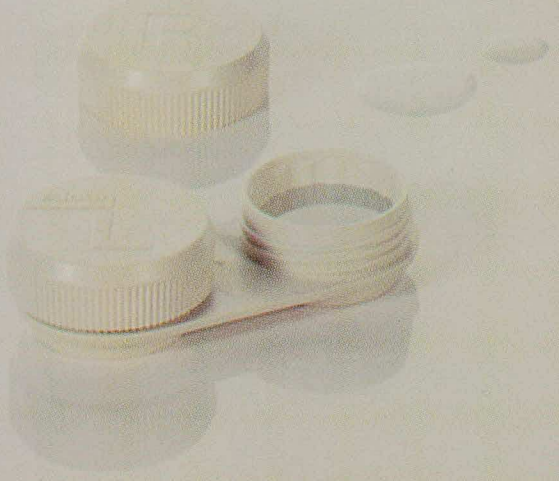
Polyclens/Polyflex**

The Uncomplicated Unperoxide System.

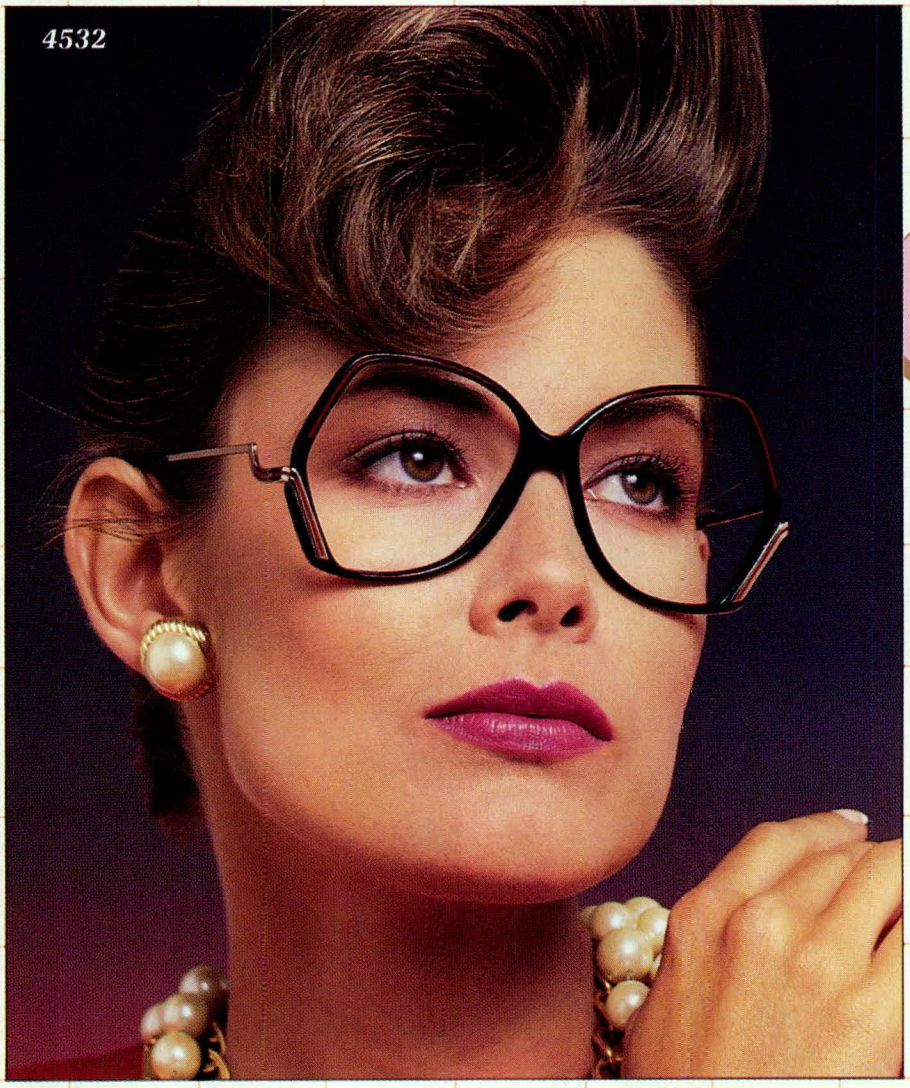
Alcon Canada Inc.
Toronto, Canada L5N 2B8

*T.M. Authorized user

MEMBER PMAC PAAB CCPP



NEW SHAPES...NEW COLORS... NEW LOOKS



LUXOTTICA®

BY

AVANT-GARDE® OPTICS, LIMITED OPTIQUES, LIMITÉE®

947 Verbena Rd., Mississauga, Ont. L5T 1T5

CALL US—IT'S FREE!

From Area Code:	CALL
416 (Free Call)	(416) 673-8104
416 (Toll Areas), 519, 613, 705	1-800-387-6720
418, 506, 514, 807, 819, 902	1-800-387-6623
204, 306, 403, 604, 709	1-800-387-6705
Téléphoniste Parlant Français— Des Indicatifs Régionaux:	APPELEZ
418, 514, 613, 819	1-800-387-3919
506, 902	1-800-387-4947

The following application form is designed for those members of CAO who wish to apply for membership in any of the currently approved Sections of the Association. Elsewhere in this issue is a Section status update.

Please ensure that the completed form (i) clearly identifies the Section for which you wish to apply (If for more than one Section, please use a separate form for each); (ii) fulfills the terms for membership in the Section.

If you wish information about any of the approved Sections of the Canadian Association of Optometrists, please contact the national Association at the address given on the form.

The Canadian Association of Optometrists — Application for Section Membership —

I would like to apply for membership in CAO's _____ Section
(Approved Sections as at **March '86**: Children's Vision)

NAME: _____

MAILING ADDRESS: _____

_____

_____

Postal Code **Telephone**

I am a member of the Canadian Association of Optometrists.

(If an application fee is required by the Section for which you are applying, please ensure that it is enclosed with your completed form).

Return this form to: CAO, Suite 207 - 77 Metcalfe Street, Ottawa, Ontario. K1P 5L6

_____ _____

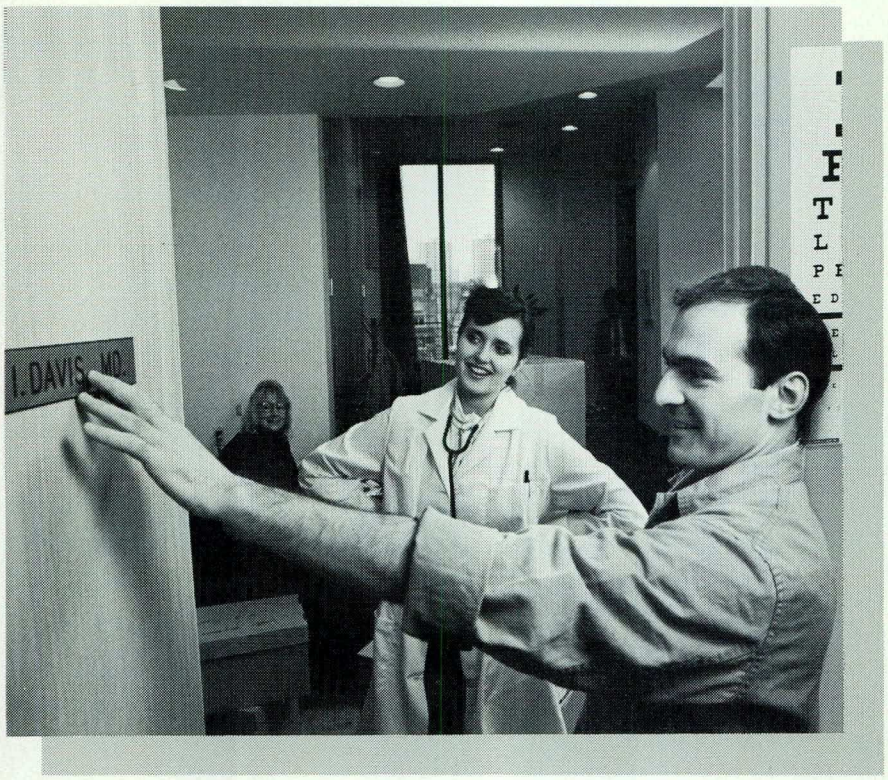
(Signed) (Date)

BANKING-THE PROFESSIONAL APPROACH

As a professional, your clients often rely on your knowledge and experience when making important decisions. You know how vital it is to act quickly and accurately when a client comes to you for advice and expects results. That's why at the Royal Bank we take a very special approach to our professional clients.

COMPLETE FINANCING SERVICES

The Royal Bank offers a complete financing service for professionals which takes into account the wide variety of purposes for which financing may be needed for your business and personal requirements:



- Operating loans to provide working capital when needed.
- Business Term Loans with variable or fixed rate options to provide longer term financing for the acquisition of fixed assets, refinancing or major expansions.
- Mortgages and personal loans with variable or fixed rate options, including financing under the Royal Buy-Back™ car loan program.
- Loans to finance contributions to a deferred profit sharing plan and registered tax sheltered plans.
- Equipment lease financing.

Our interest rates are very competitive, and repayment terms are flexible and geared to your cash flow. You can also life-insure your business loans through our Independent Business Loan Insurance Plan, underwritten by Sun Life.

BANKING ADVICE

When you bank with us, you will find our managers and lending officers experienced specialists in their field. They can discuss with you how your financing needs can best be met and can take timely action so that the money is in place when you need it.

Maximizing your cash resources is also key to your profits. Our Canadian and U.S. dollar Current and Term Deposit Accounts can make your cash work more efficiently for you and your business.

The Royal Bank's long-standing tradition of service to professionals is based on the quality of service and expertise provided by our staff.

We understand your banking needs and are committed to satisfying them. If you want a banker you can rely on to make the right decisions and offer the best banking advice, come to the Royal Bank.

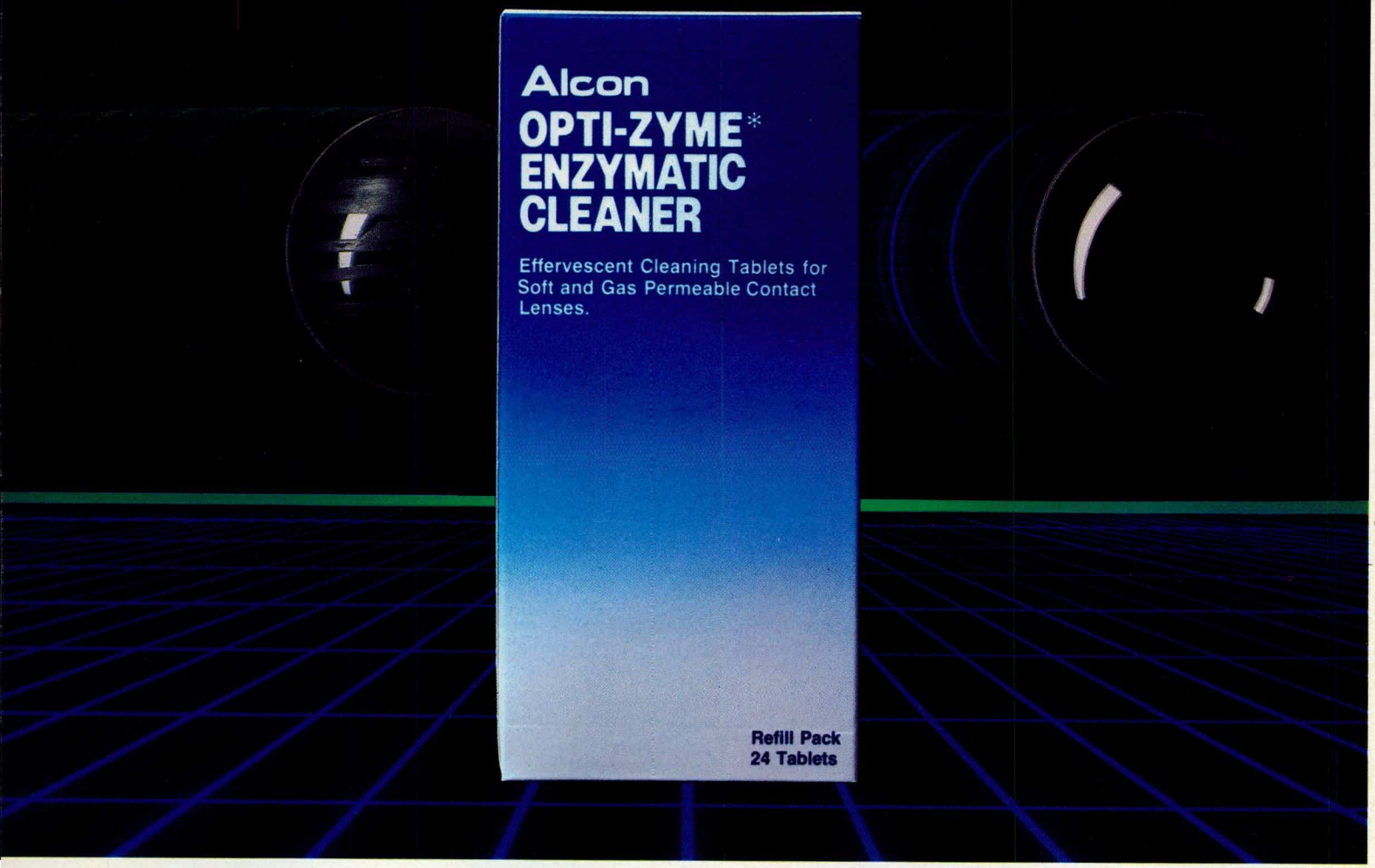
YOUR BUSINESS MATTERS

For professionals just starting up in business, we have a series of "Your Business Matters" guidebooks that can help. Ask us about them.

ROYAL BANK

Your Bank for Independent Business

OPTI-ZYME* AN ENZYMATIC CLEANER THAT REALLY CLEANS



WITHOUT PAPAIN SENSITIVITY

Clinical studies prove Opti-Zyme's unique cleansing action to be highly effective...in fact, Opti-Zyme is the only enzymatic cleaner that removes protein, lipid and mucin deposits.

Odorless and in convenient tablet form, Opti-Zyme dissolves in any saline solution in just two minutes...and cleans lenses completely in 2 to 4 hours without the risk of papain sensitivity.

Alcon Opti-Zyme Enzymatic Cleaner,
ideal for ALL soft (including extended wear lenses) and gas permeable contact lenses

Alcon

Alcon Canada Inc.
Toronto, Ontario L5N 2B8

*registered trade mark Alcon Canada Inc.

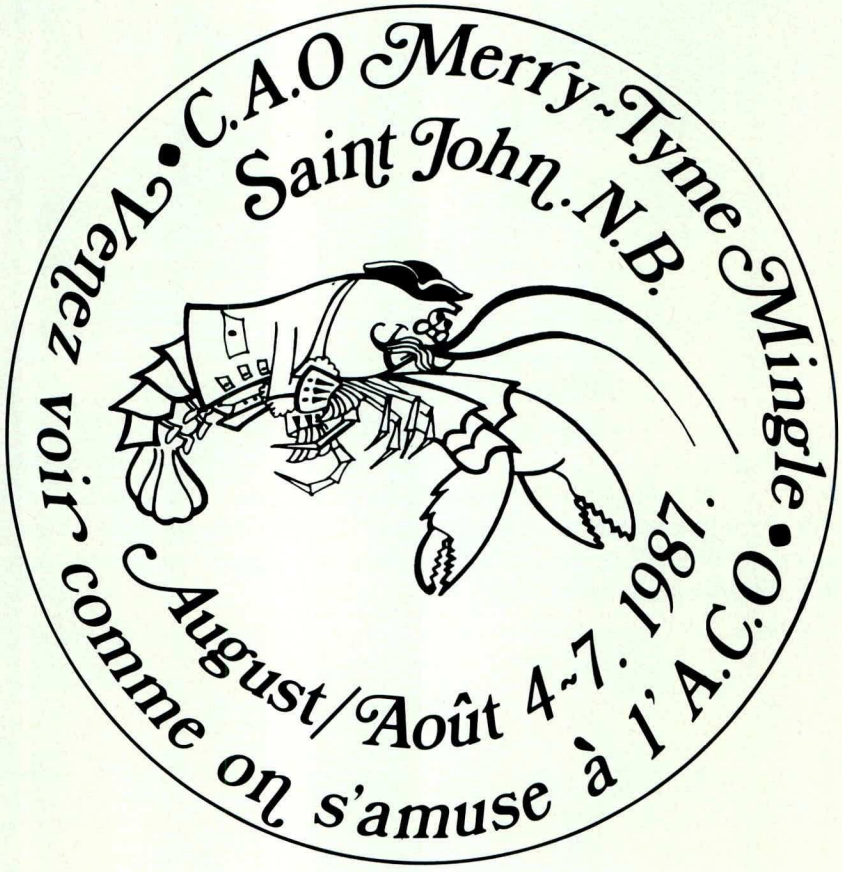
20th Biennial Congress of the Canadian Association of Optometrists

20ième Congrès Biennal de l'Association Canadienne des Optométristes

August 4 - 7 août 1987

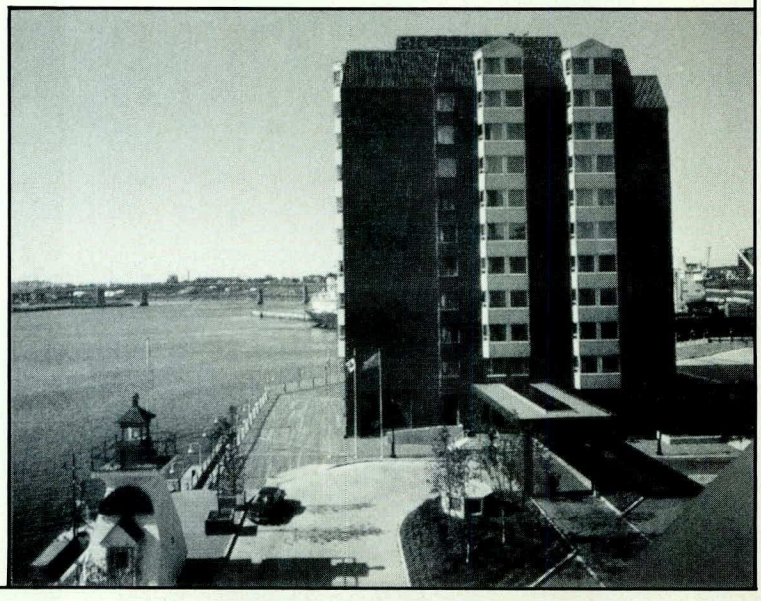
Mark your calendar and plan NOW to attend

Inscrivez-là à votre calendrier et projetez MAINTENANT d'y assister



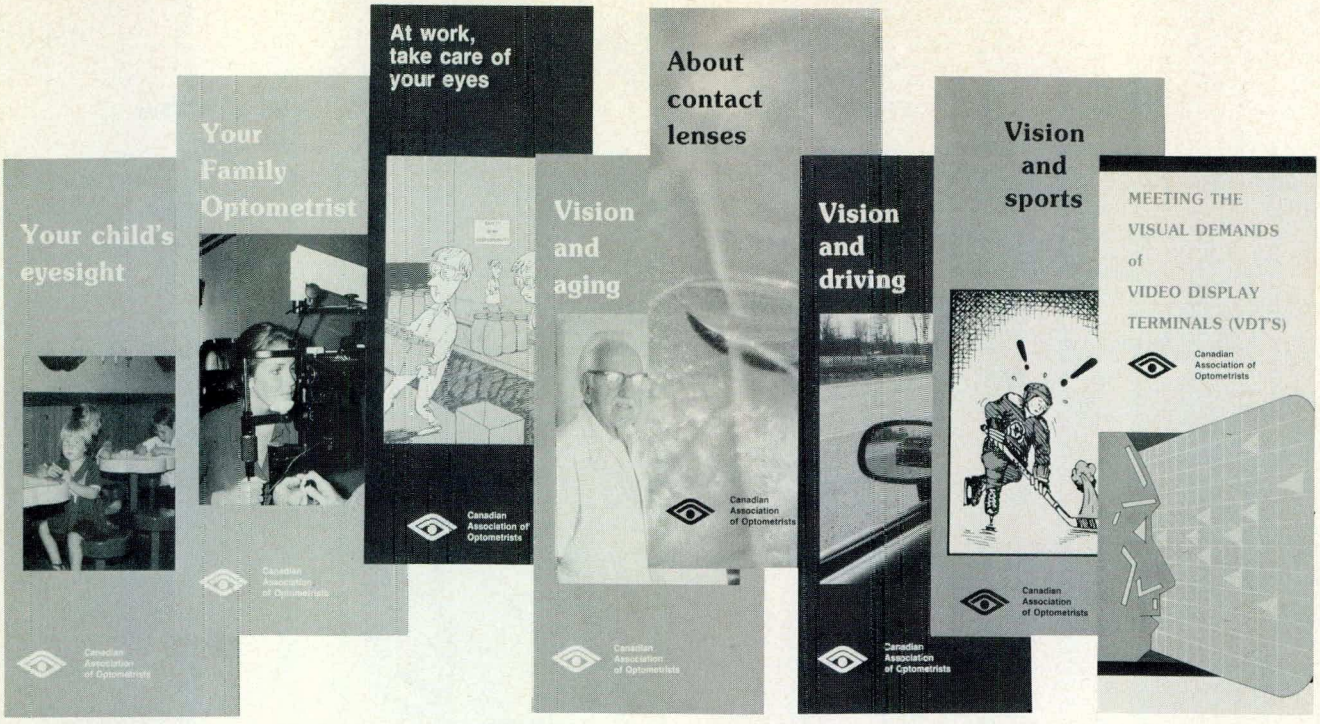
Hilton International Saint John

Saint John Trade and Convention Centre



Watch for details in future issues of the Canadian Journal of Optometry

De plus amples détails seront disponibles dans les prochains numéros de la Revue Canadienne d'Optométrie



The Canadian Association of Optometrists
— Vision Education Service —

CAO's new series of English-language pamphlets (shown above) is now available and may be ordered directly from the Association at Suite 207 - 77 Metcalfe Street, Ottawa, Ontario. K1P 5L6 (*)

* NOTE: A CAO agreement with the Quebec Association of Optometrists excludes members living in Quebec from this particular pamphlet offer. Quebec optometrists wishing copies of the above pamphlets are requested to order directly from your provincial Association.

Please send a copy of this order form with your pamphlet order.
Please **PRINT** or **TYPE** all information.

NAME: _____

MAILING ADDRESS: _____

_____

Postal Code _____ **Telephone** _____

	Please Check Quantity — (✓)		
	$10.00	$45.00	$80.00
About contact lenses	100 ( )	500 ( )	1000 ( )
At work, take care of your eyes	100 ( )	500 ( )	1000 ( )
Meeting the Visual Demands of Video Display Terminals (VDTs)	100 ( )	500 ( )	1000 ( )
Vision and aging	100 ( )	500 ( )	1000 ( )
Vision and driving	100 ( )	500 ( )	1000 ( )
Vision and sports	100 ( )	500 ( )	1000 ( )
Your child's eyesight	100 ( )	500 ( )	1000 ( )
Your Family Optometrist	100 ( )	500 ( )	1000 ( )
Sub-totals			
TOTAL			

(Shipping and Handling charges are EXTRA)

_____ Cheque or Money Order payable to CAO enclosed

_____ Please send Invoice with Order

(Signature)_____ (Date)_____

For prolonged comfort from dry eye irritation. Take the TEARS PLUS test.

This photograph of a hydrophobic surface (like the cornea) shows Tears Plus spreads more easily and is less inclined to break up when tested against another artificial tear.* The moderate surface tension of Tears Plus acts to prolong wettability.

Sustained wettability provides prolonged comfort.

TEARS PLUS™

For prolonged comfort

TEARS PLUS for day use, LACRI-LUBE S.O.P.® for night.

*Ask your Allergan representative for further information. PAAB CCPP

Allergan Inc.
SCIENCE WITH VISION

What's missing in the perfect saline?

Preservatives.

Preservatives cause irritation.
Because New Lens Plus
contains no preservatives, only
pure saline,
you can be sure your contact
lens wearers enjoy irritation-free eyes.
At a price they can afford.

NEW

LENS PLUS™

recommend perfection.

Allergan Inc.
SCIENCE WITH VISION