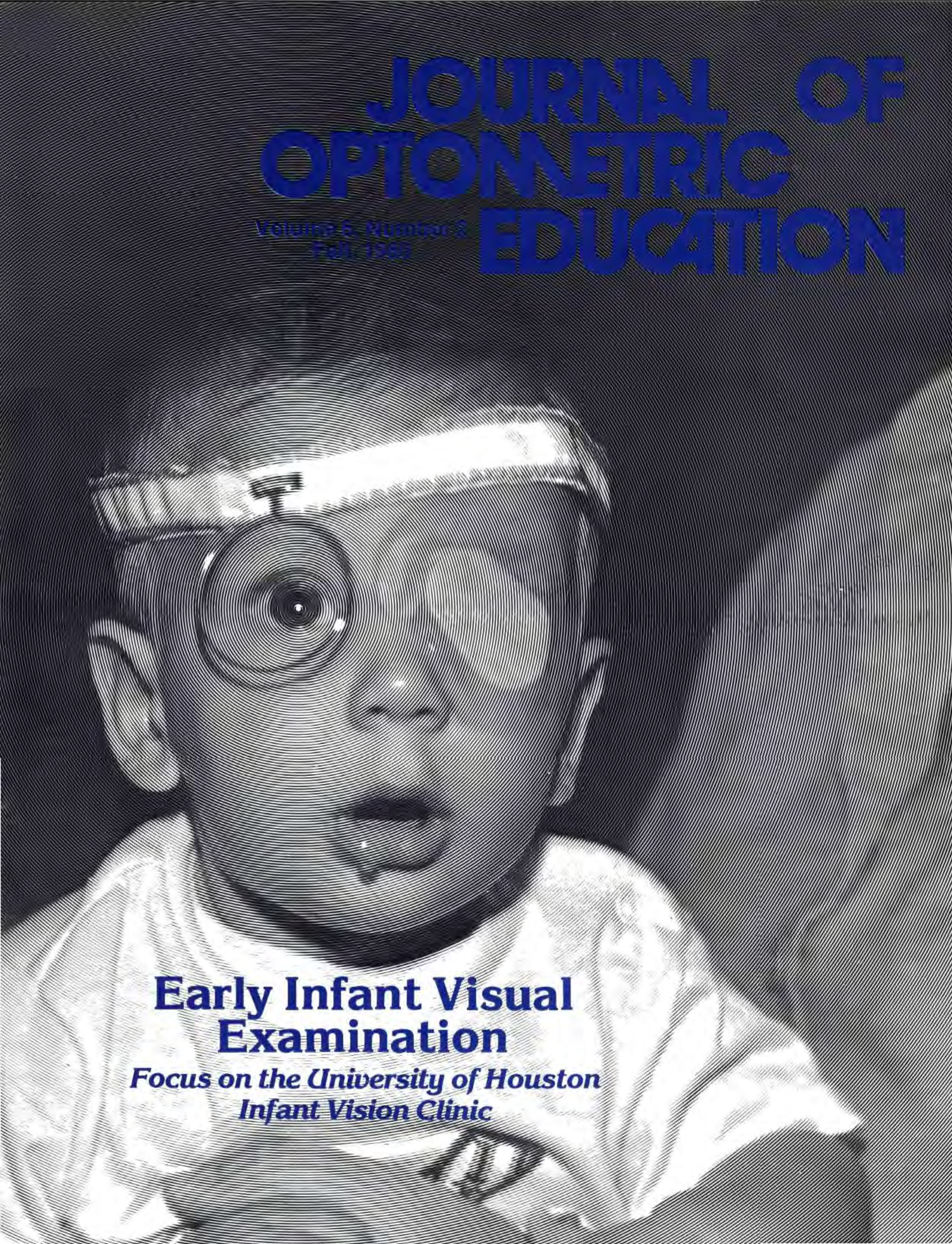
JOURNAL OF OPTOMETRIC EDUCATION

Volume 6, Number 2
Fall 1980



Early Infant Visual Examination

Focus on the University of Houston Infant Vision Clinic

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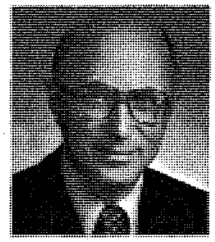

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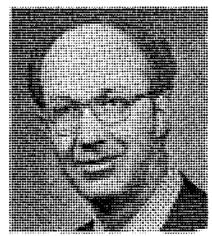

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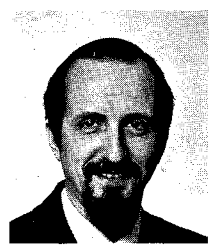

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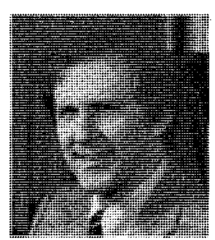

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JOURNAL OF OPTOMETRIC EDUCATION

Official Publication of the Association of Schools and Colleges of Optometry

DEPARTMENTS

Cover: Infant visual acuity may be tested with lenses by taping the lens to the forehead or by holding the lens in place with a special headband (see article, page 12).

Cover Design: Dan Hildt *Graphics: Jon Miller & Dagmar Painter* *Composition: Bobbie Peters Graphics, Inc.*

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LETTERS

Dear Ms. Long:

Congratulations upon the signal honor of "Best National Optometric Journal" for 1980. It is an honor very well deserved. We are all terribly proud of the important contribution of *JOE* to the affairs of ASCO and of your key role as its devoted and talented managing editor.

All good wishes.

Alden N. Haffner
Associate Chancellor
for Health Sciences
State University of New York

Dear Mr. Smith:

I have just had the opportunity of reviewing the *Journal of Optometric Education* for the Summer of 1980. Copy and layout are excellent and the subject articles are interesting and most educational.

My compliments to you, the authors, the editor, as well as the Board of Directors of ASCO.

An outstanding issue which I hope more people in optometry will receive and become more knowledgeable about modern optometric education.

Richard W. Averill
Executive Director
American Optometric
Association

ERRATUM

Hofstetter HW: Recent optometric education developments in the Republic of South Africa. J. Optom Educ 6(1): 8-11, Summer, 1980. Page 10: The photograph labeled Figure 4 shows a student performing tonometry with a non-contact tonometer rather than biomicroscopy as stated in the figure legend.

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Working under the direction of the Dean of the School of Optometry, the Academic Administrator will serve as a professional staff assistant to the Dean in facilitating all aspects of teaching, research, and administration. It is desirable that the candidate have the highest professional degree in optometry and/or equivalent training. Responsibilities will include academic personnel administration; supervision of staff academic personnel administration; coordinating the relationships between the School's instructional and research activities and those of the clinic; assisting the Dean in developing an Organized Research Unit; and generally providing professional staff support for all faculty administrative duties associated with the School of Optometry. Salary range $21,012-$29,064. Starting date on or after November 15, 1980. Send statement of interest, CV, and names of references to Associate Dean Kenneth A. Polse, School of Optometry, University of California, Berkeley, California 94720 by November 28, 1980.

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Working under the direction of the Dean, the Coordinator-Administrator will develop and coordinate corporate, alumni, and foundation programs for support of the school, including developing appropriate campaign materials and solicitation of contributions. Additional responsibilities include developing and maintaining a system of gift acceptance and acknowledgement; coordinating plans for fund raising with the University's Berkeley Foundation; budgeting and reporting for all programs; coordinating public information releases; and helping to develop programs of continuing education for alumni.

Applicants must have at least a bachelor's degree and successful experience in professional fund raising. Professional fund raising experience in an academic environment is desirable as is membership in the National Society of Fund Raising Executives. Salary is open and will be based on the individual's qualifications, but it is expected to be in the $25,000 to $35,000 range. Starting date on or after December 1, 1980. Send resume and names of references to Assistant Dean Darrell B. Carter, School of Optometry, University of California, Berkeley, CA 94720 by November 28, 1980.

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* * * *

JOE to Conduct Reader Survey

In the Winter issue of the *Journal of Optometric Education*, JOE editors will be asking for your opinions about the *Journal* and other questions designed to gain a better picture of our readers. Help make JOE the best possible educational journal for the profession. Watch for the "Reader Survey" in the Winter, 1981 issue and send us your responses.

Optometry to the Year 2000: The Need for a Public Study

The profession of optometry has had one major educational and sociological study* performed under the independent auspices of the National Commission on Accrediting, the term of which spanned two and a half years. The report of this very critical public study was published in 1973 and has provided important and substantive guidance not only to the schools and colleges of optometry and to the profession but to governmental and voluntary social, health and educational agencies, as well. Indeed, the authoritative nature of the document has, over the years, assumed virtual "biblical" importance.

The supervisory board for the study was composed of leaders in the university, business, commerce and social communities as well as in optometric education and in optometric practice. The study itself was pursued successfully because of the remarkable capabilities of Dr. Byron Hollingshead, Dr. Robert Havighurst, study director, and Dr. Frank Dickey of the National Commission on Accrediting. The quality of the board and the excellence of its guidance and supervision undoubtedly gave national standing and importance to the published report.

Optometric education has significantly changed since the initiation of that study. Much in the world of optometric care and services has been altered, and the visual well being of the American public has been importantly advanced. Few would argue that the very framework of health care has undergone rapid and continuing change in this period. Changes in health care organization, health care financing and government strictures on standards of practice are impinging on all professions. Optometry is no exception.

For forty years, the organized profession undertook a major professionalization program only to witness its total collapse in the 1970s by an enormous resurgence of commercialization of optometric care and service delivery. While these rather pervasive changes were taking place, optometric education was substantially altered by newer thrusts in educational content, new educational facilities and a more interdependent, interinstitutional educational enterprise. Optometric practice has been altered remarkably by drug legislation, the growing sophistication of instrumentation technology and major thrusts in the care and treatment of classes of professional problems. Indeed, the optometrist of today, produced by the optometric educational enterprise so significantly affected by the study of a decade ago, is radically different in terms of his/her role, function, attitudes and outlooks. Moreover, the composition of the body of newer professionals itself constitutes a sharp change from the past. And the world of clinical services delivery has made a profound set of shifts under conditions of greater structure and regulation.

The 1970s saw more rapid and deepening changes in optometry which remain to be evaluated in the last two decades of the century. The Havighurst study focused upon the sixties and provided but a glimpse of the '70s. The time is ripe for the Association of Schools and Colleges of Optometry and the American Optometric Association to consider the initiation of a process, along with the major constituencies of the organized professional community, leading to the development of a major new educational, sociological and professional study of the profession of optometry in the century's last two decades.

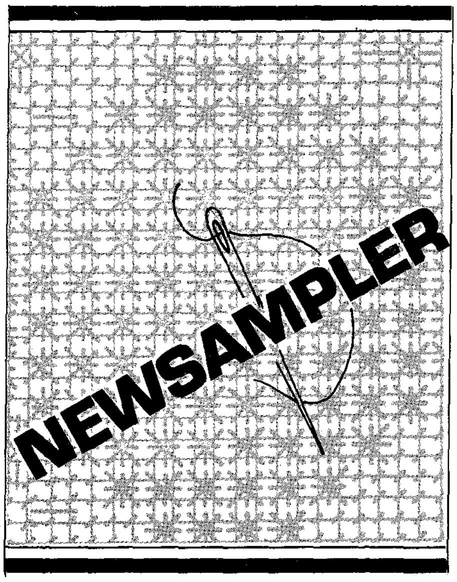
The Havighurst study was completed in 1972, and it spanned the attention of its public board for the prior thirty months. It was in preparation for two full years before it was actually begun. Funding was provided by the American Optometric Association because fund raising among the foundations proved fruitless. The major reason for the failure to raise "outside" monies was the absence of any prior "benchmark" public study. It was the opinion of Dr. Frank Dickey that future public studies and appraisals of the profession and its educational enterprise would be more readily supported by foundation philanthropy. It should be noted that, even if a new study were to be undertaken immediately, two years of preparation would be needed and then three years for the study. Half of the decade will have passed before a resultant document would be issued.

I call upon my colleagues in optometric education and in organized optometry to take the leadership to galvanize the forces in the profession in order to prepare for the development of a major new study endeavor. Optometric education and the body of the optometric profession must look to the future and must prepare for it. We are approaching the end of the century and the end of the millenium in a world of rapidly changing structures and expectations. Optometric institutions and the profession must have a clear perspective of the role that will be required in shaping a future challenged by an interprofessional and interdependent health care system of complexity and diversity.

Let us secure the future of optometry for the public weal by moving boldly and with courage. We can do no less for, indeed, the historians are watching us.

Alden N. Haffner, O.D., Ph.D.
Associate Chancellor for Health Sciences
State University of New York

*Havighurst, Robert J. *Optometry: Education for the Profession. Report of the National Study of Optometric Education.* Washington, D.C.: National Commission on Accrediting, 1973.



HCOP Grants Announced

A fiscal year 1981 grant review cycle for the Health Careers Opportunity Program (HCOP), Office of Health Resources Opportunity, has been initiated, and application materials have been distributed. The program may make grants to health professions schools and public or nonprofit private health or educational entities to design and implement programs to assist individuals from disadvantaged backgrounds to enter and graduate from health professions schools or from programs providing education in the allied health professions.

An estimated $15.5 million for section 787 (health profession schools) and $500,000 for section 798 (allied health professions) is projected to be available for competitive (new, renewal and supplemental) awards in fiscal year 1981.

All applications for fiscal year 1981 funding must be received by the Grants Management Officer, Bureau of Health Professions, postmarked *no later than December 11, 1980.*

UAB Grad Receives Low Vision Award

Darlene F. Harris of Anniston, Alabama, has been named this year's recipient of the William Feinbloom Low Vision Award during the eighth annual honors convocation of The University of Alabama in Birmingham School of Optometry. The recent optometry graduate was awarded the honor in acknowledgement of her demonstrated excellence in the academic and clinical aspects of low vision care. The award, a low vision trial set donated by Designs for Vision, Inc., of New York, is valued at $1,700.

ICO Names New Dean

John A. Cromer, assistant dean for medical education at Oral Roberts University in Tulsa, Oklahoma, has been named academic dean at the Illinois College of Optometry in Chicago.

Dr. Cromer, of Broken Arrow, Oklahoma, received his doctorate in physiology from the University of North Dakota in 1972. He also holds a master's degree in biology from Ball State University and a bachelor's degree in zoology from Taylor University.

Aside from administrative duties at Oral Roberts University, Dr. Cromer has maintained teaching and research commitments as an associate professor of physiology. He was previously assistant dean for student affairs at ORU's School of Medicine.

Dr. Cromer will be on the ICO campus part-time for several months until he can continue full-time.

COE Approves Residency Programs

Optometric residency programs located at the following sites have been awarded the approval status of "Approved" or "Provisional Assurance" by the Council on Optometric Education (COE) of the American Optometric Association as of June, 1980. The school or college of optometry with which the residency is affiliated is shown in parentheses.

Residencies at Veterans Administration Medical Centers:

Albuquerque, New Mexico (University of Houston)

Baltimore, Maryland (Pennsylvania College of Optometry)

Chillicothe, Ohio (Ohio State University)

Kansas City, Missouri (University of California, Berkeley)

Los Angeles, California (Southern California College of Optometry)

Newington, Connecticut (New England College of Optometry)

Northport, New York (State University of New York)

Tacoma, Washington (Pacific University)

Tuscaloosa, Alabama (University of Alabama in Birmingham)

Vancouver, Washington (Pacific University)

West Haven, Connecticut (New England College of Optometry)

West Roxbury, Massachusetts (New England College of Optometry)

Wilkes-Barre, Pennsylvania (Pennsylvania College of Optometry)

Non-VA Residencies:

Family Practice (University of Alabama in Birmingham)

Low Vision (University of Alabama in Birmingham)

Vision Training (State University of New York)

Pacific Students Awarded Research Grants

Nine of 15 research awards given nationally by Beta Sigma Kappa for 1980-81 have been awarded to Pacific University College of Optometry students.

Each project submitted by Pacific students received an award. The other six awards went to students at Illinois College of Optometry, Ohio State University College of Optometry, and the University of Alabama School of Optometry.

Beta Sigma Kappa is an international optometric honor society dedicated to research and development. The awards average $450 each.

(continued on page 29)

Dr. Rodney W. Nowakowski, chief of UAB's low vision geriatric clinical programs, presents this year's William Feinbloom Low Vision Award to Dr. Darlene F. Harris of Anniston, Alabama.

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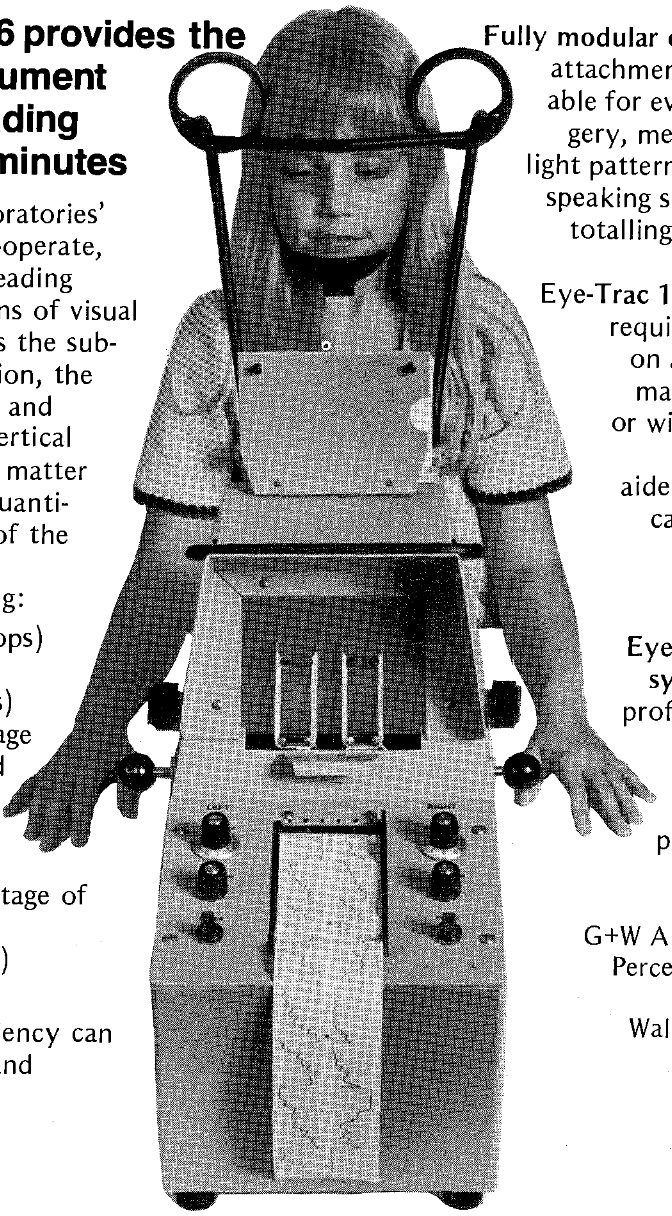
G+W's Eye-Trac® 106 provides the data needed to document and analyze her reading efficiency in 3 to 5 minutes



G+W Applied Science Laboratories' Eye-Trac 106 is an easy-to-operate, self-contained system for reading diagnosis and the evaluations of visual perceptual development. As the subject reads a standard selection, the system continuously tracks and records the horizontal or vertical position of both eyes. In a matter of minutes, you obtain a quantified, permanent recording of the key elements of binocular visual performance including:

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- rate (with comprehension)
- re-reading

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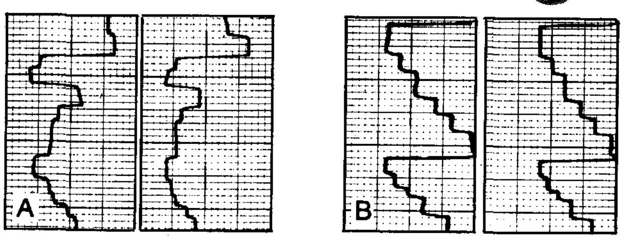
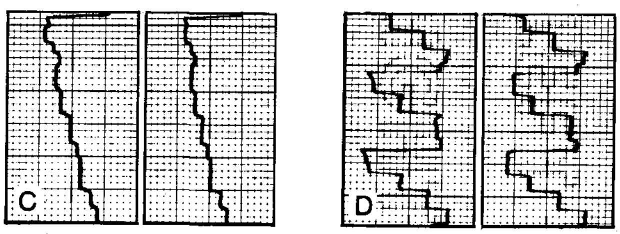


Poor vs. good directional attack: Graph A shows random, inefficient approach to reading. Graph B shows orderly, efficient directional attack.



Inefficient vs. efficient reading: Graph C shows slow, laborious reading with many long fixations. Graph D shows direct, efficient reading that is 3 to 1 lines faster than Graph C.

G+W **Applied Science Laboratories**
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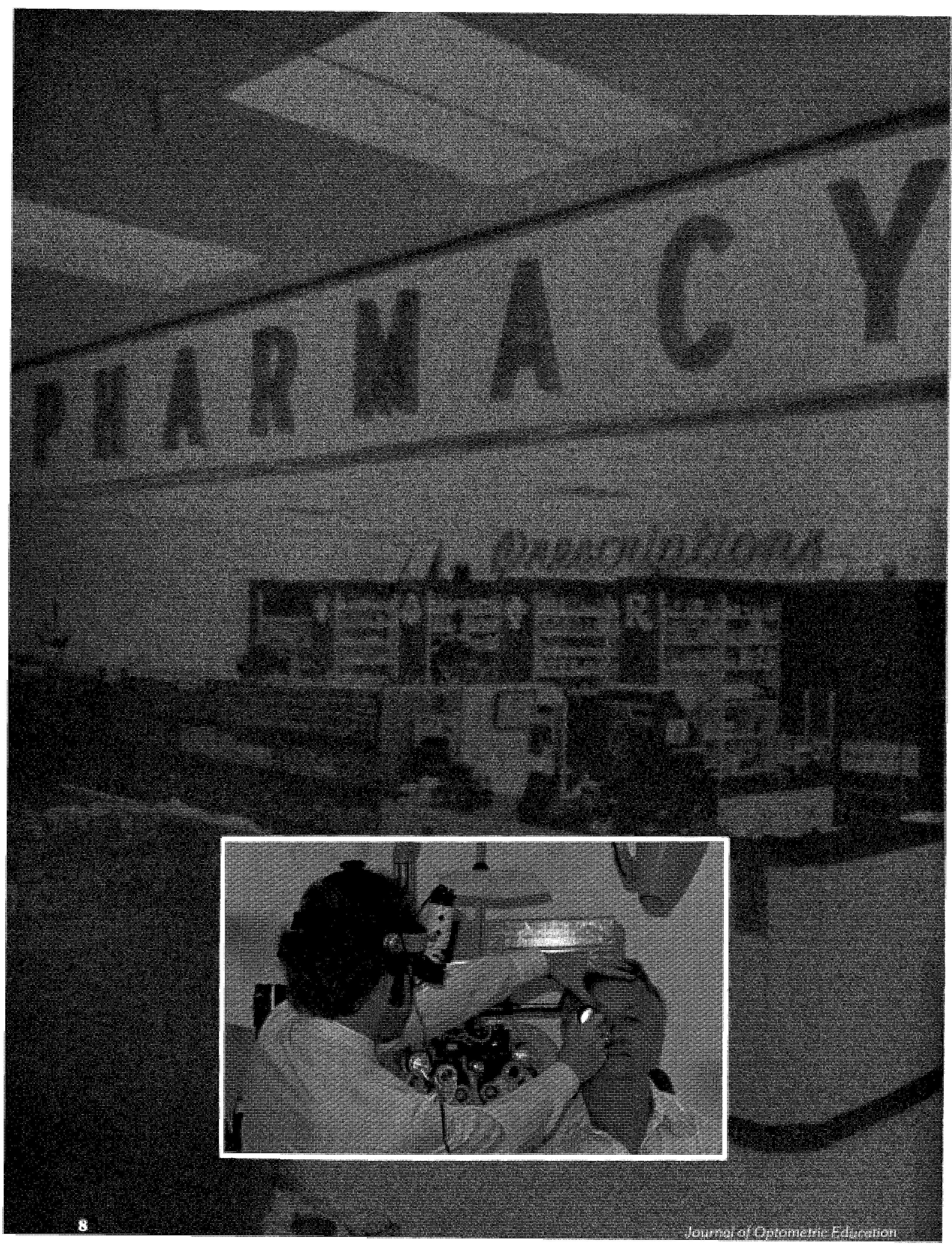


Pharmacy and Optometry:
An Opportunity for Cooperation

**William Stanfill, O.D., Robert Traylor, O.D.,
and
Mickey Smith, R. Ph.**

The professional pharmacist regards himself as the legal custodian of all drugs. Professionalization of this custodial power could only result in improved health care for all people.

(Hirsch and Wick, *The Optometric Profession*, 1968, p. 184.)

The words above, taken from an optometry textbook, reflect a prevailing view held by many optometrists which recognizes the central role of the pharmacist in drug therapy. We would like to provide some information about optometry and pharmacy and suggest areas of potential cooperation between our vital professions.

The Doctor of Optometry

Doctors of optometry are health care professionals who specialize in the examination, diagnosis and treatement of conditions or impairments of the vision system.

Specifically educated, clinically trained and state licensed to examine the eyes and related structures to detect the presence or absence of vision problems, eye diseases and other abnormalities, optometrists are the major providers of vision care in America. They provide treatment by prescribing ophthalmic lenses, contact lenses or other optical aids and by providing vision therapy when indicated to preserve or restore maximum efficiency of vision.

By gathering information and thoroughly evaluating the internal and external structure of the eyes, optometrists can detect systemic diseases such as diabetes, hypertension and arteriosclerosis and eye diseases such as glaucoma and cataract that require referral to other health care practitioners for treatment.

Doctors of optometry are providers of vision care, who, through their classroom and clinical education, are thoroughly trained in all aspects of visual science and optics. Among other things, the four-year degree program in optometry includes comprehensive training in ocular anatomy; neuroanatomy and neurophysiology of the visual system; color, form, space, movement and visual perception; ocular pharmacology; geometric, physical, physiological and ophthalmic optics; ocular disease; design and modification of the visual environment; visual performance and visual screening.

Since optometrists are members of the primary general health care team, their professional education also includes such subjects as biochemistry; cytology; human anatomy; endocrinology; microbiology; general pharmacology; general pathology; sensory, and perceptual psychology; biostatistics, and epidemiology.

The professional degree program in optometry must be preceded by a minimum of two years at an accredited junior college, college or university; six optometry schools require three years of preoptometry. Recently, however, more than 70 percent of all students admitted to optometry school held a bachelors degree, a masters degree or higher.*

The Pharmacist

Pharmacists are health care providers, who, through their classroom training and clinical experience are trained in all aspects of drugs, their uses and their effects. Pharmacists are members of the primary health care team whose professional education includes such subjects as pharmacology, biochemistry, medicinal chemistry, the chemistry of natural products, anatomy and physiology, pathology, pharmaceutics, and socioeconomic studies. An in-school clinical component is also included.

The professional degree in most pharmacy schools is a five-year program leading to the degree of B.S. in pharmacy. A growing number of schools and colleges now offer or require a program six or more years in length leading to the doctor of pharmacy (Pharm. D.) degree.

In most communities the pharmacist is the only health professional with the opportunity to monitor a patient's entire drug regimen including both prescription and non-prescription drugs.

Drug-Related Vision Problems

Many of the patients who enter an optometrist's office will be taking prescription or non-prescription drugs or both. It is not known, however, the extent to which prescribing physicians, dispensing pharmacists, practicing optometrists, and patients (the four parties involved) recognize and cooperatively deal with the effects of drugs on vision. In a first step toward gathering more information, a survey was conducted on a pilot basis among the 170 licensed optometrists in Mississippi to determine the types of drug problems encountered and what is done about them.

Thirty-six optometrists provided the data reported in Tables 1 through 4. Table 1 shows the drug classes and/or specific drugs mentioned by optometrists as being involved in vision-related problems in their practices. The most frequently mentioned drug classes

William Stanfill, O.D., is a private practitioner in Leland, Mississippi. Robert Traylor, O.D., is a private practitioner in Clarksdale, Mississippi. Mickey Smith, R.Ph., is professor of health care administration at the University of Mississippi School of Pharmacy, University, Mississippi, and editor of the Bulletin of the Bureau of Pharmaceutical Services.

*"Annual Survey of Optometric Educational Institutions, 1978-79." *J. Optom. Educ.* 5(4): 27, Spring 1980.

TABLE 1
Drugs and Drug Classes Involved in Vision Problems
Drug Classes and Specific Drugs and Frequency Mentioned

Alcohol		3
Analgesics		3
Darvon	1	
Fiorinal	1	
Percodan	1	
Anti-Convulsants		4
Anticholinergics		8
Atropine	1	
Donnatal	2	
Pro-Banthine	1	
Antidiabetics		11
Anti-Infectives/Antibiotics		5
Chloramphenicol	1	
Cardiovasculars		22
"Heart" medication	5	
Hypotensive agents	14	
Inderal	3	
CNS Depressants		4
General	3	
Barbiturates	1	
CNS Stimulants		8
General	3	
Elavil	3	
Ritalin	1	
Vivactil	1	
Cold Remedies OTC		3
Contac	1	
Corticosteroids		6
Diuretics		4
Muscle Relaxants		8
Robaxin	1	
Oral Contraceptives		10
Tranquilizers		29
General	18	
Valium	4	
Librium	3	
Miltown	1	
Mellaril	2	
Navane	1	

Miscellaneous

Anesthetics	1	Insulin	2
Anti-Arthritics	4	Phenergan	1
Anti-Histamines	5	Pilocarpine	1
Anesthetics	1	Reserpine	1
"Diet Pills"	1	Thyroid	1
Diuretics	3	Tubercular	1
Epinephrine	1	"Ulcer"	1
"Hormones"	2		

were "tranquilizers," cardiovascular drugs, antidiabetic medications, oral contraceptives and muscle relaxants. These reports, plus the other drugs mentioned, should suggest to the pharmacist situations in which special patient counseling may be warranted.

As Table 2 indicates, the large majority of reporting optometrists indicated experience with a patient whose vision is affected by drugs once a month or more. Nearly half indicated that such incidents occurred as often as once a week.

What do optometrists do about drug-related vision problems? Some (see Table 3) contact a pharmacist. One out of six do so once a month or oftener. On the other hand nearly half never contact a pharmacist. Comments supplied by the respondents appeared to indicate that optometrists who did not contact pharmacists about drug problems either: (1) were reasonably well satisfied with informational resources at hand (*Physician's Desk Reference* was mentioned by several); or (2) were reluctant to "bother" the pharmacist.

As Table 4 shows a physician contact was no more frequent than pharmacist contact.

Today, an optometrist's extensive education in ocular anatomy and pathology as well as chemistry and pharmacology makes him more aware of the significance of drug side effects and interactions—especially as they pertain to vision function. Even though some states do not allow the optometrist to use diagnostic pharmaceutical agents, the practitioner frequently must cope with visual side effects from other drugs used in the treatment of various systemic conditions.

Because most patients are often unsure about the exact type, dosage and medication they are taking, records kept by the pharmacist can be of considerable assistance in helping practitioners determine possible visual side effects caused by various medications. The pharmacist can aid the doctor of optometry by providing the necessary technical information regarding specific drugs and medications, the type of medications taken by the patient and the ocular side effects of the medication.

There are numerous areas of common interest shared by both the pharmacist and optometrist. A close working relationship in all areas of mutual concern in caring for patients can be established to better serve the vision health of the public.

TABLE 2
Frequency of Finding a Patient Whose Vision is Affected by Prescription or Non-Presription Drugs

Frequency	No. of Responses
Never	0
Once a month or less	5
One to three times a month	15
Once a week or more	16

TABLE 3
Frequency of Contact with a Pharmacist about Drug Problems

Frequency	No. of Responses
Never	16
Once a month or less	14
One to three times a month	5
Once a week or more	1

TABLE 4
Frequency of Contact With a Physician About Drug Problems

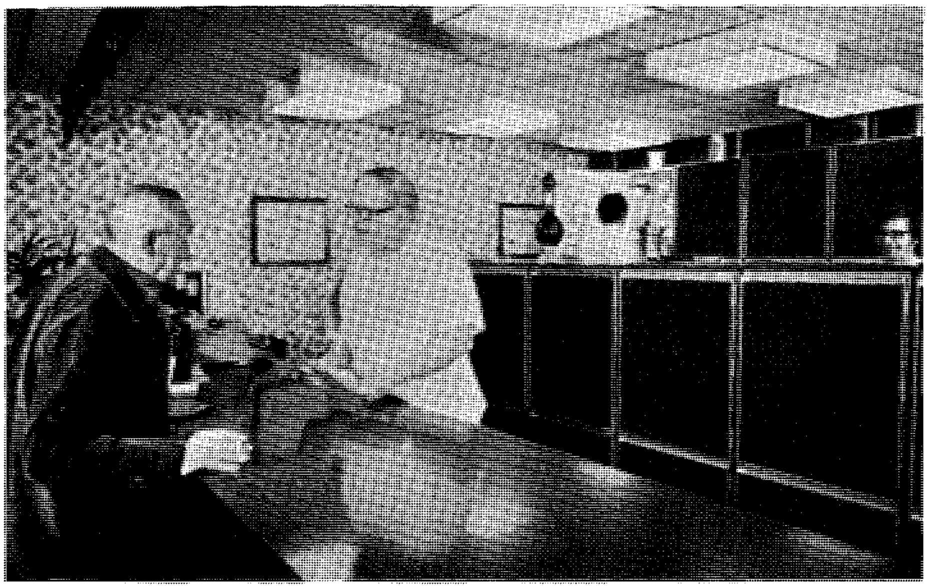
Frequency	**Number of Responses**
Never	10
Once a month or less	21
One to three times a month	4
Once a week or more	0
No response	1

Among the activities which might be suggested for pharmacist/optometrist cooperation are the following:

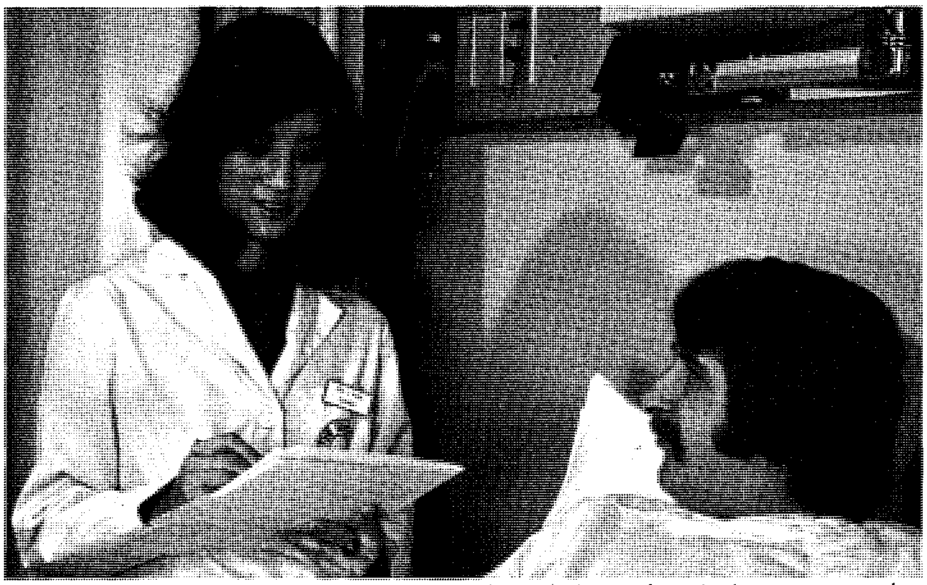
1. Establishment of routine professional contact, such that each knows the interests and capabilities of the other
2. Routine review of new drug data by the pharmacist and supply to the optometrist of information about new drugs which are known to affect vision
3. Feedback from the optometrist to the pharmacist when a mutual patient experiences drug-related vision problems
4. Careful counseling by the pharmacist of patients reporting vision problems
5. Recording on the patient's medication profile of any patient-reported or optometrist-reported drug-related vision problems

Each of the above is a step toward better patient care through individual interprofessional relations. On a more general level there would appear to be significant advantages to regular shared continuing education programs during which members of both professions could be made aware of the nature, consequences, and possible resolution of drug-related vision problems. Better, formal communications between these two vital units can only result in better drug therapy *and* vision care for the patient.

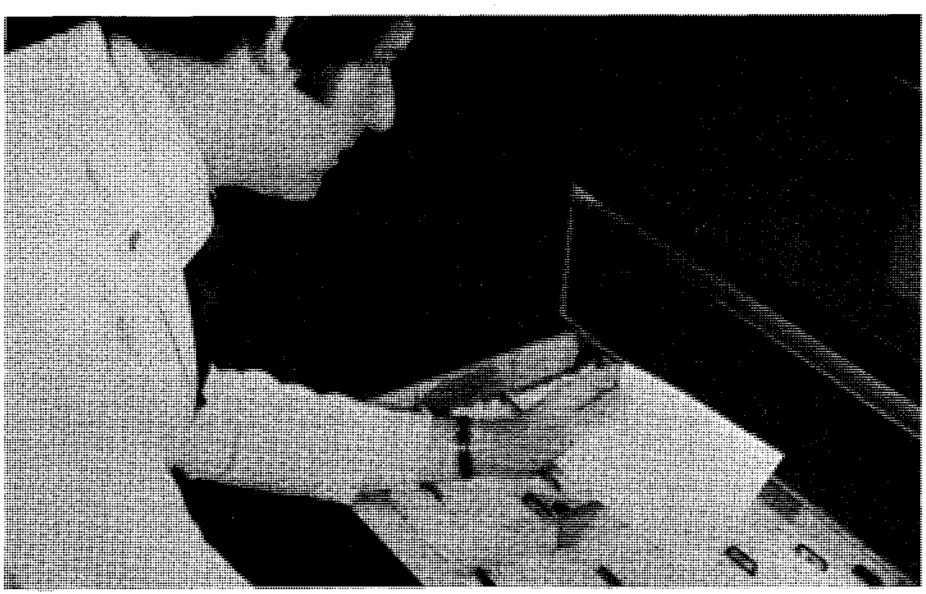
It is suggested that, in smaller communities, personal interaction may occur on a routine basis. In larger cities joint interprofessional committees could serve as the vehicle for cooperation between the professions. ☐



In most communities the pharmacist is the only health professional with the opportunity to monitor a patient's entire drug regimen.



The pharmacist can aid the doctor of optometry by providing technical information regarding medications taken by the patient and the ocular side effects of the medication.



Records kept by the pharmacist can assist the practitioner in determining possible visual side effects caused by various medications.

Adapted from an article in the *Bulletin of the Bureau of Pharmaceutical Services* (University of Mississippi) 16(3), March, 1980.

Focus on: The University of Houston Infant Vision Clinic

Ruth E. Manny, O.D., M.S. and Roger L. Boltz, O.D., Ph.D.

Based upon reports about the visual capabilities of infants and the effects stimulus deprivation may have on a developing visual system, the University of Houston College of Optometry has established a clinic specifically designed to test infants. The clinic puts to use recent developments in the field of infant visual function making the comprehensive testing of infants clinically feasible.

The routine examination of infants is a relatively new idea that has emerged from two related lines of investigation. The first concerns the ever increasing body of literature which has demonstrated, in cat and monkey, the effects of stimulus deprivation on the development of the visual system if the deprivation occurs during what has been termed the critical period.[1] Electrophysiological recordings of single units show changes in the response characteristics of cells and changes in the normal distribution of the ocular dominance columns[2,3] while histological sections from the cortex and the lateral geniculate nucleus of these deprived animals show morphological changes.[4,5] Behavioral studies with animals which have undergone stimulus deprivation during the critical period show decreases in visual acuity and contrast sensitivity.[6,7]

Similar decreases in visual acuity and contrast sensitivity have been measured in clinical patients with ptosis,[8] cataracts,[9] moderate to high uncorrected astigmatism,[10] or a large uncorrected refractive error.[11] These anomalies are presumed to have occurred early in life (during the critical period) since normal visual function is not restored with the proper optical and/or surgical correction.

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Investigations with animals show recovery of visual function if the stimulus deprivation is terminated before the end of the critical period.[12] More recent studies have indicated a partial recovery after the end of the classically defined critical period.[13] Case studies of clinical patients with anomalies leading to stimulus deprivation which have been detected and corrected early show normal visual acuity.[14,15] Hence, an important factor in preventing the consequences of stimulus deprivation is early detection and remediation of the anomalies responsible for the deprivation prior to the end of the critical period. Although indirect evidence suggests that the critical period in man may be the first one to two years of life,[16] its duration has not been clearly defined.[17] Because of this, early examination of infants is desirable as a preventive measure.

The second area of investigation which has promoted the routine examination of infants has been the growing number of reports which describe the infant's visual capabilities and the rapid development of the visual system during the first year of life. In order to investigate this development and to provide information on the expected visual performance of infants, researchers have developed objective testing methods. The preferential looking procedure developed by Teller et al.[17] has become a powerful technique which has been used to investigate the development of visual acuity,[18] color vision,[19] and stereopsis[20] in infants. This procedure is based on the work of Fantz[21] who determined that infants will prefer to fixate a patterned stimulus over a uniform field if these two stimuli are presented simultaneously.

Based on what has been reported about the visual capabilities of infants and their development and the effects stimulus deprivation may have on a developing visual system, we decided to establish a clinic at the University of Houston College of Optometry specifically designed to test infants. While the idea of examination of infants is not new,[22] the recent developments discussed above have made the comprehensive testing of infants clinically feasible.

The UH Procedure

We routinely use a staircase procedure developed by Gwiazda et al.[23] to determine the acuity of our patients. This method allows the rapid (10-15 minutes) assessment of visual acuity. Three 35mm slides of gratings at each acuity level ranging from 0.5 cycles/degree (20/1200) to 15 cycles/degree (20/38.5) in approximately half octave steps are matched with equal mean luminance uniform gray slides. These slides are then placed in two side by side projectors so that the spatial frequency of the gratings increases (stripe width decreases) in an orderly progression every third slide. The gratings are randomized between the right and left projectors so that the side of presentation of the grating varies randomly between right and left.

The slides are back projected onto two circular screens mounted on a black frame. The infant sits in a darkened room on one side of the screens while an observer is positioned behind the

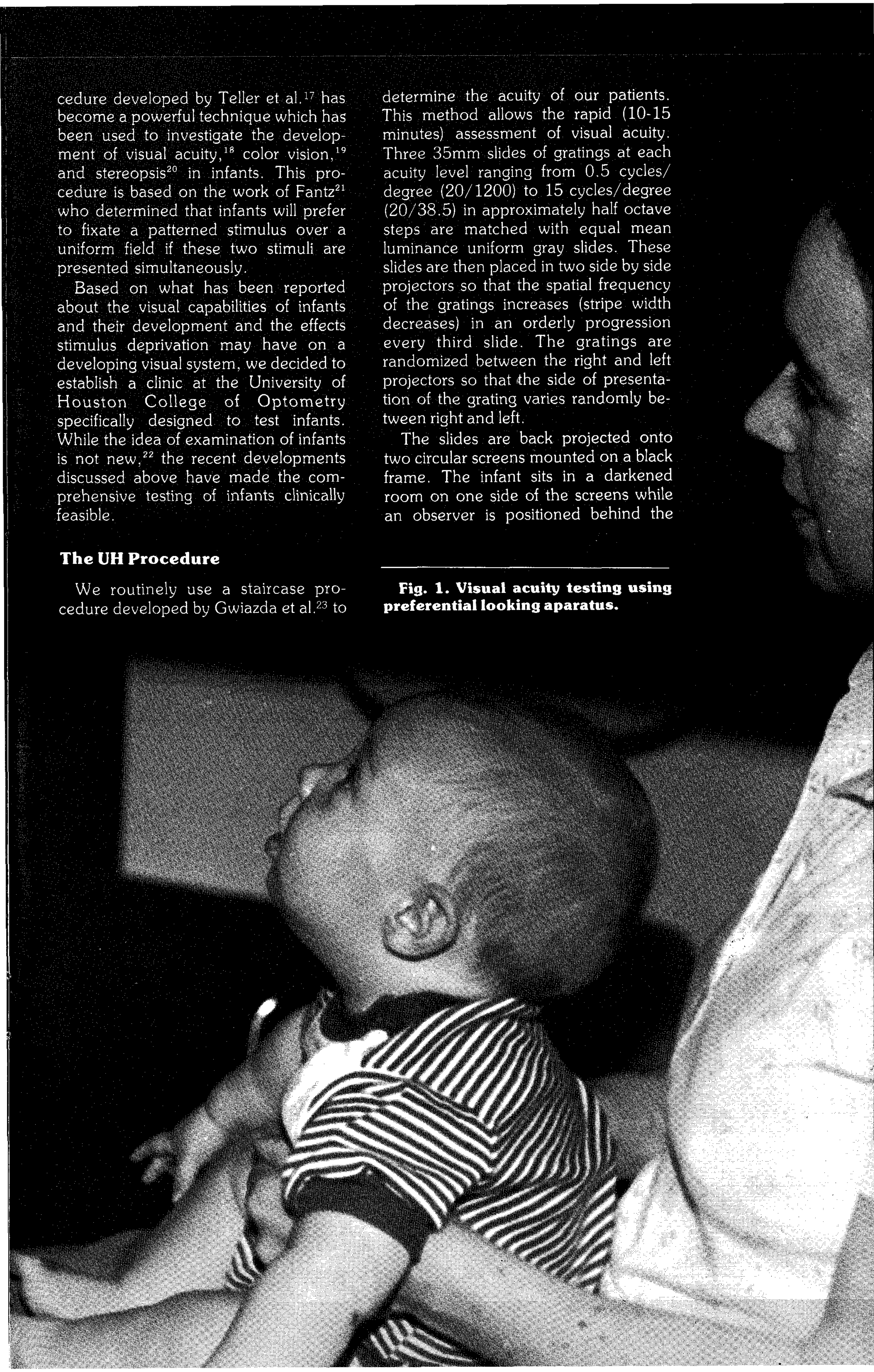

Fig. 1. Visual acuity testing using preferential looking aparatus.

screens facing the infant (Fig. 1). The observer who cannot see which screen contains the grating watches the infant's behavior when the slides are shown and must decide on which side the stripes are being presented. This continues until the observer makes an error. When an error occurs, the order of presentation is reversed until the observer makes a correct response. Gwlazda et al.[23] have determined a statistical endpoint for this procedure based on the number of incorrect trials relative to the total number of trials at a particular stripe width. From this endpoint, the acuity level of the patient can be obtained.

Equipment, Scheduling and Testing

At present, patients one year of age or younger are scheduled for the infant clinic. The clinic is equipped with a changing pad, disposable diapers, cloth diapers and pins, Wet Ones,™ blankets, rattles, bottles, apple juice, and teething biscuits. We find most parents arrive prepared, but we have found it helpful to stock these items.

One hour is set aside for each patient. Although the entire hour may not be used for the evaluation, this amount of time allows for feeding, diaper changes, and an occasional nap. Since four hours are set aside for the clinic, we can accommodate a maximum of four infants during each clinic session. Three to six senior students are assigned to the clinic on an elective basis.

Our routine examination includes the following:

1. Cover test
2. Ocular motility evaluation
3. Near retinoscopy
4. Internal examination (Fig. 3)
5. External examination including pupillary reflexes
6. Denver Development Screening Test
7. Visual acuity by preferential looking

Auxiliary testing may include:

1. Visual acuity by optokinetic nystagmus and/or visual evoked response
2. Placido's disc evaluation of the cornea.
3. Prism tests for additional binocular evaluation.

Routinely, visual acuity is measured using vertical gratings, but horizontal, right and left oblique gratings are also available in cases of significant astigmatism. A small headband occluder or Opticludes™ are used for monocular testing (Fig. 2). When a large refractive error is found lenses may be placed in front of the infant's eye using a special headband or taping them to the forehead (cover photo). Thus, visual acuities may be determined with the correction in place.

Recently, Dobson et al. and Fulton et al. have developed a screening technique based on the concept of diagnostic stripe widths.[24,25] A diagnostic stripe is defined as that stripe width which 95 percent of normal infants at a given age will pass. If an infant is between 0 and 7 weeks of age, the diagnostic stripe width is 20/800. A 20/600 stripe is used for those infants 8 to 11 weeks old while a 20/400 stripe is used for those infants 12 through 16 weeks of age. The infant is presented the appropriate stripe width for his age paired with an equal mean luminance gray. An observer who does not know the side of the grating watches the infant through a peephole in the screen and, based on the infant's behavior, determines on which side the grating was presented. An infant passes the stripe width if the observer is correct 5 out of 5, 7 out of 8, 9 out of 11, 11 out of 14, 12 out of 16, or 14 out of 19 trials. Although this procedure does not determine the acuity level of the infant, it does serve as a rapid screening technique and we anticipate including this procedure in our clinic upon completion of construction of the apparatus.

Our experience with this clinic, although limited by its recent establishment, has provided us with several interesting cases. While most of our infants have shown no visual problems, much to the relief of their parents, we have seen several cases of strabismus, nystagmus and other visual problems. We feel this clinic offers a valuable service and has been well accepted by the students, the patients, and their parents. □

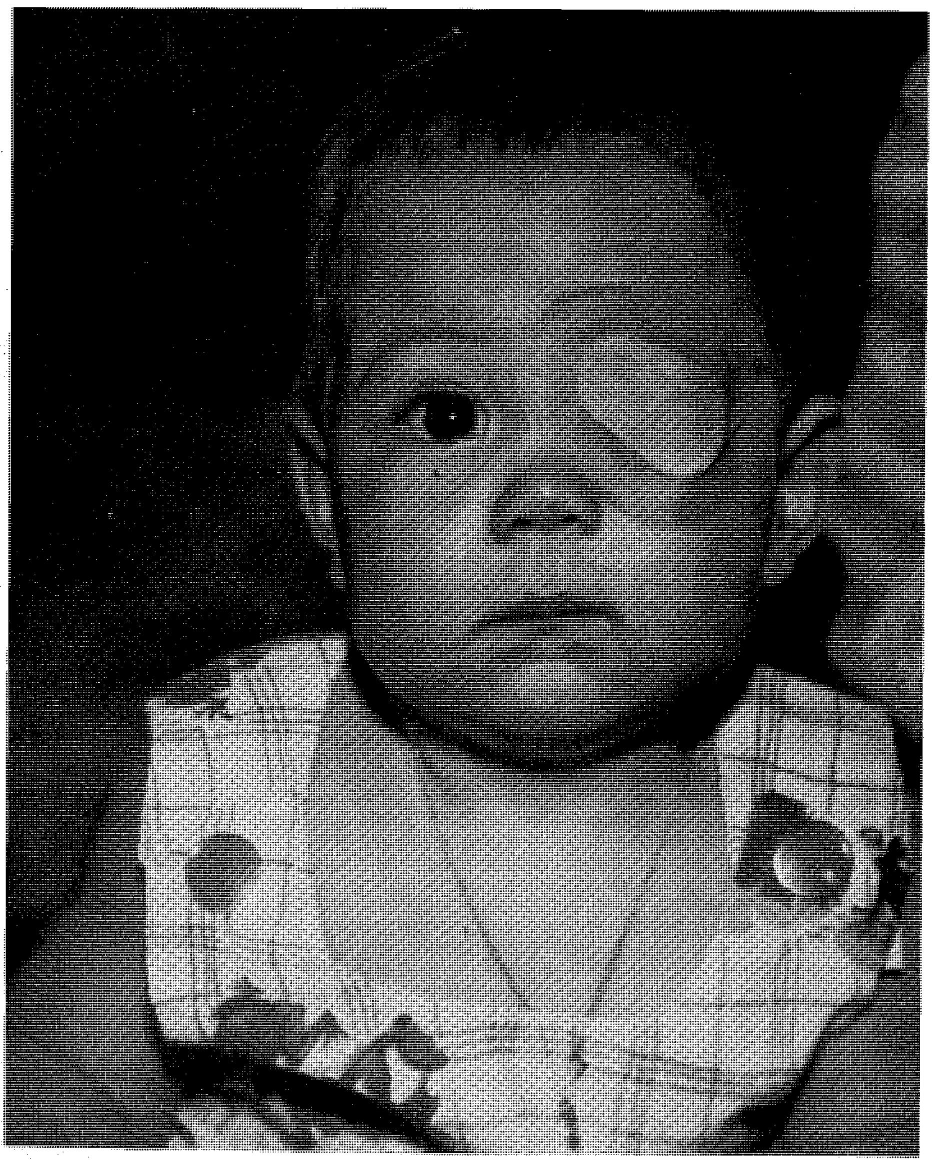

Fig. 2. Occlusion to assess monocular acuity may be obtained by an Opticlude™ as shown here or by a headband patch.

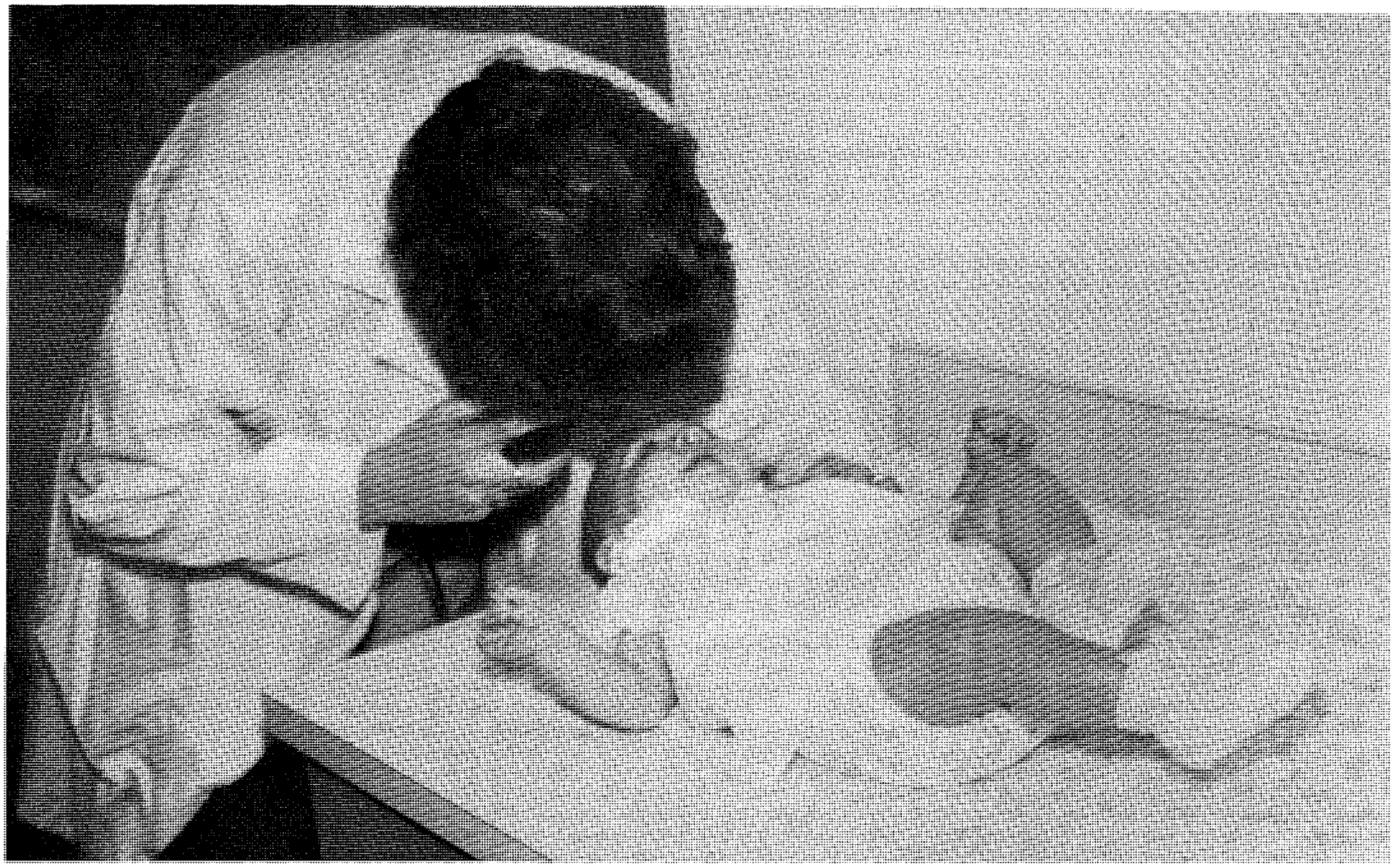

Fig. 3. Routine examination at the University of Houston Infant Vision Clinic includes internal examination of the eye (ophthalmoscopy).

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Federal Program Support of Optometric Education

1980-1981

Under PL 94-484, the Health Professions Educational Assistance Act of 1976, the Congress provided authority for institutional support programs as well as student support programs for schools of the health professions. Student support programs represented two separate approaches: one of loan assistance and another program of assistance for exceptional financial need, primarily to encourage and provide the opportunity for minority and economically disadvantaged students to participate in post-graduate education in the health professions.

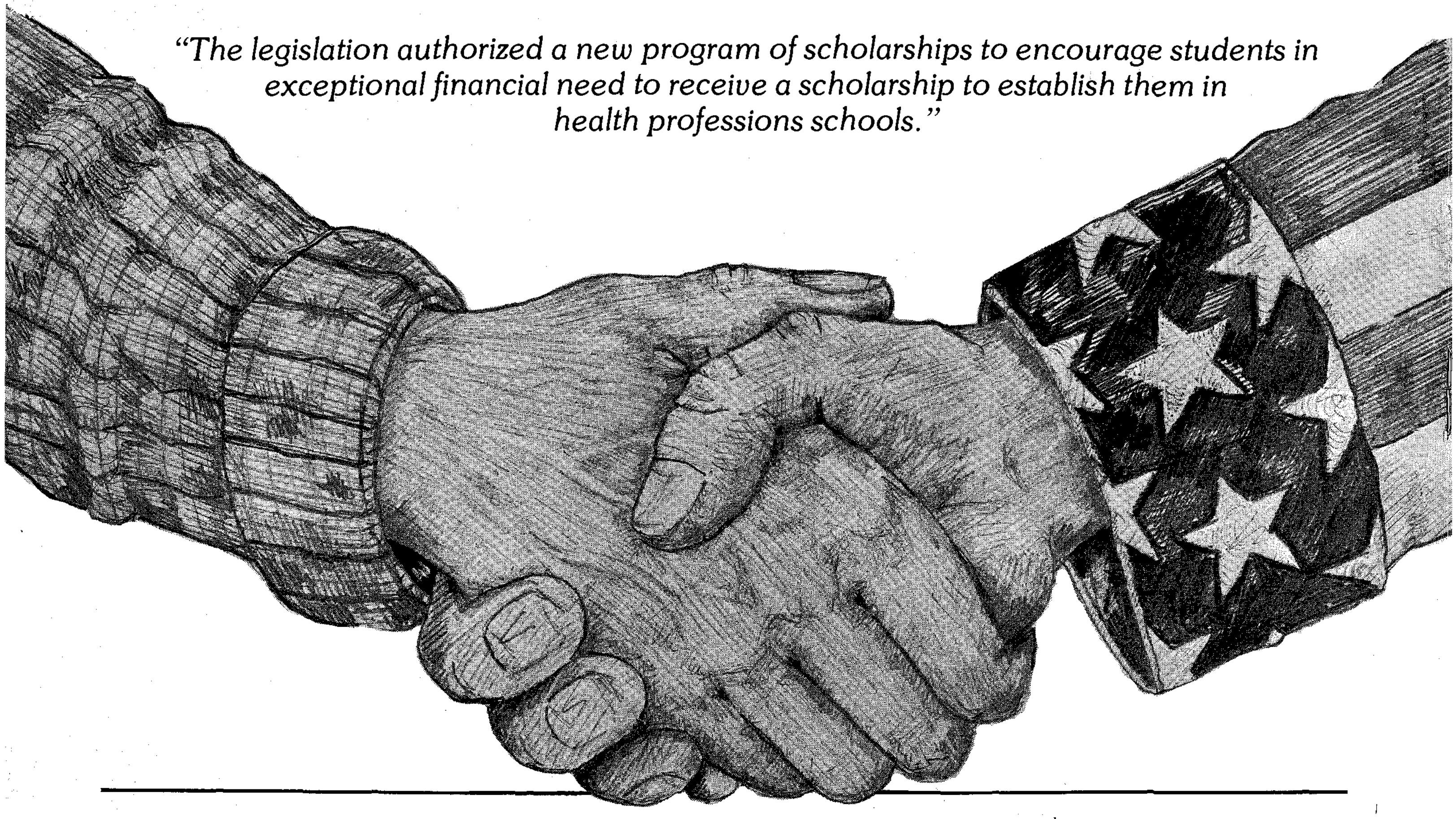
The direct institutional support program frequently referred to as capitation provided an incentive to the schools, in the case of optometry, to increase their class sizes in order to overcome projected shortages of manpower and, secondly, to insure the opportunity for students from those states which did not have schools to have equitable opportunity within the private schools of optometry to be selected.

Capitation

Under the authority for capitation grants schools of optometry were authorized to receive a level of $765 per year for each full-time student enrolled in the program. In order to be eligible for the receipt of that, it was required that schools maintain their first-year enrollments at least at the level of the previous year, 1976-77.

In addition, it was required that each of the public schools enroll at least 25

"The legislation authorized a new program of scholarships to encourage students in exceptional financial need to receive a scholarship to establish them in health professions schools."



Health Professions Educational Improvement Program Grant Amounts by Fiscal Years — Optometry

	Capitation Grants								
Institution	**1972[a]**	**1973[b]**	**1974[c]**	**1975[d]**	**1976[e]**	**1977[f]**	**1978[g]**	**1979[h]**	**1980**
University of Alabama in Birmingham	31,903	45,250	58,820	50,322	40,917	46,030	58,426	47,805	37,336
University of California, Berkeley	147,033	138,984	150,472	118,615	81,834	79,461	100,213	83,504	62,537
Southern California College of Optometry	171,308	189,019	235,557	208,783	148,366	146,512	149,740	117,651	87,272
Illinois College of Optometry	315,567	316,109	352,925	273,174	189,615	181,716	228,286	184,392	140,709
Indiana University	170,614	163,549	176,462	136,587	92,812	86,426	103,696	84,125	62,771
New England College of Optometry	176,162	202,723	230,085	192,249	130,269	122,009	136,197	112,063	86,339
Ferris State College	—0—	—0—	—0—	—0—	—0—	—0—	38,306	36,940	28,002
University of Missouri-St. Louis	—0—	—0—	—0—	—0—	—0—	—0—	—0—	12,417	9,334
State University of New York	19,423	40,725	63,198	61,413	49,100	65,342	87,832	76,675	61,371
Ohio State University	136,630	131,874	143,632	124,777	93,144	69,647	88,993	72,639	55,304
Pacific University	189,340	182,296	191,509	150,451	100,130	100,355	130,007	102,130	78,405
Pennsylvania College of Optometry	313,486	316,109	350,873	275,742	184,625	168,103	222,095	182,840	138,142
Southern College of Optometry	332,212	323,220	380,283	287,038	195,936	188,364	229,833	181,090	135,809
University of Houston	167,146	161,610	181,250	136,587	87,489	105,737	151,288	124,791	95,906
Inter-American University of Puerto Rico	—0—	—0—	—0—	—0—	—0—	—0—	—0—	—0—	7,471
Totals	2,170,824	2,211,468	2,515,066	2,015,738	1,394,237	1,359,702	1,724,912	1,419,881	1,086,708

SOURCE: Adapted from U.S. Department of Health and Human Services, Bureau of Health Professions. "Health Professions Educational Improvement Program—Table 1. Grant Amounts by Individual Schools and by Fiscal Years. Mimeographed, n.d. Grant awards for 1980 from U.S. Department of Health and Human Services, Bureau of Health Professions. "Approval List for Grants and Awards." Mimeographed, September, 1980.

[a]Amount awarded in FY 1972 represented 86.69 percent of the computed formula amount for schools of optometry.

[b]Amount awarded in FY 1973 represented 80.81 percent of the computed formula amount for schools of optometry.

[c]Amount awarded in FY 1974 represented 85.49 percent of the computed formula amount for schools of optometry.

[d]Amount awarded in FY 1975 represented 64.18 percent of the computed formula amount for schools of optometry.

[e]Amount awarded in FY 1976 represented 41.58 percent of the computed formula amount for schools of optometry.

[f]Amount awarded in FY 1977 represented 39.57 percent of the computed formula amount for schools of optometry.

[g]Amount awarded in FY 1978 represented 50.57 percent of the computed formula amount for schools of optometry.

[h]Amount awarded in FY 1979 represented 40.57 percent of the computed formula amount for schools of optometry.

percent of their first-year students from states without an accredited optometry school or in the case of the nonprofit private schools 50 percent of their first-year class from states without accredited optometry schools.

While $765 per student was the authorizing level in the enabling legislation, the appropriations process did not appropriate sufficient monies for this authority to provide for maximum funding. Therefore, over the years various allocations have been made to schools of optometry, and these are presented in one of the tables.

Financial Need First-Year Scholarships

The legislation authorized a new program of scholarships to encourage students in exceptional financial need—minorities and those in economic distress—the opportunity to receive a scholarship to establish them in health professions schools. The scholarships were authorized to be equal to the dollar value of National Health Service Corps scholarships. This represented a monthly stipend plus an amount for living expenses and the provision of direct payment of tuition and other reasonable educational expenses. This program, unlike the National Health Service Corps, did not have a service obligation attached to it.

Health Professions Student Loans

The other program supporting students is the health professions student loan program. This is a continuation of a program that existed under the previous legislation. The amount which a student can borrow is the cost of tuition plus $2500 with an interest rate established at 7%. This program is based upon the schools' application to the federal government for a level of capitalization of their funds based on the anticipated need for their students. Schools of optometry have participated in this program at various levels. Since this is a continuing program that previously existed, the students who previously had been under this program and graduated are now in a position and obligation to begin repaying the loans. The funds received by the schools in repayment of existing loans also go into that fund to add to and supplement the amount that comes from the government. At some point in time, as occurred this year with the University of California-Berkeley and Southern California College of Optometry the amounts that were being repayed by previous borrowers will be adequate to meet anticipated needs of new students borrowing from the program.

The 1980-81 levels of funds awarded to schools of optometry for each of the federal support programs are presented in the following tables. □

Exceptional Financial Need Scholarship Program
Academic Year 1980-81 — Optometry

Institution	Awards: Resident Number	Resident Funds	Non-Resident Number	Non-Resident Funds	Total Number	Total Funds
University of Alabama-Birmingham	1	$ 8,559.00			1	$ 8,559.00
Southern California College Optom.			1	$12,729.00	1	12,729.00
Illinois College of Optometry			1	13,344.00	1	13,344.00
Indiana University	1	7,869.00			1	7,869.00
New England College of Optometry			1	17,234.00	1	17,234.00
Ferris State College	1	10,454.00			1	10,454.00
University of Missouri-St. Louis	1	9,005.00			1	9,005.00
SUNY College of Optometry	1	10,050.00			1	10,050.00
Ohio State University	1	8,645.00			1	8,645.00
Pacific University			1	12,919.00	1	12,919.00
Pennsylvania College of Optometry			1	8,014.00	1	8,014.00

SOURCE: Adapted from U.S. Dept. of Health and Human Services, Bureau of Health Professions. *Notification to Members of Congress of Academic Year 1980-81 Allotments to Schools Participating in the Scholarship Program for First-Year Students of Exceptional Financial Need.* Hyattsville, Md.: Bureau of Health Professions, August 1980.

NOTE: The amounts for each school represent the allotment authorized under the Further Continuing Appropriations Act for 1980, PL 96-123.

Health Professions Student Loan Program
Academic Year 1980-81 — Optometry

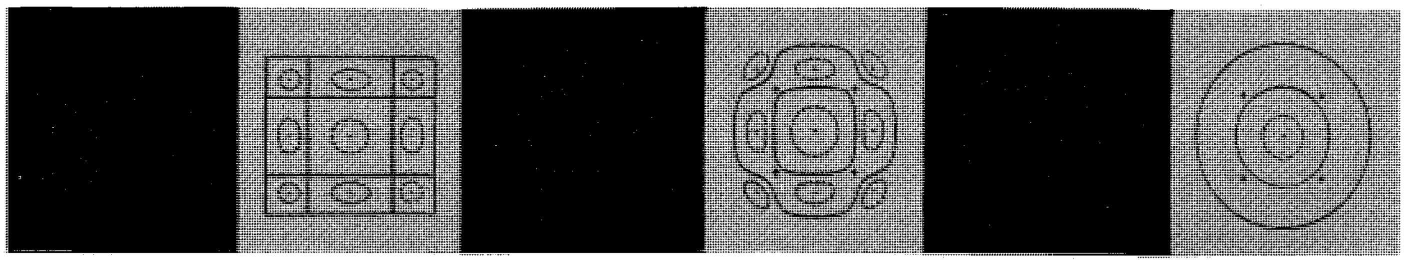
Institution	Amounts Allocated: 1st Allocation	2nd Allocation	Total
University of Alabama-Birmingham	$21,461	$ 665	$22,126
University of California-Berkeley	none requested[a]		
Southern California College Optom.	none requested[a]		
Illinois College of Optometry	84,567	2,620	87,187
Indiana University	38,374	1,190	39,564
New England College of Optometry	51,025	1,581	52,606
Ferris State College	17,055	529	17,584
University of Missouri-St. Louis	5,683	178	5,861
State University of New York	36,952	1,146	38,098
The Ohio State University	32,689	1,014	33,703
Pacific University	47,756	1,480	49,236
Pennsylvania College of Optometry	85,278	2,642	87,920
Southern College of Optometry	83,289	2,580	85,869
University of Houston	36,000	b	36,000

SOURCE: Adapted from U.S. Dept. of Health and Human Services, Bureau of Health Professions. *Notification to Members of Congress of Academic Year 1980-81 Allotments to Schools Participating in the Health Professions Student Loan Program.* Hyattsville, Md.: Bureau of Health Professions, September 1980.

NOTE: This notification represents an initial allocation made July, 1980, and a second allocation resulting from returns made by participating schools after reassessment of academic year 1980-81 needs. The total amounts for each school represent the allotment authorized under the Further Continuing Appropriations Act for 1980, PL 96-123.

[a]Return dollars adequate for 1980-81 needs.

[b]Requested funds met by first allocation.



RAYLEIGH'S CRITERION: WHY 1.22?

An Intuitive Approach without Using Bessel Functions

Michael P. Keating, Ph.D.

Rayleigh's criterion for blur resolution is a topic covered in the optometric curriculum. The appearance of the factor 1.22 in Rayleigh's criterion for circular apertures frequently mystifies the students. A more intuitive approach is to consider the Fraunhofer diffraction pattern as the aperture is smoothly changed from square to circular. In this approach, the appearance of the 1.22 seems quite natural. The following paper presents numerically calculated Fraunhofer diffraction patterns for a series of apertures ranging from square to circular to illustrate this argument.

Introduction

The factor that ultimately limits the resolving ability of an optical system is diffraction. The basic connection between diffraction and resolution is embodied in Rayleigh's Criterion for two point resolution. The appearance of the factor 1.22 in Rayleigh's Criterion frequently mystifies the students, and the fact that the 1.22 results from the first minimum of the J_1 Bessel function only compounds the mystification. This paper proposes that a student can gain an intuitive understanding of the 1.22 factor by considering the change in a Fraunhofer diffraction pattern as the aperture is smoothly changed from square to circular. This approach can be used without referring to Bessel Functions, or it can be used to supplement the Bessel Function explanation.

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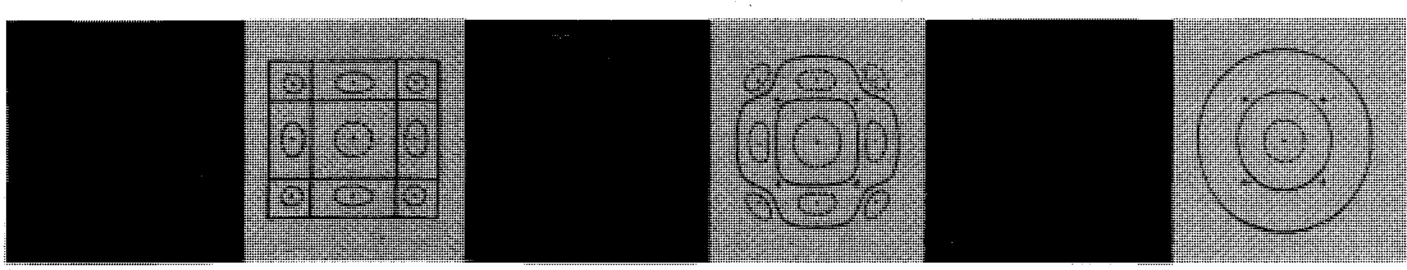
Fraunhofer Diffraction

Elementary discussions of Fraunhofer diffraction usually proceed in order from diffraction by a single slit to diffraction by a square or rectangular aperture, and then to diffraction by a circular aperture. Equation (1) gives the angular location, θ, of the first minimum of the Fraunhofer diffraction pattern for a single slit of width illuminated by a monochromatic light of wavelength λ.

$$a \sin \theta = \lambda. \qquad (1)$$

Velzel and van Heel[1] give a good intuitive noncalculus derivation of Eq. (1) in which they use Huygen's Principle and emphasize that *every* point across the slit contributes to the intensity distribution on the screen.

The extension to a rectangular aperture is straight-forward and the equations corresponding to Eq. (1) are



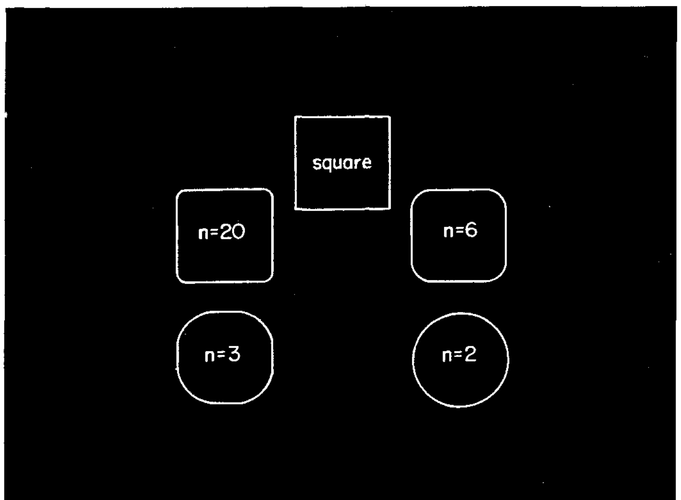


Fig. 1. Aperture shapes for various n values in Eq. (5).

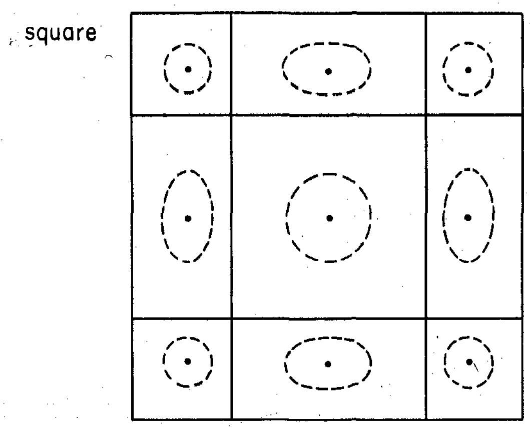


Fig. 2. Contour plot of the intensity distribution in the Fraunhofer diffraction pattern for a square aperture. The solid lines indicate zero intensity, the dashed lines indicate intensity levels of ½ the local maximum value. The dots indicate the local maximum positions.

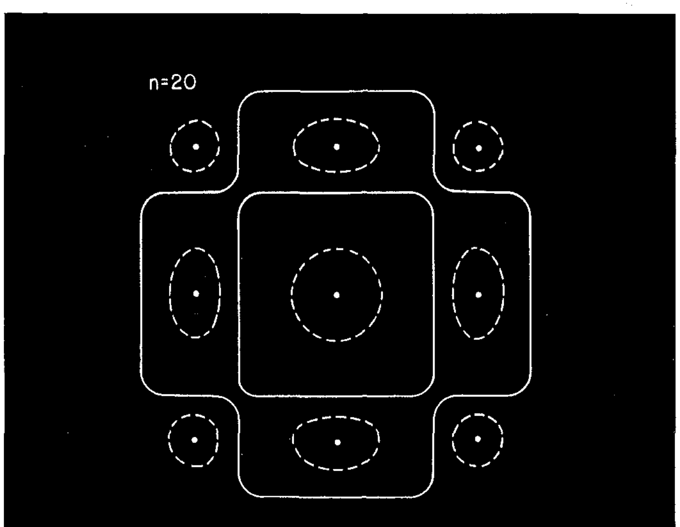


Fig. 3. Contour plot of the intensity distribution in the Fraunhofer diffraction pattern for the n = 20 aperture.

$$a \sin \theta_x = \lambda , \quad (2)$$

and

$$b \sin \theta_y = \lambda , \quad (3)$$

In Eqs. (2) and (3), θ_x and θ_y are the respective angular locations in the x and y direction of the first minimums of the Fraunhofer diffraction pattern, a and b are the respective aperture widths in the x and y directions, and λ is the wavelength of the light incident on the aperture.

The circular symmetry of the Fraunhofer diffraction pattern of a circular aperture of diameter can be made intuitively obvious by rotational invariance arguments. The angular location, θ, of the first minimum of the diffraction pattern for a circular aperture of diameter a is given by the equation

$$a \sin \theta = 1.22 \lambda , \quad (4)$$

where λ is the wavelength of the incident light. Equation (4) contains the troublesome 1.22.

Smoothly Changing Apertures

The main point of this paper is that a student can develop an intuitive understanding of the 1.22 in Eq. (4) without using the J_1 Bessel function dependence, by considering how a Fraunhofer diffraction pattern changes as an aperture is smoothly changed from a square aperture of width a to a circular aperture of diameter a. It is obvious that when the aperture is changed smoothly from square to circular, then the corresponding diffraction pattern also must change smoothly from the pattern for a square aperture to the pattern for a circular aperture. Such a change could be made in a number of different ways. One method is indicated in Fig. 1. The change is made by first filling in the corners of the square aperture and then continuing to fill in the corners until the aperture is circular.

The apertures shown in Fig. 1 were mathematically specified as follows. The center of the aperture was chosen as the origin of the co-ordinate system. The first quadrant boundary, $y_1(x)$, of the aperture was defined by the equation

$$y_1(x) = [1 - x^n]^{1/n} \quad (5)$$

where $0 \leq x \leq 1$.

Here x is expressed in units of half the aperture size, or a/2 where a is the width of the square aperture, and the diameter of the circular aperture. The aperture boundaries in the second quadrant, $y_2(x)$, third quadrant, $y_3(x)$, and fourth quadrant, $y_4(x)$ were defined symmetrically with the first quadrant. For $0 \leq x \leq 1$,

$$y_2(-x) = y_1(x) \quad (6)$$

$$y_3(-x) = -y_1(x) \quad (7)$$

$$y_4(x) = -y_1(x) \quad (8)$$

As the n value in Eq. (5) approaches infinity, the specified aperture approaches a square aperture. For an n value of 20, the aperture is approximately square, but the corners are filled in (see Fig. 1). As the n value is decreased from 20 to 2, the aperture becomes circular. The apertures for n values of 6, 3, and 2 (circular) are shown in Fig. 1.

Resulting Contour Plots

Figures 2-6 show numerically calculated contour plots of the intensity distribution in the Fraunhofer diffraction patterns for the apertures shown in Fig. 1. The solid lines in the contour plot represent the minimum (zero intensity) positions. The dashed lines represent the positions at which the intensity is one half of the local maximum. The dots represent the local maximum positions. The origin of the co-ordinate system is located at the central maximum.

Figure 2 shows the contour plot of the central part of the diffraction pattern for a square aperture. Note the perpendicularity of the minimum lines, and their intersection points. The first minimum lines occur at the angular location given by Eqs. (2) and (3).

Figure 3 shows the contour plot of the Fraunhofer diffraction pattern for the n = 20 aperture. As shown in Fig. 1, the n = 20 aperture was obtained from the square aperture by slightly filling in the corners. There is a correspondingly close relationship between the respective Fraunhofer diffraction patterns for these apertures. Comparison of the Figs. 2 and 3 shows that the only significant difference has occurred at the minimum line intersection points. As the aperture smoothly changes from square to n = 20, splits occur at each of these minimum line intersection points. The result (Fig. 3) for the n = 20 aperture is a clearly identifiable first minimum line which completely surrounds the central maximum and which touches no other minimum line. Similarly there is a clearly identifiable second minimum line which not only completely surrounds the central maximum, but which also completely surrounds the maximums of next highest intensity, and which touches no other minimum lines. If the contour plot shown in Fig. 3 was extended out further, there would also be clearly identifiable third, fourth, etc. minimum lines. It will be shown below that as the aperture is changed from n = 20 to n = 2 (circular), the first and second minimum lines of Fig. 3 will continue to change until they become the circular first and second minimum lines of the diffraction pattern for the circular aperture. This change will be referred to as the "circulatization" of the minimum lines.

Figure 4 shows the contour plot of the diffraction pattern corresponding to the n = 6 aperture. For reference purposes, the four first order minimum line intersection positions of Fig. 2 have been marked by crosses on Figs. 4, 5, and 6. On Fig. 4 the splits at these intersection positions have widened relative to those shown in Fig. 3. The first minimum has moved further inward along the diagonals, and the second minimum has moved further outward along the diagonals. In addition, both the first and second minimums have started to move slightly outward along the axis.

Figure 5 shows the contour plot for the n = 3 aperture. The first minimum has continued to circularize by moving inward along the diagonals and outward along the axis. The second minimum is circularizing by moving outward both along the diagonals and along the axis, with the movement along the diagonals being greater than the movement along the axis.

Figure 6 shows the contour plot for the n = 2 (circular) aperture. For simplicity, the maximum and half-maximum lines between the first and second minimums are not shown. In the small angle approximation, the angular distance from the origin to a diagonal reference cross is $2\frac{1}{2}\,\lambda/a$. Comparison of the first minimum with the diagonal reference crosses shows that the first minimum has an angular radius which is greater than $1\,\lambda/a$ but is less than $2\frac{1}{2}\,\lambda/a$.

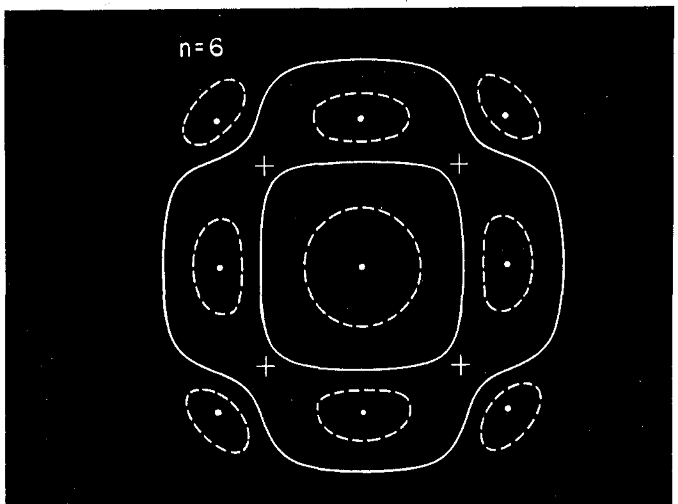


Fig. 4. Contour plot of the intensity distribution in the Fraunhofer diffraction pattern for the n = 6 aperture. The reference crosses indicate the minimum line intersection positions of Fig. 2.

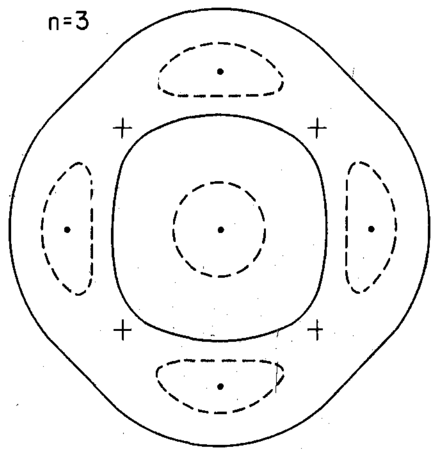


Fig. 5. Contour plot of the intensity distribution in the Fraunhofer diffraction pattern for the n = 3 aperture.

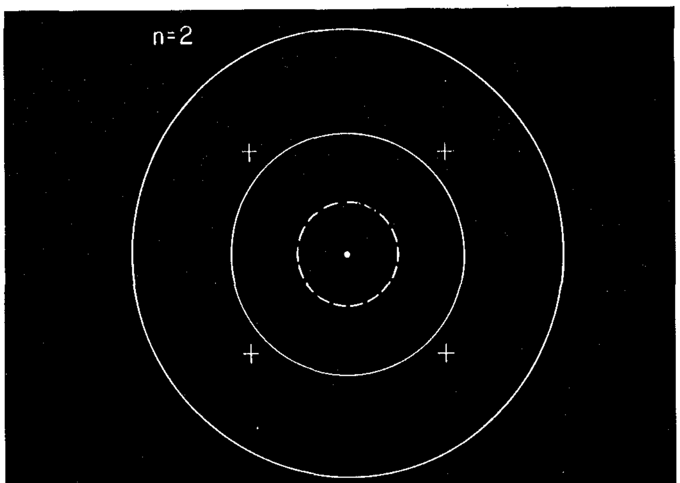


Fig. 6. Contour plot of the intensity distribution in the Fraunhofer diffraction pattern for the n = 2 (circular) aperture. For simplicity, the maximum and half-maximum positions between the first and second minimums are not shown.

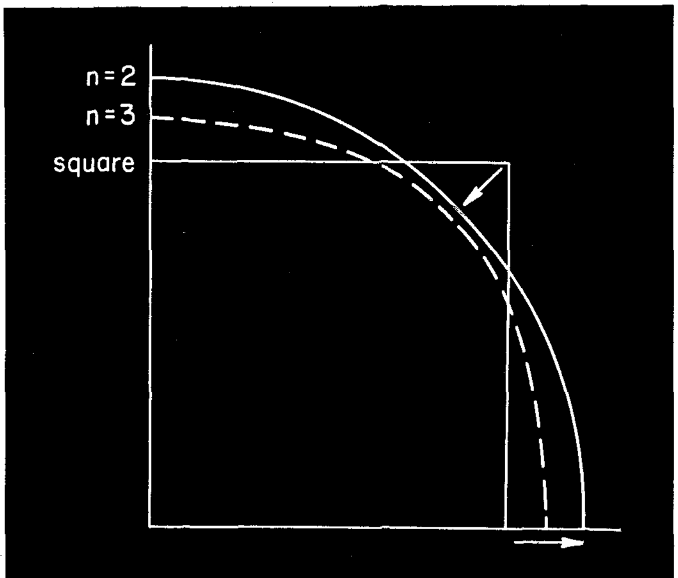


Fig. 7. First quadrant minimum positions in the Fraunhofer diffraction patterns for the square, n=3, and n=2 (circular) apertures. The arrows show the resultant directional movement of the minimum lines as the aperture is changed from square to circular.

Figure 7 shows an enlarged view of the first minimum positions in the first quadrant. By comparing the minimum position for the n=2 (circular) aperture to the minimum position for the square aperture, one notes that the resultant inward movement along the diagonal is approximately equal to the resultant outward movement along the axis. Hence, in small angle approximation, the angular location of the first minimum for the circular aperture is approximately halfway between $1\,\lambda/a$ and $2\frac{1}{2}\,\lambda/a$. Since $[1 + 2\frac{1}{2}]/2 = 1.21$, the angular location of the first minimum for the circular aperture is, to a first order approximation, $1.21\,\lambda/a$. This value is within 1% of the exact value, $1.22\,\lambda/a$.

There is one complicating factor in the argument. The first minimum for the n=3 aperture is shown by the dashed line in Fig. 7. As the aperture is changed by decreasing n from 20 to 3, the first minimum line moves inward along the diagonal and overshoots the circular location as shown by the n=3 diagonal position in Fig. 7. As n is changed from 3 to 2, the minimum line then moves back out along the diagonal to the circular position. However, this complication does not change the argument given in the paragraph above, since that argument referred to the resultant movement.

Summary

As the aperture is smoothly changed from square to circular, the corresponding Fraunhofer diffraction pattern will also smoothly change. For the purpose of this paper, the dominant features in the diffraction pattern changes are as follows. As soon as the square aperture corners are filled in, splits occur at the minimum line intersection points leaving definite first, second, third, etc. minimum lines. All of these minimum lines completely surround the central maximum. Furthermore, none of these minimum lines touch any other minimum lines. As the corners of the aperture continue to be filled in, the first minimum circularizes by a resultant outward movement along the axis. The total inward movement of the first minimum along the diagonals is approximately equal to the total outward movement along the axis. Therefore, in small angle approximation, the angular position of the first minimum for a circular aperture is approximately halfway between $1\,\lambda/a$ and $2\frac{1}{2}\,\lambda/a$. This approximation yields an angular location of $1.21\,\lambda/a$ which is within 1% of the exact value of $1.22\,\lambda/a$.

My experience has been that the discussion presented in the above paragraph supplies the student with an intuitive understanding of where the 1.22 comes from. In other words, from a student's perspective, this argument makes the 1.22 seem less mysterious and more natural. If desired, this method could serve as an introduction followed by a discussion of the J_1 Bessel function dependence. □

Appendix

While I do discuss the contour plots indicated above in courses for optometry students, I do not discuss the means of actually numerically generating the contour plots. The latter topic is more relevant and appropriate for physics students than it is for optometry students. However, this appendix is included for the benefit of those who want to verify the accuracy of the above contour plots.

With the appropriate approximations[2] the amplitude F(u,v) of a Fraunhofer diffraction pattern is proportional to the Fourier Transform of the aperture, or

$$F(u,v) = \iint_{-\infty}^{\infty} f(x,y) \exp[-i(ux - vy)]\, dx\, dy, \quad (9)$$

where the proportionality constant is not explicitly shown, and where $f(x,y) = 1$ for (x,y) inside the aperture, and $f(x,y) = 0$ for (x,y) outside the aperture.

For an aperture defined with the symmetry expressed by Eqs. (6), (7), and (8), each quadrant of the Fraunhofer diffraction pattern is symmetric with the first quadrant. For the first quadrant, Eq. (9) can then be reduced to

$$F(u,v) = 4\int_0^1 \cos(ux)\,[\sin v\, y_1(x)]/v\, dx. \quad (10)$$

The integral in Eq. (10) can then be numerically calculated on a computer or a programmable calculator.

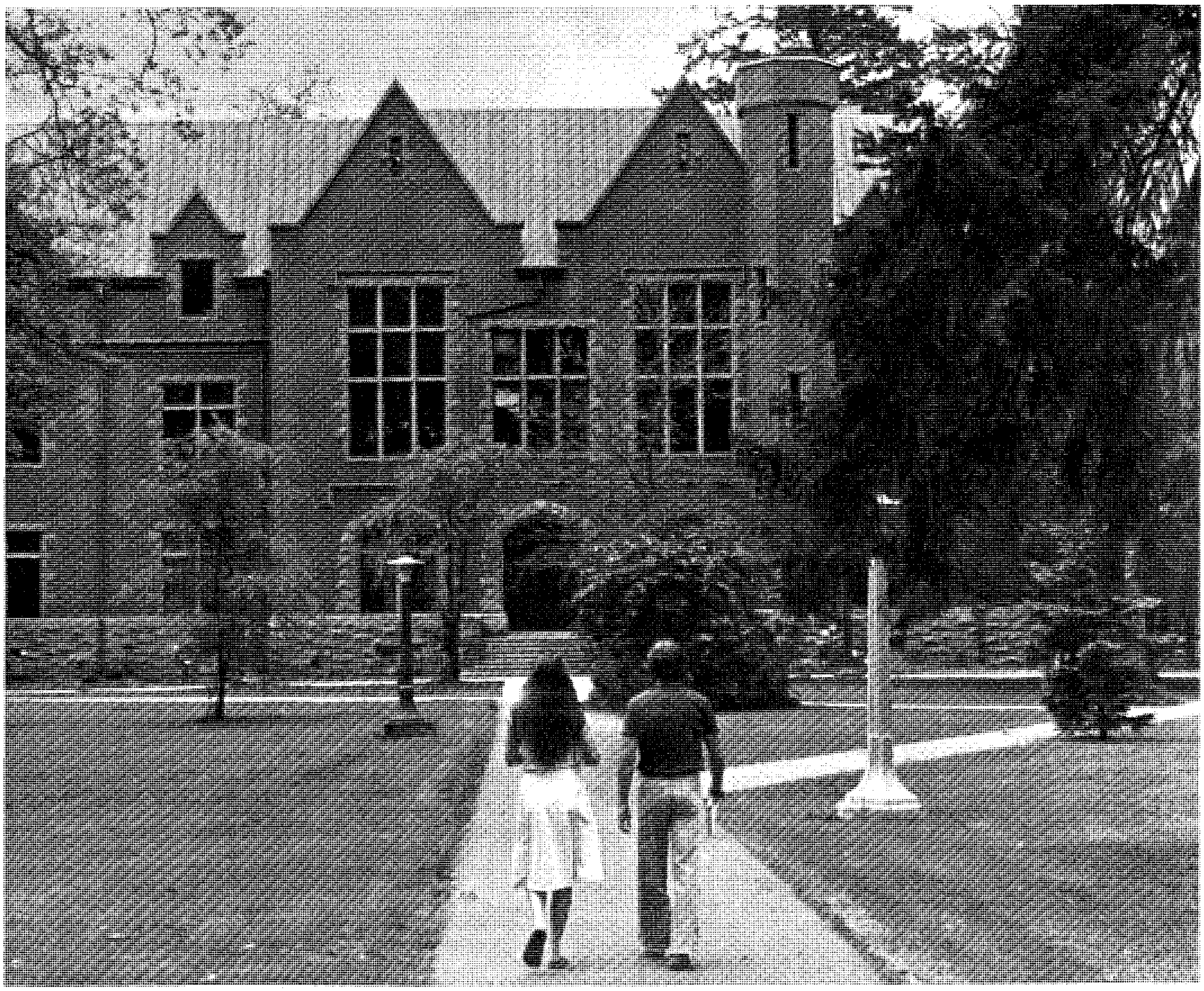
References

1. van Heel ACS, Velzel CHF: What is Light? New York, McGraw-Hill, 1968, pp. 111-118.
2. Papoulis A: Systems and Transforms with Applications in Optics. New York, McGraw-Hill, 1968, p. 3.

Annual Survey of Optometric Educational Institutions 1979-80

The accompanying tables have been extracted from the 1979-80 Annual Survey of Optometric Educational Institutions conducted by the Council on Optometric Education of the American Optometric Association.

The following report summarizes the major characteristics of student enrollment, academic achievement, financial aid and student expenditure for the academic year 1979-80. The survey is conducted annually as part of the ongoing process of accreditation; it is the intent of JOE to present highlights of this report on a yearly basis.



Courtesy Pacific University College of Optometry

Student Enrollment

Overall student enrollment for the academic year 1979-80 did not increase significantly over the previous year, totaling 4,500 in 1979-80 compared to 4,436 in 1978-79. This represented an increase of only 1%.

Female enrollment, however, has continued to increase over that of previous years. Women represented 271 students or 23% of the entering class in 1979-80 and 868 students or 19% of total enrollment. This reflected an increase of 17% in first-year enrollments and 14% in overall enrollment compared to 1978-79.

Minority students represented 8.78% of the student body in 1979-80, compared to 8% in 1978-79. This was a significant increase over previous years during which minority enrollment had declined from a high of 8.9% (346 students) in 1975-76. Although the percentage of overall minority representation increased significantly in 1979-80, the actual numbers increased by only 37, with 395 students in 1979-80 compared to 358 in 1978-79. This reflected an increase of 10%.

Women accounted for 37% (145 students) of minority enrollment in 1979-80. Of minorities enrolled, 53% were Asian American, 17% Spanish surname, 14% Black American, 13% foreign nationals and 3% native American Indian.

Academic Achievement

The majority of first-year students enrolled in 1979-80 carried four or more years of college background with them. More than two-thirds, 73% or 866 students, of the entering class had four or more years of prior college work and 65% (763 students) had a baccalaureate or higher degree. These represented increases of 5% and 1%, respectively, over the previous year, where 70% (819 students) had four or more years of college and 64% (752 students) had a baccalaureate or higher degree.

Of the remaining first-year students, 7% had 2+ years of prior college work and 19% had 3+ years.

The mean grade point average for entering students in 1979-80 was 3.31. This was up from 3.295 in 1978-79. Twelve of the thirteen institutions achieved a mean grade point average of 3.0 or better, and ten of the institutions achieved a mean GPA of 3.25 or better. These grade point averages are based on a total of 1,167 entering students reported in *Information for Applicants to Schools and Colleges of Optometry*, Fall 1981, published by the American Optometric Association in cooperation with the Association of Schools and Colleges of Optometry.*

Financial Aid

The amount of aid granted through institutions other than loans** for the academic year 1979-80 was $1,437,383. Of this amount, $347,719 or 24% was from federal sources and $563,130 (39%) was from state governmental agencies. The total amount of aid excluding loans increased by 46% over the 1978-79 figure of $983,041. While the federal share of aid excluding loans increased by 67% over 1978-79, the state share decreased by 21%. This was the reverse of the previous year's report where the federal share had decreased by 7.6% and the state share had increased by more than 100% (106.4%).

The total amount of loans granted through institutions in 1979-80 was $9,681,717. Of this, $3,868,912 or 40% was from the federal government. These represented increases of 78.5% over the total amount of $5,423,456 and a 78% increase over the federal share of $2,168,334 in 1978-79.

*Information for Applicants to Schools and Colleges of Optometry, Fall, 1981. St. Louis, Missouri: American Optometric Association. No explanation can be given for the discrepancy in numbers of first-year students reported in this booklet and the COE *Annual Survey of Optometric Educational Institutions*.

**Includes scholarships, fellowships, grants in aid, etc.

In all, the amount of financial aid granted through institutions for loans, scholarships, fellowships, grants in aid, etc. in 1978-80 amounted to more than $11 million.

Student Expenditures

The average expenditure of regularly enrolled students for tuition, fees, books, supplies, etc. for the academic year 1979-80 ranged from $1,475 to $5,720 for residents and $3,077 to $9,720 for non-residents. If no distinction was made between residents and non-residents at a given institution, expenditures were reported in the non-resident column only. The mean average expenditure for costs excluding living expenses totaled $3,243 for residents and $5,428 for non-residents.

The average room and board expenditures for 1979-80 ranged from $1,550 to $4,450. These figures were based on amounts spent if school dormitories were available, otherwise, the costs were estimated for a single student. The mean average expenditure for living costs was $2,534 for the year.

The overall mean average cost of education for optometric students for 1979-80 was $5,777 for residents and $7,962 for non-residents. □

The following abbreviations have been used in the accompanying tables.

Schools

FSC — Ferris State College
ICO — Illinois College of Optometry
IU — Indiana University
NECO — New England College of Optometry
PU — Pacific University
PCO — Pennsylvania College of Optometry
SCCO — Southern California College of Optometry
SCO — Southern College of Optometry
SUNY — State University of New York

Abbreviations *(continued)*

- TOSU — The Ohio State University
- UAB — University of Alabama in Birmingham
- UCB — University of California, Berkeley
- UH — University of Houston

Provinces and Territories

- CZ — Canal Zone
- PR — Puerto Rico
- USP — U.S. Possessions
- ALB — Alberta
- BC — British Columbia
- MAN — Manitoba
- NB — New Brunswick
- NF — Newfoundland
- NS — Nova Scotia
- ONT — Ontario
- PEI — Prince Edward Island
- QUE — Quebec
- SAS — Saskatchewan
- CAN. TER. — Canadian Territories
- O. COUN. — Other Countries

Profile of 1979 Entering Class

Grade Point Averages (4.0 Scale)

	High	Low	Mean	Number of Students
FSC	N/A	N/A	3.45	32
ICO	N/A	N/A	3.30	155
IU	N/A	N/A	3.58	69
NECO	3.90	2.50	3.19	87
PCO	3.94	2.53	3.18	150
PU	4.0	2.81	3.36	85
SCCO	4.00	2.70	3.32	96
SCO	3.95	2.18	2.90	150
SUNY	3.90	2.70	3.27	68
TOSU	4.00	2.92	3.46	60
UAB	4.00	2.58	3.36	40
UCB	4.00	2.23	3.35	71
UH	4.0	2.7	3.36	104
Total			3.31	1,167

SOURCE: *Information for Applicants to Schools and Colleges of Optometry, Fall, 1981.* St. Louis, Mo.: American Optometric Association, n.d.

N/A—Not Available

1979-80 Annual Survey of Optometric Educational Institutions
Student Enrollments

Number of First Year Students Enrolled With:

	2+ Yrs.	3+ Yrs.	4+ Yrs.	B.A., B.S.	M.A., M.S.	Ph.D.	Total
FSC	8	6	2	16			32
ICO	5	31	14	104	1		156
IU	18	20		29	2		69
NECO			8	79		9	96
PCO		22		123	6	1	152
PU	14	26	12	32	1		85
SCCO	9	15	5	62	5		96
SCO	21	25	13	89	2		150
SUNY		5		55	8		68
TOSU	11	26	3	20			60
UAB		5		33	2		40
UCB		33		35	3		71
UH		13	46	42	4		105
U.S. TOTALS	86	227	103	719	34	10	1,179

1979-80 Annual Survey of Optometric Educational Institutions
Student Enrollment
Full-Time Students Enrolled in the Professional Degree Program

	First Year		Second Year		Third Year		Fourth Year		TOTALS		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total
FSC	23	9	27	4	22	3	20	2	92	18	110
ICO	128	31	132	22	118	20	130	15	508	88	596
IU	48	22	46	21	44	18	46	17	184	78	262
NECO	72	24	64	24	64	19	76	19	276	86	362
PCO	124	28	115	29	126	23	115	26	480	106	586
PU	67	19	66	17	61	21	63	13	257	70	327
SCCO	71	25	72	19	71	21	80	12	294	77	371
SCO	128	23	132	7	143	6	131	12	534	48	582
SUNY	47	21	48	20	35	25	41	12	171	78	249
TOSU	47	13	47	14	50	9	46	7	190	43	233
UAB	30	10	32	7	28	13	27	4	117	34	151
UCB	52	19	53	18	49	12	50	13	204	62	266
UH	77	27	86	21	80	18	82	14	325	80	405
U.S. TOTALS	914	271	920	223	891	208	907	166	3,632	868	4,500

1979-80 Annual Survey of Optometric Educational Institutions
Student Enrollment
Minority Group Students Enrolled

	Black American		Spanish Surneme		Native American Ind.		Asian Amer.		Foreign Nationals		TOTALS			% of Student body
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total	
FSC	1						1				2		2	1.82
ICO		4	2				18	5	2		22	9	31	5.20
IU		10	1	2		2	2	2	4	1	7	17	24	9.16
NECO	2	1	1	1			2		7	2	12	4	16	4.42
PCO	1	7	3	5			5	6	4		13	18	31	5.29
PU			2	1	3		22	13	1	2	28	16	44	13.46
SCCO	4		9	4	3		24	15	1	2	41	21	62	16.71
SCO	5						7			1	12	1	13	2.23
SUNY	1		1	1	1		8	7	2		13	8	21	8.43
TOSU		2	1				1				2	2	4	1.72
UAB	3	4						1			3	5	8	5.30
UCB	2	5	13	2	1		40	20	1	1	57	28	85	31.95
UH	3	1	14	4	3		4	5	14	6	38	16	54	13.33
U.S. TOTALS	22	34	47	20	11	2	134	74	36	15	250	145	395	8.78

1979-80 Annual Survey of Optometric Educational Institutions
Students

	Financial Aid Granted through Institutions Excluding Loans							Student Loans Granted through Institutions					
	Percentage of Students Receiving Aid				Amount			Percentage of Students Receiving Loans				Amount	
	1st Year	2nd Year	3rd Year	4th Year	Total	Federal	State	1st Year	2nd Year	3rd Year	4th Year	Total	Amount
FSC	7	8	9	10	$ 23,400	$ 9,214	$ 13,086	14	14	15	10	$ 117,480	$ 46,770
ICO	3	2	2	1	95,115	71,145	16,717	65	44	76	61	1,828,314	256,560
IU	1	1	1	1	9,000	1,000	8,000	35	35	35	40	160,000	156,000
NECO	9	11	17	12	44,400	9,900	15,500	63	71	57	42	1,058,666	276,696
PCO	3	5	0	1	13,910	2,260	4,300	80	90	72	64	2,829,252	367,249
PU	31	47	48	39	399,177	18,000	381,177	49	49	49	49	739,554	139,400
SCCO	69	57	63	58	515,566	104,056	31,350	77	69	69	66	1,310,241	1,310,241
SCO	0	0	0	0				33	39	36	23	507,050	507,050
SUNY	10	10	10	10	101,000		31,000	75	60	50	50	250,000	60,000
TOSU	30	25	22	17	41,200	4,719		27	26	24	26	121,350	121,350
UAB	10	9	3	0	24,225	7,425	12,000	73	66	75	85	451,861	181,540
UCB	0	0	0	0				19	13	38	34	97,949	87,064
UH	35	35	35	35	170,000	120,000	50,000	20	20	20	20	200,000	160,000
U.S. TOTALS					$1,437,383	$347,719	$563,130					$9,681,717	$3,868,912

1979-80 Annual Survey of Optometric Educational Institutions
Students

Annual Student Expenditures[a]

	Resident Expenditures[b]					Non-Resident Expenditures					Average Room & Board Expenditures[c]
	1st Year	2nd Year	3rd Year	4th Year	Average	1st Year	2nd Year	3rd Year	4th Year	Average	
FSC	2,873	2,655	2,388	2,840	2,689	N/A	N/A	N/A	N/A	N/A	1,862
ICO						6,350	5,650	5,580	5,350	5,725	2,523
IU	2,490	3,676	2,727	2,325	2,805	4,310	5,340	4,495	3,885	4,508	1,550
NECO						4,760	4,370	4,350	4,210	4,420	4,000
PCO					5,720[d]					9,720[d]	4,450
PU						5,890	5,150	5,350	4,850	5,300	1,700
SCCO						6,501	5,699	5,567	5,237	5,751	3,242
SCO	4,900	4,389	4,230	2,610	4,032[e]	8,630	8,139	7,980	6,390	7,782[e]	2,728
SUNY	3,750	3,850	3,950	3,850	3,850	5,200	5,300	5,400	5,300	5,300	2,880
TOSU	4,500	4,500	4,500	4,500	4,500	6,150	6,150	6,150	6,150	6,150	1,899
UAB	2,278	2,878	1,776	1,775	2,177	3,178	3,778	2,676	2,675	3,077	2,194
UCB	1,100	2,500	1,100	1,200	1,475	3,500	4,500	3,500	3,600	3,875	2,035
UH	5,158	800	800	1,008	1,942	6,454	2,044	2,044	3,556	3,524	1,876

[a] Average expenditure of regularly enrolled students for the current year. Includes tuition, fees, instruments, supplies, textbooks, etc.

[b] If no distinction is made between resident and non-resident students, only the non-resident column was used.

[c] If school dormitories are available, the price is used for room and board; otherwise costs are estimated for a single student.

[d] Average expenditure for contract vs. non-contract students, respectively, for college fees and other costs (excluding living expenses).

[e] Regional vs. non-regional expenditures, respectively.

1979-80 Annual Survey of Optometric Educational Institutions

Permanent Residence

Totals

	FSC	ICO	IU	NECO	PCO	PU	SCCO	SCO	SUNY	TOSU	UAB	UC	UH	U.S. TOTAL
AL			1					1			33			35
AK						4	2					1		7
AZ		1		1		9	19	1						31
AR				1	1		1	37					20	60
CA		29	5	7	8	34	118	7	1			234		443
CO				1	1	20	15	4				2		43
CT		3	1	42	9	1	2	1						59
DE					8		1	4						13
DC					2							1		3
FL		13	5	11	9	4	7	60	1				23	133
GA		1	1	3	1			44			12			62
HI		4		1	2	20	12					3		42
ID		1				12	6					1		20
IL		172	12	2	1	2	1	5				1		196
IN		7	159	1			2	3						172
IA		48	6			7	13	4						78
KS		2				1	2	16					21	42
KY			1					31			8		18	58
LA							1	27			3		34	65
ME				31	8			3						42
MD		10	1	5	44		1	20			8	1	4	94
MA		4	2	117	2			3	2					130
MI	110	60	5	2	2	2	3	7				2		193
MN		35	3	2	1	17	15	2		4				79
MS			1					27			3		7	38
MO		12	7	1		2	12	6						40
MT						17	18							35
NE		4	2	1		6	7	11		8			18	57
NV					1	6	13	1				1		22
NH		2		11	2			1						16
NJ		2	3	17	79		1	6	3			2		113
NM		2	1			6	13						13	35
NY		72	6	51	64	9	2	8	239			7		458
NC		2			38			55			8		9	112
ND		4				14	7			4				29
OH		23	3	3	9	1	1	5		215		3		263
OK		1	2			2	5	34					24	68
OR						43	6					1		50
PA		22	4	10	235		2	6	2					281
RI		1	1	18	2			1						23
SC		1		1				30			7			39
SD		10	1	1		7	8							27
TN		1	1	1				72						75
TX		2						1					193	196
UT		2				13	14	1						30
VT				6			1	1						8
VA			2		36		1	12			9			60
WA		1		1		46	11	1				1		61
WV		9		1	12			19		2				43
WI		52	21	3	1	10	14	4				3		108
WY						6	11	1						18
CZ														
PR				1	6		1						1	9
USP							1							1
ALB						2								2
BC						1								1
MAN														
NB														
NF				1										1
NS														
ONT													1	1
PEI														
QUE				3										3
SAS														
CAN. TER														
O. COUN		1	5	4	4	3	1	1	1			2	19	41
TOTAL	110	596	262	362	588	327	371	582	249	230	151	226	416	4502

Newsampler *(continued from p. 6)*

Capitation Funds Cut 17%

Funds available for capitation grants in fiscal year 1980 for schools of medicine, osteopathy, dentistry, *optometry*, pharmacy, podiatry and veterinary medicine were reduced to $67.3 million, a 17 percent cut from the $81.3 million originally appropriated, in a bill signed into law July 8, 1980.

The $67.3 million in capitation funds will be distributed on a per-student basis approximately as follows: $650 for medical, osteopathy and dental schools; $383 veterinary; $255 podiatry; $199 optometry; and $187 phar macy.

Vision Care Shortage Areas Designated

On August 26 the Department of Health and Human Services (DHHS) published a state-by-state listing of areas experiencing vision care manpower shortages in the *Federal Register*. The net result is to increase the number of underserved counties by 59 to 237, and the number of optometrists required by approximately 74 to an estimated 366 (previous figures were as of October, 1979), according to David L. Lewis, governmental affairs director of the AOA Washington Office.

PCO Receives $110,000 Grant

The Pennsylvania College of Optometry has been awarded a three-year grant totaling $110,000 by the National Eye Institute. The funds will be used for PCO's study titled "Oscillatory Potentials in the Visual System" which is being conducted by John B. Siegfried, Ph.D.

Journal of Optometric Education Editorial Board

RESOURCE REVIEWS

Felix M. Barker, II, O.D.
Pennsylvania College of Optometry

Symposium on Medical and Surgical Diseases of the Cornea, Transactions of the New Orleans Academy of Ophthalmology, by Jose I. Barraquer, M.D. et al. C.V. Mosby, St. Louis, 1980, 641 pp., 603 illus. ($72.50).

Since 1964, the New Orleans Academy of Ophthalmology has sponsored an annual international symposium on eye care. Each year the topic is different but is always presented by leaders in that particular area of ocular specialization. The academy follows each symposium with publication of the presentations, symposiums, and panel discussions in a hardbound "Transactions" volume. These transactions have always been excellent compendiums of current theory and treatment. This year's volume entitled "Medical and Surgical Diseases of the Cornea" certainly follows this tradition of excellence.

The 28th "Transactions" volume contains twenty-six topical presentations and seven panel discussions on the topic of cornea. Of special interest to the provider of primary eye care are chapters on corneal anatomy and wound healing; diagnosis and treatment of keratoconjunctivitis sicca; recurrent herpes simplex; viral and chlamydhial keratoconjunctivitis; extended wear contact lenses; and keratoconus. Because the writers of each chapter are clinicians, most of the discussion can be applied directly to practice.

The obvious advantage to this text is the up-to-date nature of the information it provides. Therefore, it is ideal for the primary care practitioner who, in a very busy daily schedule, strives to keep up with current therapy and indications for surgery. For the educator in ocular pathology, this text provides an excellent library reference for selected readings.

* * * *

Optometry and Health Maintenance Organizations, 3rd ed. American Optometric Association, Government Affairs Division, Committee on Public Health, April, 1980, 160 pp., illus. (free).

This informative manual concerned with optometry's role in HMOs is one of a series of informational and instructional documents. The text is preceded with a succinct introduction containing a great deal of general information that "you should know about HMOs." Chapters deal with optometry's role as primary care providers in an HMO, steps to be taken to improve optometric participation in HMOs, and political/legislative aspects.

It is important to point out that, aside from the general information about HMOs which is provided, there is also a great deal of specific detail in this handbook. Sample contracts and scenarios are provided for those interested in becoming involved in an HMO, and there is a complete address listing of all federally-qualified HMOs as of April 1979.

All this contained within one concise volume makes *Optometry and Health Maintenance Organizations* an excellent reference for the practice management or public health professor's current course planning.

* * * *

Safety with Lasers and Other Optical Sources, by David Sliney and Myron Wolbarsht. Plenum Press, New York, 1980, 1035 pp. illus. ($49.50).

This text reviews, in detail, the current basic and applied scientific knowledge base in the areas of coherant and incoherant optical radiation.

Beginning with introductory chapters on optical physics, ocular anatomy and dermal anatomy, the authors move on to thoroughly discuss the current known effects of radiant energy on the eye and skin from ultraviolet sources, infrared sources and from solar radiation.

Detailed discussions are provided concerning the measurement and specifications of both broad-based and laser sources, as well as current safety standards and protection criteria.

Because of its broad coverage of content, this text will prove interesting to a variety of specialists. From a research standpoint, the detailed treatment of measurement concepts and safety will be useful to visual physiologists who use these devices in their research and to environmental scientists who study them. The easy reading style and textbook format will be useful to the visual science educator teaching the environmental optometry portion of the curriculum.

The publication of this important handbook is long overdue and fills an important need by summarizing current knowledge in the broad area of optical radiation.

* * * *

Ocular Pathology Update, edited by Don H. Nicholson, M.D., Masson Publishing, New York, 1980, 291 pp. illus. ($55.00).

This text presents a review of current concepts concerning a wide range of topics in eye care. Most of the presentations are derived from experimental data in federally funded research programs.

Eleven of the nineteen chapters are devoted to discussions of a variety of ocular and adnexal tumors. The remaining topical headings include: corneal dystrophies, glaucoma, diabetic mellitis, non-vascular proliferative extraretinopathies, and senile macular degeneration. A flavor of the research emphasis of this text can be had by noting that a majority of the illustrations are light and electron micrographs of tissues under discussion.

There is no question that this important volume will prove useful to the educator and researcher in ocular pathology. In view of the research emphasis of *Pathology Update* application of these concepts for the clinical provider will be less direct.

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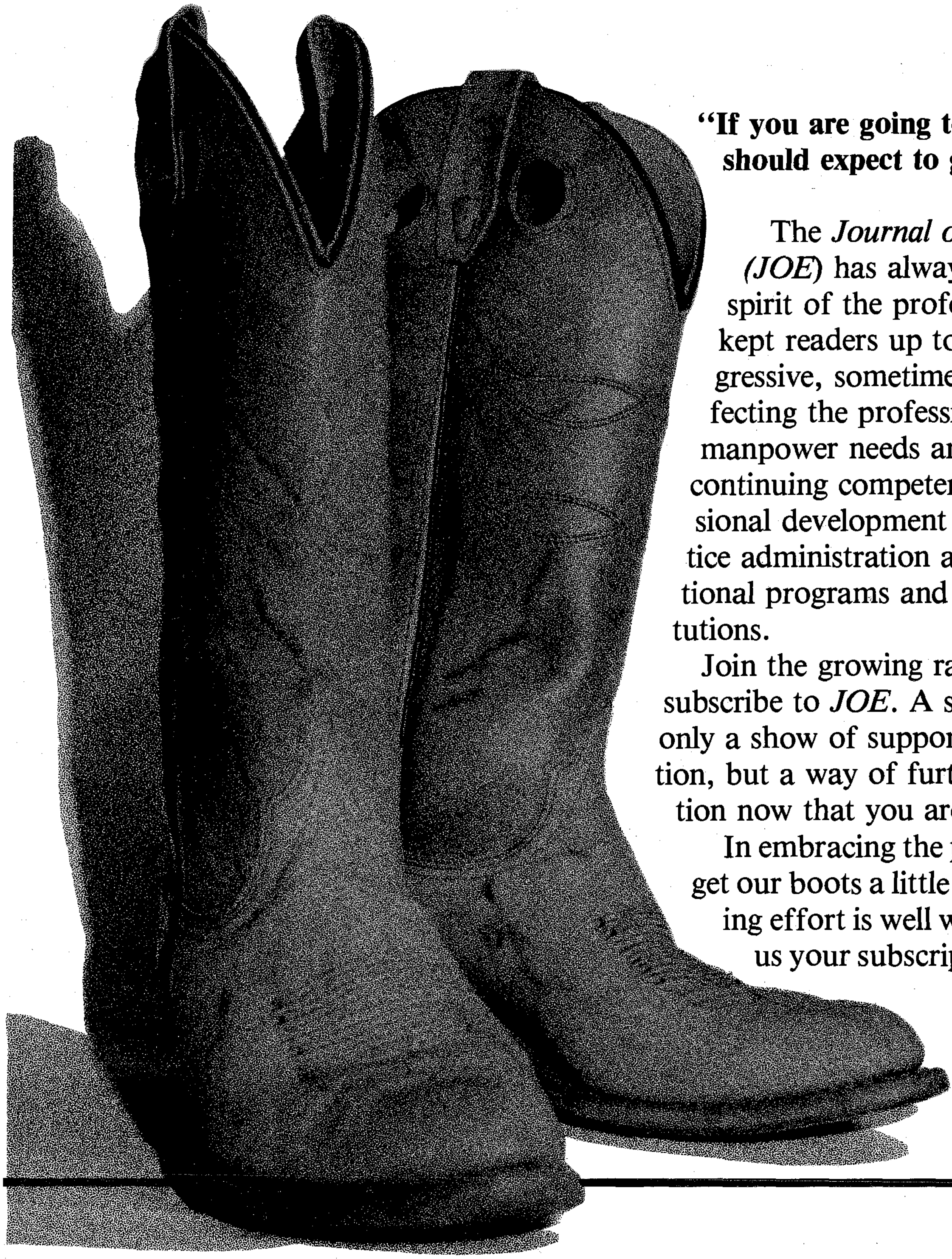

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