THE "DEMISE" OF DIAGNOSTIC AND RESEARCH OCULAR PATHOLOGY: TEMPORARY OR FOREVER?

BY ***David J. Apple MD,**** *Liliana Werner MD PhD, Nick Mamalis MD,* AND *Randall J. Olson MD*

ABSTRACT

Purpose: Several authorities have documented a significant decrease in support for modern eye pathology/pathology research laboratories. Indeed, many laboratories have closed or suffered marked cutbacks. The purpose of this report is to ask why this is so and to seek a possible means for reversing this trend.

Methods: Observations from the senior author's experience and a case from author's facility are analyzed.

Results: There are several reasons for ocular pathologists' difficulties, such as financial problems, lack of vision, personality conflicts, and problems with the departmental administration. Until recently, most research and development in several subspecialty fields of ophthalmology, including biodevices research, has been done primarily by engineers and in-house workers in industry. This precludes proper independent, nonbiased control and guidance from academia. Most ocular pathologists have not participated in this relatively new and wide-open field.

Conclusions: We suggest a new realm of activity for today's newly trained ocular pathologists. Based on personal experience of two decades of fruitful collaboration with industry, we believe that ocular pathologists are uniquely trained to apply their expertise to various new fields of research that most pathologists today have not utilized. An important example is research on clinicopathological aspects of implantable biodevices. In addition, support and oversight should be provided by the major ophthalmic societies, such as the American Academy of Ophthalmology, in order to retain (even regain) control over this field. This is mandatory in order to control the safety and efficacy of new drugs and devices being introduced almost daily. Only then can clear differentiation between profit and patient welfare be achieved as potentially dangerous devices and techniques are let loose on the market.

The field of "routine, descriptive" eye pathology is severely wounded and will return only in an attenuated fashion. In general, full-time support for ocular pathologists will not be possible unless they seek extra support from the private sector, engage in a concurrent clinical practice, or are supported by an endowed chair (a wonderful alternative).

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INTRODUCTION

The first attempts to develop ocular pathology as a self-standing specialty began primarily in Europe in the late 18th century and early 19th century. Ophthalmologists applied techniques of general pathology utilizing the gross and light microscopic techniques then available. Examples of some early pioneers, whose work remains viable today, include James Wardrop (United Kingdom), who did pioneering work on retinoblastoma (Figure1A), and Prof Samuel Thomas Soemmering (Germany), whose name is associated with the characteristic ring-shaped ocular lesion situated at the lens equator (Figure 1B). Formation of a Soemmering's ring is based on a break of the anterior capsule with extrusion of central lens substance. In Soemmering's time, the ring was usually associated with trauma and anterior capsular rupture. Today, it has assumed a much broader significance. The most common cause of a Soemmering's ring is the extracapsular (usually phacoemulsification) cataract–intraocular lens (IOL) operation.

We have divided the specialty of ocular pathology into two "golden ages," separated in general by the devastating effects of a major 19th century war and the two major 20th century world wars. The first golden age extended roughly between 1871 and 1914, preceded by the Franco-Prussian War of 1870-1871 and halted by the World War I. The majority of ocular pathologists of this era were clinicians, who often did pathologic examinations as an "extra" after their clinical work and who made extensive progress in the field of descriptive ocular pathology. Some of the impor-

From the David J. Apple MD, Laboratories for Ophthalmic Devices Research, John A. Moran Eye Center, University of Utah, Salt Lake City. Supported in part by an unrestricted grant from Research to Prevent Blindness.
*Presenter
Bold type indicates AOS member

tant leaders of this era were Axenfeld, Fuchs, Parson, Stock, and von Szily.

The second golden age commenced after World War II. The great leaders of this period were clearly Prof Norman Ashton of London (Figure 2A) and Prof Lorenz E. Zimmerman of Washington, DC (Figure 2B).

The practice of ocular pathology has evolved utilizing the standard techniques of general pathology, ranging from gross examination through routine histopathology down to the use of special stains and electron microscopy. For example, the techniques used to evaluate a metastatic melanoma of the skin to the liver (Figure 3A) are no different from those used by the ocular pathologist to examine epibulbar (Figure 3B) or intraocular (Figure 3C) tumors.

Until recently, an ocular pathologist could work with great success in the field of routine, descriptive pathology with general assurance of good financial support from his or her institution. As the finances of medicine have changed, support for laboratories has diminished greatly.[1-7] In general, those laboratories that have survived have evolved in part by focusing in subspecialties with direct clinical relevance. This has enhanced their ability to gain financial support. In our laboratory, we have developed special skills and techniques to allow us to evaluate ophthalmic biodevices such as IOLs (Figures 4A and 4B). Our modification in the 1990s of Kensaku Miyake's 1985 technique, evolving into the modern Miyake-Apple posterior video/photographic technique,[8,9] has allowed us to study these devices from a unique viewpoint. This technique, although a highly specialized one for a certain use, is also based on techniques derived from general pathology.

The last 50 years of the 20th century have been extensively fruitful in the field of eye pathology, and ocular pathologists have made immense contributions. However, several recent articles provide a warning that the future of this specialty may be in jeopardy.[1-7] For example, Norman Ashton himself (Figure 5) noted several disconcerting signs regarding the future of ophthalmic

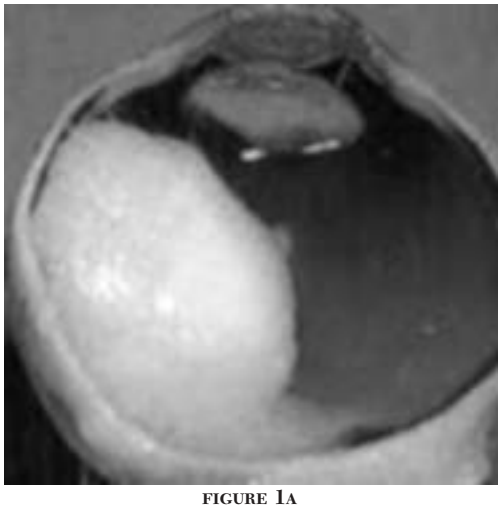

FIGURE 1A
Retinoblastoma. Gross (macroscopic) photograph.

FIGURE 1B
Gross photograph from behind, Miyake-Apple posterior video/photographic technique, of a Soemmerring's ring that formed after extracapsular cataract–intraocular lens surgery with cortical removal.

FIGURE 2A
Prof Norman Ashton, London.

FIGURE 2B
Prof Lorenz E. Zimmerman, of the Armed Forces Institute of Pathology, Washington, DC.

FIGURE 3A
Metastatic malignant melanoma.

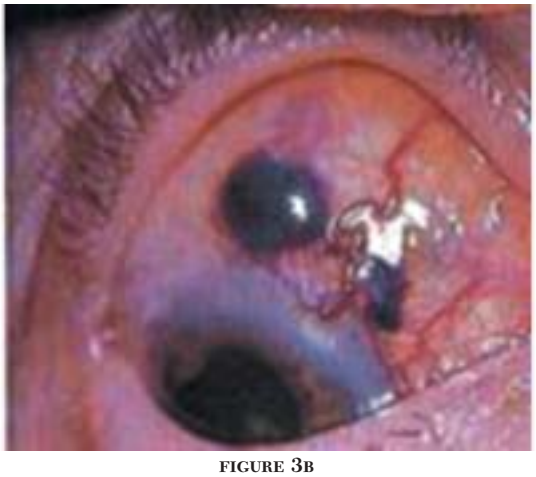

FIGURE 3B
Epibulbar melanoma.

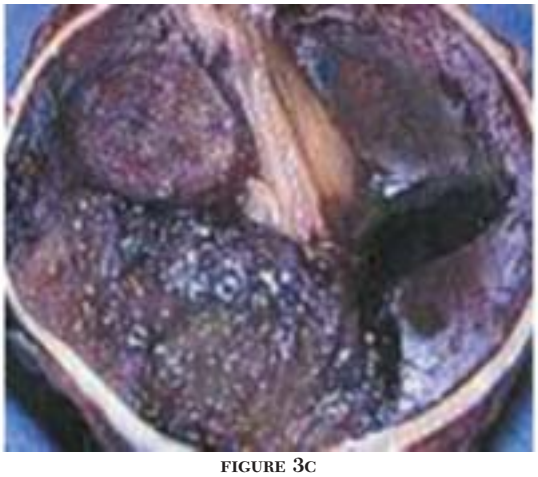

FIGURE 3C
Intraocular malignant melanoma.

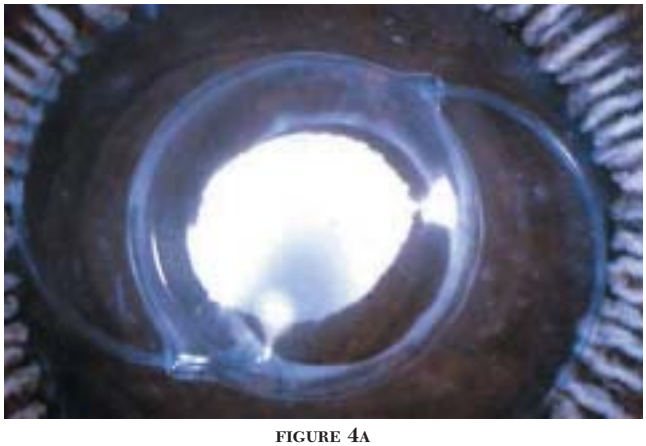

FIGURE 4A
Human eye obtained postmortem viewed from behind containing a silicone intraocular lens with polymethyl methacrylate haptics.

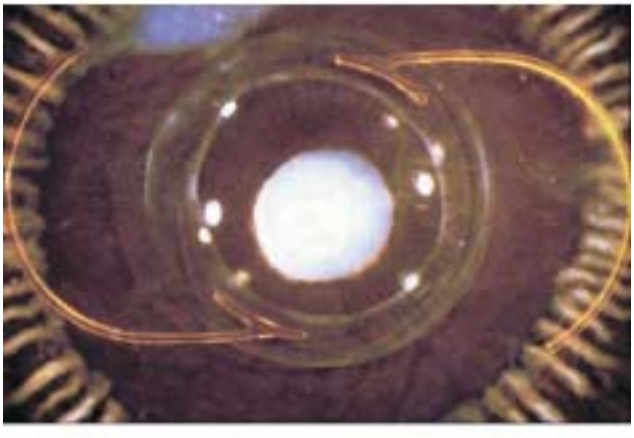

FIGURE 4B
Human eye obtained postmortem viewed from behind containing a silicone intraocular lens with polyimide haptics.

FIGURE 5
Prof Norman Ashton, London.

pathology and stated that the "scene is shifting." Spencer[5] elaborated on this and noted that "unfortunately, the scene has shifted in a negative direction during recent years, especially with respect to the growth and development of ophthalmic pathology in the United States."

Over the past decade, there has been a significant decrease in support for modern eye pathology/pathology research laboratories, and indeed many have closed or suffered marked cutbacks worldwide.[1-7] The purpose of this study is to ask why this is so and to seek a possible means for reversing this trend.

MATERIALS AND METHODS

Based on the senior author's personal experience in the practice of ocular pathology over a period of 30 years, with special emphasis on biodevice research for the past 20 years, we have tabulated a list of factors that we believe are at least in part responsible for hindering the support for and growth of modern pathology laboratories. We also report an instance in which we failed to obtain federal funding from the National Institutes of Health, specifically from the division now termed the National Eye Institute. This is included to illustrate some difficulties in funding that many laboratories now encounter.

Drawing from our previous experiences, we attempt to provide suggestions that may help enhance the survival of today's ocular pathology laboratories, with special reference to the possibilities of obtaining supplemental private or industrial support.

RESULTS

We have noted three primary factors that appear, at least in part, to be responsible for the problems experienced by many excellent ocular pathologists: (1) pathologists themselves, (2) departmental administration, and (3) sources of laboratory support. The first relates to problems inherent to each individual laboratory and has been well referenced; the second and third are based in part on personal experience.

Pathologists themselves. At times, pathologists may be conservative, similar to what is termed "being too much in an ivory tower." A pathologist may fail to build an adequate collection of specimens, ie, an insufficient clinicopathological database. He or she may lack creativity with new techniques and be unable to move away from "descriptive pathology" to, for example, pathology of biodevices, implants, or electronic laser–related issues. Over the past 10 to 15 years, many pathology laboratories have suffered a severe loss of income from routine eye pathology specimens due to a lack of cases suitable for billing. Finally, there may be an unwillingness to work with industry. On the other hand, general pathologists may have a tendency to work with eye specimens and thus earn fees from eye pathology cases.

The departmental administration. In many hospitals, failure of departmental chairpersons to support their pathologists is often due to several reasons, including insufficient departmental budgets and the chairperson's inability to recognize the teaching benefits of ocular pathology for the program's residents. Other reasons are jealousies, interest in fields that are 180 degrees away from eye pathology, and philosophies such as "pay your own way or go away" and "work in my field of interest or go away."

An increasing number of today's chairpersons are business-oriented and have no time to function as scholars or inspirational leaders, as in the past. Unfortunately, modern medical economics has helped cause this. The administration often does not realize the advantage provided by a well-run eye pathology team, including its vast teaching and research potential.

The sources of laboratory support. A single experience, which occurred in our laboratory in 1984, has convinced us that a paradigm shift regarding laboratory funding is necessary. Researchers and clinicians need a blend of public and private support and in general cannot survive with support from one or the other alone. We experienced difficulty in receiving federal support in 1984 when applying for an IOL-related grant. The National Institutes of Health's National Eye Institute division rejected our grant application and told us that (1) we would not be able to procure sufficient numbers of specimens and (2) there was a strong chance that IOLs would not survive! Contrary to those predictions, we have accessioned a total of more than 19,000 IOL-related specimens from 1982 to the present (Figures 6A and 6B). Of these, about 11,000 explants and 8,000 pseudophakic human eyes were obtained postmortem. The survival of IOLs is self-evident.

This experience, as well as later experiences of others, has demonstrated that the National Eye Institute is not necessarily friendly to eye pathologists. Much more emphasis is given to nonanatomic, non-pathology-oriented research subspecialties, such as molecular biology, genetics, biochemistry, and physiology. Even the modern technology and techniques used by today's ocular pathologists, such as immunopathology, sophisticated electron microscopy, and exotic histochemistry, have often been underevaluated by National Eye Institute reviewers.

This initially negative experience actually turned into a blessing in disguise. Since that time, we have proceeded to apply the pathological techniques provided to most American ocular pathologists by Dr Lorenz E.

Zimmerman and others and to work with industry in the fields of biodevice and biomedical engineering. This has provided for us a new and huge source of freedom and support that would not have been possible with dependency on a federal grant.

DISCUSSION

Our observations over the past several decades reveal that an ocular pathology laboratory focusing solely or in large part on classic routine descriptive pathology alone is not sufficient to ensure intellectual and financial survival of an ocular pathology laboratory. We suggest an additional approach that may broaden a laboratory's outreach and may enhance laboratory support. We suggest that young ocular pathologists just entering the field may seek opportunities for both descriptive work and research in the huge field of ophthalmic biodevices. Many such opportunities are available in the United States and worldwide. This is a wide-open and necessary field; the pathologist's participation helps industry and also provides a useful oversight, helping limit untoward bias and influence when new biodevices are evaluated or when the long-term performance of devices already in use are evaluated. The involvement of dedicated pathologists in the field of ophthalmic biodevice research also helps to achieve a clear differentiation between profit and patient. Many times, potentially dangerous devices and techniques are let loose on the market; this can be eliminated by widening the scope of such research.

In the past, most ocular pathologists have shunned involvement in the biodevices field or in the field of pathology of ocular surgery and surgical techniques, believing these to be distant from their scope of training and far afield from the usual techniques used in the typical eye pathology laboratory. On the contrary, our experience has shown that it is a very short step and a relatively easy task to apply our basic techniques of gross, light, and electron microscopy to the modern fields of biomedical engineering—especially when working in concert with individuals already trained in various aspects of these fields, eg, engineers.

Many useful discoveries have been made in the field of biodevice research. A sample of projects we have completed in this field from 1982 to the present include the following: better anterior segment surgical techniques, such as in-the-bag fixation of IOLs; cataract wound structure studies; the pathophysiology of the continuous, curvilinear capsulorrhexis; a description of localized endophthalmitis, a postoperative low-grade infection caused by Propionibacterium acnes; interlenticular opacification of "piggyback lenses"; studies of the calcification of hydrophilic IOLs (Figure 7); and the initial descriptions of snowflake opacification of IOLs and silicone oil adherence to IOLs. Tremendous progress has also been made in the field of anterior[10,11] and posterior capsule opacification (Table)[12-14] in both understanding its pathophysiology and finding out ways and means to prevent its occurrence.[13-15]

The most recent clinically significant condition that we have studied is the occurrence of opacification/calcification of several hydrophilic acrylic IOL types (Figure 7).[15,16] This example illustrates how pathologists who engage in ophthalmic biodevice research can be of great usefulness in ascertaining causes and cures of problems caused by modern, incompletely studied "innovation." In several countries, especially those in Europe and Asia, hydrophilic acrylic IOLs are becoming a "lens of choice." However, many of these lenses have been found to be defective, with a high incidence of calcification/opacification in some models.[16-18] At present, more than 25 brands of this IOL type are available in the market. It is not difficult to understand the reasons for this, including financial and pricing issues, patent issues, and confusion over the terms and names used. Pathological studies have forced industry to severely modify its attitude regarding these lenses and to remove defective models and designs.

There are numerous opportunities for engagement in pathological studies and research in the field of biodevices and new ocular surgical techniques, which offer exciting possibilities for young pathologist entering this field. Figures 8 through 16[17] illustrate only a few of many entities that can be studied and represent a small cross section of research possibilities. Most of the devices are currently under varying early phases of investigation. Perhaps a few will survive and flourish; we predict, however, that some, if not most, will fail. The pathologist can play a significant role in either validating or appropriately condemning many of these devices as well as numerous others now being tested or yet to be introduced. Indeed, not only would this represent a means of obtaining private or industrial financing for the laboratory, but also a scientific differentiation of these products will represent a positive contribution to society. Note that the service to be provided not only relates to actual biodevices, but also overlaps into the realm of evaluation and oversight of surgical techniques, including the current hugely popular field of keratorefractive surgery (Figures 15 and 16). There is no question that industry will sometimes attempt to control the researcher and the results obtained, but we have found that the work can remain independent if one is simply firm with the sponsors. There are many ways to work with the corporate sector in a positive fashion.[18]

FIGURE 6A

A, Intraocular lens explanted because of total opacification/calcification. This exemplifies the approximately 11,000 explants we have examined in our laboratory.

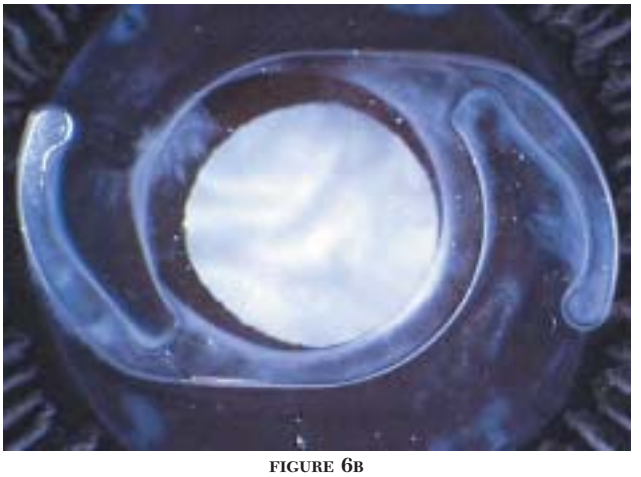

FIGURE 6B

Successfully implanted IOL, seen from behind in an eye obtained postmortem, viewed with the Miyake-Apple posterior video/photographic technique. This exemplifies one of about 8,000 autopsy globes examined in our laboratory.

FIGURE 7

Intraocular malignant melanoma.

FIGURE 8

Human eye obtained postmortem viewed from behind containing a silicone intraocular lens with polymethyl methacrylate haptics.

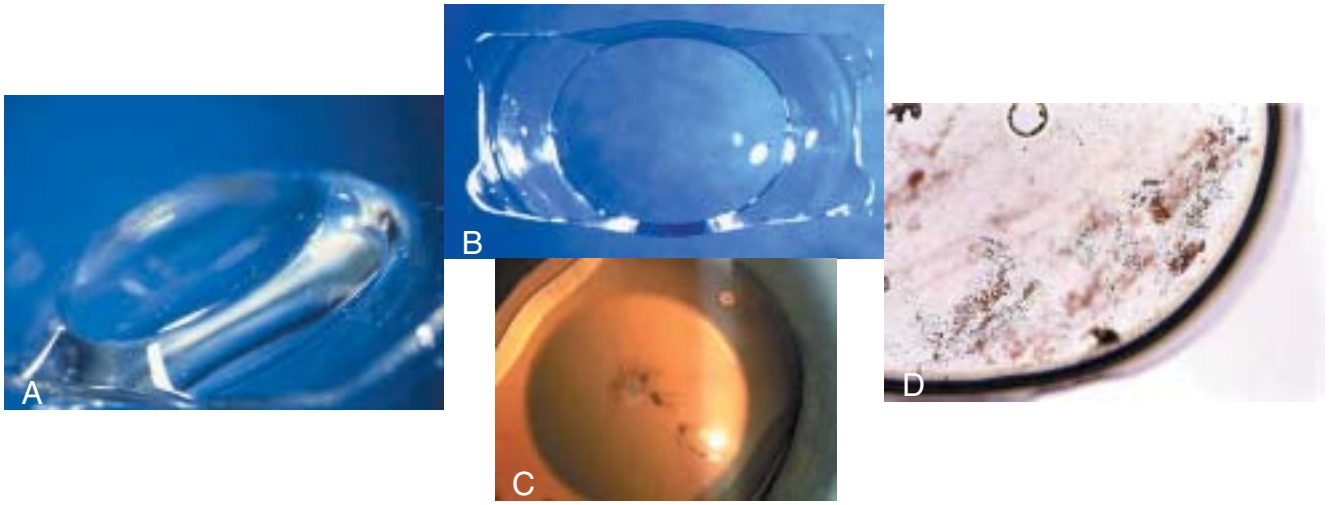

FIGURE 9

Phakic posterior chamber IOLs. A, Early model of silicone phakic posterior chamber IOL. B, Late model of a collamer silicone phakic posterior chamber IOL, so-called intraocular contact lens. C, Clinical photo of an eye containing an ICL in which an anterior subcapsular cataract subsequently formed. D, Same eye seen in C, showing evidence of uveal chafe/pigment dispersion.

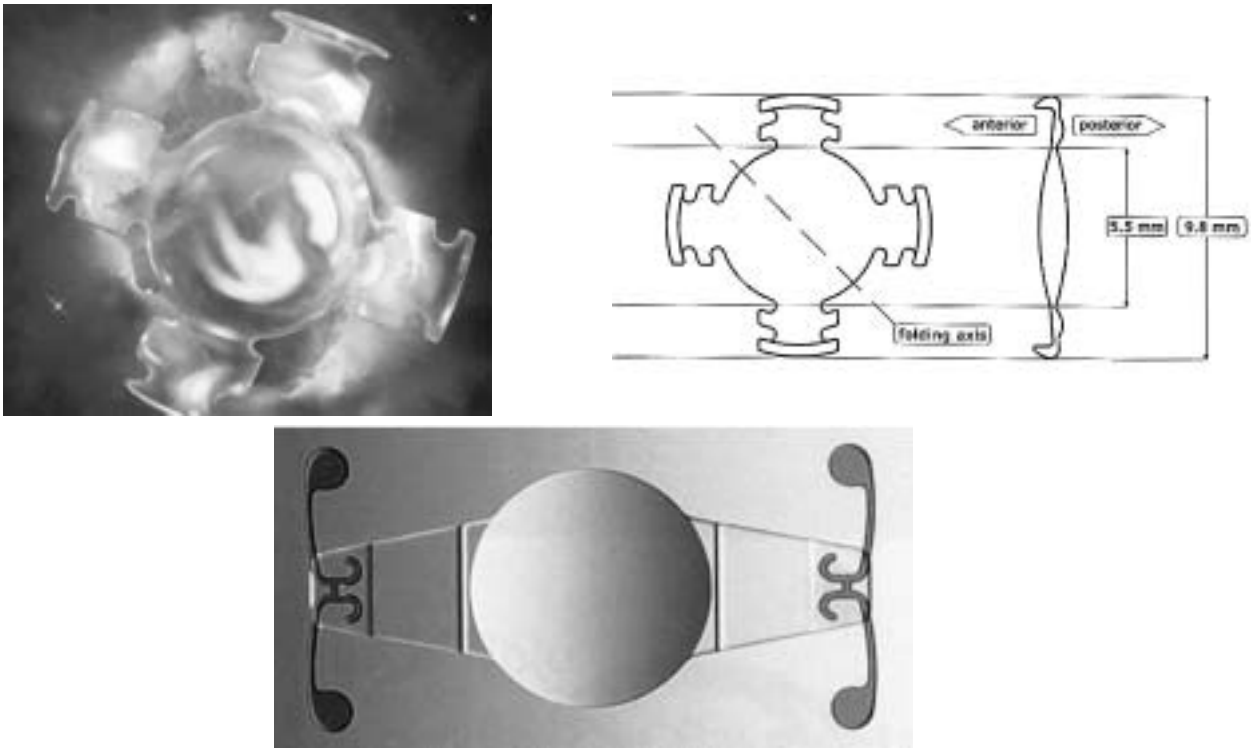

FIGURE 10
Accommodative intraocular lenses.

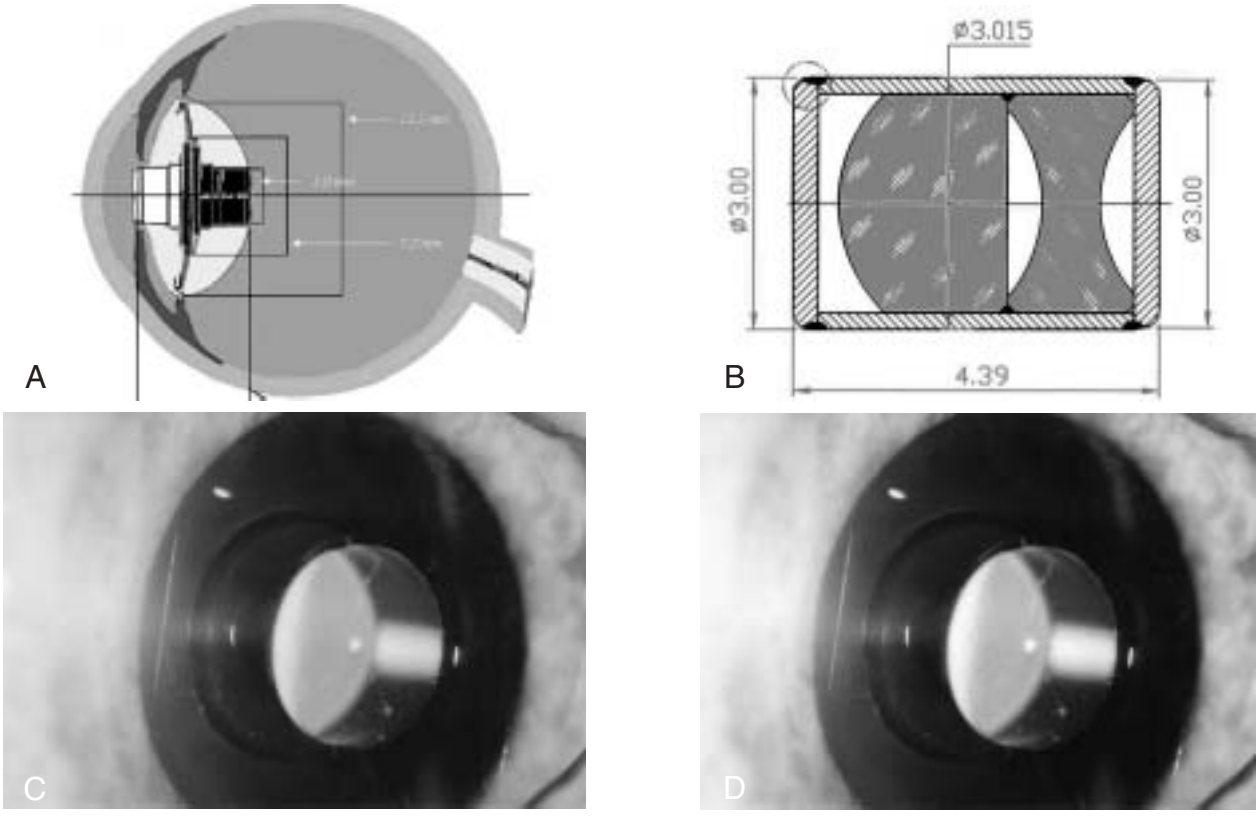

FIGURE 11
Telescopic IOL designed for implantation in patients with low vision, eg, age-related macular degeneration. (Photo C courtesy of Dr Milan G. J. Izak, Bandska Bystrica, Slovakia.)

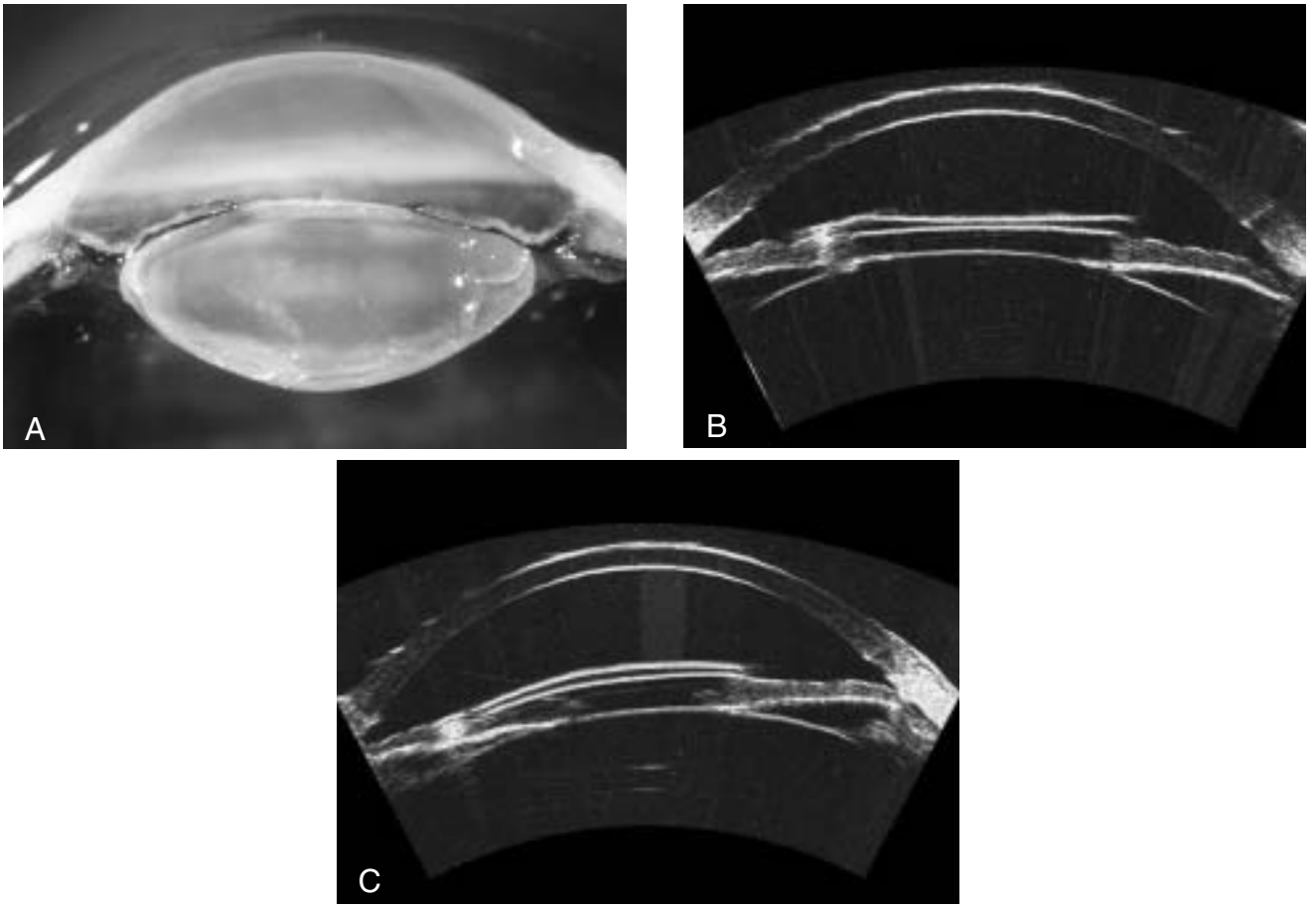

FIGURE 12

In our laboratory, Liliana Werner MD PhD, and associates are performing studies on intraocular tissue/compartment measurements, comparing actual measurements on gross tissue (cadaver eyes) with high-frequency ultrasound biomicroscopy measurements. A, Cadaver eye. B, Ultrasound biomicroscopy measurement showing a phakic myopic anterior chamber IOL. C, Ultrasound biomicroscopy measurement showing a phakic hyperopic anterior chamber IOL.

To conclude, the practice of routine, descriptive eye pathology is severely wounded. This practice will return only in an attenuated fashion but is usually not well supported financially. In general, full-time support for the pathologist will not be possible unless the pathologist seeks extra support from the private sector, engages in a concurrent clinical practice, or is supported by an endowed chair.

Spencer[5] has sounded the alarm: "It is time for the leaders in ophthalmology to recognize the potential consequences of allowing further decline in the basic education of residents to occur and to initiate steps aimed at reversing this downward drift [of ocular pathology]."

Our advice to young pathologists is not to be afraid to pick a practical line of study that is clinically useful and is also fundable. They should not attempt to always do basic, nonpractical research, just for the sake of doing basic research. The days of counting on government funding are over. Even though it may not be easy, they should try to find a departmental leader who is interested in and sympathetic to their work. They should consider signing out clinicopathological specimens as more of a service and source of research material rather than a source of income. Also, young pathologists must not disparage the small, various subspeciality societies or journals in vogue today. These may help provide an entrée into their chosen subspecialty and, in effect, may represent the "pulpit" or "mouthpiece" they may need as they advance in their careers.

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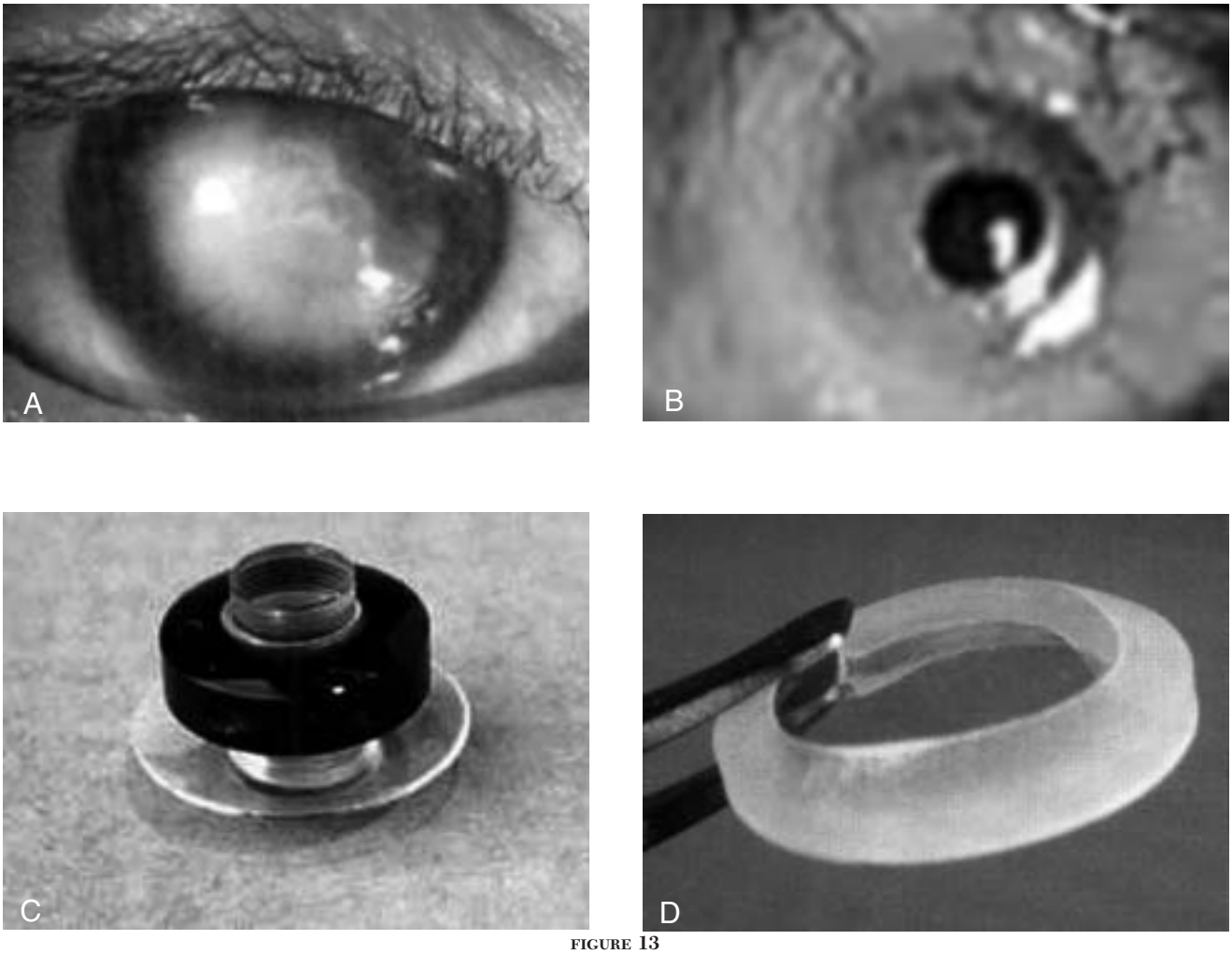

FIGURE 13

The keratoprosthesis device has often been susceptible to complications since its innovation in the 1960s but remains useful for intractable cases. A, Preoperative photo, corneal opacity. B, Postoperative photo showing keratoprosthesis. C, Early keratoprosthesis design of Ridley and Choyce. D, Gross photograph of a modern keratoprosthesis made from hydrophilic material.

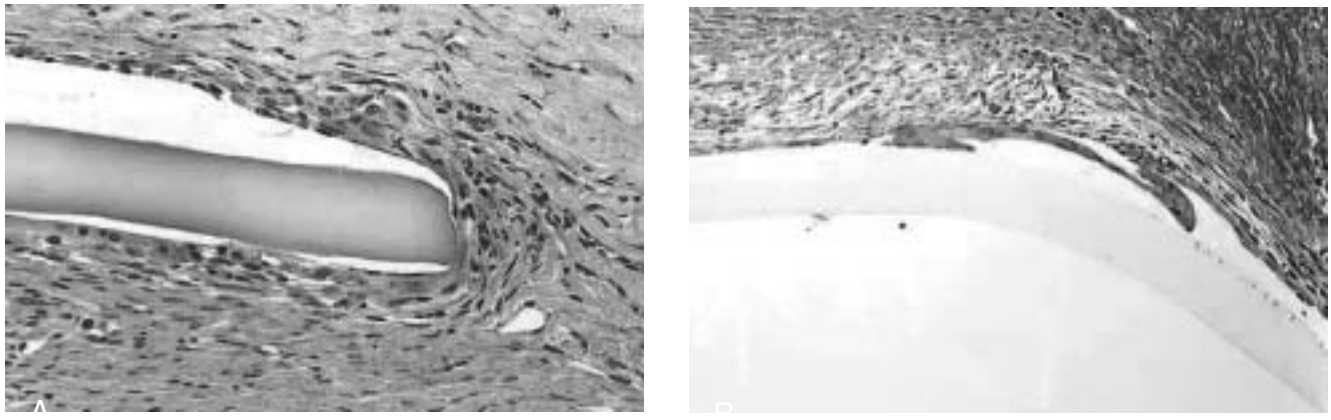

FIGURE 14

Glaucoma implant. A, Histologic study of tissue reaction around a prototype glaucoma implant, acute phase. B, Histologic study of tissue reaction around a prototype glaucoma implant, chronic phase.

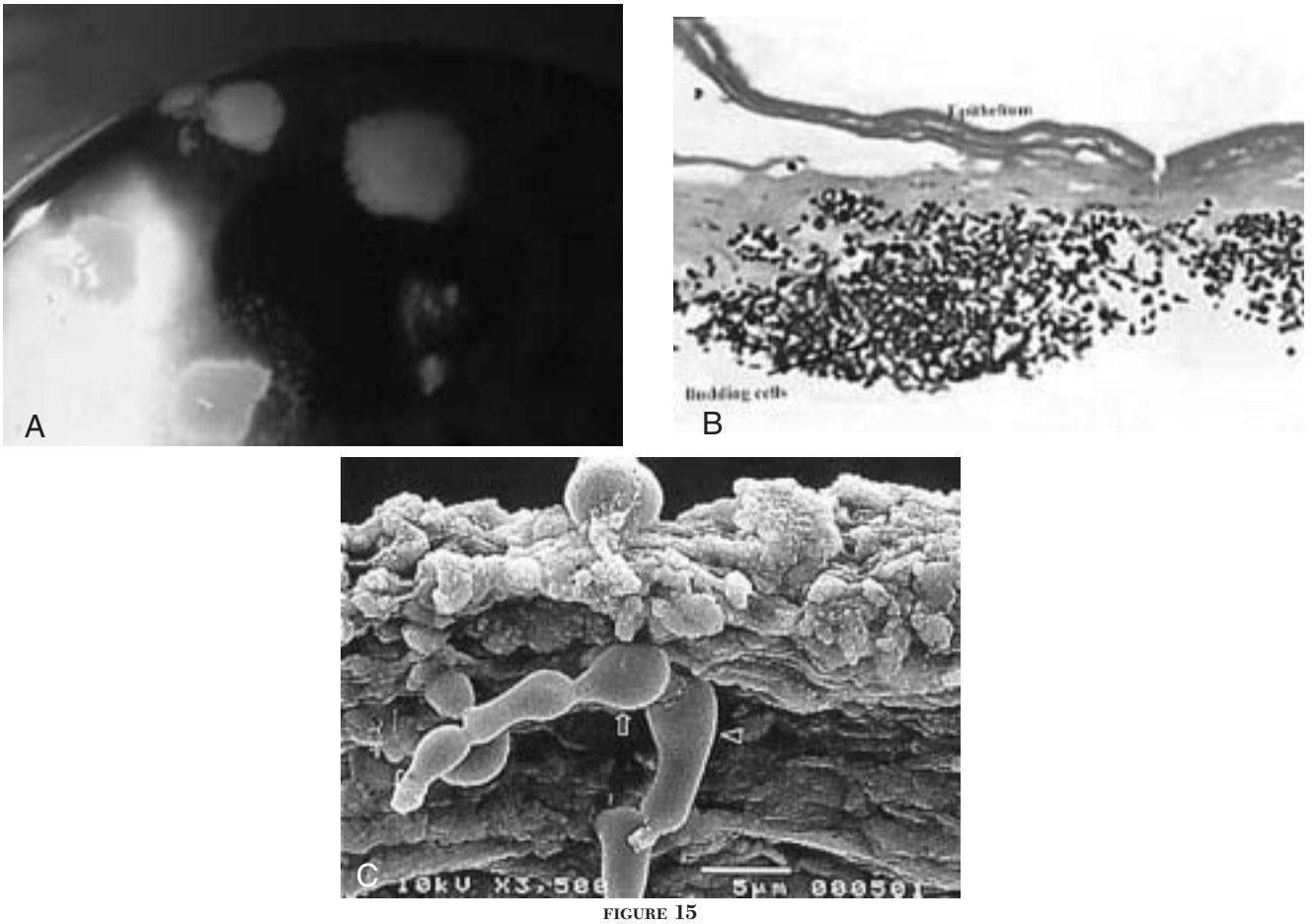

FIGURE 15

IImages of a cornea after LASIK with diffuse lamellar keratitis that progressed to fungal keratitis. A, Clinical photograph. B, Photomicrograph showing fungal organisms (Gomori methenamine–silver, original magnification ×400). C, Scanning electron micrograph showing budding fungal organisms.

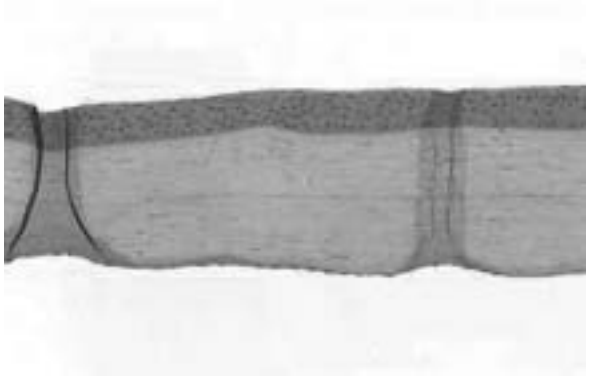

FIGURE 16

Photomicrograph of a cornea with post-LASIK corneal ectasia with measurements of central stromal thinning (hematoxylin-eosin, original magnification ×10).

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DISCUSSION

Dr Ralph C. Eagle Jr. Ophthalmic pathology currently is in a major decline. Dr Apple faults Administrators and funding agencies for their lack of support and states that the medical industrial complex could be our subspecialty's salvation. He also faults ophthalmic pathologists for their failure to embrace practical industry-supported research.

I have always thought that David Apple probably is the second most famous ophthalmic pathologist in the United States after Lorenz Zimmerman. His fame among comprehensive ophthalmologists rests on his association with the pathology of intraocular surgery and the important role he has played in the evolution of modern cataract surgery and intraocular lens implantation. As a result, Dr Apple is one of the few ophthalmic pathologists in the United States who has garnered major commercial support for his laboratory and fellows. Most ophthalmic pathologists have not had this luxury. In those rare instances when I have been asked to participate in a surgically oriented study, I have been approached by a surgeon who is working with the drug or instrument company. At best, I have been fortunate to secure a few extra dollars for my technician.

Unfortunately, many ophthalmic pathologists are not particularly interested in ocular surgery. This certainly applies to general pathologists who have a limited understanding of ophthalmic surgical procedures. Furthermore, it is possible that some ophthalmologists actually are drawn to ophthalmic pathology because they are not interested in surgery. Others choose not to devote themselves to the ephemera of surgical technique that constantly change and are rapidly forgotten, are of interest primarily to a nonacademic audience, and occasionally reside on the fringes of ethical practice.

A variety of factors have contributed to ophthalmic pathology's current troubles. These include the loss of the fellowship training grant at the Armed Forces Institute of Pathology in the late 1970's, the American Board of Ophthalmology's decision to abolish the separate oral examination in ophthalmic pathology; the CLIA laboratory regulations of 1988, remarkable advances in medical research that have greatly overshadowed purely descriptive morphological studies, changes in health care financing, the staggering indebtedness of many young physicians, and finally, the major medical paradigm shift from quality care at-all-costs to cost-effectiveness.

One of the most crucial problems that ophthalmic pathology currently faces is a lack of manpower. Our subspecialty is aging and we are training too few new eye pathologists. A major factor that initiated this decline was the loss of the training grant at the AFIP where many of the ophthalmic pathologists who are members of this organization trained. Today, relatively few ophthalmic pathology fellowships are funded and many of those with limited funding are primarily pre-residency fellowship programs that are filled by foreigners or Americans who did not succeed in the Ophthalmology match. Pre-residency fellowships may help secure ophthalmology residencies, but they do not help Ophthalmology or aspiring ophthalmic pathologists. The final corrected version of the CLIA 88 laboratory regulations stipulates that board-certified ophthalmologists must have one year of post-residency training in ophthalmic pathology if they want to legally "perform tests in ophthalmic histopathology."

As originally drafted, the CLIA regulations would have disqualified from the practice of ophthalmic pathology, the great majority ophthalmic pathologists who are boarded solely by the American Board of Ophthalmology. This would have affected Drs Bill Spencer, Dan Albert, Barbara Streeten, Ted Dryja and yours truly. Thanks to the support of many in this audience we were able to modify the law, but the threat of future legislative disqualification still hangs over the heads of ophthalmic pathologists who are ophthalmologists.

Ophthalmic pathology resides in the Department of Ophthalmology in many academic institutions and typically generates little revenue. Administrators and some departmental chairs see the residency review committee's educational requirements regarding eye pathology as

burdensome and hope that they will go away. The bottom line in this regard, as in most things, is the bottom line, and financial times admittedly are tough.

Financial constraints definitely have a major negative impact on the manpower issue. Aspiring young ophthalmic pathologists generally cannot expect to make a living doing eye pathology. Would-be practitioners have several options; they can seek additional training in basic science research, dabble in eye pathology and hope to be competitive in the market for grants, or more practically, they can train in a second, more lucrative subspecialty and do eye pathology on the side. General pathologists are free to sub-specialize in ophthalmic pathology, but very few do because there generally is little exposure to ophthalmic pathology in most pathology training programs. Neuropathologists currently claim that they are qualified to do eye pathology, but most have limited exposure and training. Restrictions on federal reimbursement for post-graduate medical educational currently make it impossible to become board-certified in both ophthalmology and pathology.

The staggering indebtedness incurred by many medical students is another extremely important factor in the manpower equation that draws them to highly remunerative, procedure-intensive, surgical subspecialties. This trend has had major effects throughout medicine; some major university hospitals now must rely on foreign medical graduates to fill their internal medicine programs. Unless they are independently wealthy, few young physicians are willing to do an unpaid or poorly paid fellowship mastering a specialty with a tenuous future that promises limited financial rewards and may put them at a disadvantage academically. Jobs for ophthalmic pathologists currently are available, but this could change if the educational requirements for ophthalmology residents are relaxed. Unfortunately, the latter could become unavoidable if the manpower crisis is not resolved.

I thank and commend the American Ophthalmological Society and the Heed Foundation for recognizing this problem and establishing the AOS-Knapp Fund Fellowship to address this need. Additional funded fellowships, endowed professorships and endowed ocular pathology laboratories are necessary if ophthalmic pathology is to remain viable and flourish.

Is ophthalmic pathology still relevant in the age in the age of molecular biology? I certainly believe so. Ophthalmology still needs well-trained knowledgeable, physicians who know ophthalmic disease and can accurately diagnose our surgical specimens. We need dedicated professors who can train our future practitioners. We need individuals who can bridge the gap between clinicians and basic scientists. And most of all, we need honest, unbiased watchdogs who can help to assure the quality and ethical nature of ophthalmic practice.

I close with a quotation from Dr Frederick A. Jacobiec that was included in his forward to a special issue of the journal OPHTHALMOLOGY devoted to ocular pathology in 1984. Dr Jakobiec's comments remain valid and compelling nearly two decades later:

"Unless one knows the natural course of a disease, it is not possible to decide whether an intervention has been efficacious or not. At a time when we are witnessing the progressive commercialization of ophthalmology and the slackening of traditional standards of professional behavior, one of the few remaining constraints that might prevent us from becoming high-tech mountebanks, peddling star wars' nostrums that are expensive and potentially meretricious, is our well-founded and ethically enhancing knowledge of ocular disease."

Dr Taylor Asbury. Ten years ago an endowed chair of ophthalmic pathology was dedicated to my mother, Marion Asbury. She was a member of this society. This endowment is presently over 2.5 million dollars. Currently there are almost no other endowed chairs in eye pathology. Obviously this is another way, and maybe the best way, to finance this specialty. Eye pathology and neuro-ophthalmology are the two subspecialties that warrant having endowment support. Most of the rest of the clinical subspecialties can be self-supporting. My message here is to urge the many department chairs that are in the AOS to work towards establishing an endowed eye pathology chair in your department.

Dr Froncie A. Gutman. I would just like to amplify Dr Eagle's comments about what the American Ophthalmological Society, through the Knapp Fund and with the support of Research to Prevent Blindness (RPB), is doing. In the year 2000, we initiated a two-year ophthalmic pathology fellowship, funded at $52,500 a year. It was an effort to attract young, talented individuals to the field of ophthalmic pathology. During the first year of training in ophthalmic pathology, the fellow initiates an investigative pathology project. The second year can be spent in ophthalmic pathology or in a subspecialty fellowship. If a subspecialty fellowship is elected for the second year of training, the fellow will continue their work on their investigative pathology project. Hopefully, these individuals will be attractive, prospective faculty candidates. I appreciate the support that RPB has given to this program. We are in our last year of funding for the pilot program and will need to reassess our plans for the future. All of our members should appreciate the efforts of the AOS in addressing this desperate need.

Dr Alan H. Friedman. I direct an eye pathology lab

where we handle about 500 specimens a year. The numbers have not changed much over the years. However, the percentages of the various kinds of specimens we process have changed. We see far fewer surgical enucleations and autopsy eyes than ever. I think this has distanced us from the rest of ophthalmology. We do live in an era of medicine where breathtaking advances have taken place in virtually every field of medicine and surgery and ophthalmic pathology is one of them. There are advances in molecular biology and in immunopathology that enable us to render diagnoses without having to resort to electron microscopy. We can render diagnoses within 24 hours. We can e-mail reports quickly because we are computerized. Surgical enucleations and autopsies have declined enormously. Surgical enucleations have declined because surgery is much better. Traumatized eyes are saved. Eyes following cataract extraction and corneal transplantation have done very well. We do not see the complications now that we saw 20 years ago. In eye pathology, we have a much closer relationship to the ophthalmic plastic surgeons who do most of the surgery calling for biopsies and who generate most of the material for us. The cornea and glaucoma service still send specimens.

We do a lot of the teaching in the second year and third year of residency but we have less with the general ophthalmologists on the staff and more to do with the plastic surgeons. I truly hope that we do not go the way of the teaching of embryology.

Dr D. Jackson Coleman. There is no question that pathology is the bedrock of resident training. I don't think it's quite as discouraging as you may have implied for two reasons. Dr Friedman pointed out the technological advances but no one has yet mentioned the technology advances in both communicating your knowledge to any of our programs by means of teleconferencing..

You mentioned a UBM light, which is an instrument called the Artemis that was developed at Cornell. Imaging does allow some advances in correlation of data. The Optical Coherence Technology 3 was developed and many people thought it would tell us where every layer of the retina was; then Dr John Marshall pointed out that many of those definitions are wrong, and others are finding the same thing. We need to have the pathologists correlate new imaging techniques with anatomy and there's no one else that can do it better than the ocular pathologists. So, I think pathology needs to relate more to the new imaging techniques.

Dr George B. Bartley. Given the changes in trends we see in practice and the improvements in communication as just noted, how many ophthalmic pathologists do we need in the next 20 years to get the job done?

Dr Dan B. Jones. There are 125 residency-training programs in the country. The response to opportunities as Dr Gutman described is simply not happening. What part are we trying to teach in terms of anatomical diagnosis or experimental pathology? There are seven papers in this meeting that have intrinsic histopathology as their basis, but only maybe two of descriptive pathology. Dr Gordon Klintworth has done a study at Duke looking at all the specimens they receive to try to determine how many of the specimens could have been diagnosed by a non-ophthalmic pathologist. So the efforts with regard to the educational issue are keeping this field alive but the pathologists need to answer the questions: How many are needed? What is the best communication methodology? Should we be giving ophthalmic fellowships to pathologists to teach them in an area, be it retina or something else, so that their skill in that particular area would advance? The fear of demise can no longer be the response here. There should be a genuine plan, and I don't think the plan to simply be attractive to more people, such as residents coming out of training is the answer to the problem.

Dr Bradley R. Straatsma. The term "ophthalmic pathology" has two words, ophthalmic and pathology. Another direction that would be very important for us to explore as a profession is the one we've used at UCLA to develop a person who has boards in both fields, ophthalmology and pathology. The reason that's important is that pathology has changed; it's no longer purely descriptive. It's molecular biology and it is using techniques and resources that are coming from the basic field of pathology. One of the directions we should explore and develop is the strength of pathology introduced into ophthalmic pathology to a greater extent than perhaps many of us have thought of.

Dr David J. Apple. How many pathologists do we need? There is plenty of work for plenty of them especially if you develop ties to industry, and that does not mean you actually have to do an industrial project. There are non-restrictive donations. We should get together and make a plan how to work with them and go to ophthalmic companies to see if they would provide some support since I am optimistic that they would be interested. The discouraging thing about the fellowship trainees is that they are discouraged about the future. The ones surviving are doing research.