

## PREFACE

Sir Harold Ridley (1906-2001) invented the intraocular lens (IOL) during the period between the 1930 and 1950s, based in part on his World War II experience with airplane pilots' eye injuries.

For the first time in history it was possible to achieve a successful restoration of sight for the millions of patients who were partially or totally blind with the condition we term a cataract—a clouding of the affected patient's lens. This is the most common cause of blindness in the world; 50 million individuals suffer from this condition. In some regions waiting-lists for cataract surgery are growing at a rate of 14,000 per day. For over 6,000 years there was no treatment of this condition except for an unsatisfactory procedure termed couching (see Frontispiece preceding the Dedication).

The IOL has made possible a real solution to this problem so that this condition, which was so long considered untreatable, is now eminently treatable and, as stated by Dr. Howard Fine, citing the work of Jonathan Javitt: "Cataract surgery is the most cost-effective and efficient surgical procedure in medicine and has the most quality-of-life-years value for society." Today there are over 10 million patients annually who are now receiving an IOL—and still the number is growing.

Harold succeeded by working with a superb team, including optical specialists at Rayner & Keeler, Ltd. (UK), experts in the field of plastics at Imperial Chemical Industries (UK), and others. He himself did not become a household name. For example, although I entered the field of vision care in 1968, I had not even heard of him until over 10 years later. I did a few dozen implants during my residency; the only teaching I received was from a senior resident at the local Veterans Administration Hospital. This resident was actually termed "too aggressive" by our faculty, but he kindly provided me instructions in a rote fashion (mostly from the company's brochure) so that I could proceed. Later, during my early years as an attending surgeon, I did perhaps 100 cases just as a return to posterior chamber IOLs was beginning—the type of fixation that Sir Harold had preferred all along. The patients did fine.

By the early 1980s when I moved to Utah I finally began working with IOLs in our research laboratory (see Chapter 4). I was pleasantly surprised! The skepticism, which had been drilled into us by our professors and the international doyens of ophthalmology for many years, vanished from my mind. Almost overnight I changed first to a positive frame of mind—soon thereafter, to outright enthusiasm. So many people had always been so negative about so many aspects of the IOL—but our research efforts changed our opinions on what we had heard constantly from the ophthalmic establishment. From the laboratory viewpoint, which in some ways may be as or more reliable than some clinical studies, our findings did show that the IOL worked!

Our published research findings, beginning with IOL #1 (see page 52) and three others that appeared in rapid succession in 1984-1985, were well-received and helped to contribute to further improvements in the quality of IOLs and helped them survive at a time when they were facing much criticism, much of it unwarranted. By 1985 Harold had apparently had become familiar with our first four published research articles.\* I was dumbfounded but honored when he invited (summoned) me to visit him in England. That summer, while in Europe, I flew to London and then took a train to his beautiful retirement cottage near Salisbury. You can't believe my excitement and pride as I stepped out of the train and walked down to meet him outside the station.

However, I was immediately stunned! His visage showed sadness and frustration—the appearance of a very unhappy and depressed man. He soon appeared very happy to see me and this increased by the hour.

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\*These four studies from 1984-1985 are cited here. See the appendix for several more publications that rapidly came off the press from 1984-1986, as well as books and book chapters.

1. Apple DJ, Craythorn JM, Olson RJ, Little LE, Lyman JB, Reidy JJ, Loftfield K. Anterior segment complications and neovascular glaucoma following implantation of posterior chamber intraocular lens. *Ophthalmology*. 1984;91:403-419.
2. Apple DJ, Mamalis N, Loftfield K, Brady SE, Olson RJ, et al. Complications of intraocular lenses. A historical and histopathological review. *Surv Ophthalmol*. 1984;29:1-54.
3. Apple DJ, Mamalis N, Brady SE, et al. Biocompatibility of implant materials: A review and scanning electron microscopic study. *J Am Intraocular Implant Soc*. 1984;10:53-66.
4. Apple DJ, Reidy JJ, Gooze JM, Mamalis N, et al. A comparison of ciliary sulcus and capsular bag fixation of posterior chamber intraocular lenses. *J Am Intraocular Implant Soc*. 1985;11:44-63.



My first meeting with the Riddleys was in summer of 1985—the beginning of a wonderful personal and professional relationship. Elisabeth is in the middle, flanked by me on her right, with Harold on her left.

would transcribe the information exchanged during our river walks and also fetched different memorabilia and papers, which we copied and expanded over a period of 15 years. We continually jotted down notes (which he referred to as “jottings”), which he would then type himself on his tiny word processor. A few years before he died he asked me to formalize all of this in his biography and I signed a contract to become his official biographer. After his death, his sons kindly sent me additional photographs and text material.



Organization of Sir Harold’s papers and memorabilia at his home near Salisbury, UK. On each visit, which averaged about three per year, we prepared drafts for the future preparation of the Memoirs of the Royal Society, which I was able to write for editorials and for this biography. In 2001, he and his wife Elisabeth signed a document designating me his official biographer.

We began a good personal and professional friendship that lasted until his death. His invention was a true gift to humanity and I thought it was an incredible injustice that he was not only not being honored, he was being ignored. The events set in motion on that summer day in 1985 are the essence of what we will chronicle in this book, ie, the long voyage (over 60 years) of a man and his innovation through periods of very rough waters to a safe harbor.

I started thinking about Sir Harold’s biography on the day I met him. I quickly realized that this would not just be an honor, but was a duty. Although it was not particularly easy to reach his idyllic cottage in Stapleford in Wiltshire near Salisbury, I made a point to visit his home two to three times each year, alone in the early years and later almost always with my wife, Ann, after our marriage in 1995.

We would often do river walks (see Chapter 5) and then would retire to his living room and then his upstairs. We

The origins of the IOL seem sometimes to have remained shrouded in mists as thick as a London fog. In this book I have explored the topic, using interviews with many of his contemporaries to catalogue as many events as possible. I have explored the actual origins of his first discussions of the IOL in the 1930s, the role of the “pilot,” the role of the “student,” the events leading to the first implantations, the early presentations and subsequent attacks which led to depressions, and the later positive events which led to a rekindling of interest in the lens and respect for Sir Harold, who was eventually knighted.

In addition to focusing on the IOL, I also have taken care to describe events and discoveries in his career that have generally remained almost unknown to most of us, ranging from his work on onchocerciasis to the use of electronic techniques derived from World War II.

Throughout the years, by far the three most common questions I have been asked regarding Sir Harold have been 1) is the “airplane story” really true?, 2) what caused the delay in widespread implementation of the IOL and why was he sometimes depressed and in conflict with one person?, and 3) was he a smart man, even a genius, or a “modest giant of science” as noted on page 31 of the text—and should we regard him as a hero, or was he an average surgeon who lucked out and appeared at the right time and place?

I will cover each of these in detail in the text and will provide a few introductory comments now.

## ***IS THE “AIRPLANE STORY” REALLY TRUE?***

By far the most common question I receive regarding Sir Harold relates to the “Spitfire” story. The first response I always must give is that if it is a true

story connected with Sir Harold, it was not a “Spitfire,” it was a Hurricane. He was adamant about that differentiation. For years I was very confused about the “airplane story” and didn’t know how to fit it into the entire pattern. The story was too good to be true. In addition, Mr. Ian Collins, former Managing Director of Rayner & Keeler, Ltd., has noted that some reasons for a lack of clear-cut documentation are that most of the records regarding the early design and manufacture of the IOL (between 1949-1960) has sadly been lost. The manufacturer, Rayner & Keeler, Ltd., had two moves of their Head Office, where the records were kept and also were victims of two floods. Therefore, ample surviving records from the company only exist from 1957 and later.

The invention of the intraocular lens by Sir Harold is not nearly as simple as often believed; in fact, it was a complex evolutionary process. The standard belief is that he observed a downed World War II pilot with eye injuries due to fragments of Plexiglas from the cockpit canopy becoming embedded in the eyes, after which he had a sudden flash of genius and came up with the idea.

It was far more complex than that—a process that lasted for over at least two decades from the time he first seriously considered the idea of a IOL until his first implantation in the mid-20th century.

In fact, the episode(s) regarding the pilot(s) was but one of many factors, albeit a very significant one. In determining the sequence of events of the invention of the IOL (see Chapter 6), I found that the “airplane story” was one of six factors. The examinations of the injured pilot(s) in effect provided a hugely important phase, the “pre-clinical” study—seemingly not planned ahead of time, but initiated after the surgeon’s realization that the injury could be used to provide evaluations necessary for future implantations. We are fortunate that at least some military and medical records of at least one pilot, Flight Lieutenant Gordon “Mouse” Cleaver, have been preserved. Many other pilots had such injuries, but reliable records are no longer available in virtually all of those cases. I have chosen to tell the story of Flight Lieutenant Cleaver and his squadron in detail to illustrate how the pilot’s injury provided a means to study the biocompatibility (tolerance) of the material Harold had chosen for his IOL.

## ***WHAT CAUSED THE DELAY IN IMPLANTING THE IOL AND WHY WAS HE SOMETIMES DEPRESSED AND IN CONFLICT WITH SOME COLLEAGUES, ESPECIALLY ONE?***

*“I had 25 years in the wilderness and a whole generation of cataract patients who might have enjoyed full visual rehabilitation instead suffered the abnormalities of aphakia.”*

*Harold Ridley*

As he started his voyage to perfect and disseminate his idea—which he knew was a good one, he thought, and hoped that he would have smooth sailing.

Something went very wrong!!

Within a few years the few kind and complimentary words that he heard from several close and supportive colleagues had largely been drowned out by a deluge of criticisms and vilifications from any naysayers, mostly emanating from the “academic establishment” of the time.

A few of many examples of these are as follows:

“This operation should never be done.”

“The first report was a layman’s magazine.”

“This operation offends the first principle of eye surgery.”

“A foreign body can cause sympathetic ophthalmia and malignant disease.”

“Rayner should be prosecuted for supplying implants.”

“Would you have one of these things put in your son’s eye?”

“Dr. Ridley, why don’t you GO HOME.”

“If any of you ever use an IOL in a hospital that I control, I will most certainly testify against you in legal process.”

“The IOL and the phacoemulsification procedure that goes with it represent a time bomb.”

If I, David Apple, had presented a new invention to the world and if such criticism had been leveled at me personally, I know that I would have shriveled up and disappeared. It is no wonder that Sir Harold on more than one occasion required antidepressant therapy, but he did hang in there.

After I met him I noticed how unknown a figure he was. Even in his little tiny village of Stapleford, the taxi driver, the butcher, the nearby farmers—all who were good friends—had no idea what he was or had done. What was really serious was the fact that the various naysayers of his era were in part responsible for blocking the implementation of his invention, not just for a few months or years, but for well over two decades! Harold was right with his comment “a whole generation of cataract patients... suffered...” There was some patriotic component to his depression.

*“As a result of the failure of British Ophthalmology to join and support the pioneers Britain lost its rightful place in a new and developing field. Through this failure a whole generation of British men and women who underwent cataract surgery between 1951 and 1975 were denied the full treatment which was then becoming available.”*

*Harold Ridley*

Finally, this did turn around... “all’s well that ends well.”

## **WAS HE A SMART MAN, OR EVEN A GENIUS AND SHOULD WE REGARD HIM AS A HERO, OR WAS HE AN AVERAGE PERSON WHO JUST LUCKED OUT AND APPEARED AT THE RIGHT TIME AND PLACE?**

There were many contemporaries of Harold back in the 1940s to 1960s who considered him anything but a hero. They certainly did not like the fact that they were being forced to change the way they did their surgery. We will speak about the huge paradigm shift that he brought about, in essence forcing doctors to place a foreign body into the eye in contrast to the well established dictum of taking things out of the eye.

Many at that time considered his approach to be cavalier, if not unethical. This feeling persists in some circles even today and some feel that he should have been thrown into jail at that time and still should be today if he exhibited the same behavior by moving forward without “oversight” of his operation.

The naysayers’ main complaint was that he did not do proper and careful basic and pre-clinical (laboratory) studies in anticipation of this operation. This is a good try, but I respectfully submit that it isn’t true. First, one has to remember that his work was going on in postwar heavily-bombed London where the niceties of such experimentation were difficult. But most importantly, he was actually—perhaps without not even realizing it—doing the best of all possible preclinical studies—on humans!

Therefore, was he smart? How many of us could figure out how to do a preclinical study on an invention that had not yet been invented? And how about the following? We will see in Chapter 15 that Harold was the inventor of the concept of the scanning laser ophthalmoscope (SLO)—long before the invention of the laser! I have the impression that it would require a very smart man to accomplish this. Look also at the list in the figure on the next page—a number of therapeutic options that his invention unlocked for us in later generations of clinicians and scientists to develop, again reflecting the work of a very competent man. There is no doubt that immense energy and intelligence were packed in that tiny frame that stood barely five feet high.

Back to the question “was he a hero?”, I would disagree with his contemporaries who would say “no.” In Chapter 4 I emphasized how I was raised in a mid-western community where I was strongly influenced by “heroes” who had lived in and around my community and environment, ranging from Abraham Lincoln to Mark Twain. Therefore, having spent two decades analyzing what Harold did, it was a very short and easy step for me to consider him a hero.

Finally, I have no doubt that each of the 10 million people who receive an IOL worldwide each year, who have absolutely no idea who Sir Harold was, would consider their unknown benefactor to be a hero.

1949

For the first time the lens capsular bag became accessible for visual and therapeutic implantations.



1. Classic IOLs
2. Refractive/vision enhancing devices (Super Vision); phakic IOLs
  - a. Toric lenses
  - b. Multifocal IOLs
  - c. Accomodative IOLs
  - d. IOLs to correct wavefront aberrations (high order Zernike polynomials)
3. Low vision IOLs (eg, Galilean telescopic devices)
4. "Sun block" IOLs
5. "Piggyback" IOLs
6. Pediatric IOLs
7. Drug delivery systems
  - a. Anti-PCO-IOLs
  - b. General intraocular therapy
8. Intraocular plastic surgery (artificial colored implants)
9. Implant site for various retinal stimulators ("artificial eyes")

Sir Harold's mid-20th century invention of the IOL initiated a major paradigm shift regarding eye surgery as follows:

Not only did he invent the basic IOL with the primary purpose of restoring vision to the partially or totally blind, he achieved more.

First, he "opened up the capsular bag" which made possible the use of many other patient procedures, lenses, and devices that considerably broadened the capabilities of the operation. Second, he in essence became a pioneer in the nascent field of biomedical engineering. He contributed to the new clinical subspecialty of organ, tissue, and artificial prosthesis implantation. He started with the lens, but many continued on with the heart, kidney, and many others.

## SOME GOALS

*"Having spent some time with Cornelius Kees Binkhorst, the great surgeon and teacher, in the Netherlands, I asked him if I could copy some of his slides before going back to my country, hoping to receive a few slides from his vast collection. The very next day, my true teacher brought a suitcase full of slides! 'Those are my slides,' he said, 'copy what you need!'"*

*"Moral of the story: Medical facts should be open. Patients deserve to know the facts and be able to understand any disease they, their relatives and friends may have so that they may be able to choose the best possible medical care."*

*Modified from C. Huber, Switzerland*

I want the facts about Sir Harold to be "open," as was so well stated by Dr. Huber. As I tell his story, including my long-term professional and personal association with him, I will cover to the best of my ability the true history and facts regarding his invention of the IOL and other innovations. My goal is to do what a good teacher should do, namely, to provide not only the basic story, but also to provide ample didactic material about the various eye diseases and therapies that we will cover.

Many friends and colleagues suggested that I present this almost as a novel, but I have decided to keep this book totally nonfiction with no intent to move into the realm of historical fiction in order to embellish the contents.\* Sometimes

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\* The reader who is not an ophthalmologist or trained eye health care provider will soon realize that most discussions and associated photographs regarding the eye and eye diseases will involve an always-difficult and often-bewildering vocabulary with a special jargon. This will also include many difficult-to-comprehend images. Please do not be discouraged!

A major goal of this book is to inform and teach by providing easy-to-understand descriptions of the eye, its diseases, and the treatments initiated by Sir Harold that will lead to better understanding of these. I have structured the text and photographs so that it should be easy for the eye care professional to skip over the various non-challenging sections if he or she so desires. Similarly, there are some sections that are probably only comprehensible in entirety to a trained professional. In chapters where the content is highly technical and difficult for the non-ophthalmologist to comprehend, I would suggest that the reader peruse the photographs of that section but pass over some or most of the text—and not get bogged down.

I have prepared the book so that it should be useful, interesting, and informative to anyone who has one or more of the eye diseases under discussion. I am sure that an individual who is about to have cataract-IOL surgery will find much of interest.

## PREFACE

truth is stranger than fiction. I have arranged things the way Harold would have liked it. I have made liberal use of quotes and comments from the master himself, done in italics throughout the text. Harold was a firm believer in crediting those who preceded him (or who also worked concurrently with him) in his various projects. That is the basic reason for the inclusion of Chapter 5, River Walks. Also, it was during the river walks that I came up to speed with Harold's thoughts and activities prior to 1985, before I met him. Events after that were usually first hand. There are certain segments that might appear out of place as a straight forward biography, eg, discussions of the Apple Korps or discussions of Charleston, SC. However, they are included because these and others are topics the Ridleys enjoyed.

After very difficult years of rejection, he was often depressed and his visage was very commonly similar to that seen on the left, below. As we continued to work together and as his life's work finally was more and more accepted, the happy man that we see in the illustration on the right, below, emerged and remained. Many people ask me what my most pleasing accomplishments were in my career. The answer is two-fold—helping improve the cataract-IOL procedure that he began and helping him become the satisfied man we see in the final photograph.

These two photographs speak volumes about Harold's mood over the years as we worked together.

LEFT: Early on, his sadness was apparent and dominant in his personality.

RIGHT: As things were sorted out in his final years and his innovations and contributions were finally recognized, we thankfully saw this positive change in his demeanor. Observing this turnabout as we grew closer and closer together has been one of the most satisfying events of my career.

