

Lee Allen, Ocularist

ABSTRACT: *It is impossible to enumerate Lee Allen's contributions to medical illustration, ophthalmic photography, ocularistry and ophthalmology; the first three fields claim him as a founding member. He invented instruments, collaborated in developing ocular implants, and constantly worked to develop new methods for giving patients the best results. Whatever he did, Lee constantly strove for the perfect possible outcome. In this article, the authors share their perspectives on Lee Allen (1910-2006) and his contributions to the field of ocular prosthetics*

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INTRODUCTION

Most professions include several members who have made especially significant contributions to the development and overall “good” of the field. Ocularistry is no exception. In the modern era of ocular prosthetics, significant contributors include the various dental departments of the United States, Canadian, and British armed forces in the years of World War II.¹⁻⁴ Fritz Jardon, whose work encompassed dental technology, stock plastic prostheses (at American Optical), and custom ocular prostheses was widely considered one of the first to fabricate an all-plastic prosthetic eye.⁵ Another leader in the ocularistry field was Joe LeGrand, Sr., who professionalized the craft, developed innovative techniques, and gave many individuals an opportunity to practice ocularistry as the demand for custom work was growing.⁶

Among these noteworthy ocularists is Lee Allen. In his book, *An Eye for an Eye*, ocularist Walter Tillman credits Allen with being “the greatest ocularist in the history of the profession.” Tillman writes, “He is an excellent teacher and has lectured innumerable times throughout the country. He has been published more than 70 times. He has received every award offered by the American Society of Ocularists, including the presidency. He has also served as president of the Association of Medical Illustrators and the Ophthalmic Photographers’ Society. His objective has consistently been to share his abundant storehouse of knowledge . . . Mr. Lee Allen has contributed more to the profession of ocularistry than anyone in history”⁷ (Figure 1).

THE UNIVERSITY OF IOWA

Lee Allen will always be associated with the state of Iowa, where he was born, brought up, educated, and spent most of his 95 years. Allen worked at the University of Iowa for some 40 years. In his leisure time, he paint-

KEY WORDS:

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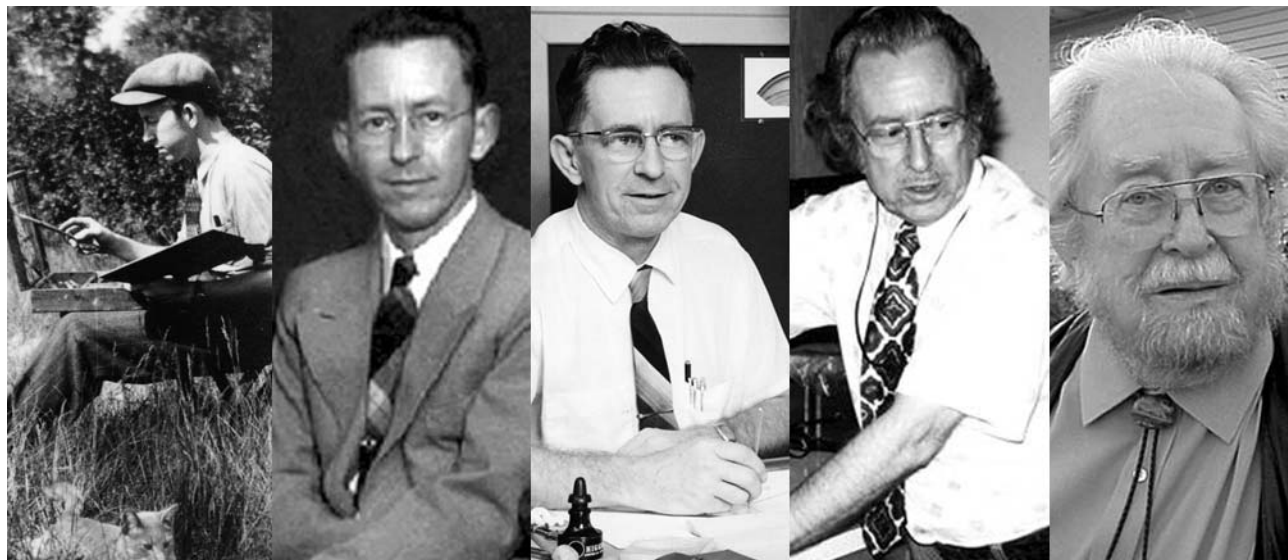


FIGURE 1 While Lee Allen's face changed over the years, his tenacity and thirst for perfection as an artist and practitioner did not.

ed scenes of the beautiful Iowa landscape.

Allen and others have detailed his early life, including his struggles to become an artist.^{8, 9} In September 1929, Allen enrolled at the University of Iowa as an undergraduate, majoring in fine arts. The fact that he did not graduate only serves to highlight his achievements as a self-taught professional. It also confirms that the craft of ophthalmology depends on skills beyond degrees or training.

It is not certain when the University of Iowa began fitting prosthetic eyes. Such details are rarely found, for most of the time these developments occur gradually. Providing patients with ocular prostheses fell to various specialists in the early years of the craft. While ophthalmology has been considered an art form ever since prosthetic eyes were made of mouth-blown glass, the eyemaker's place in health care has not always been distinct.

At the turn of the twentieth century, Iowa City was like most medium-sized communities in the United States in that the only artificial eyes available were glass stock prostheses. If it were inconvenient for a patient to travel to a larger city—in this case, Chicago—the local optician or even the eye surgeon would fit a stock glass prosthesis. Due to the difficulty of finding a practitioner, many individuals chose not to wear a prosthesis.¹⁰

When Lee Allen began his studies at the University of Iowa, most eye clinics did not employ

ocularists, although they did sometimes employ another type of artist, the medical illustrator, whose artistic skills and scientific knowledge combined to create illustrations for publications and for technical and scientific displays. Medical illustrators could become essential to the vitality of a department, and ophthalmology sometimes developed from the illustrator's art. For example, Leon Schlossberg, the first medical illustrator employed by the U.S. Navy in 1942 and later president of the Association of Medical Illustrators (1955-1956), may have been one of the first illustrators to make plastic prosthetic eyes. Schlossberg worked at Bethesda Naval Hospital and wrote several significant papers on the military's work in creating ocular prostheses.¹¹⁻¹³

Allen knew of Schlossberg's pioneering work, which he later cited in several articles.¹⁴ He also knew medical illustrator Emil G. Bethke, who like Allen would later serve as president of the Association of Medical Illustrators (1971-1972). Bethke, who introduced Allen to ophthalmic illustration while Allen was still a college student, worked as a medical illustrator in the University of Iowa's department of ophthalmology. Allen routinely studied Bethke's work, learned his illustration techniques, and, as an undergraduate, made his first drawing of the retina.¹⁵

In 1935, Bethke resigned his university position. (He later rose to prominence as a medical illustrator and an important ophthalmologist on the staff of Columbia

Presbyterian Hospital in New York City.)^{16, 17} Bethke offered his post to Allen, but because Allen was still intent on a career in the fine arts, he refused the initial offer. By 1937, however, married and with his first child on the way, Allen reconsidered and joined the ophthalmology department as a medical illustrator.¹⁵

Immediately faced with the need to understand eye anatomy, disorders, and diseases, Allen began an intensive program of self-education: viewing operations, attending medical school lectures, interviewing surgeons, and diagramming procedures. Department chair C.S. O'Brien, M.D., allowed Allen to audit whatever classes he wished, supported his independent studies, and later saw that Allen's pivotal research was credited, encouraging him to publish in professional journals.

Beyond the proficiency he gained as an ophthalmic medical illustrator, Allen became an inventor. He created an electrode for measuring the eye's electrical response known as the Burian-Allen ERG Electrode (1954). In 1955, he designed an examination lens, the Allen-Thorpe gonioscopy, which allowed physicians to view the anterior chambers of patients with glaucoma. In tandem with his interest in surgery, Allen sought new means of capturing the interior life of the eye on film, helping to establish the field of ophthalmic photography. He was the first to use dye to track the flow of blood through the eye chamber, and he pioneered retinal illustration through color fundus photography. His colleague and collaborator, Ogden Frazier, designed the instruments Allen envisioned, and the pair were internationally recognized for their achievements. These included the Allen "dot" for all Zeiss fundus cameras (1964), specialized filters for fluorescein angiography (1969), and the Allen stereo separator (1970) (Figure 2).

Ocular Implants

In 1945 James Allen, M.D. (no relation to Lee), a professor at the University of Iowa, who had previously served as a major in the Air Force Medical Service, urged the ophthalmology department head, C.S. O'Brien, M.D., to support the development of a better ocular motility implant. Dr. Allen had been chief of ophthalmology and otolaryngology at Scott Air Force Base near Belleville, Illinois, and was familiar with the dental laboratory there. He was seeking an improvement on the implants designed

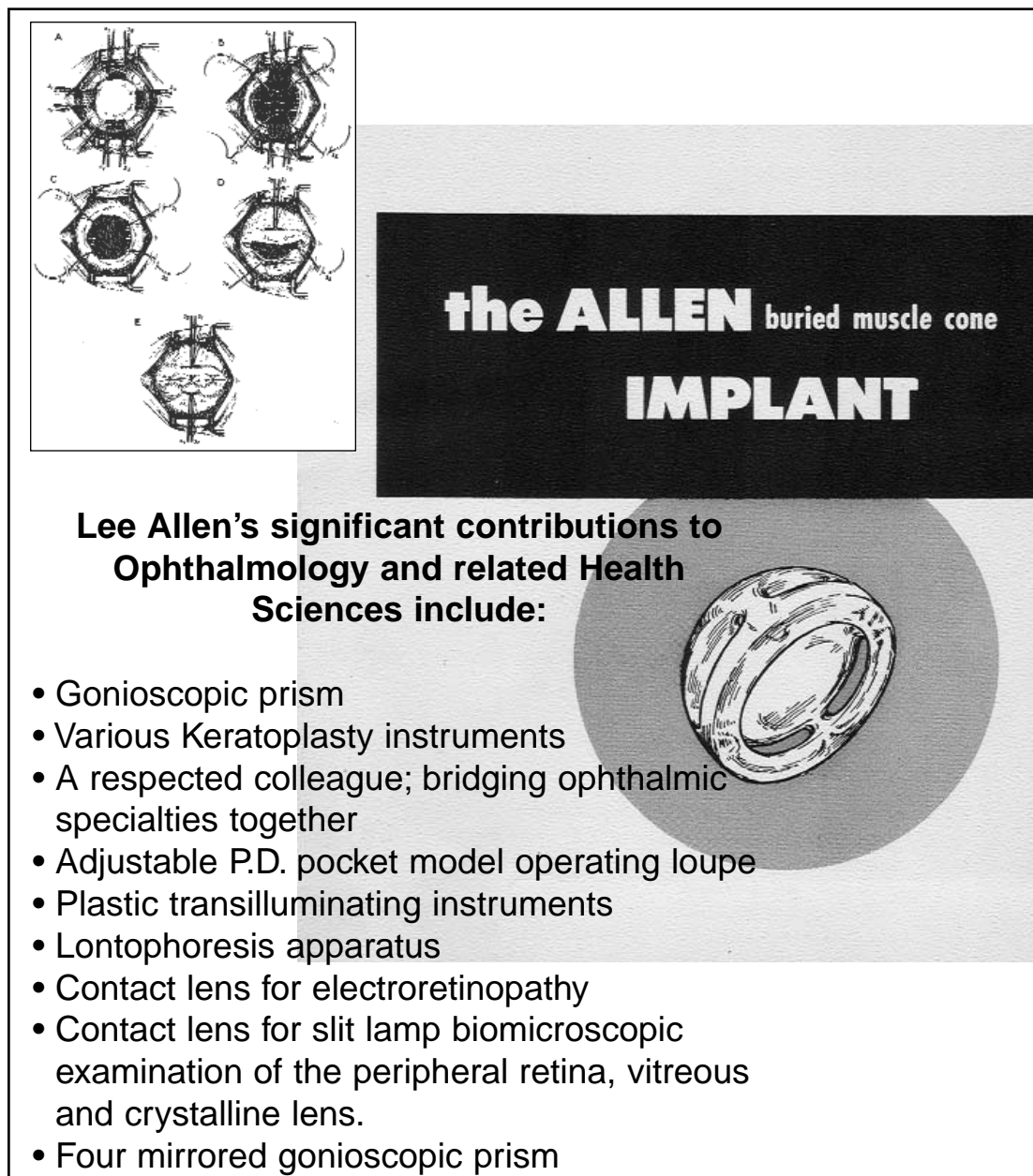
by Norman Cutler, M.D., in the military. Lee Allen later recalled, "I was really commandeered into the project because I was the medical artist in the department and could learn how to make the artificial eyes needed to fit and prove the effectiveness of the implants." Lee was sent for a "long visit" to Scott Air Force Base to learn about a new plastic material, (poly) methyl methacrylate, or PMMA.

The original Allen implant, in which Lee Allen collaborated with Dr. James Allen's design, was an exposed integrated implant connected by a thin rod to the prosthetic eye. It gave less than satisfactory results because it allowed bacteria to pass through a hole in the tissues, causing irritation, inflammation, and infection as many other integrated implants had done before. In 1948, Lee Allen reported, "I incorporated the four tunnels from Dr. Allen's design, and the new implant could bear both our names, 'Allen'." Unlike the first Allen implant, the new implant had no connecting rod. The device was a cutting-edge motility implant because, unlike many then in existence, it was completely buried beneath the tissues of the eye socket. First reported in May 1950 in *Archives of Ophthalmology*,¹⁸ Lee Allen's design for the Allen implant was widely used for more than 10 years until it was replaced by a modified version designed to address the common complaints of some of the ocularists who were fitting them.

For the redesign, Allen saw the advantage of a differently shaped motility implant with pronounced irregularity on its anterior surface. This design would connect it more securely to the prosthetic eye's posterior surface, which was shaped to match the irregular anterior surface of the implant. His next design, a quasi-integrated Iowa implant, was reported in the *Transactions of the American Academy of Ophthalmology* in 1960.¹⁹ Later modifications of the Iowa implant design led to the development of the Universal implant, reported in the *Archives of Ophthalmology* in 1987. However, the Universal implant was not widely used because it emerged around the same time that the hydroxyapatite implant was introduced (Figure 3).

Prosthetic Eyes

By 1945, at the University of Iowa, it was soon common knowledge that Lee Allen was fabricating prosthetic eyes. In 1948, the department of oph-



the ALLEN buried muscle cone
IMPLANT

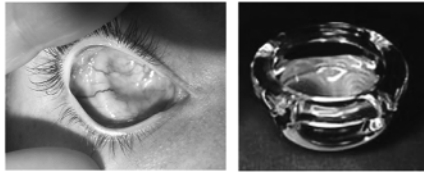
Lee Allen's significant contributions to Ophthalmology and related Health Sciences include:

- Gonioscopic prism
- Various Keratoplasty instruments
- A respected colleague; bridging ophthalmic specialties together
- Adjustable P.D. pocket model operating loupe
- Plastic transilluminating instruments
- Lontophoresis apparatus
- Contact lens for electroretinopathy
- Contact lens for slit lamp biomicroscopic examination of the peripheral retina, vitreous and crystalline lens.
- Four mirrored gonioscopic prism

FIGURE 2 Allen was involved in many areas of ophthalmic medicine, some related to oculoplasty and some not. This is only a partial list of Allen's significant contributions to the ophthalmic profession. This noted image is a vintage brochure, advertising the Allen implant to oculoplastic ophthalmologists. The upper left inset in this figure shows a suture technique, included in the brochure, which was (also) illustrated by Lee Allen.

thalmology hired an Iowa-trained artist, Howard Webster, to assist him. Allen said, "That was a fortunate decision because it made it possible that, as I would conceive of some improvements in our techniques, Howard Webster would put the ideas to use in the routine of the work with patients—and we could prove the points."

In his earliest attempts at making acrylic prosthetic eyes, Allen copied the shapes of stock glass eyes. However, he noticed that patients whose artificial eyes fitted the contours of their eye sockets most closely had the fewest problems with mucus discharge and infections. By 1952, Allen had adopted the use of alginate, as documented by



The ALLEN IMPLANT

MADE BY

PRECISION-COSMET
Company, INC.

234 HENNEPIN AVENUE GATEWAY BANK BUILDING
MINNEAPOLIS 1. MINNESOTA

Makers of Fine Ocular Prostheses and Contact Lenses



The
**ALLEN
IMPLANT**



Designed by

J. H. Allen, M. D.

Mr. Lee Allen

Dept. of Ophthalmology

State University of Iowa

Iowa City, Iowa



The

IOWA Motility Muscle Cone
IMPLANT

AGAIN AVAILABLE

Contours improved. Manufacture
authorized by original designer.

Lee Allen

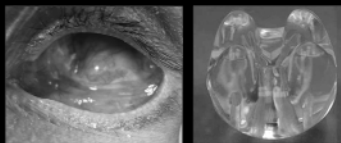


FIGURE 3 At times, ocularists have influenced the development of ocular implants. Allen was directly involved with the development of two significant ocular implants. One, the Allen implant, bears his name. The above images are (two) brochures detailing specifications and surgical implantation techniques for the ocular implants Lee Allen collaborated on.

Lee Allen's significant contributions to Ocularistry include:

- The design and development of innovative ocular implants while understanding (ocular) prosthetic limitations and patient expectations.
- Established standards for custom ocular prostheses—and presented new and creative ideas to various journals and periodicals.
- Implemented a team-approach in working with other ocularists, ophthalmologists and opticians in refining the fitting and hand painting (impression-fit) ocular prostheses.
- As a medical illustrator, utilized his talents and became an example of versatility in the ophthalmological community.
- Father of the modified impression technique of fitting and fabricating custom ocular prostheses.
- Heavily influenced the American Society of Ocularists and the National Examining Board of Ocularists in the formative years of these professional organizations.

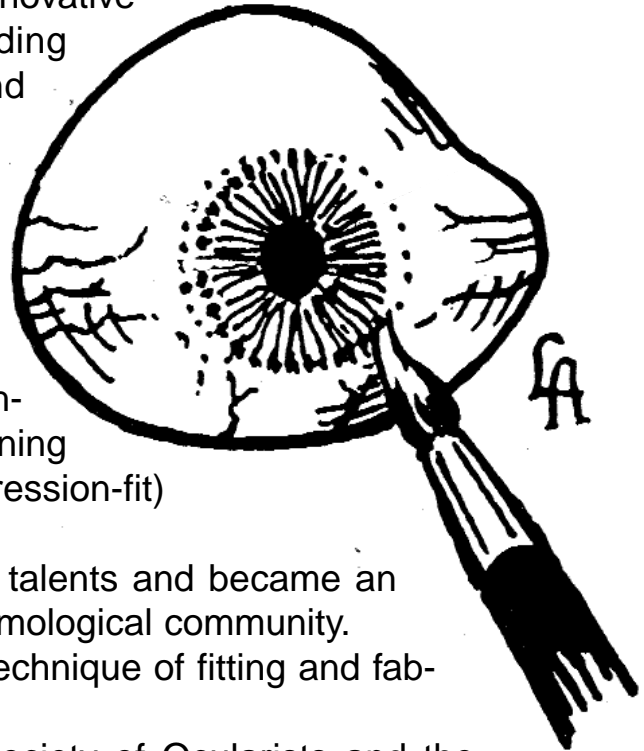


FIGURE 4 Lee Allen is credited with many innovations in ocularistry. Some of these subtle changes are so ingrained in ocularists' daily practices that they are often taken for granted. Nevertheless, Allen established so many standards, they are difficult to list. The illustration (above) was taken from Lee Allen's painting shell article published in the *Journal for the American Society of Ocularists* (1982).

the U.S. Army and Navy in several published articles, to take impressions of patients' eye sockets and thus create better-fitting prostheses.

Lee again speaks of himself and Howard Webster: "Together, we devised new shapes for the eyes for overcoming distortions of the eyelid tissues caused by an eye removal. Several new principles were then described in our first paper, [with A.E. Braley, M.D.], 'Problems in Ocular Prosthetics,' in the *Journal of the Iowa State Medical Society*, August 1953."²⁰ This paper, together with the military reports of the early 1940s, is one of the first important articles on fitting prosthetic eyes.

In 1964, Raymond Rarey joined the University of Iowa ophthalmology department, working with Lee Allen and Howard Webster. He eventually replaced Webster, who left to set up practice in Sarasota, Florida. Ray worked with the University of Iowa Dental School, bringing dental mold-making techniques and further knowledge about PMMA and its uses to the process of fabricating ocular prosthetics.


The Modified Impression Technique

Lee Allen and Howard Webster made great improvements in fitting prosthetic eyes based on

Ocularists trained by Lee Allen include:

1. Howard Webster
2. Raymond Rarey
3. David Bulgarelli *
4. Abdullah Makdissi
5. William Monte Anderson
6. Steve Young *
7. Olympia Niederecker
8. Joe Bill Jones
9. Daniel Yeager *
10. John Hadlock *
11. Terry Bulgarelli *
12. Elsie Joy *
13. Michael Boyd
14. Vaune Bulgarelli *

* *Board Certified Ocularist*



Lee Allen (left) and Howard Webster (right with neck tie) at the University of Iowa, c. 1958

FIGURE 5 Many ocularists have been influenced by Lee Allen. This list notes the names of those who worked with him directly. Many of these ocularists have been significant eye-makers and members of the American Society of Ocularists.

alginate impressions. They reported on these improvements and further refinements in shaping prosthetic eyes at the 1965 meeting of the American Academy of Ophthalmology. Their presentation, "Systematic Principles of the Modified Impression Method of Plastic Eye Fitting,"²¹ was the forerunner to another paper on the same subject, "Modified Impression Method of Artificial Eye Fitting," published in the *American Journal of Ophthalmology* in 1969.²² The latter included instructions on the use of cosmetic optics and is still considered one of the standard works on ocular prosthetic fabrication (Figure 4).

Like the study by Erff, Dietz, and Wirth published in the *American Journal of Ophthalmology* in 1946,¹ Allen's 1969 article on the modified impression method was the second significant paper that helped move the craft of eyemaking into the mainstream of ophthalmology. While many ophthalmologists do not enucleate eyes or

deal with prosthetics, Allen's milestone article on the fitting procedure is still a valuable guide for those who do. (Articles that are more recent tend to focus on ocular implants rather than fitting prosthetic eyes.) In clear detail, accompanied by simple and clear line drawings, Allen described each step in the process of taking an impression and fabricating an eye. His work at a teaching hospital clearly shaped the writing of this important instructional article.

OCULARIST APPRENTICES

Also in the late 1960s, Allen began the hands-on teaching of ocularistry. In 1968 because the demand for custom artificial eyes was increasing, he brought his first true apprentice to work with him at the University of Iowa. By 1973, Fred Blodi, M. D., then department chair, agreed to a training program for the department's ocularists.

The apprentices, who came from diverse backgrounds, received a modest stipend and, more importantly, hands-on training in the craft of ocularistry.

Lee Allen retired from the University of Iowa Hospitals and Clinics in 1976 with the rank of Emeritus Associate in Ophthalmology. He opened a private practice, Iowa Eye Prosthetics, Inc., in Coralville, Iowa, with David Bulgarelli, a former trainee from the University of Iowa who had stayed on to work with Allen after his apprenticeship. At Iowa Eye Prosthetics, Allen continued the training program begun at the university. Between the two training programs, Allen trained fourteen apprentices, eight of whom are still practicing ocularists. Several of Allen's apprentices became certified ocularists and important members of the American Society of Ocularists (Figure 5).

Shortly after starting his private practice, Allen refined a procedure he had developed with Steve Young and Monte Anderson, two University of Iowa apprentices, for control of the total cosmetic effect in a plastic eye. He and Bulgarelli described the technique, dubbed the "Iowa painting shell technique," in the *Journal of the American Society of Ocularists* in 1982.²³ Many ocularists use it today, along with other small technical improvements that Allen developed or refined.

Allen's passion for art led him to the field of ocularistry. His curiosity and his background in medical illustration led him to study and understand the orbit and the design and fabrication of artificial eyes that matched the living socket. He also learned how to manipulate the tissues to achieve a more normal appearance and function. Lee Allen is the father of the modified impression method of artificial eye-fitting.

Many ocularists may be unaware of Allen's contributions to other fields. Allen's knowledge of anatomy led him to an understanding of orbital tissues and muscles, and of how enucleation surgery affects orbital shape and function. In 1983, he wrote an article, "The Argument Against Imbricating the Rectus Muscles Over a Spherical Implant After Enucleation," because he recognized the problems that arose from having the muscles tied across a smooth, slippery ball.²⁴ This technique caused the implant to migrate, decreasing

motility and causing problems with fitting the ocular prosthesis. This was just one of Allen's many contributions that affected both ocularistry and ophthalmology for the good of patients.

Although he was originally hired as a medical illustrator, Allen's role at the University of Iowa and in his chosen field expanded greatly as his talents and knowledge developed. The ophthalmology department acknowledged his productivity with increasing rank. By 1951, he held the rank of research assistant in the department, and by 1958, he was an associate in ophthalmology, one of the highest academic ranks attainable without an M.D. During his time at the University of Iowa, Allen also served as president of several national professional associations. He was president of the Association of Medical Illustrators (1959),¹⁵ founding member and first president of the Ophthalmic Photographers' Society (1969),²⁵ charter member and president of the American Society of Ocularists (1969),¹⁵ and an organizational task force member and charter board member of the National Examining Board of Ocularists. The American Academy of Ophthalmology awarded him both the Senior Honor Award in 1984 and the Outstanding Lifetime Achievement Award in 2001.

Allen illustrated many medical textbooks, wrote numerous scientific articles, designed many medical devices, and created scientific exhibits. His illustrations in Wallace Alward's *Color Atlas of Gonioscopy* are of particular merit. Nonetheless, throughout his busy professional career, Allen never stopped creating fine art. While at the University of Iowa, he painted portraits of several medical staff members, made bronze and bas-relief portraits of others, and painted landscapes in oils and watercolors for friends and colleagues.

After retiring from ocularistry, Allen took up the fine arts full-time again. Even as he was losing his own vision to age-related macular degeneration, he shared his knowledge through art, coauthoring and illustrating a University of Iowa-sponsored book, *The Hole in My Vision*, published in 2000. As Allen's disease progressed, he illustrated his declining vision through his art, leaving a legacy to others facing similar circumstances and providing information to doctors treating that disease.

PRESENTATIONS AND PUBLICATIONS ON OPHTHALMIC PROSTHETICS

- O'Brien CS, Allen JH, Allen L. Evisceration with intrascleral implant: a new technique. *Trans Am Ophthalmol Soc* 1946; 44:296-303.
- Allen JH, Allen L. A buried muscle cone implant: I. Development of a tunneled hemispherical type. *Arch Ophthalmol* 1950; 43:879-890.
- Braley AE, Allen L, Webster HE. Ocular prosthetics: solutions of several common fitting problems. Paper presented at: Annual Meeting of the American Medical Association; June 1953; New York, NY.
- Braley AE, Allen L, Webster HE. Ocular prosthetics: solutions of several common fitting problems. Paper presented at: American Academy of Ophthalmology and Otolaryngology; October 1953; Chicago, Ill.
- Allen L, Braley AE, Webster H. Problems in ocular prosthetics. *J Iowa State Med Soc* 1953; 53:329-335.
- Allen L, Ferguson EC, Braley AE. A quasi-integrated buried muscle cone implant with good motility and advantages for prosthetic fitting. *Trans Am Acad Ophthalmol Otolaryngol* 1960; 64:272-286.
- Allen, Lee. Systematic principles of the modified impression method of plastic eye fitting. Paper presented at: American Society of Ocularists; 1965; Chicago, Ill.
- Allen, Lee. Motility in ocular prosthetics. Paper presented at: American Society of Ocularists; 1965; Chicago, Ill.
- Spivey BE, Allen L, Burns CA. The Iowa enucleation implant: a 10-year evaluation of technique and results. *Am J Ophthalmol* 1969;67: 171-188.
- Allen L, Spivey BE, Burns CA. A larger Iowa implant. *Am J Ophthalmol* 1969 68:397-400.
- Allen, Lee. Fitting the cosmetic prosthesis: a challenge. Paper presented at: American Academy of Ophthalmology and Otolaryngology; October 14, 1969; Chicago, Ill.
- Allen L. Fitting the prosthesis: a challenge. *Trans Am Acad Ophthalmol Otolaryngol* 1970; 74:1318-1320.
- Allen L, Webster H. Modified impression method of artificial eye fitting. *Am J Ophthalmol* 1969; 67:189-217.
- Allen L. Treatment of upper and lower lid entropion with prosthetic modifications. Paper presented at: American Society of Ocularists; 1971.
- Allen L. Unfortunate results from indiscriminate fitting of shell eyes. Paper presented at: American Society of Ocularists; 1971.
- Allen L. Prosthesis fitting, cosmesis and motility criteria. Paper presented at: American Society of Ocularists; 1973.
- Allen L. Prosthesis fitting, cosmesis and motility criteria. In: Guibor P, Gougelman HP, eds. *Problems and Treatment of Enucleation, Evisceration, Exposure: Selected Papers and Discussion from the Sixteenth Annual Meeting of the American Society of Ocularists*, Dallas, Texas. New York: Stratton Intercontinental Medical Book Corp., 1974.
- Allen L. Reduction of upper eyelid ptosis with the prosthesis, with special attention to a recently devised, more effective method. Paper presented at: American Society of Ocularists; 1974.
- Allen L, Blodi FC. A conoidal exenteration implant. *Trans Am Acad Ophthalmol Otolaryngol* 1974;78: OP617-21.
- Allen L. Individualized care of plastic artificial eyes. In: Blodi FC, ed. *Current Concepts in Ophthalmology*. Vol. IV. St. Louis, Mo: Mosby; 1974.
- Allen L. Motility in ocular prosthetics. Paper presented at: American Society of Ocularists; 1975; Dallas, Texas.
- Allen L. Anatomy of the anophthalmic orbit and adnexa. Paper presented at: American Society of Ocularists; 1977; Dallas, Tex.
- Allen L, Bulgarelli DM, Yeager D, Hadlock J, Bulgarelli T. The tarsi and ophthalmic prosthetics. *Ophthalmology* 1979; 86: 1374-1376.
- Allen L, Kolder HE, Bulgarelli EM, Bulgarelli DM. Artificial eyes and tear measurements I. *Ophthalmology* 1980;87:155-157.
- Kolder HE, Allen L, Bulgarelli D, Bulgarelli EM. Artificial eyes and tear measurement II. *J Ophthal Prosthetics* 1982.
- Allen L. An iatrogenic ptosis after enucleation and its correction by prosthesis. Paper presented at: Third International Symposium of Plastic and Reconstructive Surgery of the Eye and Adnexa; 1980; New York, NY.
- Allen L, Bulgarelli DM. The painting shell for artificial eyes. *J Ophthal Prosthetics* 1982; 12:14-18.
- Allen L. The argument against imbricating the rectus muscles over spherical orbital implants after enucleation. *Ophthalmology* 1983; 90: 1116-1120.
- Allen L. The custom made artificial eye; use of the painting shell. Paper presented at: International Congress on Maxillo-facial Prosthetics and Technology; September 1983; London, England.
- Mausolf FA, Allen L, Albert S. Twice exposed Allen implant replaced by modified Iowa implant. Paper presented at: Joint Session of the American Academy of Ophthalmology and American Society of Ocularists; November 1983; Chicago, Ill.

OTHER PRESENTATIONS AND PUBLICATIONS

- Allen L. A new contact lens for viewing the angle of the anterior chamber of the eye. *Science* 1944; 99:186.
- Allen L, O'Brien CS. Gonioscopy simplified by a contact prism. *Arch Ophthalmol* 1945; 34:413-414.
- Robbie W, Leinfelder PJ, Allen L. A transparent plastic tank and cover for the Warburg manometric apparatus. *Science* 1946; 103:144-145.
- Lee OS Jr, Allen L. Keratoplasty; a preliminary report on development of instruments. *Am J Ophthalmol* 1949; 32:71-78.
- Allen L, Douvas N. Anterior segment photography with the Nordenson retinal camera. *Am J Ophthalmol* 1950; 33:291-292.
- Allen L. Stereoscopic drawing techniques. *Med Biol Illust* 1951;1:182-200.
- Braley AE, Allen L. A corneal contact prism and a corneal contact lens for slit lamp biomicroscopic examination of the peripheral and central fundus. *Trans Am Ophthalmol Otolaryngol* 1951; 49:477-483.
- Allen L. How to make your own orthoptic slides. *Am J Orthopt* 1953; 3:35-42.
- Allen L, Braley AE, Thorpe HE. An improved gonioscopic contact prism. *Arch Ophthalmol* 1954; 51:451-455.
- Braley AE, Allen L. Gonioscopy in non-glaucomatous young eyes as a basis for evaluating changes in relation to glaucoma. *Acta XVII Conc Ophthal* 1954; vol:pages.
- Burian HM, Braley AE, Allen L. External and gonioscopic visibility of the ring of Schwalbe and the trabecular zone: an interpretation of the posterior corneal embryotoxon and the so-called congenital hyaline membranes on the posterior corneal surface. *Trans Am Ophthalmol Soc* 1954-1955; 52:389-428.
- Burian HM, Allen L. A speculum contact lens electrode for electroretinography. *Electroencephalogr Clin Neurophysiol* 1954; 6:509-511.
- Allen L, Burian HM, Braley AE. A new concept of the development of the anterior chamber angle. *AMA Arch Ophthalmol* 1955; 53:783-798.
- Allen L, Burian HM, Braley AE. The anterior border ring of Schwalbe and the pectinate ligament: embryologic and comparative anatomic studies. *Arch Ophthalmol* 1955; 53:799-806.
- Burian HM, Braley AE, Allen L. Visibility of the ring of Schwalbe and the trabecular zone: an interpretation of the posterior corneal embryotoxon and the so-called congenital hyaline membranes on the posterior corneal surface. *AMA Arch Ophthalmol* 1955; 53:767-782.
- Burian HM, Allen L. Mechanical changes during accommodation observed by gonioscopy. *AMA Arch Ophthalmol* 1955; 54:66-72.
- Allen L. Abstraction, synthesis, and symbols. *J Assoc Med Illus* 1958;10:20-29.
- von Noorden GK, Allen L, Burian HM. A photographic method for the determination of the behavior of fixation. *Am J Ophthalmol* 1959; 48:511-514.
- Allen L, Burian HM. The trabeculotome, an instrument for trabeculotomy ab externo. *Trans Acad Amer Ophthalmol Otolaryngol* 1961; 65:200-201.
- Burian HM, Allen L. Histologic study of the chamber angle of patients with Marfan syndrome: a discussion of the cases of Theobald, Reeh and Lehman, and Sadi de Buen and Velazquez. *Arch Ophthalmol* 1961; 65:323-333.
- Allen L, Burian HM. Trabeculotomy ab externo, a new glaucoma operation technique and results of experimental surgery. *Am J Ophthalmol* 1962; 53:19-26.
- Watzke RC, Allen L. The Allen-Watzke corneal graft holder. *Trans Am Acad Ophthalmol Otolaryngol* 1963; 67:558-559.
- Allen L. Stereoscopic fundus photography with the new instant positive print films. *Am J Ophthalmol* 1964; 57:538-543.
- Allen L. Ocular fundus photography. Suggestions for achieving consistently good pictures and instructions for stereoscopic photography. *Am J Ophthalmol* 1964; 57:13-28.
- Allen L, Kirkendall WM, Snyder WB, Frazier O. Instant positive prints in fluorescein photography of the ocular fundus. Paper presented at: Midwest Section Meeting, Association for Research in Ophthalmology; 1965.
- Allen L, Burian HM. The valve action of the trabecular meshwork; studies with functional silicone models. *Am J Ophthalmol* 1965; 59:382-389.
- Allen L, Kirkendall WM, Snyder WB, Frazier O. Instant positive photographs and stereograms of ocular fundus fluorescence. *Arch Ophthalmol* 1966; 75:192-198.
- Snyder WB, Allen L, Frazier O. Fluorescein angiography. An aid in the diagnosis of occluded vessels. *Arch Ophthalmol* 1967; 77:168-175.
- Snyder WB, Allen L, Frazier O. Fluorescein angiography of ocular tumors. *Trans Am Acad Ophthalmol Otolaryngol* 1967; 71:820-832.

OTHER PRESENTATIONS AND PUBLICATIONS (continued)

- Allen L, Frazier O. "Evidence favoring wide band filters for fluorescein angiography." In: Amalric P, ed., *Proceedings of the 1st International Symposium on Fluorescein Angiography, Albi, France, June 1969*. Basel: Karger;1971:2-5.
- Allen L. "Analysis of so-called hyperstereo in fundus photography." In: Amalric P, ed., *Proceedings of the 1st International Symposium on Fluorescein Angiography, Albi, France, June 1969*. Basel: Karger; 1971:6-7.
- Watzke RC, Allen L. Subjective slitbeam sign for macular disease. *Am J Ophthalmol* 1969; 68:449-453.
- Allen L. Stereoscopic fluorescein angiography of the ocular fundus. *J Biol Photogr Assoc* 1971; 39:89-96.
- Allen L. Ophthalmic photography and its potential. Presidential address, Ophthalmic Photographers' Society Annual Meeting; 1970;Las Vegas, Nv.
- Allen L. Ophthalmic photography and its potential. Japanese *J Clin Ophthalmol* 1971; 25:100-103 [in Japanese].
- Allen L. Slit lamp stereography. Associates for Research in Vision and Ophthalmology annual meeting;1972;Sarasota, Florida.
- Schatz H, George T, Liu J-H, Maumenee AE, Patz A, Allen L. Color fluorescein angiography. American Academy of Ophthalmology and Otolaryngology annual meeting; 1972; Dallas, Tex.
- Allen L, Frazier O. The results of tests on a broad band filter combination for fluorescein angiography. Paper presented at: Third International Symposium on Fluorescein Angiography; February 1972; Tokyo, Japan.
- Frazier O, Allen L. The results of tests on a broad band filter combination for fluorescein angiography. In: Blodi FC, ed. *Current Concepts in Ophthalmology*. Vol. III. St. Louis, Mo: Mosby; 1972.
- Allen L, Frazier O. Photography and stereography with the corneal contact fundus cameras. Paper presented at: Fourth International Symposium on Fluorescein Angiography; March 1976; Ghent, Belgium.
- Spivey BE, Allen L, Stewart WB. Surgical correction of superior sulcus deformity occurring after enucleation. *Am J Ophthalmol* 1976; 83:365-370.
- Allen L. Slit-lamp biomicrography. *Int Ophthalmol Clin* 1976; 16:145-180.

DISCUSSION AND WORKSHOP GROUPS

- Fitting methods and procedures, care and cleanings. Moderators Lee Allen and Henry Gougelman. American Society of Ocularists; 1970.
- Discussion and workshops. Moderator Lee Allen. American Society of Ocularists; 1971.
- Manuscript and speech preparation workshop. Moderator Lee Allen. American Society of Ocularists; 1972; Freeport, Me.

SYMPOSIA

- Symposium on orbital implants (participant). Reconstructive surgery program, American Academy of Ophthalmology and Otolaryngology; 1969.
- Molding techniques (participant). American Society of Ocularists; 1969.
- Hygiene and general care of the orbit and prosthesis (participant). American Society of Ocularists; 1969.
- Symposium on Fluorescein Angiography (participant); 1970; Miami, Fla.
- Third International Symposium on Fluorescein Angiography (participant); 1972; Tokyo, Japan.
- Fourth International Symposium on Fluorescein Angiography (participant); 1976; Ghent, Belgium.
- Third International Symposium on Plastic and Reconstructive Surgery of the Eye and Adnexa (participant); 1980; New York, NY.
- The International Congress on Maxillo-Facial Prosthetics and Technology at Royal College of Surgeons and Froebel College (participant); 1983; London, England.

CONCLUSION

Lee Allen was an important professional who, in addition to his significant work in medical illustration, photography, and design, contributed immeasurably to the development of ophthalmology. Allen's legacy to the profession is his unending curiosity and desire to create the best possible result for patients. More than any single technique, idea or suggestion, his colleagues will remember his quest for perfection.

REFERENCES

1. Erff SF, Wirz MS, Dietz VH. Plastic artificial eye program, U.S. Army. *Am J Ophthalmol* 1946; 29:984.
2. MacDonald GM. Plastic ophthalmic prostheses. *Treatment Bulletin, Department of Veterans Affairs* 1949; 4:3-9.
3. Sellers FJ. Acrylic ocular prosthesis. *Journal of the Royal Army Medical Corps* 1947;79: 91-100.
4. Office of the US Surgeon General. Instruction booklet, *Valley Forge Plastic Artificial Eye Program*. Washington, DC: US Army; 1944.
5. Medicine. *Life*, December 13, 1948, 157-158.
6. LeGrand J. Memories of a modern pioneer: Joseph A. LeGrand. *J Ophthalm Prosthet* 2007; 12:5-33.
7. Tillman W. *An Eye for an Eye: A Guide for the Artificial Eye Wearer*. Publisher: Author, 1987.
8. Wong D, Fishman M. Lee Allen: The man, the legend. *Journal of Ophthalmic Photography* 1990; 12:51-67.
9. Allen L. *The Hole in My Vision*. Iowa City, IA: Penfield Press, 2000.
10. Hughes MO. Eye injuries and prosthetic restoration in the American Civil War years. *J Ophthalm Prosthet* 2008; 13:17-28.
11. Murphy PJ, Schlossberg L. Eye replacement by acrylic maxillofacial prostheses. *U.S. Naval Medical Bulletin* 1944; 43: 1085-1099.
12. Murphy PJ, Schlossberg L. Eye replacement by acrylic maxillofacial prosthesis. *Military Surgeon* 1945; 96: 469-478.
13. Hughes MO. Two (almost) forgotten soldiers. *J Ophthalm Prosthet* 2000; 5:37-43.
14. Allen L, Webster HE. Modified impression method of artificial eye fitting. *Am J Ophthalmol* 1969; 67: 189-218.
15. The Stone City Art Colony and School, 1932-1933. Lee Allen. www.mtmercy.edu/stone/artists.htm. Accessed September 3, 2008.
16. Bethke EG. *Basic Drawing for Biology Students*. Springfield, Ill: Thomas Publishing; 1969.
17. Bethke EG. Criteria and guide for evaluation of ocular prostheses. *Am J Ophthalmol* 1952; 35: 527.
18. Allen JH, Allen L. A buried muscle cone implant: development of a tunnelled hemispherical type. *Arch Ophthalmol* 1950; 43:879-890.
19. Allen L, Ferguson EC, Braley AE. A quasi-integrated buried muscle cone implant with good motility and advantages for prosthetic fitting. *Trans Am Acad Ophthalmol Otolaryngol* 1960; 64:272.
20. Allen L, Braley AE, Webster H. Problems in ocular prosthetics. *J Iowa State Med Soc* 1953; 53:329-335.
21. Allen, Lee. Systematic principles of the modified impression method of plastic eye fitting. Paper presented at: American Society of Ocularists annual meeting; 1965; Chicago, Ill.
22. Allen L, Webster H. Modified impression method of artificial eye fitting. *Am J Ophthalmol* 1969; 67: 189-217.
23. Allen L, Bulgarelli DM. The painting shell for artificial eyes. *J American Society of Ocularists* 1982; 12:14-18.
24. Allen L. The argument against imbricating the rectus muscles over spherical orbital implants after enucleation. *Ophthalmology* 1983; 90:1116-1120.
25. An interview with Johnny Justice, Jr. www.opsweb.org/AboutOps/FFather.htm. Accessed January 15, 2008.

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PHOTO CREDITS

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The implant images from Figure 3 are courtesy of Francois Durette, Montreal Canada

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