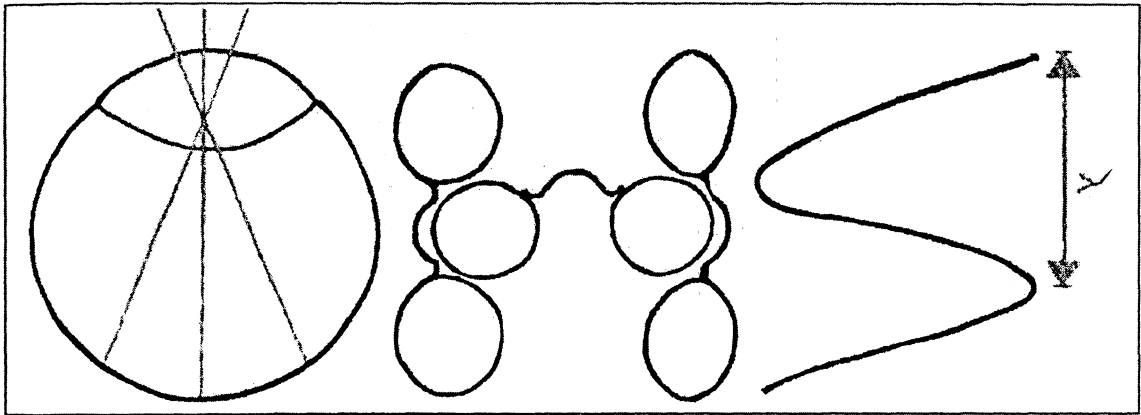


HINDSIGHT

Journal of Optometry History

April, 2008
Volume 39, Number 2



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OPTOMETRIC HISTORICAL SOCIETY

Hindsight: Journal of Optometry History publishes material on the history of optometry and related topics. As the official publication of the Optometric Historical Society, Hindsight: Journal of Optometry History supports the purposes and functions of the Optometric Historical Society.

The purposes of the Optometric Historical Society, according to its by-laws, are:

- to encourage the collection and preservation of materials relating to the history of optometry,
- to assist in securing and documenting the recollections of those who participated in the development of optometry,
- to encourage and assist in the care of archives of optometric interest,
- to identify and mark sites, landmarks, monuments, and structures of significance in optometric development, and
- to shed honor and recognition on persons, groups, and agencies making notable contributions toward the goals of the society.

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On the cover: The drawing represents OHS for Optometric Historical Society: the O an elementary schematic of an eye, the H three intersecting pairs of spectacles, and the S a representation of a light wave with the Greek letter lambda indicating one wavelength. The drawing artist was Diane Goss.

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TABLE OF CONTENTS

The Need for Recognition, Regularization and Regulation of Eye and Vision Care Practices in India: An Oration/Paper for Presentation to The Palkhivala Foundation, Chennai, Tamil Nadu State, India, on January 26, 2008, <i>Jay M. Enoch</i>	26
An Early Sixteenth Century Optometrist's Shop: Jacob Cornelisz. van Oostsanen's "Lx Siin Tiid", <i>Sara Newman</i>	58
William Molyneux and the Optometry Content of his 1692 Book <i>Dioptrica Nova</i> , <i>David A. Goss</i>	67
A Little Personal Optometric History, <i>Lester B. Kahn</i>	72
Communications Concerning the O.D. Degree and Licensure.....	75
Book Review: The Science of Leonardo: Inside the Mind of the Great Genius of the Renaissance, <i>David A. Goss</i>	78
Book Review: Isaac Newton, <i>David A. Goss</i>	81
Instructions to Authors.....	83
OHS Membership Application Form.....	84

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INDIANA UNIVERSITY

APR 30 2008

The Need for Recognition, Regularization and Regulation of Eye and Vision Care Practices in India: An Oration/Paper for Presentation to The Palkhivala Foundation, Chennai, Tamil Nadu State, India, on January 26, 2008

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Definitions of Terms

The following terms are defined as follows in this paper:
"Recognition" as used here signifies acknowledgement or acceptance of a qualified professional or technical group of individuals serving a defined role. In turn, a suitable organization may represent each such group of qualified providers. Each such organization should reflect the will of the majority of individuals represented in the group, and may represent that group in appropriate settings associated with actions of governmental, administrative, or professional nature.

"Regularization" means *to make regular*. This term implies achieving "good order", and asks that all parties and organizations comply with, and adhere to accepted societal, educational, and legal standards.

"Regulation" means *a rule or order prescribed by authority*, which serves to regulate conduct, or is a governing direction, or a law".

Introductory Remarks

It is a pleasure to have an opportunity to address this most distinguished audience. I have carefully weighed ophthalmic professional issues to be considered, and I try to provide you with insights as to how you might best proceed in recognizing, regularizing and regulating ophthalmic and vision care in India. I have not chosen an easy path, but, rather, I chose one which I hope will advance ophthalmic care in India. I have taken a rather controversial, but, hopefully, a rational position. These issues speak to protections offered to the people whom you serve in this vast Nation.

Some of you know me well, and I am pleased to meet others among you for the first time. I feel you have a right to know, "Who is this fellow?" In an Addendum appended to this document, I discuss a number of aspects of my career which touch upon issues considered. I also

disclose prior actions taken by me which are pertinent to aspects of this discussion.

Terminology does count in matters addressed in this document. Hence, I have tried to choose words and terms used carefully.

Introduction

Collectively, we address a major set of issues today! I can advise you as to what I feel are appropriate actions. In concert with others, individually, each of you has responsibility to make solutions happen. No one promised that the tasks, upon which you have embarked, will be easy.

It is clear that, over time, a number of aspects of ophthalmic-care-provision in India either were not carefully planned, and/or executed. I hope you will approach issues facing eye-and-vision-care-provision in this Great Nation constructively. Stated alternatively, let us find workable solutions to problems faced, and help each other to overcome difficulties encountered.

As one part of a solution, I believe it is necessary to recognize, to regularize and to regulate appropriately "modern optometry" as a profession in this nation. And, it is necessary to define properly, that is, regularize all other groups serving or working in concert with the professions of ophthalmology and optometry in an orderly way. Minimum acceptable educational standards for *all* groups need to be defined, to be reviewed, and to be updated regularly. We must consider those aspects of the "Three R functions" appropriate for each of these several affected groups of individuals.

Optometrists must properly refer patients, as appropriate, for ophthalmological or other necessary care. Ophthalmologists must respect the recommending clinician. These two groups, ophthalmology and optometry need to work together, effectively, efficiently and purposefully in order to provide needed services to the larger community, the Indian Nation. All parties need to *continually* upgrade their knowledge in the face of growing research, acquired knowledge, and changing modes of practice.

There is a need to upgrade systematically those with lesser training in order to create a larger effective and cooperating body of quality eye and vision care practitioners. All necessary protections for the public must be put into place! Literally, the future of eye care in India is in your hands!

On a related but different note, *simple refractive techniques can be largely automated today*. Let us grow as patient care providers and fill a broader role in eyecare in behalf of this society, and let us do it cooperatively. *Refractive errors based upon both focus and aberrations can be almost totally corrected using adaptive optics and associated techniques. **These new approaches to refraction are powerful tools! You dare not ignore them.***

Please put aside politics and raise yourselves up in such a way that you better serve this vast and growing population. My one talk will not alter current practices, but the time has come for you as a group to grasp your own future! The price you pay is the need to learn a number of evolving and newer ways now being pursued avidly in many nations.

I remember vividly, the first day I served as Dean at Berkeley. I was called to the office of the Provost for Professional Schools and Colleges at the University of California at Berkeley. Provost Doris Calloway's opening words to me were, *"Dean Enoch, I pay you to be effective, not nice. If you can be effective and nice, so much the better! But, be effective!"* These were my marching orders as Dean! And Doris was right. Here, *I am trying very hard to be effective in your behalf!*

Your problem is larger than you yet contemplate. Come, let us join the 21st Century!

Recently Proposed Legislation #1:

In the past year a proposed legislative action was prepared for submission to the National Parliament of India. This document is titled **"Initial Vision Council Draft: "Vision Council of India," Vision Council Act, 2007. (An Act to Regulate the Profession of Optometry and Vision Science)**. I found a number of items contained in this document to be difficult to accept. I will detail my objections below. In this talk, I address a number of pertinent issues for your consideration, hopefully to be addressed by the Parliament at a later time in a revised document.

Your task (our collective task) is *to address effectively* the ever-demanding eye and vision care needs of India at a time of great population growth and the rapid expansion of this society! These matters relate to the safety, efficacy, efficiency, and costs of ocular care delivery in this great Nation.

When we consider eye and vision care, we need to reflect upon collective reductions achieved in the maternal death rate, in increases in survival rate of infants, and in the very meaningful enhancement of longevity of life of India's vast population. It is known that *virtually 100% of individuals benefit substantially from vision care as they age. And it is recognized that quite a number of major incapacitating and blinding ophthalmic diseases and disorders increase in prevalence with increasing age* (e.g., cataract, age-related macular degeneration, glaucoma, diabetic retinopathy, complications of high myopia, etc.). Along with demographic realities in India, there must result growth in demand for eye and vision care services of all kinds, and necessary development of visual rehabilitative care for the vast visually impaired population in India.

Thus, services provided for care of the older citizens of this Nation must increase in proportion with the continued growth and aging of the population of India (and of virtually all populations in the area and the World).

It is important in the near future for the Parliament of India to address, with some urgency, the series of problems and issues considered in this discussion! What we do

here affects not only the efficiency and abilities of the individual, but extends benefits to the larger economy by enhancing ocular comfort and real productivity of workers.

Please assume an individual has been practicing a specific skill(s) as either a professional practitioner, or as a trained aid, associate, technician, sister, etc. That individual may, as a result of such activities be faced with requirements which make necessary his/her access to added special knowledge in order to meet new and emerging needs specified by regulatory groups or professional organizations in their specific category of care-provision. That is, reasonable added course material, or clinical experience may be required to bring that individual up to a new level of performance.

After necessary training, most probably that individual will be asked to take a suitable examination(s) designed to allow him/her to establish a new qualification level, and then, assuming passage of such examination(s), he/she can be advanced to a higher level of practice. In a *modest number of instances*, the regulating Board or Council (or appropriate supervisory agency or group) should be able to decide whether, due to self-study, and/or their considerable extensive clinical experience, some individuals already qualify for the new role. The latter actions are commonly termed "acceptance by 'grandfathering'".

Given the recent and seemingly ever-accelerating pace of new knowledge acquisition, one assumes there will be a *life-time requirement for Continuing Education (CE) in support of each and every form of health-care provision!* This differs from advancement to a higher or different level of provision of eye or vision care. And CE need not be limited to eye-care alone. For example, currently in California, each year, *each health care professional* must pass qualification in CPR (Cardiopulmonary Resuscitation). Sometimes, there needs to be mandatory upgrading of care by all practitioners for defined purposes such as the introduction of a new form of therapy, surgery, or other aspect of practice which is associated with modern health care delivery. In such a case, the skill level of the practitioner needs enhancement without altering his/her official status *per se*.

As *but one example* of our ever-expanding knowledge base through new scientific research and modern technology, consider a set of meaningful new developments in ophthalmic optics. These will provide high-tech applications of optics and electronics to eye care, assessment, and near-instantaneous and more perfect correction of ocular imagery, and much more. These techniques greatly improve visual corrections by minimizing either or both ocular and spectacle or other lens-induced aberrations. Here, I refer to three (four?) largely independent techniques in development, *Adaptive Optics (AO)*, *Coherent Scanning Laser Ophthalmoscopy (CSLO)*, and *Optical Coherence Tomography (OCT)* [sometimes incorrectly described as Ocular Coherence Tomography (see just below)], and associated *Flood Illumination (FI)*. *We are just beginning to appreciate the real opportunities for clinical applications of these devices, both individually, and in combination(s)*. As but one of several results, the role(s) of the ophthalmoscope is(are) being redefined for the first time since its discovery by Hermann von Helmholtz in the latter half of the 19th Century.

Adaptive optics offers advanced aberration-minimized, laser-assisted, corneal surgery for refractive corrections. Sankara Nethralaya has had such an instrument for some period of time. No doubt other fine institutions in India do as well. I remember Dr. S.S. Badrinath proudly remarking on acquisition of such a device to some of us after we had attended the very special memorial ceremony for the renowned Sri Chandrasekhar Saraswathi in Kanchipuram. These sophisticated technologies, *already here*, will play an important and increasing role in eye care and in the design of, and modification of visual corrections in future.

On November 4, 2007, I received the following notice by e-mail for a talk given at our next local East of San Francisco Bay-Area optometric group meeting:

The Alameda/Contra Costa Counties Optometric Society

Presents: Tuesday, November 20, 2007

Donald Siegel, O.D.

**Multifocal Contact Lens Fitting And
Integrating Ocular Coherence Tomography into the Optometric Practice**

It is clear that meaningful aspects of *these technologies are here now!* While these tools are, in many ways, still in development, and are being modified regularly, their utilization is growing and spreading with rapidity! In the near future, we as educators and clinicians need to educate eye and vision care professional practitioners, as well as refracting technicians, and other interested parties, relative to uses and applications of these emerging techniques and tools. As one who regularly attends Ophthalmological and Optometric Grand Rounds (see below), I can assure readers that there is much else in the offing!

These new techniques can make a real difference! *Indeed they can, but...!* Let us say that we seek to eliminate *all* blur in/of the retinal image. Particularly for younger folks, a word of caution is needed. Please note, the “accommodative mechanism”, the internal eye-lens power adjustment used to correct eye focus for different and varying ocular viewing distances, *utilizes image blur with remarkable accuracy in order to correct the focus of the eye.* Assuming one is able to eliminate totally blur of a retinal image, will that person still be able to accommodate satisfactorily for different object distances?

Some Important Distinctions

Before proceeding, I want to make some important distinctions, e.g., between *professional practitioners versus technical support personnel*. The technical staff *supports* (and often broadens) services rendered by the clinician, or the activities of a group of professionals. Such support services may occur within the office of the health care professional, but, in a number of cases, such services need not be located there or within a clinic or hospital. Some examples of the latter “external supportive services provided by technical staff” are roles played by a visiting home nurse, the physical therapist, the pharmacist, etc. They are health professionals in a number of ways by training, but they are limited in terms of making independent decisions relative to what test(s) to perform, or what treatment to pursue, or what medication to administer. As

noted, in some cases their activities are not conducted in the medical practitioner's office, because of space restrictions, instrumental or other technical requirements, or limitations on mobility of the patient, etc. These personnel may not have been taught extensive differential diagnostic skills, although they are often able to detect the presence of a disorder, and if they find an unreported anomaly, they are obligated ethically, and/or often by statute, to refer the patient for appropriate follow-up care. In the United States (U.S.A.), such individuals can only dispense many of their services with a formal prescription in hand issued by a licensed clinician.

In some instances these same individuals legitimately undertake certain responsibilities outside of the presence of the referring professional. In such cases, professional lines are somewhat blurred. As examples, the pharmacist may advise the patient within certain bounds and/or prescribe or dispense certain medications. The dietitian has some leeway in deciding how to best manage his/her patient's diet, one may state the same thing about the physical therapist, etc. I address this matter, in part, because we need to define properly the roles of all eye and vision care professionals and of technical support personnel. For example, what are the defined roles of various categories of opticians in Indian society?

Note, the word *technician* is in no way a sign of disrespect, rather it is a term associated with mastery of a defined set of "technical" skills. An instrument maker, as an example, is a *very highly skilled technician*! I have watched a number of these outstanding machinists address instrument design problems with frank awe! On the other hand, I do not favor the term *para-medical* personnel. It says nothing other than that these individuals serve medicine. My *Webster's Universal Unabridged Dictionary* defines this term as, "related to medicine in a secondary or supplementary capacity". It is not complimentary, *per se*, and does not consider skill level.

An important and separate question is, *what does the professional practitioner "sell"?* I will argue that this individual should primarily market his/her extensive learned and licensed knowledge, and in the eye care field, he/she should not offer a "free eye examination". This question is critical when we consider the role(s) played by optometrists. This issue/matter peaked in the United States at about the time when I was a young optometrist (I was licensed in 1950 within a few weeks after reaching the minimum required age for licensure of 21 years). Then, most optometrists offered "free" eye examinations, and most "sold 'glasses'"!

Were they appreciated for this mode of practice? Absolutely not! Optometrists were regularly accused of prescribing glasses when they were really not needed! And it was not possible to prevent such allegations against them from being levied. The wiser optometric practitioners quickly learned they received an average of *five* referrals of new patients in each situation when they told the patient that they did not need a visual correction or a new replacement set of lenses! *That is, patients were amazed by such honesty!* Thus, it turned out that there was a real incentive for optometrists not to prescribe spectacles when they were not required. Shortly thereafter, it was argued (properly!) that a true professional charged for their services and acquired skills, not just for the sale of spectacle corrections or other products and materials.

Does the physician charge for the visit by the patient? Does the dentist? Why do many individual optometrists in this country often *not* charge for an examination? *This is a major mistake from many points of view!* A new patient examination, and/or a more complex examination during an office visit is(are) charged at a higher rate (and reimbursed by insurance carriers as such!), and there is a charge for each *office visit*.

In the United States, I receive a bill for a substantial sum of money for a house call made by every electrician, plumber, gardener, or other service person, whether he/she does something or not! Why-ever should we optometrists not be paid for the conduct of a *bona fide* eye examination? Also of very great significance, *health insurance plans almost universally pay the practitioner for their eye examinations, and not for dispensing visual corrections!* I do not know the current status of health insurance plans in India, but this form of practice has become dominant in the United States and Europe. In one form or another, if health insurance plans do not exist as yet in India, I suspect you will find them taking a prominent place in ophthalmic practice in future years! I find it hard to believe that the operant principles applied in other Nations will be different within India.

And in the United States, the American Academy of Optometry does not accept those in "*commercial*" practice into membership, and utilization of other than limited advertisements by their members are not acceptable. *I realize that employed optometrists in India may not be able to establish practice modes different from those specified by their employer.* So saying, a more professional approach needs to be taken in future by all contributory parties! I hope this policy will be re-examined by responsible individuals, and actions taken to end such forms of practice.

Do individuals practicing optometry or ophthalmology commercially still exist in the U.S.A.? Yes, but though these individuals are still rather numerous; today they are in the minority, and the majority of us are proud of the changes which have been made in order to professionalize properly ophthalmic practices! All optometrists in America – no matter their practice mode/setting are educated and trained *to the same minimum standards*. In India also, there should be only one optometry, with meaningful/sincere efforts made to enhance the quality of education and to upgrade those in lesser forms of practice.

Additionally, in California, optometrists organized *their own health insurance program, the Vision Service Plan (VSP, a corporate entity)*, and this structure has benefited the profession greatly! In recent years, the very successful VSP program has been expanded Nationwide in the U.S.A. with comparable favorable results. And VSP has offered a similar service to ophthalmologists, and I understand a number of them use this service at this time. *VSP has also been a force for uplifting the general quality of eye examinations by giving bonus reimbursements to clinicians who perform specific advanced diagnostic procedures! This interesting technique has proved to be a very efficacious method for enhancing the skills of the professional optometrist, and for paying for the addition of special diagnostic instruments in their offices.* In many service areas, VSP also fills spectacle prescriptions.

Separately, office dispensing of prescribed eye glasses by the optometrist makes good sense as well. Yes, optometrists do make a profit from this activity, but it is a

lesser proportionate charge than in prior times (and is presented as such to the patient!). In part, this is because the examination(s) is(are) properly charged separately, and the charge for providing, dispensing, and fitting materials is levied separately from billings for the original and subsequent office visits. It has been found that if one provides *the full service* of (1) conducting the ophthalmic examination, (2) writing the prescription, (3) filling, or arranging for the prescription to be filled, (4) checking accuracy of the resultant spectacle product or contact lenses prior to dispensing, and (5) then fitting and delivering prescribed materials to the patient, the result has been far more satisfactory and successful!

On November 5, 2007, on U.S.A. national television stations (news reports), there was a major *exposé* of poor follow-through in proper spectacle delivery of a clinician's prescription (ophthalmologist or optometrist) by a number of national *big chain providers* of low-cost visual corrections (by Wal-Mart, Target, CostCo., etc.). Significant errors of various types occurred in as high as 80% of Rx's delivered to patients in this substantial clinical study! These large corporate groups apparently automatically assumed correctness in the filling of the prescription, and did not provide follow-through by careful checking of the product against the original prescription Rx prior to delivery of that visual correction to the patient. As a result, a great deal of error resulted, and patient satisfaction was compromised! *Long ago*, optometrists in the U.S.A. found it to be *critical* to provide follow-through on spectacle and/or contact lens Rx(s) by checking properly these products prior to these corrections being dispensed.

Thus, by using appropriate care, the modern optometrist takes full responsibility for the entire service rendered. Today, in the U.S.A., very few urban and suburban optometric offices manufacture their own visual corrections, rather they receive them either fully assembled or partially assembled through wholesale optician services. The spectacle Rx orders are sent to the optical wholesaler on-line (by computer), and the ordered materials are delivered quite promptly to the practice. Modes of practice vary in different settings and locations.

Recently Proposed Legislation #2:

Like everything else, a bit of reconsideration is often valuable when seeking to write legislation. I encountered some items to which I object in the proposed legislation.

1. Please distinguish between the clinical entities which we define and consider here, and the basic science(s) underlying and effectively supporting those activities. *Clinical Eye and Vision Care are being considered in the proposed legislation.* And *Vision Science or Visual Science* is that very broad set of scientific knowledge which underlies the associated branches of health care provision including ophthalmology and optometry.

In recent years, *supporting sciences underlying modern clinical practices for these endeavors have literally mushroomed in all directions!* It was felt that a more broadly-based term for this highly interdisciplinary field of study was needed. Scientists settled upon the terms, "Vision Science" (preferred) or "Visual Science". *Thus, I practice optometry; I study and conduct research on vision science.* I do not practice the latter. The same and other scientific disciplines also underlie the even more

broadly-based medical practice. The title of the legislation should read, "The Act to Regulate the Profession of Optometry [*please delete "&Vision Science"*]."

2. The proposed legislation talks only in a limited way about optometry! There seems to be confusion here between regulation of all parties associated with eye care (with very little mention of ophthalmology), or even the profession of optometry. What I term here as "Modern Optometry" has matured World-wide, and in recent years this form of ophthalmic practice has begun to emerge in India. It is already well established in Great Britain plus in Canada, South Africa, Australia, New Zealand, Singapore, etc. and the U.S.A. (all of the latter were former British Colonies). And in the proposed document, a variety of technical support personnel in related fields are listed and represented. Many practice independently. This is an additional reason why regulation of the eyecare field is so long overdue!

The first step in establishing a modern optometric profession must be standardization of the educational programs and the academic credential that is awarded at the completion of that program. In India, there are also substantial numbers of individuals who graduated-from, or who are being trained-in institutions which provide less complete training (e.g., those who receive two rather than the four years associated with modern optometric education). They are also termed optometrists, but, sadly, by modern educational standards, these individuals cannot be as well, or as broadly trained! Similarly, they do not have the training to equip them to handle emerging trends in the optometric profession, nor many aspects of eye care which optometrists now need to know. The long term management of these several institutions and their graduates will require special attention and careful consideration. I do not criticize these individuals for practicing their profession as it has been taught to them. Rather we must face the realities of our collective responsibility to the public, and help them to make the transition to more modern forms of optometric practice.

Optometry in the U.S.A. underwent a similar transition or conversion, "growing pains", if you prefer, from two-year and three-year programs in the 1940's and 1950's to the current four-year graduate-level programs of today. For quite a period of time (decades), more than one optometric curriculum was in use until all schools and colleges of optometry were transformed to modern four-year programs. The same is true for the evolution of the academic credential (Doctor of Optometry, or O.D.) earned in these programs. The first doctoral-level degree was awarded in 1923, but it took until the early 1970's before all schools and colleges awarded this same degree. While it will be discussed later in this document, it is important to note that optometric programs in the U.S.A. now are actually 8 years long(!), comprising four years of undergraduate collegiate education *including a majority of pre-requisite courses (see discussion below)*, and four years of Graduate School training leading to the degree, Doctor of Optometry, or O.D. (Note, D.O. is the designation used by Doctors of Osteopathy.)

Today's optometrist needs a much deeper understanding of optics and mathematics, as well as of the physiology, anatomy, molecular biology, genetics/the genome, biochemistry, pharmacology, diseases and disorders of the eye, as well as systemic infirmities of the individual which affect the ocular system, and principles of

Public Health in order to properly meet requirements of current and emerging optometric practice!

I understand that when Australia underwent this same transition to the more modern form of optometric profession, they introduced an additional useful feature into their program. They recognized that the process of transformation could go on interminably (as it did in the U.S.A.). Thus, they provided a “time-certain” for completion of the transformation period. I assume that a reasonable time period for this process was set. That is, they established a time-certain date for the end of the transformation process including upgrading of educational and clinical experience of less educated optometrists, and for “grandfathering” of a limited number of appropriate individuals.

Here, I do not mean to enter into contentious inter-professional or intra-professional issues. I recognize the existence of the lesser trained graduates and their schools. We need now to consider how they can effectively be more extensively educated in order to fit into the fabric of modern ophthalmic care. Fundamentally, they require a much broader foundation, which, in turn, will enable them to grow in knowledge, and to serve the public effectively *for some years into the future. Thus, at this time, I recommend strongly that we bring all optometry programs up to the now common four year education program employed throughout the modern World.*

Hence, there is a need to clarify what legislation is being written, and for whom it is being written. *The overwhelming consideration of such legislation should be protection of the health and welfare of the public!*

3a. The definition of the main committee (and all committees) created under the proposed act leaves ophthalmologists out, and provides them with only an observer, and without a formal vote. It gives two votes to optometry (I assume there are two separate organizations in optometry, that is, one vote is for the “modern” optometric group, and, separately, one vote is offered to the earlier form of optometry offering a shorter curriculum), and there are single votes allocated to quite a number of technical groups.

Thus, in the proposed legislation, the *modern profession of optometry* is grouped with a substantial group of less educated individuals who are also termed optometrists. Because of the latter group’s limited training after secondary school (50% of that of modern optometrists), the less educated group is less able to provide the breadth of professional eye-care services of the modern optometrist, nor do they have the breadth of foundation upon which to build.

3b. There is a second complication in the design of the committee structure in the proposed legislation. A number of different groups of technicians are each represented equally on committees along with the two optometric groups. For modern optometric programs, this is one step forward, and several steps backward. Thus, I regard this arrangement as completely unacceptable. Would ophthalmology or other medical specialty accept such a design for its regulation; whereby registered nurses and other highly important, but “dependent” ancillary support groups could control effectively the regulation of medical practitioners? I doubt it very much, and it certainly should not; nor should optometry accept such an arrangement!

(So saying, these valued technically-trained-individuals are quite capable of making helpful and constructive suggestions, or acting as effective members of a team. Hence, it is appropriate that they do have a clear voice in the process, but not the controlling hand.)

4. This proposed legislation constructs what seems to me (perhaps as an outsider) to be a very complex organizational structure, and an over-lapping bureaucratic arrangement. I hope I am wrong, but I worry that there might be endless delays in actions taken, and un-necessary duplications of effort encountered. While I recognize there are sectional differences in peoples, resources, and needs; the definition of a profession should be a common one for the entire Nation, defined educational requirements should be national in scope, etc.

In short, I argue that the proposal needs to be modified and simplified, and functions delegated properly for orderly and rational national and state administration.

5. Finally, please let us properly address modern optometry (given the title of this proposed legislation). This is only fair!

Recognition, Regularization and Regulation of Eye and Vision Care

India currently lags behind most of the advanced segments of Industrialized Society in recognition, regularization and regulation of eye care professionals and technical persons in the eye and vision care field(s). The singular exception to this set of statements is the role of the ophthalmologist. Apparently, they are properly recognized, regularized, and subject to regulation. I am not sure of the status of ophthalmic nurses. This leaves the remainder of those providing eye and vision care in India in a state of some disarray. As a result, the public can be subjected to forces other than what might be considered best for the care and safety of patients. I recognize the need for optometrists to make a reasonable profit, and favor his/her being recognized primarily for demonstrated professional skills. In this day and age, I feel that basing practice largely on sales of ocular devices sold, and offering free eye examinations as a sales inducement to be rather demeaning of the individual!

There are overlapping groups of differently educated practitioners offering similar or related services. As noted, ocular refractions are conducted by ophthalmologists, modern well-trained optometrists, older forms of lesser-trained optometrists, nurses, refracting technicians, refracting sisters, probably some opticians, and still others. Let us assume the content, quality, and extent of pertinent training in clinical refractive care provided to the different groups of individuals varies meaningfully! And, many individuals practice for an extended time period, i.e., careers can be very lengthy (consider my career!). To remain relevant, clinical practitioners require both a broad and strong foundation of knowledge, and quality continuing education programs in order to enable participation by the practitioner throughout their career. I accept arguments in support of selectively trained short-term (a few years of service) technicians, but re-education and upgrading are absolute necessities today for those in long-term or career practice.

In the United States, there are recurring discussions about the need for professional re-licensure periodically by all practitioners! The principle is quite correct(!), but the thought is daunting to virtually all of those so affected. Let us not speak only of optometrists, but for the moment, consider the physician, perhaps the ophthalmologist, the dermatologist, the neurologist, etc. Based upon numerous discussions which I have attended on this matter, such re-examinations will include *all of medicine*. So saying, how many of these practitioners after a period of “n” years will be familiar with the latest techniques for delivery of infants, or complications and subtle diagnostic issues regarding the digestive system, or questions associated with psychiatric diagnoses and treatments, etc.

Where added training and/or upgrade of educational programs is indicated, I most certainly do not intend the result of such activities to be punitive. *I assume all parties enter their respective fields for honorable purposes!* If a group of practitioners is deemed not to be adequately trained in modern ways of doing things, let us try to enhance their status, if it is at all reasonable to achieve such a goal. Such actions are not easy, and will arouse the ire of many of those affected! Hence, we must seek to be sympathetic with their predicaments. So saying, the *status quo ante* does not serve this fine Nation as it enters dynamically into many new fields of endeavor in the modern World.

Thus, a higher threshold of education and achievement needs to be set in the ophthalmic area! And, repeating, we must not overlook accompanying and increasing demands for enhanced ophthalmic care in this rapidly enlarging and aging society. Not only must “this house” be put in good order, but emerging and changing patterns of eye care in India must be met promptly and effectively in an adequate, responsible, and orderly manner!

Definitions of Professions and Technical Groups

At the outset, I defined the terms: *recognition, regularization and regulation of eye and vision care*. Often applications of these activities overlap to some degree. A definition of a profession or professional group today can be rather complex, but such definitions or descriptors of functions are necessary. Involved are statements describing the role or roles filled by this group of individuals in society. Even better perhaps, a defined, standardized, recognized (or accredited) or representative curriculum is indicated for training such practitioners, and a statement of a reasonable minimum time period for conduct of such studies is needed. And curriculums need to be updated regularly every few years. In such discussions, prerequisites for training in a chosen field should be clearly defined, and adjusted periodically in order to keep pace with emerging needs and modern developments in basic and clinical science. Similarly, one needs to specify reasonable minimums for student exposures to patients of certain types under satisfactory supervision by licensed or certified practitioners within a defined field of study or specialization.

The definition of a technical support group is also complex. These definitions may differ to some extent within different practices, in various settings, and in time.

To achieve necessary goals, considerable groundwork is needed:

Medicine has been recognized in India; Dentistry as well (e.g., The Dentists ACT, 1948 (16 OF 1948), (As modified up to 1st July, 1987 – my copy); modern optometry as a learned profession, needs to be properly recognized, regularized, and regulated.

Additional schemes for advanced training of academics also need to be considered. As one example of the latter, The Elite School of Optometry at the Sankara Nethralaya now has a formal arrangement as an external program with the Birla Institute of Technology and Science (B.I.T.S.), Pilani, Rajasthan. With B.I.T.S.'s review and approval, the Elite School provides approved degrees of B.Sci. in Optometry (a 4 year program), as well as the advanced degrees of M.Phil., & Ph.D. in Optometry for future academics and researchers in Optometry and Vision Science. Dr. T. Surendran of Sankara Nethralaya led this academic development some years ago. Other schools have followed a similar path.

Just as in medicine and dentistry, specialty practices in optometry will evolve in India. We have them in optometry in the U.S.A. As examples, advanced training is offered in special and/or complex cases/and pediatric contact lenses; in binocular vision; in pediatric eye care, and developmental reading and learning problems; in low vision care and visual rehabilitation; in the presence of aniseikonia, and complex refractive cases; in ergonomics, e.g., in conjunction with optimizing vision and visual comfort associated with extended use of computers or other visual display devices; in sports medicine (here, eye and vision-related care), etc.

A Suggested Definition of Modern Optometry

I have made an attempt to define a modern optometrist as a professional health care provider in India as follows: "Optometrists are independent primary health care providers who have successfully completed at least an appropriate four year collegiate training program after secondary school, have been suitably examined (tested), and who are licensed and registered to examine, to diagnose, to manage*, and to correct visual anomalies and disorders of the eyes, the visual system, and associated structures. Specified pharmaceutical agents may be utilized for diagnostic purposes. When an optometrist detects and diagnoses ocular diseases and disorders, and when it is appropriate*, he/she refers such individuals for further follow-up care. He/she also seeks to address requirements of patients with low vision, and to promote their visual and social rehabilitation." [Note, I borrowed here from a variety of other sources and definitions.]

* The speaker does not propose specifics at this time at these two points (*) in the proposed definition of modern optometry. A number of issues need to be considered/addressed. As examples: In a particular patient, what exactly is involved, where does the examination take place vis-à-vis other resources(?), is emergency/prompt care required(?), how available is an ophthalmologist or an emergency room physician(?), what is the training of the practitioner(?), and are special additional resources needed to provide care? Etc. Were the decision mine, I would argue that at a minimum, CPR, first aid, and acute care training, are essential for optometrists at all levels. For purposes such as these (for definitional purposes), the

presence of multiple classes/forms of optometric training does not serve the public interest well.

The World Council of Optometry employs the following definition of the profession: "Optometry is a health care profession that is autonomous, educated, and regulated (licensed/registered), and optometrists are primary health care practitioners of the eye and visual system who provide comprehensive eye and vision care, which includes refraction and dispensing, detection/ diagnosis and management of disease in the eye, and the rehabilitation of conditions of the visual system." Cited in: *Optometry and Vision Science*, 81(5): 289-290, 2004.

Please note, there is a great need for enhanced rehabilitative care for visually impaired persons in India! *We must never forget that 1/3 of all blind and visually impaired people in the World reside in India!* Such statistics have long been cited by WHO (I sat/sit on a WHO Committee addressing refractive needs in Developing Nations, and this figure has been cited often by them). Research programs into this area of vision science and associated optometric studies are clearly of importance, such studies do not conflict with other group efforts, *and this form of activity is needed badly!*

We can make a difference to quite a number of individuals requiring such care. That is, optometrists should be able to contribute effectively to the independence of a number of the visually impaired people, to the relief of care-givers from at least part of their service to handicapped persons, and to allow a modicum of these low vision patients to enter into useful employment. Needed are optical and electronic interventions, aids to daily living, mobility techniques, rehabilitation counseling, etc.

Optometrists serve not only as proper referral sources of patients; but in certain areas, these practitioners can serve effectively as valid distributors of medications for prevention of trachoma and/or other disorders and diseases; and they can help to arrange and to participate in eye camps visits, to detect/diagnose, and to manage/monitor glaucoma (that is, they can sample the intra-ocular pressure in eyes, assess properly visual fields, and observe and record the optic nerve head and the fundus), etc. *As always, the goal must be efficient service for, and orderly care of the Indian public.* And it goes without saying that meaningful cooperation among the professions will be of great advantage to affected patients.

Thus, modern optometry is much more than refraction and the fitting of eyeglasses. He/she addresses ophthalmic diagnosis, rehabilitative care, and so very much more. These definitions also speak to regularization of the profession and to its proper regulation!

Regularization involves establishment not only of recognition, but also of an organizational structure for representation and participation in the process of recognition, establishment of rules for practice, definition of malpractice, examination and approval processes for new graduates of schools, etc. Clearly, it will be advantageous for Government-based Boards or Councils of Examiners to be established.

Separately, additional schools and appropriate programs need to be established which meet the professional requirements of modern optometry or of other groups

serving the eye and vision care professions. Clearly, idealized model curriculums need to be established (or already have been established?) which can serve as guidelines for new or evolving schools.

The Elite School curriculum as first formatted was similar to that of the School of Optometry at the University of California at Berkeley at the time the Elite School was created in ca. 1985. Of course, a number of necessary adjustments have been made in this model in order to enable this curriculum to meet conditions extant in, and perceived needs of India. In turn, efforts were made to coordinate the training provided to the needs of Sankara Nethralaya. I am sure the curriculum has been updated with the passage of time to meet the ever-changing requirements in this Nation.

Assessing and accrediting school programs

I advocate application of an important program we employ in the United States! Each School must pass accreditation (or re-accreditation) reviews every 5 years (well established and highly rated schools are assessed at somewhat less frequent intervals, i.e., each 7 years). These are serious reviews/examinations! Assessments of all phases of the School program are conducted. Included in this extensive review are the overall status of the institution and its programs, the relationship(s) of the School with the Profession, the selection of appropriate students and faculty, its curriculum and plans for development of the School in the future. Student-faculty ratios for didactic teaching, for laboratory teaching, and for clinical teaching must be reviewed and approved (and must meet or prove superior to agreed minimum standards). School administration, finances, building(s) and plant adequacy and safety, are all defined and examined. And there needs to be demonstrated evidence of satisfactory production of qualified students; there must be support of research endeavors designed to advance learning *per se*, as well as the needs of eye care. Continuing education programs for graduate optometrists must be offered. Numbers of, and types of clinic patients seen by each student are assessed, and quality of clinic supervision and teaching are reviewed. Laboratory experiments conducted by students are considered for relevancy and content. Library resources available, and inter-library loan programs are determined and critiqued. Outreach programs for students are carefully reviewed for adequacy of instruction at these often remote locations, and they are also examined as to the numbers and the types of patients provided and availability of quality supervisors/teachers at that site. Graduate programs and residencies are assessed.

Prior to the review, a *book-length self-review* by the school administration, the faculty, the students, the staff, etc., is assembled and submitted to the reviewing Board, Committee, or Council as an aid to them!

The review itself is conducted by an external “blue-ribbon” Council, which includes distinguished educators not only from optometry, but also from other professions (often ophthalmology), as well as representatives (in the U.S.A.) of the Association of Schools and Colleges of Optometry (ASCO), the Association of Regulatory Boards of Optometry (ARBO), the American Optometric Association (AOA), an optometric technician, and two public members. This substantial Council meets at the School for about a week or ten days in order to conduct the review. At the end of these detailed examinations, and after meetings with the administration of the University

and the School or College, the faculty, the staff, and the students in each program, the review committee not only prepares a lengthy review in the form of a report for interested parties, but they also present their immediate findings to (and for discussion with) the Dean/Director/Principal of the School, and to the Senior Administration of the School or College (Chancellor, Provost, President, Chairman, etc.). Deficiencies are noted, *and must be resolved within a finite period of time*. If these are not satisfactorily met, the School is placed on probation, and/or can lose its accreditation. In sum, such a program is of great value to all parties, and is taken most seriously, even by the strongest institutions. This program is very effective!

A different authority needs to be formed for setting standards for ophthalmic materials employed, eye tests employed, and minimum practice standards. These matters may be handled by organizations representing the professions, or by an organization such as an Indian version of the American National Standards Institute, or by suitable governmental bodies and committees. This is a critical task as it strengthens referral policies, the quality of, and the uniformity of patient test procedures and materials dispensed and methods used, the approaches taken in educating students and practitioners, in exchange of research and other data, etc. For example, if individual practitioners (all groups) apply different tests, or different test conditions, any chance of reproducing test results will either be lost, or greatly reduced. Common methodology makes transfer or portability of data much easier and more meaningful when referring a patient for care to another office. Good examples of clinical examinations for which standards have been established include the testing of visual acuity, and/or perimetry, etc.

A National and/or State Board (Council) of Examiners serves to assess candidates for licensure at the completion of their academic and clinical training, and/or considers the application of individuals who move to another State seeking licensure within its borders. Today, usually there is required passage of a National Board Examination for all graduates of Schools and Colleges of Optometry at the completion of Schooling (often individual parts of these examinations are staged at different time periods during student training). Usually, special provisions are made for those in the military, or in the Public Health service, etc., because of the different conditions under which such individuals may practice their profession. Consideration should be addressed as to whether it is desirable to offer National versus State Licenses? I cite a reference (a bit below) which addresses the issue of "portability of licensure".

Importantly, State and/or National Regulatory/Licensing Board(s) of Examiners must also address charges of malpractice or other forms of irregularity/impropriety in practice. We must take such claims seriously, and have a legitimate means of managing such matters fairly, with great care, and expeditiously.

You must decide which matters are to be handled "locally" in the individual States or whether certain issues are National in scope or importance. Accreditation of Schools, establishing a minimum curriculum for Schools and Colleges (which is updated on a continuing basis), National Board Examinations, definitions of, and recognition of Professions, and classes of Technical Support Personnel should be addressed centrally. Administration of local added State Board examinations (covering local special legal requirements, ethical issues, malpractice regulations, etc.) might best be

administered at the State level. The State must also attest to the validity of the credentials of the individual applicants. Similarly, issues requiring direct contact with practitioners, as well as establishing appropriateness of practice settings, propriety of advertising, etc., are probably most suitably handled in the States. Etc.

A good source of information relative to professional regulation is a paper written by Ms. Sherry L. Cooper. The licensure mobility experience within the United States. Optometry, the Journal of the American Optometric Association, 76(6): 347-352, June, 2005.

Resolutions presented to and passed by the American Optometric Association at its meeting, June 2007. Optometry, the Journal of the American Optometric Association, 78(10), 492-493, October, 2007. The following example is rather useful for format purposes for resolutions, etc.

Please note a recently approved resolution in the U.S.A. which is pertinent to situations such as the problem set considered here is presented on the next page. It was *"Adopted by the House of Delegates of the American Optometric Association on June 28, 2007."*

Support for the Recognition and Regulation of the Profession of Optometry by All Sovereign States

WHEREAS, the American Optometric Association represents the profession of optometry in the United States; and

WHEREAS, optometry was legally recognized as a profession in the United States in 1901 when the first licensure law was enacted; and

WHEREAS, optometrists are trained and educated to provide safe and effective eye and vision care; and

WHEREAS, eye and vision problems are substantial public health problems which have profound global human and socioeconomic impact; and

WHEREAS, the American Optometric Association strives to ensure that public policy related to eye and vision care will uniformly recognize optometrists as primary health care providers; and

WHEREAS, there is a demonstrable public health benefit when all people have access to comprehensive optometric care, now therefore be it

RESOLVED, that the American Optometric Association strongly encourages the government of every Sovereign State where optometry is not recognized as a profession to enact laws establishing the licensure and regulation of optometrists; and be it further

RESOLVED, that the American Optometric Association strongly encourages the government of every Sovereign State to recognize the authority of optometrists to practice in their jurisdiction at the highest level of their education and training.

The Optometries

We face a special problem in India. Today, as already noted, there are two or more optometric groups offering their services to the Indian public. They are not equivalent. One, which I have termed "modern optometry", is a more advanced form of the profession of optometry, requiring considerable added training. This form of optometry is practiced almost World-wide, and has flourished with modest variations for a number of years. In the case of modern optometry, the professional course we established in India at the Elite School of Optometry at Sankara Nethralaya, and which has been largely reproduced elsewhere in India, requires four years of professional training after secondary school. As noted, a curriculum is a *living document* and needs periodic updating and reconsideration.

Interestingly, quite a large number of the graduates from modern Indian Schools and Colleges of Optometry have continued on for advanced optometric training and research in India, Singapore, Australia, and the U.S.A. (and no doubt elsewhere). Currently, I have an Elite School of Optometry graduate in my laboratory. She follows a long list of other very able individuals who have worked with me over the past decades.

The older, and long established form of optometry in India requires *only* two years of training after secondary school. This group maintains quite a large number of schools in India (ca. 40). There is also a three year optometry-like program offered at the All India Institute of Medical Sciences (AIIMS) in New Delhi. This program is titled "Ophthalmic Technique" and provides a B.Sci. degree after three years. The school trains a limited number of students in optometry per annum. It is not clear to me if there are other centers (how many?) offering this or a comparable program as well. AIIMS seeks to offer a high quality and mostly clinical curriculum in optometry. I urge that this program (and ones like it) be expanded to a four year program. Given the limited number of students trained per annum in these programs, added basic and formal clinical science training might be provided at one or more of the other modern optometry schools, if indeed this presents a special problem for AIIMS. I lectured briefly more than once in that program quite a number of years ago.

At this point, for comparison, it is useful to consider current requirements for optometric programs in the U.S.A. There, optometry students now are required to study a minimum period of eight years after secondary school! Today, under-graduate pre-optometry programs for students planning to enter into optometry are very much like programs in pre-medicine, pre-dentistry, and other health care fields in the U.S.A. These programs include roughly three(+) undergraduate collegiate years of intensive study of a goodly number of pre-requisite courses. Included are anatomy (gross human, neuro-anatomy, histology, embryology, etc.), biology and physiology including molecular biology, neuro-physiology, chemistry through advanced biochemistry, often pharmacology, genetics/the

genome, mathematics, and physics (including enhanced optics), and biophysics. In short, it is recognized that *fundamental knowledge has proliferated to the degree that it can no longer be contained within the formal four year professional medical/dental/optometric teaching program.* Optometry, now, like medicine and dentistry, is purely a four year graduate training program leading to the Doctor of Optometry (O.D.).

Further, there is a steadily growing trend for these optometrists to stay on as residents or fellows for another one or two years of advanced (often specialty) training! These developments are quite separate from our graduate programs for eye and vision researchers. When I stepped out as Dean in 1992 after serving for 12 years, about 15-16% of optometric graduates at Berkeley were seeking post-graduate optometric training as residents or fellows. The current Dean at Berkeley, Dennis Levi, estimates that today that number is approximately 19-21% nationally, with almost 30% of Berkeley graduates going on for such special training.

These advanced students concentrate on/specialize in (1) advanced cornea and contact lens care, e.g., correcting/fitting of more difficult cases, including neonates, keratoconus, distorted/irregular corneas, monocular aphakics, telescopes, etc.; (2) amblyopia, vision training, binocular vision anomalies and strabismus; (3) low vision care and vision rehabilitation, (4) pediatric eye care, and (5) those concentrating upon reading disorders, the latter programs are sometimes combined with programs in special education in Colleges of Education; (6) primary eye care/ family practice, and (7) ocular disease. Within the numerous Veterans Administrations (VA) Hospitals, there are optometric residencies offered either in (8) low vision care and rehabilitation (related to, but somewhat different from (3)), or in (9) hospital-based residencies. These post-graduate students include individuals seeking careers as optometric providers within VA hospitals, as well as those in the military, the public health service administration, and a number of individuals participating in ophthalmology practices, etc. There also are residencies addressing (10) ergonomic treatment of computer-related visual problems, and (11) vision care associated with sports optometry.

Clearly, the group studying optometry in India for four years is not equivalent to those studying for two years, and they in turn are different from many of those studying outside of this nation. *Then, how do we define licensure for optometry in India? There are two or perhaps three groups with the same or different names but having different traditions and durations of training, and somewhat different modes of practice. They are not equivalent. Hopefully, they will cooperate and find solutions to their differences and reasonable means/methods for upgrading, and reconciliation of their programs?*

My Positions

I have been stating my positions clearly. The larger group of optometrists in India, those who have studied at two year colleges, are practicing a rather archaic form of optometry. This form commonly existed widely during the latter part of the 19th Century with extensions into the first half of the 20th Century. In a number of cases, these are very commercial and questionably professional forms of practice focusing a

great deal on the dispensing aspect of optometry, *and not upon medical and or health related issues*. From my point of view, the older format is a creature of our past.

I have been very proud to practice professional optometry in a variety of venues for 58 years! I would be deeply insulted if a patient said to me he was not willing to pay my examination fee. Here, I do not speak of those in poverty, or experiencing other situations where they just cannot afford to pay that fee. We accept their condition as it is, and treat such individuals as being worthy and having a sense of honor, and ask them to pay whatever and whenever they can! And most all of those able to do so, pay their bills.

Are we to be bound by the past? I do not think so; our World literally has moved on! I would not expect the two year student to compete on an equal basis with the four year student in examinations for licensure. This does not mean that any individual is better or worse than the other; rather, less education surely affects the outcome. How does one decide what knowledge is necessary in order to provide necessary care, safety, and efficacy, and all suitable protections for the public whom we serve? *I feel we must take all measures to ensure that we practice a form of optometry which meets the very highest current professional standards.*

I would like to see all optometric programs in Indian optometry coalesce upon the four-year curriculum model. Obviously, at the same time, all modern health care professions have changed or are changing dramatically. That is, training programs in medicine, and all other health professions, in recent years have had to keep in-step with incredibly rapid scientific and social progress made, as well as with demographic realities. It may be that in future, in India, as in the United States, sustained pressures of a comparable sort will force health-related professional programs, including optometric ones, to expand into a pre-professional undergraduate program for a substantial portion of their basic science studies.

Similarly, it will be necessary to create added post-graduate professional residency curriculums for specialty training. In parallel, there will have to be added training programs established in order to provide/to create the required researchers and academics for this expanding set of educational and health care resources.

I have stated many times, *certain research programs must be developed here in India*, as we in the U.S.A. and Europe do not see many of the large numbers of patients with characteristic diseases and disorders which place so much pressure upon the health delivery systems of South and South-East Asia (and which also are encountered in quite a number of Developing Nations). Similarly, you owe it to your enormous visually impaired and blind populations to develop meaningful research into low vision and vision rehabilitation practices.

Above all, I hold tightly to the belief that it is critical that optometry and ophthalmology be cooperative professions and not competitive entities! I am a forever a Rounds participant! Weekly, I still participate and enjoy this form of continuing education! From 1958-1974, I attended regularly grand rounds at Washington University in Saint Louis led by Prof. Bernard Becker, M.D., (and I also used to conduct scheduled refraction rounds with my good friend, Benjamin Milder, M.D., at that institution for several years); during the many years I shuttled back and forth between

St. Louis, Missouri, U.S.A. and Berne, Switzerland, I used to join in the remarkable rounds conducted there by Prof. Hans Goldmann. From 1974 to 1980, I regularly attended rounds at the Department of Ophthalmology at the University of Florida in Gainesville led by Prof. Herbert Kaufman. Since 1980, I have participated in rounds programs at the University of California in San Francisco. And that same year, as Dean at the University of California at Berkeley School of Optometry, I introduced the same teaching modality to Schools of Optometry. I have learned (and we all can learn) much from this classical, well-established, and largely Socratic-form of medical health debate and education. Not surprisingly, there are remarkable differences today between case presentations, differential diagnoses, presentation of histology data and genetic information(!), and treatment options considered previously!

Happily, optometry has kept up with these developments (at least in the San Francisco/Bay Area). For example, on November 7, 2007, I attended a fine rounds program held at the nearby Palo Alto (California) Veterans Administration (VA) Hospital. Cases were presented by Optometry Residents at the VA Hospitals in the (larger) San Francisco area, and by current U.C. Berkeley Optometric Residents. On this day, I was very proud of our 12 residents who presented diverse cases in a first-class five-hour session.

The key issue we need to consider here is, how will India define optometry in the future, and how shall we deal with existing variants among those identifying themselves as optometrists? I feel it may be a mistake in modern times to license the group with limited training. I very much suspect it will not be easy task to alter/upgrade that particular form of practice to a modern-criterion-level if that group is recognized in its current state within the legal system. Today optometry is so very much more. True, modern optometrists do refract, as refraction (or a form of visual correction) is the historic root of all optometry, but so does the ophthalmologist, or his nurse, or refracting sisters, etc. I make this distinction here because *the modern optometrist takes far greater responsibility for his patient's welfare than do refractionists, per se.*

Alternatively, shall we offer the larger group a different title and scope of practice? Does this really solve the problem? I think not. *Education upgrade* is the logical way to go, although it may take some time and/or prove to be difficult.

Modern Indian optometry should be a licensed profession with reasonable control over its fate. That is, this profession should have its own Licensing Board or Council. It should prepare and implement national tests which can be supplemented by local State tests as regards local laws, etc. It needs to have both a designated school accreditation body and a committee to establish national test and other standards for practice of the profession. It needs to address honorably and properly issues of malpractice and malfeasance.

Yet again, I emphasize again that I do not oppose the many two year refractionists/ optometrists. I was one of them! As stated, I accept that these are fine individuals, and, no doubt in many ways, very capable people. Rather, as currently constituted, I just do not see them building a future for the optometric profession in India! *As the standard of care for eye and vision care has evolved over the decades,*

separation of a refraction from a comprehensive eye exam is no longer acceptable and, most importantly, this is poor public health policy.

I have stated the hope that provision will be made in order to allow these refractionists/ optometrists trained in two years to take additional courses in order to make it possible for them, in time, to qualify for examination and licensure as modern optometrists. I also suggested that their academic leaders and some well recognized individuals might be "grandfathered" into the category of modern optometrists. I urge their schools to consider upgrading their faculties and curriculum to qualify as modern optometric programs. As I understand the situation, that this process has begun.

Here, I am concentrating on what it will take to resolve this impasse in order for optometrists, as eye care professionals, to better serve India. Necessary transitions will take a number of years.

Let us assume we seek to upgrade/update the education of the two-year optometric graduates. Will there be a single upgrade program devised which is applicable for all participants, that is, a "one-size-fits-all solution"? I wonder? Here we deal with a large number of two-year post-secondary school programs. Was the curriculum the same in each of these schools, or nearly so? Did these early programs also dedicate a meaningful portion of their total teaching program to training their students in opticianry as well as in optometry? I appreciate that this might have been suitable for the times. And, we must not forget that these programs have existed over quite a long span of years, and it has been a number of years since a number of these individuals were first trained.

I have taught in ophthalmologic, optometric, and opticianry programs. They are each quite different!

If we are going to pursue the recommended approach, let us do it properly! *What I fear is that many of these individuals will not even perceive what they do not know!* Given the backgrounds of the two and three year trained groups of optometric practitioners, the courses will have to be formatted such that they are seen to be clinically applicable. And where does one start? This set of issues will take serious consideration by able, dedicated, and caring individuals/academics. And do we have qualified individuals to teach this large cohort of existing practitioners? What are associated costs? In parallel, the existing two-year schools all will have to adjust/change to the accepted modern four-year curriculum.

As another feature, I recommended above an approach employed in Australia years ago when they faced similar issues. Provision was made (1) to arrange to have the group(s) with briefer training take special designated upgrade-courses during a defined period of time, (2) all school/college curriculums were brought into compliance with an agreed 4 year-program standard, and (3) certain individuals were grandfathered into licensure. The Australians then (4) *set a time-certain date after which no-one was granted optometric licensure unless they had completed a four-year optometric training program and passed a Board or Council examination.* I am sure we will all agree that the transition-process should not continue endlessly as it did in my own Nation.

And we should initiate promptly regular, required, and meaningful CE programs if they do not already exist!

In Closing

Optometrists, in this great Nation, must become aware of their real value to society and to India, and develop a true sense of pride as regards themselves, and relative to their profession! You can be so much more!

Modern optometry can make a meaningful contribution to eye care and to this Nation. It should be recognized, regularized, and regulated!

We need to consider as well the regularization, and regulation of all technical support individuals/groups. Regulation is designed to protect the public. Hence, it is logical for all ophthalmic care groups to be defined properly and regulated. To achieve such developments will take good will, understanding, and, above all, cooperation by all parties.

As an absolute minimum, please address the issues I raised in criticism of the proposed new law. While a number of my suggestions are no doubt highly controversial, I have sought to be constructive in my approach to the problem.

Writing in a recently published and magnificent book(!), Prof. Emeritus Vincent Ilardi, of the University of Massachusetts at Amherst (U.S.A.), closes his text with a wonderful quote by the scholar and philosopher, René Descartes, in *La Dioptrique* (Dioptrics), dated 1673: *"The whole conduct of our life depends upon our senses, among which vision is the noblest and most universal, there can be no doubt that inventions to increase its power are the most useful there can be."*

Ilardi also quotes the early Spanish historian/author Daza de Valdez, who declared in his book in 1623 that practitioners of the refractive art were *"divine"*, and Ilardi adds, *"today's more educated and mathematically sophisticated opticians can feel justly proud that they are practicing a "divine" calling."* **May we collectively achieve that status!**

Ilardi's book is: *Renaissance Vision from Spectacles to Telescopes*, Memoirs of the American Philosophical Society, Vol. 259, (citation p. 251), 378 pages. Philadelphia, PA., ISBN-10: 0-87169-259-7; ISBN-13: 978-0-87169-259-7. *Winner of the American Philosophical Society J.F. Lewis Award in 2006 for Best Book of the Year!*

Acknowledgements

Quite a goodly number of individuals have kindly helped me with this document, both in India and the United States. Ms. Sherry Cooper of the American Optometric Association was a fount of knowledge on the general topic of licensure, accreditation, etc. Friends in India among former Elite School of Optometry students (e.g., Mrs. Kripa Nagarajan Karthikeyan, B.S. Opt., 2006) were of great help, as was Dr. Krishna Kumar, Ph.D., Principal of ESO. So saying, *all comments made are mine and I take full responsibility for them.* I apologize that this document is so lengthy. Had I some weeks more, I am sure it would have been less lengthy.

ADDENDUM

Who Am I?

I was a child of the “great depression” (this terrible event in our Nation [and World-wide] occurred just months after I was born in 1929 in New York City). My parents, like so many others, were negatively and significantly affected by that event and its enduring aftermath. I “survived” growing up in the streets of New York at that time. I earned admission to the outstanding Bronx High School of Science, and was pleased to be awarded a full New York State Regents’ Scholarship to Columbia University. So saying, there was *no money* available to enable me to consider any form of advanced training beyond the bachelor’s degree, and my father made it clear to me that *I must choose an educational path that led to licensure*, a privilege which could not readily be taken from me, and one which would provide opportunity for me *to open my own practice* and allow me to escape the hiring and firing cycles which so devastated most all individuals during the depression years of the 1930s, and which only ended during World War II (WWII).

In 1946, I was one of *very few individuals* (a few handfuls) who were not veterans of WWII who achieved admission to Columbia College, a distinguished four year undergraduate College within Columbia University. My choice was limited by my father’s instructions to the programs in pharmacy, accounting, and optometry. Oddly, in retrospect, teaching was never considered! From the short list offered to me, I chose optometry, because I had (still have) vision problems and found the topic quite interesting.

At a dance held shortly after I entered optometry school, I heard an optometry Professor, Dr. Isidore Finkelstein, say to others that he was offering individuals \$1.00 per hour to serve as his experimental subjects. A dollar an hour! Wow! I literally crashed my date into him, and, thus, I entered the scientific and academic world. Importantly, this work was being conducted at the Columbia University Medical School Campus within the Department of Ophthalmology Research. There, I worked both with Dr. Finkelstein and his then mentor, Prof. Dr. George Smelser, who was both a superb anatomist and a specialist in corneal physiology.

Later, Dr. Smelser kindly sent me for further training and research experience to Harvard University to work with Professors David Cogan, and Everett Kinsey. Such connections and experiences allowed me to meet and to later work with many of the then leaders of Ophthalmology and Optometry.

I was called up to military service the very first day of the Korean War! Because of my years of work with Finkelstein and Smelser as a student, I was assigned as #2 lead in the management of the same research project (!) in the U.S. Army ...Amazing! In turn, that service during the Korean War enabled me to obtain “G.I. Bill” funding for graduate and research training in vision science! Among my several teachers and supervisors in subsequent years were Prof./Dr. James McGraw (Syracuse U.); Profs. Brian O’Brien and Robert Boynton (U. of Rochester); Profs. Glenn A. Fry, Vincent Ellerbrock in Optometry, Prof. Paul Fitts in Psychology, and Profs. Edwards and Knopf in Anatomy, etc. (Ohio State U.); Drs. Walter Stanley Stiles, F.R.S., and Brian Crawford (National Physical Laboratory, Teddington, U.K.); Profs. Bernard Becker, Paul Cibis, M.

Constant, Robert Moses, etc. (Washington U., St. Louis); Prof. Herbert Kaufman (U. Florida); Profs. Hans Goldmann, Franz Fankhauser, Baldur Gloor (later Chair, Basel/Zurich), and the Berne group (U. of Berne, Switzerland); and Prof., Dr. Charles Schepens (Retina Foundation, Harvard U., Boston). Because of my sustained connections with, and understanding of both optometry and ophthalmology, I have made a life-time commitment to try to reconcile differences between these two professions!

From the point of view of development of legislation, I played a key role as a young man *for some years* during the mid-1960s as Executive Secretary, of The Subcommittee on Vision and its Disorders, of the then National Advisory Neurological Diseases and Blindness Council, National Institute of Neurological Diseases and Blindness, of the National Institutes of Health (NINDB, NIH). Our distinguished Subcommittee, chaired by Prof. Bernard Becker, M.D., was charged to review the then current status of *all* eye and vision research, detail then current funding and support mechanisms of eye and vision research, and we were asked to make recommendations to the NINDB as to how to strengthen our then (recognized as deficient!) programs serving eye and vision care in the United States. Both Profs. Becker and Kinsey were then serving members of the National Advisory Neurological Diseases and Blindness Council.

I was given critical access to *all pertinent data* at the NIH (what an education that was!). I had to visit (and to study in considerable depth) *many* of the major eye and vision research venues in the U.S.A., and to lead in the preparation of, and writing of much of the subsequent major three volume report of the Sub-Committee.

Rather quickly, it became evident to all members of this Subcommittee that it was necessary for them to consider (*without overtly saying so*) the development of a new and separate National Eye Institute (NEI) at the still young and growing NIH. In my role, I wrote most all of the plan for the proposed Institute. The Subcommittee strongly supported that plan and its recommendations! In fact, the late Professor Edward Maumenee, MD, then Chairman of the Department of Ophthalmology at Johns Hopkins University Medical School and a Subcommittee member, asked me, "Jay, however did you know how to write such a plan?" (I didn't know, I just did it!)

Creation of the new NEI was later approved by the United States Congress (in 1968). Some wording in the rather brief enabling legislation was identical to wording in the Report we had submitted. Today, research in support of the extramural eye and vision research budget of the NEI has grown remarkably (and well beyond our wildest expectations!) into a potent resource in support of effective ophthalmic and vision care.

On six/seven occasions, I had the privilege to support the program and budgets for the new NEI in testimony presented before the two houses of the U.S. Congress. On some of those occasions, the late and very prominent Mrs. Mary Lasker (a key figure in development of the NIH!) would come and sit directly behind me. Thus, in effect, she offered great (and remarkably effective!) support for my testimony. I later served two terms on the National Advisory Eye Council of the NEI. I was appointed by President Richard Nixon, and reappointed by President Jimmy Carter.

Separately, about 15 years ago, I helped two senior California State Legislators write legislation for the later-approved Academic Geriatric Resource Program (AGRP). Because at that time substantial programmatic weaknesses as regards teaching and research existed relative to issues pertaining to aging populations in California, this ongoing and now long-standing legislative program provides a structure for enhancement of teaching age-related topics in the five State of California-financed Medical Schools and at U.C. Berkeley. Also, it authorized modest, but key start up funds for pertinent research on geriatric (and gerontological) subjects. It recognizes that California is a "sun-belt" State to which aged individuals in the U.S.A. tend to flock in retirement, and it recognizes the very real need for the State to meet its academic obligations to its burgeoning millions of "senior citizens". And for more than a decade, I served on the AGRP Advisory Board at Berkeley. Part of our duties were to build our teaching and research programs in aging at Berkeley (including vision-related programs) and to coordinate associated U.C. Berkeley programs with those at the five medical schools. Today, this is a full-fledged research and graduate training program with a number of course offerings taught each year (including by the speaker).

(As used here, the term "geriatric" refers to the study of old age and its diseases and disorders, while "gerontologic" considers virtually all other issues associated with aging. As examples, the later term deals with population statistics, social issues, economic and social issues related to retirement, and post-retirement life, transport of the elderly, risks encountered by elderly persons (e.g., falls in homes, on escalators, etc.), provision of non-medical care to the elderly, e.g., nursing home conditions and standards, questions of death and dying (other than direct health issues), hospice programs, designs of buildings serving the elderly, etc. These two words define rather broad sets of issues and requirements.)

I served as Dean of the School of Optometry at Berkeley for 12 years, and by the time I stepped down from this role, I had become the Senior Campus Dean at Berkeley.

For some years during this period of my career, I also served on the U.C. Systemwide Health Sciences Committee. I was appointed to their Sub-Committee for Foreign Health Science Graduates. That group had to deal with requirements for licensed immigrant health care practitioners (mainly in medicine) seeking to practice their skilled profession in California. At that time such individuals were moving to the United States in large numbers! All manner of questions arose as to the qualifications of these individuals, equivalence of their education, the definitions of individual professional training programs in the several countries of origin of these many students, etc. There were also demands made by some of applicants' countries that their graduates return to their home countries in order to serve the needs of their country of origin.

I also was named Co-Chairman of the Committee on Documented (legal) and Non-Documented (that is, illegal) Immigrant Health Care in California. (What a mess!) During our assessment of this complex situation, we had a major measles outbreak and epidemic in California, and quite large numbers of children (in particular) died of this disease. Not surprisingly, individuals included in *both* immigrant population categories, documented and non-documented, were among those who died. The then Governor of

California sought to deny provision of health care to non-documented individuals including their children, and revoked the licenses of physicians who were found to provide such care to these individuals! Our committee pointed out that infectious diseases do not respect the legal/illegal status of people, and crowded living conditions among the poor favor disease transmission, etc. We also asked the very practical question, did physicians have the time, or the appropriate personnel needed to assess properly an immigrant's residence status before that individual was provided with necessary emergency medical care?

My son contracted the measles, and his survival was touch and go for a period of a week or more. Candidly, if a child had been presented to me with a very high fever such as is commonly encountered in children with measles, and had I been trained in their care, I would have treated the child regardless of his/her immigration status, or fiscal resources.

Separately, as Dean, I had to provide an orderly mechanism to make periodic curriculum changes, and to lead two cyclical re-accreditation reviews of our school, etc.

In another set of actions, issues arose relating to the presence of over 4000+ Philippine U.S.A. residents who were graduates of the (then) seven unregulated optometry schools in their native land. At that time they resided in California (living/ located mainly in the Los Angeles area). These individuals were not licensed to practice optometry in California. *A then California State Senator* (later removed from elective office for cause!) *stated I had agreed to provide additional education for these 4000 individuals such that they could then qualify to take the California State Board examinations.* At that time, we had only about 4000 (exact number ?) licensed optometrists in all of the State of California. *Neither this California legislator, nor his staff had ever spoken to me or to my associates about this issue!* This State Senator pushed a law through the legislature, which was signed by the Governor, obligating our School (as the single State-financed School of Optometry in California) to provide such training for these individuals. This would have been a major task for us (without even considering language issues), and we were neither equipped, nor had adequate manpower for this additional role.

At that time, we graduated about 65 optometry students per year (a four year professional optometry program), we also had about 26 graduate students at various stages in their M.S. and Ph.D. programs designed to train teachers and researchers for careers in academia, and about 10-12 individuals annually taking specialty programs in advanced clinical subjects as either residents or fellows.

The State legislation which was passed carried *no funds* to hire individuals to teach this major additional program to the Philippine optometry graduates. Similarly, neither space, nor facilities were provided in the legislation for this activity (we had one classroom for our entire school!). Our faculty each had a fair teaching load, and showed *absolutely no enthusiasm* for this large added obligation! Thus, I had no choice but to oppose this program and law. It was a bruising confrontation. So saying, I neither oppose Philippine people, nor Philippine optometrists. Rather, we were placed in a wholly untenable position by this legislator and his staff. I am sure my former Philippine students and then-faculty members will attest to this point.

Setting of standards

I participated as a representative of *many* groups over an extended period of time in actions associated with setting of professional ophthalmic examination and product standards. These standards involved issues associated with testing of visual acuity, standardization of perimetric devices and perimetric tests, standardization of terminology employed in ophthalmic settings, spectacle-lens standards, sunglass-lens standards, contact lens standards, contact lens case, cleaning agent and wetting agent standards, safe use of lasers, etc.

At different times, in these several actions, I represented the American Academy of Ophthalmology, the American Academy of Optometry, the American Optometric Association, the *Concilium Ophthalmologicum Universale* (COU) in my role as elected Chairman of the Visual Studies or Vision Functions Committee of the COU, the Optical Society of America, the International Perimetric Society (a component of the COU), the National Academy of Science - Armed Forces National Research Council Committee on Vision, American National Standards Institute (ANSI), etc.

Standards setting activities by professional societies are important for quite a number of reasons! They *regularize and define* the preferred/designated approach to testing of patients by ophthalmic practitioners, as well as establish minimum performance standards of products described from safety, quality, and functional points of view. They also provide a critical resource for proper referral of patients by one practitioner to another in the same or different ophthalmic professions. That is, by establishing standardized measurement techniques, e.g., visual acuity, individual practitioners and their co-workers are able to compare effectively their results with those of other practitioners. *Some* published standards with which I was associated were as follows:

Concilium Ophthalmologicum Universal, Perimetry Standards and Perimetric Glossary of the International Council on Ophthalmology. (Perimetric Standards, 1978). Jay M. Enoch (USA) Chairman, of the International Perimetric Society Research Group on Standards, Editor, and Committee. Dr. W. Junk, bv Publishers, The Hague, The Netherlands, etc., 1979. Pp. 133.

Note: Also included in the same publication was an approved *glossary of terms used in vision testing* translated into ten different languages (English, French, German, Spanish, Russian, Italian, Swedish, Dutch (Netherlands), Polish, Japanese) based on efforts of a second committee, chaired by the late ophthalmologist, Dr. Guy Verriest of Belgium. I served on, and exercised administrative control on this committee as well. *It is urged that this list be further translated into Hindi and other Indian languages, etc.*

Jay M. Enoch, Presidente, August Colenbrander, Secretário-Geral. Media padrão da acuidade visual, Comitê de funções visuais, Concilium Ophthalmologicum Universale, 1984. Published in ARQ. BRAS. OFTAL. 51(5), 203-212, 1988. See also Visual Acuity Measurement Standard: Italian Journal of Ophthalmology II/I, 5-19, 1988. Etc

American National Standards Institute

Portions of the report in item 2 *just below* have been reproduced in Trauma (1978, 1979). And, in due course, by the American National Standards Institute, Committee Z.80. I participated on the parent ANSI Z.80 Committee, and chaired the ANSI Z.80 Subcommittee on Contact Lenses. The latter inter-professional group completed a number of standards during 1970-77. I remained as a consultant to ANSI Z.80 and to its Contact Lens Subcommittee for several years thereafter. Listed are some of the contact lens standards with which I have been affiliated.

1. Prescription requirements for first-quality contact lenses, ANSI Z.80.2-1972.
2. Standard for accessory solutions used with contact lenses made of conventional hard plastic materials such as polymethyl-methacrylate, ANSI Z.80.4-1974.
3. Standard for "Physico-chemical properties of conventional hard plastic contact lenses", ANSI Z.80.6-1976.

How I came to India, and some of my activities here

My first contact with an Indian individual was with Dr. Narinder Singh Kapany, one of the fathers of modern fiber-optics, with whom I often visit to this day! We first met at a meeting of the Optical Society of America well over 50 years ago. He has been a close friend and one of those who taught me early-on about fiber optics. Now, he lives in nearby Palo Alto. Narinder invited me to write a chapter in his first book on fiber-optics. I wrote on the retinal receptor as a fiber-optics element. That activity proved rather seminal in my career, and led me, among other things, to meet the writer of the next chapter in the same book, Member of the Board of Directors, Dean of Science and Technology, and Professor of Optics Emeritus Hitoshi Ohzu of Waseda University. Hitoshi became my Fulbright Fellow for two years at Washington U. in St. Louis, and later I was his guest as Visiting Professor of the Japanese Society for the Advancement of Science at Waseda University. The three of us, Narinder, Hitoshi and I maintain a close relationship to this day.

Separately, in later years, Narinder and I, and the late Sri Bhai Mohan Singh, founder of Ranbaxy Corp. (an early associate/schoolmate(?) of Narinder), tried to organize an optometry school in Chandigarh (this was some years after the founding of the Elite School). We did not succeed. Some years after that, Bhai Mohan Singh played a meaningful role in development of the Bausch and Lomb School in Hyderabad. I believe he was also then President of Bausch and Lomb, India.

I first came to India in response to an urgent request from then Chancellor Ira Michael Heyman of the University of California at Berkeley. In the immediate aftermath of disorders occurring following the assassination of Prime Minister Indira Gandhi, efforts were made to locate and to assure the security of all Berkeley students then studying in India. Two alumnae of our School were then registered for studies in India, and apparently they could not be contacted/reached. Since I knew these ladies, and at the time served as Dean of the School of Optometry, I was sent promptly to India to locate them and to bring them, if indicated, safely home. I asked the obvious questions, "Where are they studying or conducting research?" They (U.C. Berkeley) didn't know!

“Where do I start?” They didn’t know! India is a big country, and I knew almost nothing about it at that time! I felt like Cervantes’ Don Quixote tilting at windmills. To be brief, purely by chance, I found one of these young ladies (I might add looking rather glamorous!) at an evening lawn party in Hyderabad. She was perfectly happy, and she really didn’t want to be saved! It turned out that our second former student was then vacationing on the beach in Kerala. So much for my Quixotic quest!

As I was then in India, I decided to visit (then) Madras, (later) Chennai, in order to visit with the distinguished father of my then graduate student (now Professor Vasudevan “Vengu” Lakshminarayanan, U. Waterloo, Ontario, Canada; he holds full professorship in optometry, physics, and electrical engineering!). Vengu had then just completed a brilliant dissertation! His father, the late Professor Vasudevan, was the founding Director of the Institute for Advanced Mathematical Studies (Matlab) located in Chennai. I wanted to describe to him my pride his son’s truly fine research work. While discussing this research with Prof. Vasudevan, and after I lectured at Matlab, he told me of the truly good works of Dr. S.S. Badrinath (“Badri”) at Sankara Nethralaya, and of Badri’s nascent plans to build, in Chennai, a quality optometric institution associated with Sankara Nethralaya. He asked me to meet with them both, and I was pleased to do so. In turn, they asked for my cooperation in the effort to create, and to build, a new school of optometry. I gladly joined in this worthy effort, which was designed to further develop eyecare in India in hopes of reducing the substantial backlog of patient demands for eye and vision care in India.

As I noted above, Optometry, the profession, had developed to a high level in Great Britain, and in former major British Colonies in Canada, South Africa, Australia, New Zealand, the U.S.A., etc. Frankly, I didn’t understand why parallel development of modern optometry had not also occurred in the Indian subcontinent.

A small number of us modified modestly the then Berkeley curriculum to meet the perceived needs of your fine Nation. (I am most pleased that this curriculum has been so widely copied!) I arranged for members of our faculty to teach at the School for extended periods of time during the early years, and I asked them also to act effectively as role models (an important requirement when establishing a new/modern profession!). I sent a large consignment of surplus clinical equipment (accumulated over 50+ years at our School) to help to start the Rural Eye Clinic on the new Sankara Nethralaya Campus located near St. Thomas Mount in Chennai. And, over a number of years, I have been pleased to (and continue to) transfer my personal professional library to the School here in Chennai. The intent has been, and remains, to provide a valuable resource for teaching and research programs at the emergent Elite School of Optometry (and through inter-library loans, to help serve the other emerging colleges of optometry, as well as ophthalmological programs).

Early on, I regularly chaired meetings of the *very impressive* Board of Studies established to guide the new Elite School of Optometry. Since its initial development, I have been active in many programs of this fine School, and I have been most pleased to participate both in its inauguration, and in its recent 20th Anniversary meetings and celebration. I also should mention the very significant contributions made by the very accomplished, but recently deceased, first Principal/Director of the Elite School, Prof.

Govindarajan. He set very high standards for the School and for the profession! His fine successors have been most able as well!

Quite separately, and with encouragement from the National Eye Institute of the National Institutes of Health, I developed a research laboratory at the Aravind Eye Hospital located in Madurai, Tamil Nadu State. Over a period of a number of years, I sought to develop a test of vision which would assess the quality of vision available behind “dense” ocular media opacities. Given the incredible backlog of cases with such opacities, e.g., such as cataracts, corneal leucomas, etc., the demand for surgery far exceeded then existing capability-to-serve the populace by then available ocular surgeons. The questions asked were, “Who should we operate, and which of two eyes should we operate among our patient population?”. Then, in most non-private cases, only one eye could be treated with then available resources.

A simple clinical test was developed based on Vernier acuity techniques, and this interesting test proved to be independent of the age of patients(!), or the density of cataracts or other opacities. Over the years, quite a number of associated research projects were conducted, and accompanying research papers were published. Among the numerous individuals who worked with me on this program was Dr. S. Aravind. I also went into the clinic with Dr. Venkataswamy (Dr. “V”), and, at his request, I demonstrated successfully and rapidly (on quite a sample of patients) a simple version of the test, only requiring two portable hand-held battery-driven flashlights.

On several occasions, Dr. V emphasized to me, the largest group of patients seen in eye camps (ca. 38%) were those either requiring refractions, or simple magnifiers for low vision. Actually, the total number of these patients modestly exceeded the number of those individuals requiring cataract surgery! And the cost of serving these people was far less, and could greatly reduce the visually-impaired population in India. To emphasize this point to me, Dr. V, placed me for some years on the Aravind Eye-Camp Committee. Each week, data were available on eye camp populations sampled, tested and managed. Dr. V was absolutely correct about the proportion of patients requiring only refractive and/or low vision aids.

Dr. V also asked me to teach visual optics and a variety of other topics to classes of students at Aravind (variously to the residents, visiting ophthalmologists, the staff, and to the sisters). Also, I conducted graduation ceremonies for groups in training, etc. When I last saw Dr. V at the fine new Aravind Eye Center in Pondicherry, just shortly before his death, he told me proudly of two new optometry schools he was starting both in Madurai and at their fine new facility on the Coromandel Coast. Earlier, I had arranged for the Aravind group to receive several “rooms” of surplus refracting equipment from our School for the refraction clinic in Madurai.

Also worthy of note, Dr. Namperumalsamy of Aravind Hospital in Madurai, and Dr. S.S. Badrinath, both fine senior retinal surgeons(!), were very proud of having served earlier as students of the late, distinguished, retinal surgeon, Dr. Charles Schepens of Boston. In addition, “Nam” earlier spent a period of time studying low vision care in New York City with the late George Hellman. Other ophthalmologists with interest in this topic have included the Drs. Desai, father (now deceased) and son. I point this out, because *knowledge of low-vision-care and rehabilitation services remains*

in very short supply in India, and must be strengthened as part of an effective program for the visually-impaired of this Nation.

Separately, I maintained a close relationship with the British-trained optometrist, the late, Naval Balliwala (of Balliwala and Hom, Ltd.) of Mumbai. He was one of few individuals in India who consistently championed development of low-vision-care in India. And for years Balliwala organized and headed a succession of small optometry schools in Mumbai; I also arranged for him to receive some of our surplus clinic equipment for use at those institutions. Balliwala also served on the Elite School of Optometry Board of Studies. I was so very pleased, very shortly before his death, to speak with him during the ceremonies celebrating the 20th Anniversary of the Elite School. Similarly, I had an opportunity then to interact with my old friend, Prof. Govindarajan, who has also passed on!

After my original trip to India, and for quite a number of years after that, I also served on the Board of Directors of the U.C. Program for Graduate Professional Studies/Research in India.

And, finally, I had the pleasure of participating in a number of meetings of the All-India Congress of Ophthalmology, where I was invited to present quite a number of research papers over a period of many years. On one of these occasions, I delivered the first lecture on Low Vision Care presented in India (at least that was told to me by a number of individuals).

Our several visits to India have been a very special pleasure for both my wife Becky and me. It is a special honor for me today to have an opportunity to address this very distinguished forum! I have had opportunity to read some of the works of Sri Palkhivala, and I was most impressed by his scholarly contributions (particularly) to the Constitution of India.

An Early Sixteenth Century Optometrist 's Shop: Jacob Cornelisz. van Oostsanen's "Lx Siin Tiid"

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Abstract

In Jacob Cornelisz. van Oostsanen's early Dutch painting (ca.1511-1514), an elderly gentleman hands a pair of spectacles to a young woman within a richly filled interior. Although the painting has acquired various names and is described more generally as a genre piece, no research has considered its specific imagery and the reason for its commission. This article argues that the painting depicts an early sixteenth century eyeglass maker's shop and may even be the earliest known advertisement for such an establishment.

Key words: advertising, Amsterdam, Dutch painting, eyeglasses, genre painting, Jacob Cornelisz. van Oostsanen, optometry, optometrist 's shop.



"Lx siin tiid"

Workshop of Jacob Cornelisz. van Oostsanen

ca.1511-1514

49 x 35 cm

Utrecht, Museum of Catharine's Convent

In a small painting in Utrecht's St. Catharine Convent Museum, an elderly gentleman holds a pair of spectacles—pinch-nez's to be exact—in his left hand and,

with the right, gives a coin to a young woman. Before the woman, on the viewer's left, sits a small box containing similar glasses from which she lifts another pair. Behind and between the two, another man and woman appear, their genders, ages, and physical locations reversed. In this case, a young man, on the left, grabs coins from a pot held by an older woman as this second couple kisses. These two transactions, contrasting and yet complementary, take place within an interior cramped full of objects and activities.

To the untrained twenty-first century observer, the painting is no doubt mysterious in ways it would not have been to its intended sixteenth century audience. For that audience, the people, the objects, and their interactions in Jacob Cornelisz. van Oostanen's early sixteenth painting (ca.1511-1514) would be familiar. These elements, moreover, identify the painting as a transitional one; it is at once a product of the mystical medieval world in Northern Europe preceding its creation and of the developing commercial world in Northern Europe which followed, reaching its apex, some say, in seventeenth century Holland's Golden Age.

The painting's complexities aside, one thing about it seems clear, even to the contemporary viewer—it has something to do with the transactions that figure so prominently in it. With these exchanges in mind, it has been called *The Spectacle Seller* (Carroll¹), *A Scene in a Brothel* (Steinbart²), and "*Lx siin tiid*" ("each to his time," see below; Utrecht, Museum of Catharine's Convent), and described more generally as a genre piece. But, no research has considered the painting's specific imagery and the reason for its commission. After undertaking such tasks, I suggest that the eyeglasses are not only the centerpiece around which Jacob Cornelisz.'s painting resolves but also the purpose which occasioned its creation. In what follows, I argue that the painting depicts an early sixteenth century eyeglass maker's shop and may even be the earliest known advertisement for such an establishment. To link the painting and these possibilities, I turn first to the histories of optometry, advertising, and artistic representation of them in the early sixteenth century and then to Jacob Cornelisz. and his art.

Optometry and Advertising in the Early Sixteenth Century

Although optometry was not officially recognized as a profession until the nineteenth century, it existed *de facto* long before that; humans have studied glass, optics, and refraction for millennia and, with this, attempted to harness these capacities and materials to improve vision.^{3,4} Eyeglasses *per se* are thought to have been invented just before 1300 perhaps by a cleric, a workingman, or a scientist.^a With the invention of the printing press (1441), the availability of reading materials increased and, with this, the demand for glasses.⁵ At the time of Jacob Cornelisz.'s painting, then, glasses would have been available for several centuries, and increasingly so for citizens on The Netherlands whose desire for them was supported by greater commercial opportunities and abilities to produce, disseminate, and buy them (see Gregg,⁶ for example).

The earliest known representation of glasses appears in a painting by Tommaso da Modena, a *Portrait of Hugh of St. Cher*, painted sometime between 1352 and 1360

(Rosen,⁷ p. 205; Rome, Ministry of Education). Shortly thereafter, glasses became a standard attribute of individuals in portraits, indicating perhaps that the wearer was modern, learned, and fairly wealthy. In another example, Jan Van Eyck's *The Van Der Paele Madonna* of 1436, the subject, Canon van der Paele, holds a pair of spectacles much like those in the Jacob Cornelisz. painting (Bruges, Musée Communal des Beaux-Arts).

As optometry achieved professional recognition in the nineteenth century, so too did advertising attain such professional status in the time period, due in large part to the role of newspapers in disseminating information.⁸ Still, humans have long attempted to sell their wares. Evidence of advertisements exists in Babylonia and ancient Greece and Rome.⁹ Although these ads consist of inscriptions, the majority of early advertising was oral, carried out by means of town criers.¹⁰

In addition to town criers, medieval craftsmen advertised in graphic media but not in terms familiar today. In the collective spirit of those times, commissions for goods took place under the auspices of guilds. And, in the religious spirit of the times, each guild had a patron saint who sanctioned and protected its members and their wares, St. Luke for the painters' guild, for instance (see below, 6th page of this paper). Thus, the windows of Chartres Cathedral represent 42 guilds (including bakers bankers, blacksmiths, coopers, and carpenters, etc.), each of which is a token of the guild's sponsorship of the cathedral.¹¹ (see 4th page of this paper below). Advertising in this way acknowledged the authority of God, the ultimate creator (cf. 4th page of this paper), but also implicitly acknowledged the craftsmen and the product without inappropriate hubris (cf. below on artist's and signing works). A guild with such blessing was presumably a worthy one.

As cities grew, advertising continued to be handled by guilds but in less explicitly religious forms. Notable, then, is Pieter Aertsen's 1551 *Meat Stall* (Raleigh, North Carolina Museum of Art), which was commissioned by the Antwerp butcher's guild and located in its hall (Craig¹² and see below, 6th page of this paper). The majority of the work details the meats hanging in the butcher's stall. In contrast, the religious element, the "Flight into Egypt," is inverted; that is, it is a tiny background scene which is almost indistinguishable as that or any religious event. Thus, Aertsen's "inverted still-lives" are not only important as evidence of advertising but are also considered the turning point in the development of genre painting.¹³ By the mid sixteenth century, then, advertising did not require overt religious sanction although it was far from the more widely disseminated, product-oriented forms of advertising which developed subsequently.

Jacob Cornelisz. Van Oostanen and Early Art in Amsterdam

Although not much is known about Jacob Cornelisz. van Oostanen, the style of his art and the words of his early seventeenth century biographer, Carel Van Mander (1604),¹⁴ place him in Amsterdam at the beginning of the sixteenth century. As such, Jacob Cornelisz. has been called the city's first artist.¹⁵ Even if that moniker is not strictly correct, his oeuvre represents what art in that Northern European city was like at

a time when the Church-bound medieval world was giving way to secular cities with various classes of citizen, including the new middle-class.^{16,17}

According to Van Mander, the artist was born in Oostsanen, in the vicinity of modern-day Haarlem and Amsterdam, around 1472.¹⁸ Nothing is known of the route Jacob Cornelisz. took to Amsterdam nor of the training he received prior to his arrival. But, as Van Mander again tells us, the artist owned a house in Amsterdam in 1500, ran a successful workshop in the city, and died there in 1533. The existing artistic evidence associated with Jacob Cornelisz. speaks to the character and range of his production. His extant works belong to various media: oil painting, woodcut, church vault paintings, drawing, and embroidery for clerical robes. Across these media, he primarily depicts traditional *New Testament* scenes along with some *Old Testament* fare, some portraits, and some unusual scenes such as the painting in Utrecht.^b Such subjects reflect the taste of his patrons, still by and large grounded in a Church-based world, while the range of media speaks to the different artistic patrons and possibilities for them in that growing commercial environment (see below).^c

Significantly, Jacob Cornelisz. did not sign and date all of his works, nor did he sign and date them consistently; some works are dated but bear no signature and some bear the signature without a date. These practices are in keeping with the transitional environment in which the artist worked and with the spirit of advertising at this time mentioned above. In previous centuries, artists did not sign their works, at least not as marks of creativity because, from a medieval standpoint, only God created. Artists, therefore, were considered craftsmen, and simply adorned the objects they made with marks of their associated guild and/or its patron saint, these, as indicated, to offer protection for the guild members and sanction for their products.^d

In cities governed by secular authorities, artists could increasingly take credit for their art as creative works and, on that reputation, sell them (see Faries,¹⁹ pp.2 ff). Thus, Jacob Cornelisz.'s signature marked works that he designed and executed himself, making them more expensive and valuable. The unsigned works, often in media other than oil, were from his workshop or copies of them; being generally of less expensive material, less original design, and a less skilled hand, they were also more affordable. These workshop practices enabled Jacob Cornelisz. to serve the needs of a community with citizens, individual and municipal, of various incomes and needs.

The signed and/or dated works also provide a framework for identifying Jacob Cornelisz.'s handiwork and determining a chronology and characterization of it.^e Although the artist signed only five paintings of the 27 attributed to him, and these from the end of his career, he created more than 200 woodcuts, many of them belonging to signed and dated series.^f His first signed and dated work is a series of woodcuts from 1507, *the Life of the Virgin* (Amsterdam, Rijksmuseum) and his last, a *Self-Portrait* from 1533 (Amsterdam, Rijksmuseum). These circumstances suggest that he began his career as a woodcutter (see Meuwissen,²⁰ p. 65ff.).

All variations aside, his works exhibit the following stylistic elements, all of which are said to reflect his efforts in illustration (Meuwissen,²⁰ pp. 60 ff): heart-shaped heads with large foreheads and small chins, foreshortened bodies and perspective, intricate details, and black contouring.⁹ Works baring these characteristics but have signature and are unevenly executed are attributed Jacob Cornelisz.' workshop. Within these works, a stylistic development is evident.^h His early works are more medieval in their use of symbolic imagery and greater detail, and his later works more concerned with accurate representation of perspective and the human form; that is, they show the influence of Italian Renaissance art which had discovered its early Roman heritage and brought back to the North by Jacob Cornelisz.'s student, Jan Van Scorel, the first Dutch artist to study in Italy.²¹

The painting in Utrecht is a workshop piece because it is unsigned and its execution flat, uneven, and less crisp than those by the master's hand. The piece is dated between 1511 and 1514 because of stylistic and compositional similarities to signed and/or dated works in Jacob Cornelisz.'s oeuvre from around that time (cf. a *Nativity* dated 1512 ; Naples, Capodimonte Museum). Nonetheless, the style appears to be the master's, evident in the characteristic shapes, details, and perspective. A lost version of the same painting, known through a photograph, suggests both that the piece had a certain amount of popularity and that they are copies of a lost original by the artist himself.^{22, i}

The Utrecht work is also typical of Dutch art at the time in its use of symbolic objects to offer a moralizing message. This message is encapsulated in a phrase on the balcony at the back of the room, "Lx Siin Tiid" or "each to his time." Of Biblical origins, the proverb indicates that a time and place exists for each person and each activity.^j As such, the painting depicts two pairs of individuals, these of contrasting ages, arrangement, and genders, each pair involved in a different activity. In the most prominent pair, the old man hands the younger woman a coin as part of an exchange for a commodity, glasses; complementing this, the younger man grabs coins from a pot in exchange for another kind of transaction with the older women, presumably a prostitute. Thus, two kinds of knowledge and activity are contrasted.

Within the painting, the meaning of each exchange is suggested and reinforced by symbolic objects. On the right in the back, a young luter and woman "consort" as an older man looks on, music being a symbol of intimate relations.^{23, k} In the center, over the fireplace, a fool with his cap and staff reflects on the young man and older woman's exchange; associated in Renaissance imagery with love, folly, and youth,²⁴ this less than virtuous being warns the couple of the folly of their actions. Thus, the kissing couple represents a certain kind of knowledge, intimate knowledge, which has a time and place but is often a foolhardy pursuit.

The contrasting transaction focuses on a different kind knowledge, one symbolized by eyeglasses and, thus, vision. Sight has a longstanding association with light, and, therefore, with enlightenment, that is, with cognitive and conceptual knowledge. From this well-known perspective, vision facilitates insight, and insight

leads to proper actions at the proper time. For some people, however, acquiring such vision requires glasses.

Sight and its enhancement are symbolized by other objects in the room. To the left and complementing the amorous activities on the right, the room is tightly packed with objects; many are accoutrements of a sixteenth century apothecary and/or optometrist, such as the weights for measuring materials, the vessels for grinding lenses, and the fireplace for making and shaping glasses; the mirrors and beads are other products made in the shop. All this leads to a window in the back, the shop looks out on a street, offering a view of the world for those who have to vision to see it.

Typically, the early sixteenth century painting presents a moral lesson which contrasts good and bad behavior. The viewer is warned that humans must choose between nearsighted folly or clearer vision, the latter often enabled by eyeglasses. In contrast to earlier portraits which included glasses, those in Jacob Cornelisz.'s painting are not an attribute of an individual, but, I would suggest, the subject of the painting.

Although the non-biblical subject is unusual for Jacob Cornelisz., it belongs within the tradition of genre pieces and within this to a type associated with guilds (and hence advertising) called the "occupational portrait."²⁵ As a snapshot into a shop or room, this type of genre painting has precedents in more overtly religious painting involving transactions. Petrus Christus' 1449 *St. Eligius as a Goldsmith* (the Lehman Collection, New York) takes place in a room where a goldsmith sells gold rings to a couple.²⁵ The goldsmith is represented appropriately by that profession's patron saint, St. Eligius. Similarly, Rogier van der Weyden includes St. Luke, the patron saint of artists, in *St. Luke Portraying the Virgin* from c.1435-40 (Boston, Museum of Fine Arts).¹ His inclusion was appropriate since, as documentation confirms, the work was "presented to the Guild of Saint Luke for their chapel."²⁶ By the beginning of the sixteenth century, occupational genre pieces without overt religious symbols emerge. Thus, Quinten Metsys' *Banker and his Wife* (1514; Louvre, Paris) shows an exchange that recalls Christus's work without the saint.^m And as indicated, Aertsen's seemingly secular 1551 *Meat Stall* was commissioned for the butchers' guild and hung there with no explicit reference to religious matters.

Jacob Cornelisz.'s genre piece not only focuses on vision and appropriate actions but also on the ways in which vision can be enhanced, this within a shop containing tools of the optometrist's trade. Given the conventions of the time and comparable art works, it is likely an occupational portrait. Given its content, the painting would be most fitting for an optometrist's shop in early sixteenth century Amsterdam. Conversely, its subject would be inappropriate for liturgical purposes in a public religious site and unusual for a home.

Conclusions

It is unlikely that any document will be found that will definitively link Jacob Cornelisz's painting with an optometrist's shop. Nonetheless, the evidence suggests that the painting was designed for such a location. Understood this way, the Utrecht

painting shows us what the interior of an early sixteenth century optometrist's shop was like and, in so doing, indicates that regular people were familiar with, bought, and used glasses at this time. The representation also suggests something about how eyeglasses were conceptualized in that environment. Still a new technology, eyeglasses were the product of a world in transition from the so-called dark ages to times presumably more enlightened; such enlightenment could be facilitated by extending the reach of the written word and the ability of any individual to read it. By opening up the possibilities inherent in improved vision, the painting opens our eyes to the fact that literacy, art, and technology always develop together rather than in isolation and that seeing has always been a window to the human soul.

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Notes

a. See Gregg²⁷ for a complete history of optometry. In 1286, Roger Bacon discusses the convex lens in his text on magnification, *Opus Majus*. In the West, spectacles probably originated in the late 13th century in Italy (see Rosen⁷). In a manuscript from 1305 AD, a monk from Pisa named Rivalto wrote, "It is not yet 20 years since there was discovered the art of making eyeglasses: (cited in Gregg,²⁷ p. 46). Spectacles were probably invented in China around the same time (Gregg,²⁷ p. 50). The oldest extant glasses, pince-nezs, were found in Weinhausen Convent in Germany whose founding dated to 1221 (see Gregg,²⁷ p. 55; cf. Rosen,⁷ pp. 206 ff. on glasses in Germany in the fourteenth century).

b. More specifically, his works include *Nativity*, a *Lamentation*, *Salome*, *Christ in the Garden of Gethsemane*, *Virgin and Child*, and several *Crucifixions* and the works listed in note f. For a complete list of his oeuvre see Carroll.¹

c. Of note, too Jacob Cornelisz.:

-was the the first Dutch painter to paint a harbor scene (background of the *Nativity*, Naples' Capodimonte Museum).

-was one of the first Dutch painters, like Albrecht Durer, to paint from drawings made as guild on his canvas.

-likely painted the first Dutch "trompe l'oeil" painting, evident in the paper on which he signs and dates his painting *Saul and the Witch of Endor* (1533, Rijksmuseum, Amsterdam).

-was the first Dutch painter to make an independent self-portrait (1533, Amsterdam).²⁸

d. The independent portrait and the self-portrait especially are considered signs of increasing secularization in both cases and emerging artistic independence in the case of self-portraits. Jan Van Eyck signed what is thought to be a self portrait in 1433 in the National Gallery, London; Durer painted many self-portraits, for example in 1498 in the Prado, Madrid.

e. See Faries¹⁹ (pp. 1-5) on Dutch artists, including Jacob Cornelisz., at this time and Meuwissen²⁰ on Jacob Cornelisz. Issues of attribution and chronology are understandably difficult but have been helped by recent infrared reflectography and knowledge of workshop practices. For complete discussions and catalogues of Jacob Cornelisz's art, see Carroll,¹ Friedlander,²⁹ Hoogewerff,³⁰ and Steinbart.²

f. These five include: *Triptych* (ca. 1515, State Museum, Berlin); *All Saints* (1523; City Museum, Kassel); *Salome with the Head of St. John the Baptist* (1524 Rijksmuseum, Amsterdam).

g. This characterization of his style avoids critical evaluation. Friedlander,²⁹ for example, is not very impressed by Jacob Cornelisz.'s talents.

h. Today, dating and chronologies are made with the help of infrared reflectography. It reveals preparatory under drawings beneath the visible surface of a painting. If the painting is not dated, then, its under drawings can be compared with dated works. (See Faries¹⁹ and Meuwissen²⁰).

i. The painting was formerly in Groningen, The Netherlands, Groninger Museum, Inv. No. NK 2495, on loan from Dienst voor's Verspreide Kunstwerken, The Hague.

j. The proverb reads "Elk Zijn Tijd" in modern Dutch. The phrase is found four times in the *Bible*. The closest to the proverb in the Utrecht painting appears in *Ecclesiastes* 3:1. Variations appear in *Ecclesiastes* 8:6, the *Book of Proverbs* 15:23, and in the New Testament's "Letter from St. Paul to the Ephesians" 5:16.

k. A contemporary example is Quinten Metsys *Ill-Matched Lovers* (c. 1515 Washington, D.C., National Gallery of Art).

l. Luke "was likened unto a Christian Apelles, and thus was the natural patron saint for the artists' guild" (Snyder²⁶).

m. According to Carroll,²² "genre first became popular in Northern late Medieval prints. In works such as Israel van Meckenem's *Scenes of Daily Life*, ca. 1495, the religious and portrait connotations were almost totally eliminated, Washington, D.C., National Gallery of Art, and in Lucas van Leyden's 1508 *Chessplayers* (Berlin, Berlin-Dahlem Museum) they are gone.

William Molyneux and the Optometry Content of his 1692 Book *Dioptrica Nova*

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Abstract

*This paper provides an overview of the life of William Molyneux (1656-1698) and his book *Dioptrica Nova*, published in 1692. The first part of that book examines the geometrical optics of lenses, the eye, telescopes, and microscopes. The second part consists of commentaries on various topics, including spectacles, telescopes, and physiological diplopia.*

Key words: history of optics, history of optometry, Irish physicists, optometry books.

Tidbits of optometric wisdom can be found in various unexpected places. One such place is the book *Dioptrica Nova* published by the Irish physicist William Molyneux in 1692. Molyneux was born in Dublin on April 17, 1656 to a wealthy land-owning family.¹ He entered Trinity College Dublin in 1671 at the age of fifteen and received the bachelor's degree in 1675. He then studied law in London from 1675 to 1678. Molyneux later observed that "my inclination to the Study of the law was not so strong as to make me master of the profession."² After studying law in England, Molyneux returned to Ireland. He later received honorary M.A. (1692) and L.L.D. (1693) degrees.³

Molyneux was wealthy enough that he did not have to work to earn a living. He held various commissions, including Surveyor General of the King's Buildings and Works in Ireland from 1684 to 1688 and from 1690 to about 1698. It appears that Molyneux occupied much of his time with scientific studies, which he viewed as a way of showing "That God is the Fountain and Original of Truth."² In 1680, Molyneux published a translation of Descartes' *Six Metaphysical Meditations* and wrote a preface to the translation. He also translated some of Galileo's work from the Italian but did not publish it.

Molyneux's wife Lucy went blind in January of 1679, a few months after their marriage in September of 1678. She had a severe illness in November of 1678, which was followed by declining vision, severe headaches, and dizziness. By January she could only perceive light. They sought care for her in England in 1679 and 1680 from a number of leading physicians, but could find no one to improve her vision.⁴ Lucy's eyes did not seem to be affected, and Molyneux perhaps correctly deduced that the vision loss was due to a disease of the brain. It is said that she accepted her difficulties with patience, diverting "herself with music and handwork, in which she developed remarkable dexterity."⁴ Lucy died in 1691, perhaps due to the strain of the life-threatening illness of their son Samuel, the only one of their three children to survive into adulthood.⁵

Molyneux's concern over Lucy's vision problem may have led him to pose the question that has since come to be known as the Molyneux problem. This question was posed in a letter to his good friend John Locke. Molyneux asked about a man that was born blind but learned to be able to tell between a sphere and a cube by touch. If that person had his vision restored, would he be able to immediately distinguish between the sphere and the cube by sight without touching them? The Molyneux problem has drawn the attention of numerous leading philosophers over the years.⁶

In the early 1680s, Molyneux undertook studies in mathematics, optics, and astronomy. In his study of optics, he was assisted by correspondence with John Flamsteed, Astronomer Royal, and Edmond Halley. In a 1682 letter to Flamsteed, Molyneux said that he was "much enamoured with optics, for in them there is such a mixture of physics and mathematics that renders this subject very pleasing."⁷

In 1683, Molyneux founded the Dublin Philosophical Society. His first presentation to the society in October, 1683, was on the moon illusion.⁸ Over the first three years of the society's existence, he read 25 papers covering a wide variety of topics.² In 1685, Molyneux was elected to fellowship in the Royal Society. Also in 1685, Molyneux published a book entitled *Sciothericum Telescopicum*, in which he described a telescopic dial he had designed.

Molyneux was hindered somewhat in his studies by lack of equipment in Ireland. He was also forced to flee Ireland with his family to Chester, England, in 1689 due to the oppression of King James II. King William defeated King James II in 1690, allowing Molyneux and other Irish refugees to return to Ireland.

Molyneux's most famous scientific work was the book *Dioptrica Nova*.⁹ He told his brother that his goal in writing the book was to improve on previous books on the subject, making "that useful part of mathematics more complete and plain."¹⁰ He may have completed the manuscript in 1690, because his dedication to the Royal Society was dated April 17, 1690. He consulted Edmond Halley on the content of the book. Halley added an appendix and guided the book through the publication process. The title page is dated 1692. *Dioptrica Nova* consists of two parts.

The first part is essentially a geometrical optics textbook, and contains numerous detailed ray diagrams. It covers the optics of planoconvex lenses, planoconcave lenses, meniscus lenses, the eye, eye/lens combinations, telescopes, and microscopes. A total of 184 pages in length, the first part is organized around 59 propositions. Many of the propositions build upon preceding propositions.

Proposition 28 deals with the optics of the eye. Molyneux recognized that the eye changes in order to view objects at different distances, but he didn't take a stand on the mechanism. He wrote: "'Tis therefore contrived by the Most Wise and Omnipotent Framer of the Eye, That it should have a Power of adapting itself in some Measure to Nigh and Distant Objects. For they require different Conformations of the Eye; Because

the Rays proceeding from the Luminous Points of Nigh Objects do more Diverge, than those from more Remote Objects.

“But whether this variety of Conformation consist in the Crystallines approaching nigher to, or removing farther from the Retina; Or in the Crystallines assuming a different Convexity, sometimes greater, sometimes less, according as is requisite, I leave to the scrutiny of others, and particularly of the curious Anatomist.” (page 104)

Molyneux drew an optical diagram showing the inversion of the retinal image. He did not view this as contrary to one’s observation of the world, “For ‘tis not properly the Eye that sees, it is only the Organ or Instrument, ‘tis the Soul that sees by means of the Eye.” (page 105)

Molyneux also described how the point of best focus in a myopic eye is a point in front of the retina. He suggested that the cause of myopia was a crystalline lens which was “too convex.” (page 108) He observed that myopes can see near objects clearly without lenses, but they need concave lenses to see distant objects clearly.

With regard to presbyopia, Molyneux said that “the Eyes of Old Men have their Crystalline too Flat and cannot correct the Divergence of the Rays...’tis requisite they add the Adventitious Convexity of a Glass...Spectacles help Old Men, not by magnifying an Object, but by making its Appearance Distinct...”. (page 108) Molyneux included a ray diagram showing the point of focus for a near object in presbyopia to be behind the retina.

“The Second Part Containing Various Dioptrick Miscellanies” extends over pages 185 to 301 and consists of eight chapters, the eighth chapter being Halley’s appendix. Chapter 1 discusses the nature of refraction and light. Chapter 2 explains why four convex lenses in a telescope can result in an erect image.

Chapter 3 is entitled “Of Glasses for defective Eyes.” In the first paragraph of chapter 3 he extols the virtues of spectacles: “Were there no farther Use of Dioptricks than the Invention of Spectacles for the Help of defective Eyes; whether they be those of old Men, or those of pur-blind [myopic] Men; I should think the Advantage that Mankind receives thereby, inferiour to no other Benefit whatsoever, not absolutely requisite to the support of Life. For as the Sight is the most noble and extensive of all our Senses; as we make the most frequent and constant use of our Eyes in all the actions and concerns of human Life; surely that Instrument that relieves the Eyes when decay’d, and supplies their Defects, rendring them useful, when otherwise almost useless, must needs, of all others, be esteemed of the greatest Advantage. In what a miserable condition do we count those, in whom it hath pleased the great Contriver of the Eyes and Sight, to shut those two little Windows of the Soul? And we may imagine, that they, in whom these Lights are but partly obscured, so in some measure partake of the Misery of the blind. How melancholy is the condition of him, who only enjoys the Sight of what is immediately about him? With what Disadvantage is he engaged in most of the Concerns of human Life? Reading is to him troublesome, War more than

ordinary dangerous, Trade and Commerce toilsome and unpleasant. And so likewise, on the other hand; How forlorn would the latter part of most Mens Lives prove, unless Spectacles were at hand to help our Eyes, and a little form'd piece of Glass supply'd the Decays of Nature? The curious Mechanick, engaged in any minute Works, could no longer follow his Trade than till the 50th. or 60th. Year of his Age: The Scholar no longer converse with his Books, or with an absent Friend in a Letter. All after would be melancholy Idleness, or he must content himself to use an other Man's Eyes for every Line. Thus forlorn was the State of most old Men, and many young, before this admirable Invention; which, on this very account, can never be prized too highly." (pages 207-208)

In chapter 3, Molyneux also discussed rules for choosing spectacles. For presbyopia, he advised the least plus power "that will possibly help our Eyes." (page 209) He then gave an example. If one can read moderate print at about two feet, and you want to read moderate print at about one foot, you need glasses that reduce the divergence of light from the object at one foot such that it would be as if the light was coming from an object at two feet. For myopia, he noted that the focal length of the correcting lens should be equal to the distance to the person's far point of clear vision.

Molyneux also commented in chapter 3 on Robert Hooke's idea of using a convex lens to correct myopia. We know, as did Molyneux, that any lens so placed as to have its second focal point coincident with the punctum remotum will produce a clear image. Molyneux noted that using a convex lens in that way for myopia would result in objects being seen upside down and backwards, and that the lens would have to be held so far away as to be impractical. The last section of chapter discusses how the design of telescopes and microscopes could be modified to correct myopia and presbyopia.

Chapter 4 of the second part of *Dioptrica Nova* is named "Of Mechanick Dioptricks." In that chapter, Molyneux listed authors that described grinding of lenses and discussed methods of evaluating lenses and of finding focal lengths and centers of lenses. Chapter 5 covers various topics related to telescopes. Chapter 6 includes comments on the history of lenses and telescopes and the discoveries made with telescopes.

Chapter 7 is entitled "An Optick Problem of Double Vision." It includes a careful description of physiological diplopia. Molyneux suggested that "we see with both Eyes at once," (pages 293-294) and he recognized the importance of binocular vision when he said "that which is commonly known and practiced in all Tennis-Courts, that the best Player in the World Hoodwinking one Eye shall be beaten by the greatest Bungler that ever handled a racket; unless he be used to the Trick, and then by Custom he gets an Habit of using one Eye only." (page 294)

After 1690, Molyneux became involved in Irish politics and economics, and was an important figure in the new Dublin government after the defeat of James.¹ In the year of Molyneux's death, his last, and overall best known, book, *The Case of Ireland's*

being Bound by Acts of Parliament in England, Stated, was published. He argued that the English Parliament should legislate for Ireland only if there were Irish members in Parliament.² It is thought that the expression “No taxation without representation” was first stated in this book.¹ Molyneux’s book was used in the efforts of the American colonists in the Revolutionary War. Thomas Jefferson and James Madison had copies of the book in their libraries, and Benjamin Franklin and Samuel Adams referred to it in correspondence.¹¹ Molyneux died in 1689 of a long-standing kidney ailment.

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A Little Personal Optometric History

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Editor's Note: *This article by Dr. Kahn had its origin in an email sent to Irving Bennett and which was then forwarded to the Editor. Additional emails to the Editor added more information to make this article possible. The original email to Irving Bennett spurred other email communications concerning licensure and the O.D. degree. Excerpts from those emails are recorded elsewhere in this issue of Hindsight.*

I had absolutely no idea of what I wanted to be or do after my high school education. I did know that a secondary education was important to succeed. On my mother's side of the family there were several uncles in the dental profession. On my father's side, all the men were in some kind of manufacturing business and most of the women were teachers. None of those occupations seemed appetizing to me. My older sister (by six years) wore glasses and after talking to her optometrist I thought that would be great way to make a living.

Academically I was not that great. I did apply at Columbia University's optometry school and was told that I would be admitted the following year. I didn't want to waste a year so I applied to Pennsylvania State College of Optometry (PSCO) and was accepted. I entered PSCO (later to be known as Pennsylvania College of Optometry, PCO) in September, 1941, only to learn that the school was not recognized in New York State. I loved the school, the students, the curriculum, and Philadelphia. I just thought that my days as a New York State resident were over.

World War II had just started and, unfortunately for me, my draft board number meant that I would be in the service very soon. There was always the possibility that I would not be taken, because I was asthmatic, but they took me anyway. After two years of service, my asthma flared up, and I received a medical discharge toward the end of September, 1944. A week after my discharge, I returned to school and graduated on November 26, 1946. I immediately took the Pennsylvania and New Jersey Boards, not knowing where I would get a job or set up a practice.

When I went back to Newburgh, New York to see my parents late in 1946, my sister's husband, who was a local attorney, invited me to a Christmas party. The party was given by state Senator Thomas Desmond. At this Christmas party, Senator Desmond asked me when I would be opening my office in Newburgh. I had to tell him at that time that the optometry college I went to was not recognized in New York State.

The Senator was quite upset. He asked how it was possible that New York State did not recognize a college that was recognized in all the other 47 states. He invited me

to Albany where he took me over to the State Education Department. We saw Dr. Irwin Conroe who was the Commissioner of professional education. I returned to Newburgh and a few days later I received a call from Dr. Conroe, who said that they had found a loophole in the law and that I would be able to take the state boards. He also asked me if I knew others that were in the same position as me. I gave him some names, and later we were told a special state board exam would be given. We took the state boards at Columbia University in the spring of 1947. Within a week I was told that I'd passed and that my license was in the mail. I immediately picked a location, purchased equipment, and was head over heels in debt. Immediately after that, New York State recognized most of the other colleges of optometry.

The loophole in the law was an old law that was on the books since World War I. The law simply stated that honorably discharged veterans of the War would be permitted to take the state boards in their field of study regardless of what school they attended. In 1947, the law was still on the books. They never figured there would be another world war. It took a sharp aide of Senator Desmond to uncover this law.

Shortly after starting practice, I experienced another problem. Up until that time, most optometrists in New York State did not have the O.D. degree. Many of them had B.S. degrees in optics. Soon after I opened my office, the state inspector came around and said that I had to change the signs and eliminate the title "Dr.". The practicing optometrists and ophthalmologists were upset because a few of us who had earned an O.D. degree used the title "Doctor". Thanks to Ashley King of the New York State Optometric Society we gained permission to use the title Doctor. Those who wanted to be called doctor were told that they would have to go back and take postgraduate courses to receive an O.D. degree. Both Pennsylvania and New England Colleges of Optometry offered such postgraduate courses.

When I started my practice the scope of optometry was primarily to check the health of the eye and do a refraction to determine any visual insufficiency. After a few years, contact lenses became an important part of vision care. I took the Pennsylvania optometry school's postgraduate course in fitting of contact lenses. Contact lens fitting became an important part of my practice. I also had many school children as patients and visual training became an important service in my practice. For some time I attended the Wednesday morning postgraduate course at the State University of New York College of Optometry.

As my practice grew, I knew I would need additional help. I was looking for a young associate. I became very discouraged after interviewing many young people. It seemed that they were primarily interested in salary, benefits, vacation time, and how long they would have to work before they became part of the practice. At that time, I was president of our local Hudson Valley Optometric Society. I received a call from Dr. Ashley King telling me that they just hired a recent graduate to travel across the state and do a legislative survey. I offered my home to this young man while working in the area. I liked him and told him to keep in touch with me and that when he finished the

survey I would hire him. That young man, Joel Coplan, a 1970 PCO graduate, soon became my junior partner. This past year he retired, making me feel old!

One day a well-established ethical practitioner friend passed away. His son had graduated from optometry school and was in military service. He became the sole financial supporter of the family. It was important to save the practice. He was able to get released immediately. However, he had never taken the New York State boards and had no license to practice. Fortunately, we were able to convince the State Board that they could offer a special exam because they previously done so in the spring of 1947.

I sincerely hope that this information is of interest to *Hindsight* readers. I enjoyed and received much satisfaction during my active years in optometry. Unfortunately, because of my health, I had to retire much sooner than I had planned.

Communications Concerning the O.D. Degree and Licensure

Editor's Note: *Private optometry schools started offering the O.D. degree before the state university optometry schools. In 1948, according to Hofstetter's book, Optometry: Professional, Economic, and Legal Aspects, four of the nine nationally accredited optometry schools granted the O.D. degree, those being Pacific University, Pennsylvania State College of Optometry, Northern Illinois College of Optometry, and Southern College of Optometry. Los Angeles School of Optometry awarded a doctor degree after a year of graduate work beyond the bachelor degree in optometry. Pennsylvania State College of Optometry granted the O.D. degree starting with its first graduating class in 1923. Massachusetts College of Optometry conferred its first O.D. degree in 1953. Columbia University, which closed its optometry school in 1954, never offered an O.D. degree program. The desire of optometrists to advance the Columbia curriculum to provide for the O.D. degree was, in fact, one of the reasons for its closure. Ohio State University and Indiana University graduated their first O.D. classes in 1968 and University of California Berkeley in 1970. All American optometry schools founded after 1970 granted the O.D. degree from their beginnings. The change in optometry curricula from five years (total pre-optometry studies plus optometry school) to six years in the 1960s made it possible for the optometry schools at state universities to gain approval from the university administrative boards for a doctorate degree. In the years when not all optometry schools granted the O.D. degree, some schools offered an educational program for optometry graduates without O.D. degrees so that they could obtain an O.D. OHS member Irving Bennett shared an email from Lester Kahn with some of his colleagues (that email from Kahn has been incorporated into the article by him on previous pages of this issue of Hindsight). Irving Bennett shared two subsequent emails he received with the Editor of Hindsight. Those emails and a third one are excerpted here with the permission of their authors. They illuminate an interesting chapter in the history of optometry.*

The following is from an email sent from John D. Robinson to Irving Bennett dated January 27, 2008. Robinson has served as a member of the North Carolina Board of Optometry for a number of years. He is also active in the Association of Regulatory Boards in Optometry.

I recall New York optometrists coming to Pennsylvania State College of optometry (PSCO) on weekends in the 1950s seeking an O.D. degree so that they could present themselves to the public as "Doctor". Many optometrists at that time were graduates of Columbia where they received a bachelor's degree.

Another piece of history that you may be aware of is that in the late 1950s and into the 1960s, the North Carolina Board of Optometry notified the schools and colleges of optometry that future applicants to take the North Carolina boards would have to have graduated with an O.D. degree. The only practitioner we had at the time who did

not have an O.D. degree was Glenn Fry's younger brother, Jim Fry. The fact that he referred to himself and his practice of optometry as "Doctor Fry" was overlooked by the board and his fellow practitioners. However, for a number of years in the late 1950s and early 1960s, there were no Ohio State graduates taking the North Carolina board because they lacked the O.D. degree.

When we passed our therapeutic law in 1977, there were significant numbers of Ohio State graduates applying to take our examination. They were among the "best and brightest" graduates looking to practice in a state where, at the time, there had been such a dramatic change in the scope of optometric practice. The Ohio State graduates were consistently among the highest scorers on our examinations into the late 1980s, when their numbers began to decrease as additional states, including Ohio, gained therapeutic privileges.

Another example of "pushing the envelope" by the North Carolina Board during this period was mandating that applicants would have to be graduates of a six-year curriculum. We were told by officials at the Illinois College of Optometry (ICO) that they would not be able to meet such a requirement. However, they did make the change within the time frame and no ICO graduate was ever denied application for licensure in North Carolina.

The following is from an email sent to Irving Bennett on January 28, 2008, by Bud Lilly, who had been Bennett's partner in optometry practice.

I started my college education in 1963 at Indiana University in Bloomington with the full intent of completing my optometric education there. Within the first year, my curriculum counselor (it may have been Merrill Allen) mentioned to me that graduates of Indiana University's optometry school were not eligible to take the Pennsylvania state board exam. I did not know that prior to entering school.

He knew that I wanted to return to Pennsylvania to practice and indicated that the law, regulation, or policy would likely not hold up in court. He urged me to stay at Indiana University and become the "test case" to force such a change. As a young fellow with a strong desire to return home to practice, I did not want to take the chance. I applied to Pennsylvania College of Optometry (PCO) and was offered a four year full tuition scholarship. That sealed the deal. I completed two years of undergraduate studies in pre-med at Indiana University and entered PCO in the fall of 1965.

Having read the emails from Irving Bennett, Jay Enoch offered the following in an email to the Editor on January 28, 2008.

I was a Columbia University graduate in optometry with a B.S. in 1950. Thus, I did not receive an O.D. degree, although I have my full share of doctorates, both earned and honorary!

When I came to Berkeley as Dean, as is appropriate, I sought licensure in California. I then learned that without an O.D., technically I could not apply! Within days of our arrival there was a banner headline in the Los Angeles Times on their first page (!). It went something like, "New Dean at Berkeley Optometry School Does Not Qualify for Licensure in California!" Appended was a very large picture of me in long white clinic coat, grimacing as if in pain! A rather mocking story followed; what a welcome! Where-ever did they get that picture?

To save space, the California Optometric Association saved the day, by requesting passage of a special brief California State Legislative Bill allowing me to take the California State Board Examination. To prevent further suspense, I passed, and all simmered down!

Book Review: The Science of Leonardo: Inside the Mind of the Great Genius of the Renaissance

The Science of Leonardo: Inside the Mind of the Great Genius of the Renaissance. Fritjof Capra. New York: Doubleday, 2007. xx + 329 pages. ISBN: 978-0-385-51390-6. Hardcover, \$26.00.

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This book examines the wide-ranging scientific investigations of Leonardo da Vinci (1452-1519). It also provides a sketch of other aspects of his life. Leonardo was the embodiment of the phrase "Renaissance man." He, of course, painted masterpieces such as *The Last Supper*, *Mona Lisa*, and *Madonna of the Rocks*. He was a sculptor, a mapmaker, and a civil and military engineer. He designed buildings and gardens. I also learned in this book that he designed sets, costumes, and mechanical devices for plays and pageants and that he was a musician and an athlete. As an example of the latter, in his forties, he climbed Monte Rosa, the second highest mountain in Europe.

Leonardo's scientific work was not published and was largely unknown until his notebooks were discovered centuries after his death. For this book, Capra examined over six thousand pages of Leonardo's notebooks. (Unfortunately, perhaps at least half of Leonardo's notebooks have not survived) Capra is the author of four bestselling books, including *The Tao of Physics* and *The Web of Life*. Approximately the first half of the text of the book (Part One entitled Leonardo, The Man) presents a biography of Leonardo. The second half (Part Two, entitled Leonardo, The Scientist) describes Leonardo's scientific work.

Capra describes Leonardo as a pacifist and an animal lover. Leonardo bought birds in the market place in order to set them free. Capra notes that Leonardo designed military machines for the rulers where he lived, but that "Leonardo was well aware of the conflict between his work as a military engineer and his pacifist nature." (page 102) Capra suggested that some of Leonardo's artworks show the terror of war rather than depicting the glories of military victory as was hoped by his patrons. Capra also observed that Leonardo was "utterly aloof from politics." (page 99) Leonardo did not receive a formal education. He served an art apprenticeship with Verrocchio. Later he studied from books he purchased and from library books, and he learned as much as he could from mathematicians and scholars of his acquaintance. Capra described Leonardo as having many friends and as being self-confident, but not boastful.

The author suggested that Leonardo's view of the world was an organic, ecological view. As an example, the author described Leonardo's map of the Arno River as looking like veins, "testimony of how Leonardo saw water as the veins of the

living earth.” (page 99) Leonardo “was deeply aware of the fundamental interconnectedness of all phenomena and of the interdependence and mutual generation of all parts of an organic whole...Leonardo’s science is a science of qualities, of shapes and proportions, rather than absolute quantities. He preferred to depict the forms of nature in his drawings rather than describe their shapes, and he analyzed them in terms of their proportions rather than their measured quantities.” (pages 168, 169) Leonardo studied related areas to better understand a particular topic. For example, to better understand the function of muscles, tendons, and bones, he not only did anatomical dissections, but he also studied the physics of balances, levers, pulleys, and objects hanging from cords.

Capra considers Leonardo centuries ahead of his time in suggesting that the buildings, cities, and objects that humans design should mimic nature. Leonardo is quoted as saying, “Though human ingenuity in various inventions uses different instruments to the same end, it will never discover an invention more beautiful, easier, or more economical than nature’s, because in her inventions nothing is wanting and nothing is superfluous.” (page 260)

A new approach in Leonardo’s science was “his relentless reliance on direct observation of nature.” (page 160) An epigraph in the front matter of the book puts it in Leonardo’s words: “First I shall do some experiments before I proceed farther, because my intention is to cite experience first and then with reasoning show why such experience is bound to operate in such a way. And this is the true rule by which those who speculate about the effects of nature must proceed.” Capra observed that Leonardo refused “to blindly accept the teachings of the classical authorities. He studied them carefully, but then he tested them by subjecting them to rigorous comparisons with his own experiments and his direct observations of nature. In doing so, I would argue, Leonardo single-handedly developed a new approach to knowledge, known today as the scientific method.” (page 156)

Also important to understanding Leonardo’s science is that he didn’t separate science and art as distinctly as we do today. The careful observation skills he learned as an artist were essential to his scientific work. “He used his scientific understanding of the forms of nature as the intellectual underpinning of his art, and he used his drawings and paintings as tools of scientific analysis.” (page 259) Capra observed that plants and rocks were accurately portrayed in Leonardo’s paintings and that drawings were often used in his notebooks to provide notes on his readings or on the development of his ideas.

The accurate dating of Leonardo’s notebooks in recent years has made it possible to construct the progression of his ideas. Previously it was thought that his notes instead contained contradictory statements. He recorded notes in many different fields in his notebooks, including human and animal anatomy, the flight of birds, dynamics of water flow, botany, geology, mechanics, and mathematics. He developed numerous machines, including rotary cranks, hoists, cranes, water-powered milling machines, and others. He used geometry to study motions of natural phenomena,

which he called "geometry done with motion." His transformations of geometric patterns into other shapes have been said to have foreshadowed some aspects of calculus and topology.

Capra discussed Leonardo's work on optics, the eye, and the senses in some detail. Among the areas studied by Leonardo were the optics of linear perspective, reflection of light rays from mirrors, formation of shadows, the pupillary light reflex, ocular anatomy, and visual perception. Leonardo suggested that light spreads out in a circular pattern, and likening that to the circular spread of ripples of water, he thought that light, as well as sound, was propagated in waves. He noted the differing speeds of light and sound.

Leonardo distinguished between central and peripheral vision, but he did not correctly describe image formation in the eye. He correctly thought that the optic nerves carry visual information from the eyes, but incorrectly suggested that visual information went to the cerebral ventricles. It may also be incidentally mentioned that Leonardo wore eyeglasses for presbyopia, having worn them "for a few years" by the age of 55.

A quotation from Leonardo's *Treatise on Painting* shows that he had a great appreciation for vision: "Don't you see that the eye embraces the beauty of the whole world? It is the master of astronomy, it practices cosmography, it counsels and corrects all human arts; it transports man to different parts of the world. [The eye] is the prince of mathematics; its sciences are most certain. It has measured the heights and sizes of the stars, it has discovered the elements and their locations...It has created architecture, perspective, and divine painting...[The eye] is the window of the human body, through which [the soul] contemplates and enjoys the beauty of the world." (pages 237-238)

This is a very enjoyable and informative book. Capra effectively communicates an admiration and awe for Leonardo the man and the scientist.

Book Review: Isaac Newton

Isaac Newton. James Gleick. New York: Vintage Books, 2004. Xii + 272 pages.
ISBN: 1-4000-3295-4. Paperback, \$13.95.

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Isaac Newton was born in 1642 in rural England. His father had died before Isaac was born, and when Isaac was three years old, his mother left to remarry. Newton was left under the care of his grandmother. Later at age ten, he boarded with an apothecary while he attended school. Living with the apothecary, he learned some chemistry, read the apothecary's books, and started keeping a notebook.

Newton was admitted to Trinity College at the University of Cambridge in 1661. The curriculum was largely based on Aristotle, but Newton read widely from Trinity College's more than three thousand books. Amidst epidemic in 1665, the colleges of Cambridge shut down and Newton returned home. He spent much of his time working on the mathematics of geometry, curves, motion, and other problems. He also observed the world around him. These observations led to many of the ideas for which Newton is famous. The author also discusses some of Newton's less known observations; for example, on page 61, the author discusses Newton's observations of pressure phosphenes.

When the plague subsided, Newton returned to Cambridge. Newton did not speak of his experiments, but he did share some of his mathematical studies with Isaac Barrow, professor of mathematics. Newton started to gain notice when Barrow sent some of Newton's work to a Royal Society colleague. In 1669, Barrow left Cambridge, and Newton took his place as Lucasian professor. On page 71, the author mentions that Newton was "grinding glass and polishing lenses in difficult, nonspherical curves" and that because he recognized the cause of the color fringes that bothered the makers of refracting telescopes, he made a reflecting telescope. Barrow showed the telescope to his friends in the Royal Society in London. However, it wouldn't be until 1675 that Newton appeared before the Royal Society himself.

One of the emphases of the book was Newton's disputes with Robert Hooke. This began late in 1675 when Henry Oldenburg read a paper from Newton to the Royal Society concerning his corpuscular theory of light and some of its ramifications. In the paper, Newton mentioned that Hooke's account of diffraction was preceded by Fabri and Grimaldi.

In the years at Cambridge, Newton mostly kept to himself and wrote in his private notebooks about extensive alchemy experiments and his study of theology and the Bible. He conducted experiments in optics and continued his mathematical studies. In

1684, Edmund Halley visited Newton at Cambridge and asked him, based on Kepler's work, what type of curve planets would make. Newton said that he had calculated some time before Halley's visit that the path would be an ellipse and promised to send Halley the proof. Two years later he sent to Halley the first part of his famous book, *Philosophiae Naturalis Principia Mathematica*. Among other things, the *Principia* contained Newton's law of gravitation. A second edition of the *Principia* appeared in 1713.

In 1696, Newton left Cambridge and moved to London to take up an appointment from the king as Warden of the Mint. He received a salary and a percentage of each pound that was coined, eventually making him wealthy. In 1703, Robert Hooke died, and Newton published his second book, *Opticks, A Treatise on the Reflexions, Refractions, Inflexions and Colours of Light*. It contained work accumulated over decades, which he said he had not published "To avoid being engaged in Disputes" (page 163). Early in the eighteenth century Newton became President of the Royal Society.

The book discusses the conflict between Newton and Gottfried Leibniz over credit for the development of calculus. The author concluded that Newton "and Leibniz had created the calculus independently. Leibniz had not been altogether candid about what he had learned from Newton – in fragments, and through proxies – but the essence of the invention was his. Newton had made his discoveries first, and he had discovered more, but Leibniz had done what Newton had not: published his work for the world to use and judge." (page 172)

Newton died in 1727. The last chapter of the book (pages 175 to 191) discusses some of the memorials to Newton and some aspects of his legacy. This book presents an interesting introduction to the life of Isaac Newton. The text of the book is followed by 48 pages of reference notes and supplementary notes, an 18 page bibliography, and an index.

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Hofstetter HW. *Optometry: Professional, Economic, and Legal Aspects*. St. Louis: Mosby, 1948:17-35.

Chapter in a multi-author volume:

Penisten DK. Eyes and vision in North American Indian cultures: An historical perspective on traditional medicine and mythology. In: Goss DA, Edmondson LL, eds. *Eye and Vision Conditions in the American Indian*. Yukon, OK; Pueblo Publishing, 1990:186-190.

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