OPHTHALMOLOGY

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A Link With Our Past

An Interview with

Paul Boeder, PhD

OPHTHALMOLOGY

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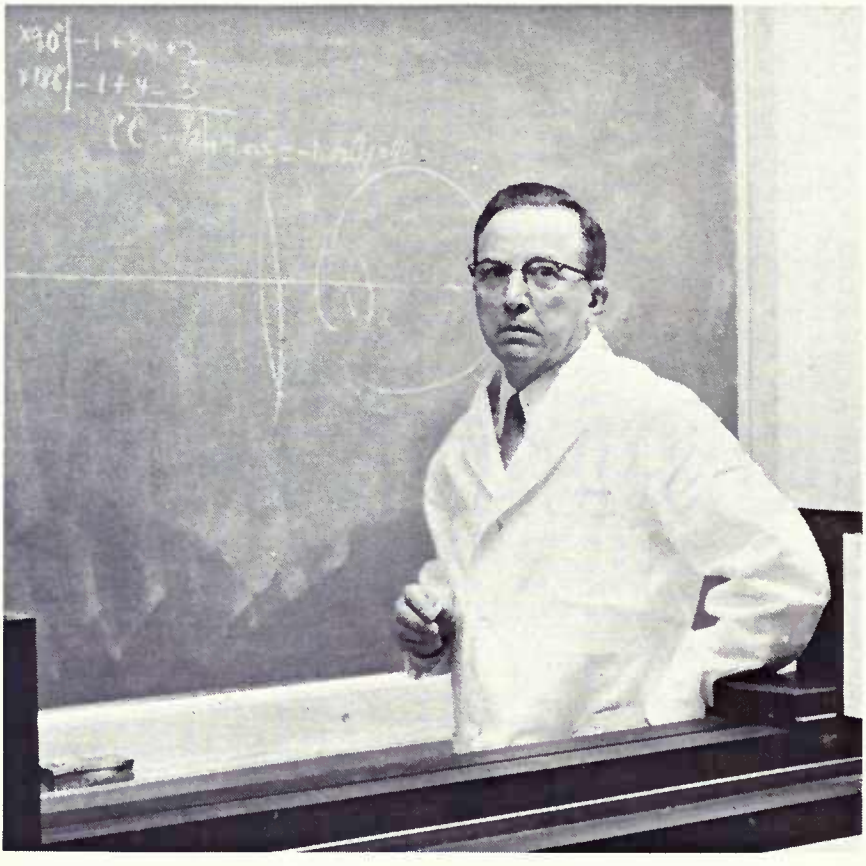

Paul Boeder, PhD
c. 1963

Paul Boeder, PhD

Teacher of Physiological Optics

An Interview Conducted by
Sally Smith Hughes, PhD, 1989

With Introductions by
Frederick C. Blodi, MD
Hansjoerg E. Kolder, MD
Melvin L. Rubin, MD
Bruce E. Spivey, MD

The Foundation of the American Academy of Ophthalmology, San Francisco
Regional Oral History Office, University of California at Berkeley

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Paul Boeder, PhD, Teacher of Physiological Optics, 1992, xxix, 194pp.

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The Foundation of the American Academy of Ophthalmology and
The University of California at Berkeley.

Born Hamburg, Germany, one of seven children of Ludwig Wilhelm Boeder and Anna Schubert Boeder; attended teachers *Seminar*, Hamburg; immigrated to the United States in 1923; graduate studies in mathematics, University of Pennsylvania, 1925-1926; PhD, Göttingen, Germany, 1931; chairman, Department of Mathematics, Susquehanna University, Pennsylvania, 1932-1935; married, Evelyn Alison Boeder, 1935; staff member, 1935-1940, director, 1940-1957, American Optical Company, Bureau of Visual Sciences; consultant, Dartmouth Eye Institute, 1935-1947; studies on aniseikonia; discussion on use of eikonometer; associations with Adelbert Ames, Jr., Alfred Bielschowsky, Hermann Burian, Kenneth Ogle, Walter B. Lancaster, Arthur Linksz; discussion on beginnings of Lancaster Course in Ophthalmology; lecturer in ophthalmology, 1950-1952, instructor of ophthalmology, 1953-1957, Harvard Medical School; professor, Department of Ophthalmology, University of Iowa, 1957-1971; teaching optics at Iowa and nationwide; associations with P.J. Leinfelder, Hansjoerg E. Kolder, Frederick C. Blodi, Gunter von Noorden, Robert E. Bannon; studies on anomalous retinal correspondence and the response shift; studies on cooperative action of extraocular muscles; chairman, board of trustees, Retina Foundation, 1950-1962; Distinguished Service Award, American Academy of Ophthalmology, 1988; hobbies: gymnastics, golf, German theatre. Introductions by Frederick C. Blodi, Hansjoerg E. Kolder, Melvin L. Rubin, and Bruce E. Spivey.

Interviewed in 1988-1989 by Sally Smith Hughes, PhD.

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PREFACE

Ophthalmology Oral History Series

American ophthalmology has undergone striking changes since World War II, not only in terms of basic science, diagnosis, and therapy, but also in terms of its internal organization and relationship with the rest of medicine and with the federal and state governments. Aware of the need to document these changes, the Foundation of the American Academy of Ophthalmology sought a means to preserve the memories, experiences, and insights of individuals who had lived through them.

The result was the inauguration in 1986 of the Ophthalmology Oral History Series, an ongoing series of in-depth interviews with senior ophthalmologists and others who have made significant contributions to the specialty. Aside from providing enjoyment and inspiration, the series' intent is to preserve a fund of historical information which might otherwise be lost and to give ophthalmologists a sense of their discipline's heritage.

In January 1986, an Oral Histories Committee, consisting of William H. Spencer, MD (chairman), Stanley M. Truhlsen, MD, Susan E. Cronenwett, Patricia I. Meagher, and David J. Noonan, was formed to facilitate collection of the oral histories. A selection subcommittee, with an anonymous membership of three senior ophthalmologists, was appointed to select individuals to be interviewed from nominations by the Foundation Board of Trustees and the Academy Board of Directors.

In selecting individuals to be interviewed, the subcommittee considers the individual's age, prominence in and contributions to ophthalmology, and ability and motivation to participate in the project. An effort is made to select interviewees from different areas of the country and with different subspecialty interests. Colleagues in the interviewee's geographic region provide information and assist in fund raising for the oral history series, which is entirely supported by private contributions.

Production of the oral histories is a collaborative effort of the Regional Oral History Office of the University of California at Berkeley and the Ophthalmic Heritage Department of the Foundation of the American Academy of Ophthalmology. For over thirty years the Regional Oral History Office has conducted interviews with West Coast leaders in all

walks of life and is pleased to have the opportunity to expand nationally to document the history of American ophthalmology. Sally Smith Hughes, PhD, a medical historian with the Regional Oral History Office, conducts the research, interviewing, and editing, and confers with the Foundation on final production of the oral history volumes. Willa K. Baum, director of the Regional Oral History Office, serves as consultant. Licia Wells, director of the Foundation's Department of Ophthalmic Heritage, is responsible for the management and administration of the series.

An oral history memoir is a recorded and transcribed series of interviews designed to preserve the recollections, knowledge, and reactions of a person who has played a significant role in or observed important events. It represents an important way to preserve information and opinions that the narrator alone is able to provide. The transcriptions are edited, reviewed by the narrator, retyped, indexed, and bound with photographs and illustrative material, and placed in appropriate research libraries.

The finished product is both a record of a conversation and a primary research source. It should not be regarded as having the polish and finality of a published book. It is not intended to present the final, verified, and complete account of events. Rather, it reflects the narrator's view, sometimes recounted with partisanship and passion, sometimes with impartiality and objectivity, but always vivid, immediate, and irreplaceable.

Oral history in one sense is an informal art, one that relies on the give and take between two individuals holding a directed conversation. Thus the reader should not expect a studied, impersonal, and invariably exhaustive and factual discourse in the pages that follow. Instead, good oral history offers a view of the narrator and his opinions up close, expressed with the immediacy, appeal, and occasional errors and distortions of everyday conversation.

Indexed and bound transcripts of the interviews are available to readers at the Foundation of the American Academy of Ophthalmology, the Bancroft Library, the National Library of Medicine, and other medical and manuscript libraries. The interview tapes and supplementary material relevant to each interview are on deposit at the Foundation. Oral history volumes may be ordered from the Foundation.

Sally Smith Hughes, PhD
Senior Interviewer-Editor
Regional Oral History Office
University of California, Berkeley

William H. Spencer, MD
Oral Histories Committee
The Foundation of the
American Academy of
Ophthalmology

Revised, June 1992

INTRODUCTION

Frederick C. Blodi, MD

It would be difficult to overestimate the influence that Dr. Paul Boeder had on the teaching of physiological optics to American ophthalmologists. For decades he was practically the only person who could and would instruct young residents in the intricacies of this science. Many thousands of American ophthalmologists have been his students. He participated in practically every ophthalmic basic science course, including one for orthoptists and one for Latin American ophthalmologists, held annually in Puerto Rico.

Paul Boeder took up the torch when Walter Lancaster passed it on at the end of World War II. Lancaster had approached the subject from a physiological-medical point of view; Boeder presented it more from a mathematical-physical view. His teaching was characterized by precision, clarity, and simplicity. He could teach anybody, provided the student would pay careful attention and not miss a single sentence. Paul's knowledge of higher mathematics is phenomenal, and he therefore can calculate in his head complicated equations and then present the result to a stunned audience. But he could also go slowly, proceed step-by-step, so that even a simple clinician could follow him.

Paul had not an easy life. He came to this country with nothing but his education and his intelligence. For a while, he had to work on the assembly line in an automobile plant. He became an instructor in a small college before he was recruited by the American Optical Company, where he finally became chief of its Bureau of Visual Sciences.

Paul loves to teach and wants to be surrounded by keen and eager young students. For this reason, he wanted, many years later, to return to academics. The American Optical Company supported this desire and put him on paid leave. It is to the credit of Dr. A. E. Braley's recruiting skill that Paul and Evelyn moved to Iowa City, joining the faculty of the University of Iowa. He spent fruitful decades in this midwestern university town, not only continuing his didactic circuits, but also engaging in valuable and sophisticated research, for example, the mathematical

treatment of the action of extraocular muscles and the nature of anomalous retinal correspondence.

Paul has many other interests. He enjoys athletics. As a young man, he was a splendid gymnast and a motorcycle racer. Later, he became an avid golfer. Paul has an infectious enthusiasm and optimism. He is absolutely honest and bluntly straightforward. What a privilege it is to count him among my friends.

May 1990

INTRODUCTION

Hansjoerg E. Kolder, MD

Paul Boeder broke away from his family in Hamburg, Germany at the height of the inflation that followed World War I. A relative provided the fare, but no more. Paul never needed much. He made decisions rationally and lived spartanly. He had no practical streak, but he integrated comfortably with all social strata. After arriving in this country, Paul tried his luck as a salesman, assembly line worker, and telephone operator, without satisfaction. He went back to school and did well even though his scholastic background had been quite different. While in college, he made a friend whose father encouraged both young men to further their education in Germany and bankrolled it. The years in Göttingen must have been glorious when a BMW 750 motorcycle provided transportation and the cream of mathematicians had not yet left Germany. However, the shadow of Hitler's intentions came to Paul's awareness when the exodus of several of his Jewish teachers left him with the choice to conform or to leave also. He left and never regretted his decision. Paul does not verbalize his political preferences but is critical and accepts consequences.

While appointed to his first real job as professor of mathematics at a small college in Selingsgrove, Pennsylvania, Paul was very fortunate to meet a teacher of French. Evelyn became and remained Paul's attractive, active, communicative, and joyful companion throughout her lifetime. She enabled Paul to preserve the aura of a German professor, encouraged him to travel, to meet people and maintain friendships, and to have a secure, comfortable home. Evelyn liked to drive, and Paul didn't mind turning the Toronado over to her. They had no children, though both took an absorbing interest in their friends' offspring. Paul always inquired about progress in school and whether a wedding was in the planning. He was perceptive and generous with gifts, and he remembered preferences. Children admired him.

Paul Boeder was attracted to science. He liked to formulate ideas mathematically and accepted that ophthalmologists as a rule nodded approvingly to his teaching *ex cathedra* but needed more mundane fare. A decisive turning point occurred for Paul when the venerable Dr. Lancaster, the model of command performance, asked Paul to substitute with "some

lectures in optics." By that time, Paul had already translated the book by Tschermak-Seysenegg on physiological optics from German into English and had earned his spurs with the American Optical Company, a giant in manufacturing optical devices. Paul had to lecture in Dr. Lancaster's course, as he always respectfully referred to it, from book to mouth. He did well and all the optical problems that he worked out with his students had unique answers. Here, his mathematical mind did not tolerate imprecision. From this incidental and modest beginning, to teach first-order optics with ophthalmic importance, grew Paul's influence until he had taught the invariantly true facts to more than 9,000 students. Paul reached most residents in ophthalmology at some time or other—on their home turf, at basic science courses, or at the annual meeting of the American Academy of Ophthalmology. He needed reassurance from students, and he would agonize about the reason he lost contact with some students on the third or fourth day after having lectured in one-and-half-hour segments for six hours a day. He used and distributed his concise lecture notes, but frequently modified the problems to be solved to recognize those students who had "missed the point"; he would forfeit a coffee break in order to be available to weary students with questions. Occasionally, a glimpse of rebellion would be visible in his eyes when a half thought-through idea was presented to him indicating that the pupil was "totally lacking in understanding."

Paul remembers his students over the years, oftentimes in association with their specific talents or shortcomings. He liked to demonstrate optical phenomena with practical sessions. Although here he preferred assistants to see him through trouble when experiments did not confirm the predictions; of course, they always did, but not necessarily on the first trial. Disciplined thinking and provable theorems remained his teaching objectives. Applications interested him only peripherally, though he was quite ready to develop a model for the interaction of all extraocular muscles to attain any specific eye position, or to investigate a comprehensive and parsimonious theory of retinoscopy. Paul was delighted like a child at Christmas when he received his first electronic calculator because "now I can extend the calculation of the contribution of each eye muscle, which is too time-consuming to be done by hand."

Upon invitation from Dr. Braley, Paul made the Department of Ophthalmology at the University of Iowa his home. American Optical had allocated an annuity to Dr. Boeder "to be used to further the understanding of optics by ophthalmologists." Paul thus had hard money on which to support himself and Evelyn. He kept an office full of journals and mechanical models for teaching physiological optics. He was compassionate and cooperative with colleagues but rarely involved himself in professional politics. Since his comprehension of optics was so unique and supreme, he had no competition or, unfortunately, graduate students

to follow him. Paul never refracted a single patient, but he taught thousands of residents how to do it—in principle. Paul was respected for his thoughtful remarks during discussions.

Paul could afford to spend half a year away from his base, parceled out in small doses of a few days, returning home with haste to enhance rounds with pertinent remarks about optical principles, physiological optics, refraction, and instrument design. To travel and lecture on the road must have been stressful. Paul did not complain. He had his routine. As a devout gymnast, Paul started his day with exercises, had milk and cookies in his room at 6:00 am, walked to and from his lectures when possible, napped during the lunch break, and enjoyed a good dinner. After losing his adored wife, Evelyn, Paul, who did not have to take care of the house or a meal for more than forty years, adjusted. He gave meaning to living alone. He corresponded with his numerous friends using a firm almost calligraphic script, visited frequently his extended family in this country and in Germany, and most important telephoned, "This is Paul. . ."

Paul Boeder came from Germany and can talk about his upbringing in the Hanseatic city of Hamburg without dwelling on events during dark years. He maintains a tinge of teutonic tongue and the demeanor of a gray eminence, but there is no doubt that he values above all the interaction with ophthalmologists, not his peers but his lifeline to appreciation.

February 1991

INTRODUCTION

Melvin L. Rubin, MD

"Paul Boeder—master teacher, scholar, and friend." So reads the 1965 dedication of my first book, *Studies in Physiological Optics*. It indicates the high degree of esteem in which I hold this grand man.

We first met in 1958, early during my eye residency training at the University of Iowa. I was one of eight eager residents groping for a sensible way to understand the eye as an optical instrument. Paul's talents as an educator were immediately evident. He led each of us by the hand through the mathematical complexities (in his view, they were simplicities) of optics and visual physiology. You must understand the challenge that task presented! Physicians, you see, have a genetically determined bias against mathematics that has steered them away from careers in the physical sciences and engineering and toward the biological and health sciences. One of Paul's greatest assets as an optics teacher was his recognition of that fact. He managed to fertilize our mathematically fallow minds with humor and a deft pedagogical style. Without question, his clarity of thought and simplicity of expression have made optics vital and understandable to generations of ophthalmologists the world over for more than half a century.

It is not an overstatement to say that no individual in this country has had a greater impact on the teaching of visual optics. Paul can take pride in having elevated national awareness of and expertise in this topic, directly and indirectly injecting it into the practice of clinical refraction. There is hardly a practicing ophthalmologist extant who has not been a student of his— at the Lancaster course at Colby College, in classes at Stanford, at Harvard Medical School, the University of Pennsylvania, Puerto Rico, or in a course at the annual meeting of the American Academy of Ophthalmology. For years, he was one of ophthalmology's two "circuit riders" (the other being the late Jack Copeland), offering one-on-one sessions on site at residency training programs across the country. Unequivocally, he has brought Helmholtz back into ophthalmology.

Permit me to add a few personal vignettes relating to Paul. I was fortunate to work under his tutelage for my master's degree in physiological optics. Though there were always a few moments to spare between research steps, Paul decided that even those gaps should be productively used. "To broaden my horizons," he suggested that I try to learn something of the French language. He cleverly maneuvered me, a rather ungifted linguist, into spending part of every day learning French and reading French stories aloud. His efforts were not totally wasted. I can still count in French and recognize a few words identifying eye structures!

For several years after I completed residency, Paul and I lost contact. However, our paths crossed again in the mid sixties, when I was invited to teach ocular physiology (with the late Arthur Linksz) at the Lancaster course at Colby College in Waterville, Maine, where Paul was teaching visual optics. We had the opportunity to renew our friendship for ten days each summer, over an eight-year period. My wife and children also had a chance to get to know him, and they readily recognized his special, superior qualities. Now, almost thirty years later, he still commands my family's adoration and respect.

During one of those summers, I was in the midst of writing *Optics for Clinicians*. Recognizing that I was habitually prone to verbosity, Paul related a story about a prominent scientist who came to him with a thesis manuscript, requesting a review. Paul looked down at the two-volume manuscript, then looked up at the author asking, "Why didn't you make your thesis shorter?" The learned author responded, "I didn't have enough time!" The point, of course, was that it takes effort and time to write clearly and succinctly. Now every time I get the urge to write a four-page memo to my faculty, I hear Paul's gentle reminder, "Shorter, always shorter!"

The next lesson was an inadvertent one and came about the same summer I was writing that book. I had just decided to include a formula for expressing how corrective lens power changes as the lens is moved away from the eye. Sure, I could have looked it up or even developed it myself, but being naturally lazy, I turned to Paul, who happened to be sitting next to me at one of our Colby cafeteria dinners. I knew I could rely on his encyclopedic mind for the precise information I needed. He did not disappoint me. Later that evening came a quiet knock at my door. Paul stood there, appearing sadder than I had ever seen him. "What's the matter, Paul?" I asked in my most empathetic tone. He answered, "Mel, the formula I gave you was ambiguous—it was wrong!" Since even a master could occasionally be confused, what could I expect of my mortal readers? Then and there I made the decision that I would not resort to

formulas in the new book, since formulas, with their units and signs, were too dependent on memory, and I wanted to encourage logical thinking.

The third lesson was the most pragmatic of all. Paul taught me the gastronomic delights and fine points of attacking and consuming (nay, devouring) a Maine lobster without leaving anything but the shell! So thanks, Paul, for these and for so many other lessons that have served me well over the years.

These glimpses are personal. How might someone more objective characterize Paul? Appropriate descriptive terms would surely include erudite, cultured, sensitive, and modest. He is a human being with exceedingly diverse interests. And he is able to charm anyone! As the years pass, he continues to mature like a fine wine as he devotes himself to refining his retirement activities—golf, piano playing, and reading novels in Spanish.

Several years ago, as president of the American Academy of Ophthalmology, I was privileged to honor Paul with the AAO's 1988 Distinguished Service Award, for fifty years of service to ophthalmology—his scientific contributions, his outstanding teaching skills, and his dedication to ophthalmic science. Writing this introduction provides me yet another opportunity. I hope it does him justice.

May 1990

INTRODUCTION

Bruce E. Spivey, MD

Gentle, disarming, precise, tolerant, scholarly, loyal, enthusiastic, and dedicated—these are the adjectives that come to me in describing Paul Boeder. This fatherly figure (in recent years, a grandfatherly one) has a quiet personality which hides deep feelings and extraordinary insights. Very European and proper and totally dedicated to family and friends, he is a delight to be around. Upbeat, thoughtful, modest, Paul seems totally interested in what his student, guest, or golf partner is doing.

A self-effacing individual, Paul nonetheless did more than anyone else to give American ophthalmologists an understanding of physiological optics. In courses across the country, he taught—and touched— more of them from the 1940s through the 1980s than any other teacher in ophthalmology. He had total command of his subject, yet was always open to questions or challenge. He often presented optics in six- to eight-hour blocks over three to five days. His stamina and persistence are legendary.

I first met Paul when I was a medical student at the University of Iowa where he had come to commit his future career to the teaching of physiological optics and to collaborate with faculty members, such as Hermann Burian. It was clear then that Paul's intellect and incisiveness put him in a category apart. As first year residents at Iowa, we had weekly sessions in Paul's office, which was lined with blackboards on which he introduced us to the seeming mysteries of bending light rays back and forth through infinity. It was brought forcefully to my reality that here was an individual who truly knew and loved optics. Paul as a human being was engaging and charming. Paul as a teacher was riveted to his subject. He stimulated the most gifted and was supportive of those at the other end of the spectrum. He was persistent in wanting us, all of his students, to understand and be excited by physiological optics. His dedication was unique among my many teachers.

Paul's personal life was centered on one person— his wife Evelyn. She created the tranquil, almost idyllic, environment conducive to his classic scholarly manner. Yet the image of scholar was balanced by that of athlete of substantial proportions. An award-winning gymnast in the Germany of

his youth, he was also a devil-may-care adventurer on the largest BMW motorcycle available in the pre–World War II years.

By the time I knew Paul, his main avocation was golf. He was good at it. He carried only three clubs—three wood, five iron, and a putter. Enthusiastic about golf, he was anxious to help others. I remember a time after dinner in his home when he took me into his study and showed me a small book with pictures of Ben Hogan in the right-hand corner of each page. He repetitively flipped the pages and showed me Hogan's swing, pointing out the critical elements as we viewed them. This twenty-five-cent book, probably from the late 1940s, had been viewed by Paul many, many times. This simple gesture evidenced his analytic processes as well as his devotion to teaching.

The most dedicated teacher I have ever known in ophthalmology, Paul Boeder has left an indelible print on physiological optics—and on the hearts of the many thousands he has taught.

July 1990

INTERVIEW HISTORY

Sally S. Hughes, PhD

This oral history of Paul Boeder is the sixth in the Ophthalmology Oral History Series, a series featuring book-length interviews with prominent individuals in ophthalmology. The Foundation of the American Academy of Ophthalmology, sponsor of the series, selected Dr. Boeder because of his lengthy service in and dedication to the teaching of physiological optics to an entire generation of ophthalmologists.

The oral history begins with Dr. Boeder's recollections of his childhood in Hamburg, Germany, as the second youngest of six children in the family of a jewelry maker. Modest financial circumstances forced him to attend a *Volksschule* instead of a university preparatory school. His consistent record as top student eventually won him acceptance into a teachers training school, which he recognized as a means to escape the limited opportunities of a *Volksschule* education.

Teaching diploma in hand, young Paul found that job prospects were bleak in a Germany devastated by war and economic upheaval. With a loan for travel expenses from relatives in the Bronx, he immigrated to the United States in 1923. Within three years of his arrival he had earned a master's degree in mathematics from the University of Pennsylvania, a remarkable feat since he also supported himself by tutoring math and acting in the German theatre of Philadelphia.

The chairman of Penn's mathematics department was sufficiently impressed by the young man to arrange for his appointment in 1926 as instructor of mathematics at the University of Delaware. A year later he returned to Germany, expenses paid by a wealthy American, to become a doctoral student in applied mathematics at the University of Göttingen, whose mathematics faculty at the time was arguably the best in the world. He graduated in 1931 magna cum laude on the basis of his dissertation on *Sturmungsdoppelbrechung,* a topic best left to Dr. Boeder to explain in the oral history.

Returning to the United States in 1932 in the midst of the Depression, Dr. Boeder recounts his good fortune in obtaining a position as chairman of the mathematics department at Susquehanna University in Pennsylvania, at a

time when many American universities were laying off faculty rather than taking new faculty on. In 1935, he left academe to join American Optical Company as a member of the Bureau of Visual Science. He was immediately sent as company representative to the Dartmouth Eye Institute in Hanover, New Hampshire, where Adelbert Ames, Jr. and his group were attracting attention by their work on aniseikonia. Aniseikonia, a condition in which the two retinal images are unequal in size, was thought to cause eye problems. When word got out, patients from around the world flocked to the institute for treatment. American Optical benefited by selling instruments and corrective lenses, which Dr. Boeder helped to develop, to assess and treat aniseikonia.

At Dartmouth, Dr. Boeder associated with an outstanding group of ophthalmologists, optometrists, and visual scientists attracted to the institute at its apogee in the 1930s. He gives his impressions of such stellar figures as Adelbert Ames, Jr., Alfred Bielschowsky, Hermann Burian, Walter Lancaster, and Arthur Linksz. By the early 1940s aniseikonia's flame was flickering and by 1947 it was essentially extinguished, the institute staff disbanded, and aniseikonia relegated to the purgatory of a passing fad. By then Dr. Boeder had a more pressing mission: the teaching of physiological optics to ophthalmologists. He began at the first Lancaster Course in Ophthalmology, sponsored by Harvard in 1946, as an overnight substitute for the ailing Walter Lancaster. To Lancaster's apparent chagrin, the students gave Dr. Boeder a round of applause at the end of the course, prompting Lancaster to "fire" him, or so Dr. Boeder would have us believe. The "firing" did not last long. Before the year was out, Lancaster asked him to present another optics course, this time in Florida. Dr. Boeder was thus launched as *the* teacher of optics to American ophthalmologists, an occupation he considers his greatest contribution. How did he keep his enthusiasm for teaching? "Well, when you get appreciation as I got, how can you lose enthusiasm? I just enjoyed what I did, and I got a lot of compliments about it."

Dr. Boeder's first task was to overcome the ophthalmologist's general distaste for any subject requiring mathematics. And overcome is exactly what he did. His tools were enthusiasm, careful explanation, and simplification of what to many was an intimidating subject. He traveled from institution to institution across the land, at American Optical's expense, spreading the gospel of physiological optics and winning over his students by his personal charm and commitment to making them understand.

In 1957, Dr. Boeder became professor of ophthalmology at the University of Iowa Medical School, a position underwritten by American Optical for the fourteen years remaining until his retirement in 1971. In these years, he taught and thought and continued to "circuit ride," teaching physiological

optics in institutions throughout the country. Upon retirement, he and his beloved wife, Evelyn, moved to Norfolk, Virginia where they continued to play golf and he to teach, this time at the Eastern Virginia Medical School. His teaching continued, even after Evelyn's death, but in 1988 the commute became too much and Dr. Boeder was reluctantly allowed to retire completely. He was eighty-six.

What had kept him teaching course after course, year after year? "Everything was stimulating to me when I saw lights on their [students'] faces." "And you always did?" "Always did."

Oral History Process

In preparation for the oral history, short interviews were conducted with ten friends and colleagues of Dr. Boeder: Drs. Frederick C. Blodi, Alson E. Braley, Ronald M. Burde, Arthur J. Jampolsky, Hansjoerg E. Kolder, Richard D. Richards, Melvin L. Rubin, Bruce E. Spivey, H. Stanley Thompson, and Gunter K. von Noorden.

Five interviews were recorded with Dr. Boeder between November 7, 1988 and March 23, 1989, the first two at the Academy headquarters in San Francisco, and the last three in Dr. Boeder's apartment in Norfolk, Virginia. There, much in evidence, was the Academy's Distinguished Service Award, and the Spanish novels which he reads for pleasure.

I spent more than three days in Norfolk, interviewing Dr. Boeder from early morning until suppertime, the remarks made in the interviews amplified over dinners featuring seafood of the Chesapeake Bay. Dr. Boeder's manner in the interviews was relaxed, expansive, and digressive. Dismayed by the frailties of old age—"Eighty-eight, that's overdone!"—he had generally excellent recall of events long past but frequently hesitated over proper names and recent events. In fact, those who know Dr. Boeder best may notice omissions and mistakes which in his prime would have not occurred.

The tapes were transcribed, edited, and the first two interviews sent to Dr. Boeder for editing. His interspersion of German words and phrases and occasional use of Germanic word order generally have been left as he spoke them to give the reader a flavor of his fluent yet foreign English. After extensive work on the first three pages, Dr. Boeder felt unequal to the editing that remaianed.

In June 1990, I returned to Norfolk and spent a weekend with Dr. Boeder, first dealing with specific questions raised in editing and then reading the transcript aloud for his comments and corrections. Unfortunately, time ran out. Dr. Boeder did not review the transcript after the section in chapter III entitled, "The Department." The reader must therefore keep in

mind that Dr. Boeder did not review the final portion of the oral history. The original tapes and transcripts are on deposit at the Foundation of the American Academy of Ophthalmology.

This oral history would not have been possible without the assistance of many friends and colleagues of Dr. Boeder. Thomas A. Weingeist, chairman of the Department of Ophthalmology at the University of Iowa, graciously arranged for my visit to Iowa City, where some of these interviews were conducted, and gave me access to the department's folder on Dr. Boeder. Jack and Nancy Matheson, Dr. Boeder's close friends, made me welcome during my visits to Norfolk. I particularly wish to thank Robert E. Bannon, OD, formerly of American Optical Company and the Dartmouth Eye Institute, for his many informative telephone calls and repeated searches through his American Optical files to retrieve documents relevant to Dr. Boeder's story. His help was critical since Dr. Boeder has retained few documents relating to his career. Drs. Bannon, Blodi, David L. Guyton, Rubin, and Truhlsen kindly agreed to review the manuscript. I am grateful to all these individuals for their time and assistance.

This account, we hope Dr. Boeder's intimates will agree, not only provides an entertaining biography and some little-known history, but also reveals contrasting aspects of the man himself: a humbleness tempered by well-warranted pride in his mathematical and teaching abilities, a frank and humorous tongue belying his mild appearance, and a devotion to his friends matched by candid remarks about their weaknesses.

The image that surmounts all these complexities is that of teacher—a teacher trained in the Hamburg seminary, a tutor supporting his graduate studies in Philadelphia, a professor of college mathematics, and, above all, a teacher for forty years of physiological optics. His students, estimated to number around 9,000, can doubtless still hear him say in accented English: "U plus D is equal to V. Now you have the most important optical relationship that we are going to encounter."

For these students of his, these ophthalmologists spread across the length and breadth of North America and extending south to Puerto Rico, it is Paul Boeder who represents physiological optics.

February 1991

The interview process
American Academy of Ophthalmology, San Francisco
November 1988

I. FAMILY BACKGROUND AND EARLY EDUCATION

The Boeder Family

[Interview 1: November 7, 1988, American Academy of Ophthalmology, San Francisco, California]

Hughes: What are the names of your grandparents on your paternal and maternal sides?

Boeder: The names of my paternal grandparents were August and Amalia Boeder. Both died before I was born. They had seven children, four boys and three girls. The oldest boy immigrated to the United States, the second son to Brazil.

The name of my maternal grandparents was Schubert. I liked my grandfather Schubert; he made things for me that little boys like, such as a wooden sword.

Hughes: Do you remember what he did?

Boeder: All I know is he painted beautiful pictures. Three or four of these were on display in our apartment.

Hughes: And what did grandfather Boeder do for a living?

Boeder: *Hab' keine Ahnung.* [I've no idea.] Remember, he was gone before I was born.

Hughes: Please talk about your brothers and sisters.

Boeder: Our oldest was Max, born in 1892. After his eight years of school, he became a *Lehrling* [apprentice] in a business which dealt in oil and harbor supplies. At age twenty, he began to serve his two years in the army. When only forty or fifty days were left of these two years, his regiment was ordered to France. The year was 1914, the beginning of World War I. After five years of fighting the trench war in France, he and one other soldier of the original regiment were the only ones who had not been killed, wounded, or taken prisoner.

My sister Hedwig came after Max. Hedwig—we called her Hedi—was liked by all of us because she was in all respects a wonderful person.

Hughes: What did she do later in life?

Boeder: She directed a foremost business of ladies' hats in Hamburg. One of her girls told me that she seemed to have a new idea at any given moment. All she needed was a piece of cloth to which she gave all sorts of different shapes until she found a shape she liked. Hedi was very artistic.

Hughes: That artistry was perhaps passed down through your grandfather.

Boeder: Perhaps it was. Also, my father [Ludwig Wilhelm Boeder] was artistic. He was a trained jewelry maker who designed chest medals and other objects in gold and silver for the government of Saxony.

Hughes: And your mother?

Boeder: Our mother, Anna Schubert Boeder, gave birth to four girls and three boys. Of course, we liked and respected her. But she had a temper. Anything wrong, then, boom! [laughs]

Hughes: Was she the disciplinarian of the family?

Boeder: Yes, she was. She had a quick hand. Of course, we smaller children did not always behave.

Hughes: Who came after Hedi?

Boeder: Clara, [pause] dear Clara, how different she was from Hedi! Early in her life she fell in love with Hans Bach and married him when she was still very young. She had a miserable, early death, I hate to tell you. After Clara came Eda. Eda was the prettiest of the Boeder girls. She also had a beautiful voice; we loved to hear her sing. When she was thirteen, she contracted diphtheria in

school. Penicillin wasn't heard of at that time; she died in a day or two. Then came Toni, the only one still alive of the four Boeder girls.* She is three and a half years older than I. In September 1989, she will be ninety-one years old.

Hughes: Is she in Germany?

Boeder: Yes, she's living in Hamburg with the younger of her two daughters.

Hughes: Then came you.

Boeder: Yes, and Hansi came one year later. He died when he was about one year old.

Early Education

Hughes: Well, tell me about your early education.

Boeder: Well, my early education started in the *Volksschule* [an elementary school for students not heading for the university]. Our family didn't have much money; they couldn't send me to the same school that my neighbor friend went to. He went to a school which prepared one for the university. I didn't regret it much. I was happy in my school; I liked my teachers. We were ranked in accordance with our marks. He who had the smallest sum total of the marks was number one, and he who had the largest sum total of the marks was last. I always had the smallest total. In other words, I was always number one in the elementary school.

Hughes: From the very beginning?

Boeder: Yes, from the very beginning. That was a record for the family. My brother and all the girls were very good in school, but none of them scored number one.

Hughes: Did the Volksschule *run all the way up through high school?*

Boeder: No, the *Volksschule* offered a program of eight years and that was insufficient for entrance into a university. In order to be admitted into a university, one had to have passed the *Abitur*, which was the final examination after a twelve-year official school program.

* Toni has since died.

Every year there was an examination for *Seminar*, teachers seminary. From all the schools they had 200 applicants, all the number ones. Then you were examined for about six days in all fields, written and oral both, and 20 would be accepted. I was accepted.

Hughes: That's remarkable.

Boeder: Well, that was good. My father was a little skeptical whether he could pay, even for the books, but my brother Max wrote from the trenches in France, "Let Paul get the higher education. I know what it means not to have it." My father was directed, actually, by his eldest. You know how it is—the eldest knows everything.

Hughes: Did your mother take part in this debate?

Boeder: No, she just hoped that I would be all right.

Hughes: Was it the Gymnasium *[a university preparatory school]?*

Boeder: No, it was not the *Gymnasium*; it was the teachers *Seminar*. I never went to the *Gymnasium*, but I went to teachers *Seminar* for six years. Then when I was through with my final examination, I was twenty-one. So I decided to go to the United States.

Hughes: Well, before we get that far, let me ask you a few questions. At the Seminar, *were there any particular teachers that you were close to?*

Boeder: Yes. One was the teacher of the class; he went along with the class to the higher grades. His name was Samtleben. I was close to him. I didn't have special interests, except mathematics. Samtleben was a mathematics teacher.

Hughes: Is there a correlation there?

Boeder: [laughs] Well, there is to an extent, but he was not a very good mathematician.

Hughes: What was the goal of the education at the Seminar*?*

Boeder: The goal was to make you a good elementary teacher.

Hughes: And was that your goal as well, for a while?

Boeder: Yes, but it was also the only avenue to a little higher status. You see, I had missed the very beginning that puts you into a good

situation. I went to a *Volksschule*. The only way out of the *Volksschule* into a higher school was the *Seminar*. That was difficult, because out of 200, only 20 were accepted. I never became a teacher in Hamburg. I went to the United States.

Family Life During World War I

Hughes: Well, one more question before you go to the United States. What was a typical day like in the Boeder family when you were young?

Boeder: Well, everybody went their own way. There was harmony only at the eating table. We thought of Max in the French trench. There was a lot of family anxiety at that time. We watched when people came to inform that somebody in that household was killed. "Is he coming here? Is he coming here?" It was a terrible time, because at any minute we could be informed that Max was killed in France.

Hughes: Was the war disruptive in other ways?

Boeder: In all ways, yes, it was.

Hughes: Was there rationing?

Boeder: Oh, and how! Rationing! There was a time in 1917 that we had at our table in the morning, turnips. At noon, a variation—turnips were raw at noon. In the evening, turnips. We even had turnip coffee. The British fleet, you see, made sure that nothing of value as far as food was concerned got into Hamburg.

Hughes: And they were very successful.

Boeder: They were successful, they were successful. Let them rot, that was the message that you got. [laughter] And the poor mothers had to invent different things to make out of turnips.

Now, I have to give a good word to the Quakers, the Friends. When they say they are against war, they mean it. Immediately after armistice, they came with their own doctors, and we were all subjected to a good [medical] examination, and we were all found to be undernourished. My father said, "How did you come out?" I said, "Well, we're going to get food. The Quakers said, 'Tomorrow you bring a little bowl, a spoon, and we're going to serve you chocolate rice.'" Chocolate rice! How can it be? [laughter] Impossible. It was tremendous, but the Quakers did

it. Therefore, today when I get a request by Friends for a contribution, I always give. They certainly were wonderful.

Hughes: Do you think that was happening all over Germany?

Boeder: That was all over Germany, and it was all over Russia too. They'd go everywhere for peace. It was a very wonderful thing. Hamburg needed it because we were starved, and the Quakers did something about it. I'll never forget them.

Gymnastics

Hughes: I understand you were an athlete.

Boeder: Yes, I was an athlete. I could walk on my hands.

Hughes: A gymnast, then?

Boeder: A gymnast.

Hughes: I would think that undernourishment would have interfered.

Boeder: Well, it didn't mean that my body wasn't a little lighter. I will say without bragging, I excelled in gymnastics.

Hughes: Was gymnastics taught in the Seminar?

Boeder: Oh yes.

Hughes: Did you win prizes?

Boeder: Yes. Even when I was still in the *Seminar*, I had the *Damen Riege* [women's squad]. Do you know what that is?

Hughes: No.

Boeder: Well, I had a group of ladies under my direction for gymnastics.

Hughes: Now, was it standard for a good gymnast to lead one of these classes?

Boeder: No, that was forbidden. [laughs]

Hughes: How did it come about?

Boeder: Well, they needed somebody, and I was recommended as a teacher for the ladies. I enjoyed it. Well, when I say ladies, they were from age sixteen to twenty-five or so.

Hughes: Young enough to be of interest to you then.

Boeder: Yes, but I didn't show any preference for anyone there, although I had some. [laughter]

Hughes: How long did that go on?

Boeder: Oh, for years. It was a little money.

Hughes: How were you financing your education?

Boeder: By tutoring. Our family had no money.

My father had a miserable business. He was a *Galvaniser* [a person who plates iron with zinc to prevent it from rusting]. He was liked by his *Kunden* [customers] and those people for whom he worked. He worked as a *Juwelier* [jewelry maker] for people with jewelry businesses. He had been trained as a *Juwelier*. He knew how to make *Ketten* [necklaces] better looking. He had been at the Saxony court as a jewelry maker. That was pretty high. He was good, no doubt. He was able to goldplate, silverplate, and clean.

Hughes: Did he teach you any of these techniques?

Boeder: No. He said he didn't want Max or me to be jewelry makers. It's no business for them. They have to get higher.

Hughes: So he did have ambitions for his children.

Boeder: Oh yes, he did.

Hughes: What did Max end up doing?

Boeder: Well, he was a *Kaufmann* [merchant]. He had to write letters and direct certain businesses. He was good. Hamburg gave him the greatest little distinction that you can get.

Hughes: What was the distinction?

Boeder: Well, he got an *Auszeichung* [award] for being a good *Kaufmann*. He was the recognized *Bürger* of Hamburg, a citizen of distinction. I said, "Well, Max, I can't get that; you beat me in

this." "No, you can never get this," he said. [laughs] I'll never forget that. I was joking, and he was joking.

Hughes: Was your father equally proud of his sons?

Boeder: Oh, he was proud, especially of Max. That was his firstborn. You know what the firstborn does to the father. For life, he would consult Max. Even in the trench, he consulted him about me.

Hughes: Did you have trouble finding time for your studies, since you were also tutoring, doing gymnastics, and teaching gymnastics?

Boeder: I had enough time for play. I was not so busy that I had to eliminate activities. My consuming interest at that time was gymnastics.

Hughes: Did you ever think of making it a career?

Boeder: Yes, and I did. I had a group in Bergedorf, I taught those girls. And for boys, I had a group in Hamburg. I had a bunch of boys, maybe 100.

Hughes: Did you consider becoming a gymnastics instructor full time when you graduated?

Boeder: Yes, I did, and I actually had those appointments by that time.

Immigration to the United States

Hughes: Now, how did you get the idea to immigrate to the United States?

Boeder: That idea was not original with me. A friend of mine, Walther Thomas, who is the grandfather of Corinne [Thomas], had gone to the United States in 1923 with the aid of his uncle in Brooklyn. We had been good friends; that is why in Las Vegas I introduced Corinne as my granddaughter.*

Hughes: Yes, I remember.

Boeder: Her grandfather and I were close friends, and he was instrumental in getting me to the United States. He went to my relatives in the Bronx and said, "You ought to get Paul over to the

* In October 1988, Corinne Thomas accompanied Dr. Boeder to Las Vegas for the annual meeting of the American Academy of Ophthalmology where he received the Academy's Distinguished Service Award.

United States. He needs only $200 to come over. When he's here, he can find his way alone." They yielded to that.

Hughes: Now, which relatives were these?

Boeder: He was a man who was much older than I. I called him "Pa" when I arrived. He was at least thirty years older. Actually, he was a first cousin, but I never said cousin, I said "Pa." His wife, I called "Ma." And there was Julia and Flora, and Leo also.

Hughes: Did they act as your family away from home?

Boeder: Yes, I lived with them. I had a nice room. For me, that was a real sensation. I had a room on the third floor, all alone.

Hughes: You'd always shared a room before?

Boeder: Oh yes, a little room I had in the dark. And here I had a beautiful view outside, trees and everything. They had a nice location in the Bronx.

Hughes: How long had they been in this country?

Boeder: Well, they came in the last century.

Then the first job I had was at the New York Telephone Company. It was a busy principal office downtown. I had to take the elevated train down. When I got there, I said, "You say I have to telephone, that's the principal task that I have here, but I don't know English." The boss said, "You speak better than those boys over there; you know English."

Hughes: You had had it in school?

Boeder: Yes, I'd had it in school, but my word, when you come all of a sudden into New York, you cannot speak English.

The boss said, "That's all right. Now, pick up that phone, it's ringing, and I'll listen in." Well, I picked up the phone and babble, babble, babble, that's all I heard. I could not differentiate the words at all. The boss said, "Tell him he may have that extension station." I didn't know what an extension station was. I said, "You may have the extension station." The man on the other side of the wire blew up. He told me, "Put another man on the wire; I cannot speak Italian!" [laughter]

Hughes: That's wonderful. Did you keep the job?

Boeder: Yes, I had the job. My title was innocence itself. I was an order clerk. But when there was a phone ringing . . .

Hughes: You had to answer it.

Boeder: I must say, it was a time that I do not regret, because all people helped you. Especially the people on the switchboard that you never saw in your life. They said, "You must say numbers entirely different. You mustn't say, Melrose six [pause] seven [pause] eight [pause] four. We don't know numbers; we only know rhythms!" [laughter] "So you must say, Melrose [faster and rhythmically] six-seven-eight-four. That we understand."

Hughes: Had you come to this country with the idea of staying permanently?

Boeder: Yes.

Hughes: Why did you make that decision?

Boeder: Because in Germany, there was nothing, *garnichts los* [nothing at all happening]. Nothing to really get ahead.

Hughes: You thought of America as the land of opportunity?

Boeder: Well, of course, the land of opportunity—and it was. If you wanted to work in this country, at least in my time, you could get a job. That's what happened to me. I always had a job.

Hughes: How long did you stay with the telephone company?

Boeder: One year. Then I went over to Philadelphia because my friend Walther Thomas wanted me to come over. He would say, "You should study optometry."

Hughes: Now, why did he choose that field?

Boeder: Well, because there was a nice possibility in Philadelphia. They all made money afterwards. So I went to the optometric school in Philadelphia for almost a whole year, but what they taught there was just a little below me. I mean, it was nothing that I couldn't do without any instruction. It was just very elementary.

So I decided to go to the University of Pennsylvania, and I got into the graduate school.

Graduate School, University of Pennsylvania, 1925–1926

Hughes: In what field?

Boeder: In mathematics. And there the happiness began, because there were the Quakers again. Professor Hallett, Professor Klein—they were Quakers. They not only gave you a good education, they also saw to it that you got a job. I really have an admiration for the Quakers.

Hughes: They were mathematics professors?

Boeder: They were mathematics professors. Professor Hallett was the department head. In one year, I had my master's degree from the university. That was a nice mark [degree] to have here in this country, because now I could teach.

Hughes: Was just course work required for the master's degree, or did you also have to do research and write a thesis?

Boeder: Course work, and I had to write a thesis. Well, a little thesis.

Hughes: But to finish within a year was very quick, was it not?

Boeder: Yes, it was quick. No doubt about it. I started from scratch, as far as the mathematics of that university was concerned, and I wasn't too hot yet. But it was a wonderful time.

Look at Professor Hallett, for instance. He said, "Boeder, before you go on here, you should do some teaching." I said, "Where?" He said, "Well, go to the University of Delaware in Newark, Delaware, and present yourself. I know they need an instructor in mathematics."

I went down, and when I got there, I had the distinct impression that they were very much disappointed. They thought, maybe he can be enrolled as a student here, but as a teacher, no.

Hughes: You were too young?

Boeder: Yes, too young, and too small, and everything was wrong. So I went back to Philadelphia and said, "Dr. Hallett, I don't think they want me. I have now waited for two or three weeks and have no word." He said, "Now, Boeder, you have to be a little patient. These things take time, a decision like that. Just take it easy and see what happens."

Well, what happened was that after one week (or one week and a half), I was appointed. But only later I found out what Professor Hallett did. A coworker said, "Do you know why you got this position?" I said, "No, why?" "One day, Professor Hallett of Pennsylvania came here and said, 'I want to see the dean and the president.'" Of course, he was well known to these people; Professor Hallett was the chief of graduate mathematics at Pennsylvania. He simply said (this was told to me), "You've got to take that man." [laughter]

Hughes: But Professor Hallett would not have taken those extreme steps if he hadn't thought well of Paul Boeder.

Boeder: Well, that was nice for me to think too, very nice, because he went down there on his own and said, "I have to see the dean and the president." I came back and said [to Hallett], "Well, you were right; I have an appointment now." "What did I tell you? You have to have a little patience." What a man!

Hughes: Was he also a good mathematician?

Boeder: Yes, head of the department.

Hughes: And what about the rest of the mathematics faculty at Penn?

Boeder: They were all good. They promised me an assistant professorship if I came back from Göttingen with my doctor's degree.

PhD Candidate, Göttingen, Germany, 1927–1931

Billy Bond

Boeder: Now, how did I get into Göttingen? Well, one day when I was teaching at Delaware as an instructor in mathematics, a young man came to see me. He stood at the door, and he was six foot, two inches tall. Wonderful specimen. I said, "Mr. Bond, come in and sit down. What's on your mind?"

He said, "I wonder whether I could take a higher course. You're now teaching trigonometry and it's all known to me. I would like to go into the sophomore class and study analytical geometry." I said, "Mr. Bond, I cannot make that decision on my own. If I could, I'd say go ahead, but I have to find out what the dean thinks about this."

I went to the dean, and he said, "Well, give Mr. Bond a tough examination and see whether he knows this stuff." I wrote him

an examination and made it tough—three hours long—and he did it alone. He handed the paper in after one hour, and it was an A+.

Well, I went to the dean and said, "Listen, that man deserves special handling." So time went on, and he did well in the higher course. But he said, "I want to quit this school immediately." I said, "What?" Well, he had been hazed, and he was offended to the core. They humiliated him.

Hughes: Why was he hazed?

Boeder: Hazed because he was different from the rank and file of that school. They gave him the works, and he wouldn't go near the school. He went to the dean and said, "I want my money back; I am through here."

I said, "Now, what are you going to do? You were going for your bachelor's degree. Where are you going now?" He said, "I'm going to Göttingen." I said, "You're going to Göttingen! Do you know what Göttingen means? Göttingen means the best in the world, better than Paris," at this time, in mathematics. I said, "You're nineteen years old, without a bachelor's degree, what do you mean? Is your grandmother going along?" He was very fond of his grandmother. I believe he was fond of her especially because he had the misconception that she had plenty of money. [laughter] He said, "No, no, she's not going."

I said, "Well, who is going?" "You." I said, "No, sir! Going to Göttingen? I don't want to hit Göttingen." "Oh yes, let's go." And we did, together. It didn't cost me anything.

Hughes: How did that transpire?

Boeder: Well, that transpired by luck, you might say. I was able to find out who was the man in Göttingen who had a little push—Richard Courant. We wrote a letter to Professor Courant, department head of mathematics at Göttingen. Courant read the letter and said, "Write to the dean immediately, let us be in the good tradition of our university and admit this man and see what he can do." The dean said, "Go ahead."

Hughes: Highly unusual.

Boeder: Very unusual. I believe it cannot be done a second time, really, I do.

We went to hear a session. He had never been in a session like that. There were 500 Germans, and not only Germans, but people from all over the world, listening to Professor Herglotz, a tremendous authority on differential equations. He was known

to talk to 500 people at a time. There were always some commotions, so when we came in, he talked very, very low [to force us to be quiet].

But now what happened? Billy said, "Let's go to Lugano." [laughs] He was literally knocked out.

Hughes: Too many people?

Boeder: No, no, he couldn't understand a thing. He was just knocked out by Professor Herglotz.

Hughes: Did he speak German?

Boeder: Very little. That's what I said also, "What are you going to do? Your German is not adequate." But he was a bright fellow. He could get along on his own in German. We talked German all morning, and he wanted to hear more German and speak more German. Then at Göttingen, he was knocked out by Herglotz, and he said, "Let's go to Lugano." So we went to Lugano for three weeks. Marvelous time.

Hughes: You were going just for fun?

Boeder: Just to have fun. We stayed there three glorious weeks. I wrote to his family and said, "We are not in Göttingen at the moment; we are in Lugano." His father was well-to-do. He had a good business in Wilmington and had some good patents. There was money enough.

Hughes: Were you financing your own way?

Boeder: No, not a penny. I didn't have any money. They paid for everything.

Hughes: Why had Billy decided that you must come with him?

Boeder: Because I arranged that he could go to a higher class [at the University of Delaware]; I went to the dean. That impressed him. So he thought a man who does that for me may do other things. That's about it.

Hughes: Were you going with the idea of working towards your doctorate?

Boeder: Both of us were sent and supported by his father under the condition that we were working hard for our degrees.

Hughes: What happened when you wrote that you were spending three weeks in Lugano?

Boeder: They were glad about it.

Hughes: What happened after your three weeks?

Boeder: After three weeks, we went back to Göttingen, and my intent was to make up for the lost time. Billy was through with work. He had bought a motorcycle, and he wanted me to drive it—a BMW 750 Sportsmachine. Marvelous thing. We did take a few trips, but he wanted to take longer trips. I said, "Look, Billy, I am not going to waste my time here. If you go back without the degree, you go back to money. If I go back to the United States without my degree, I'm through. There's quite a difference. We were sent here to get a degree." Well, he put himself in front of a radio and listened to Radio Toulouse out of France for hours and hours and didn't work. I couldn't say, "You work now or else."

The Mathematics Curriculum and Faculty

Hughes: Were you getting along all right with differential equations?

Boeder: Yes, I was. It took years, of course, to get the degree there in mathematics. I worked hard and I had assistance. I was put, by the secretary of Professor Courant, in one of the rooms in the cellar in the mathematics institute. Nobody knew about it, and I was all alone. I could work there to my heart's content. Her name was Hilde Pick; she was a cousin of Professor Courant. She did a lot of things for me, I must say.

Hughes: Were you recognized once again as an outstanding student?

Boeder: No. Not in Göttingen.

Hughes: How many serious graduate students were there at that time?

Boeder: You might say 500. It was a tremendous university; they all wanted to hear people of rank. There was Professor [Edmund] Landau, Professor Herglotz, and several other big names. They attracted students from every corner of the world.

Hughes: How was the course of study arranged?

Boeder: With 500, you're listening [to the professor]. If you're away from that, you're on your own. And then you take an examination.

Hughes: At the very end?

Boeder: At the very end.

Hughes: So you're really on your own.

Boeder: You're on your own. There's no help. Of course, I had good friends by that time. The fact that I am here at the moment I owe to a Göttingen friend who died in August, and who had a memorial service in Berkeley.

Hughes: Ah, Hans Levy.

Boeder: Hans Levy. A wonderful mathematician. A real talent. Hans Levy was a good friend.

Hughes: Was he a student at that time?

Boeder: No, he was already a *Privatdozent* [lecturer]. And also, Rudolf Luneburg, an excellent mathematician. They're both dead now.

Hughes: Did you have a special relationship with these people?

Boeder: Friendly. We were friends; we undertook things together.

Hughes: You mean mathematical things?

Boeder: Rarely. I remember that I taught mathematics with Rudolf Luneburg, not with Levy.

Hughes: You must have chosen an area of concentration.

Boeder: Yes. It was applied mathematics.

Hughes: And you had determined that?

Boeder: I had determined that, yes. But I didn't do it with Courant; he was not interested in applied mathematics. He was more interested in the big stuff, differential equations and so on. I went to Professor [Ludwig] Prandtl and became what they called a *Doktorant*. *Doktorant* means one who is working for one's doctor's degree. But, I came through the final examination *sehr gut* [very good], which was good enough for me.

Hughes: Is that comparable to cum laude?

Boeder: Oh yes.

Hughes: Were you working strictly on your own?

Boeder: Yes, even my contact with Rudolf Luneburg did not focus on specific things. It was just discussions of fields that he was interested in.

Doctoral Studies

Hughes: What problem did you decide to tackle?

Boeder: That's an interesting question. I published what I considered perhaps the best paper I've published. That was on *Sturmungsdoppelbrechung.*

Hughes: You'll have to translate.

Boeder: Well, *Sturmung* means a flowing liquid, and some of those become like crystals. I wrote the first theory of *Sturmungsdoppelbrechung* [double refraction of a flowing liquid].

Hughes: Was the thesis recognized?

Boeder: Oh yes, it was recognized. It went immediately to the best *Zeitschrift* [journal] for that and was accepted. Then many people would read it.

Hughes: Why had you chosen that particular subject?

Boeder: That I didn't choose. I went to Prandtl and said that I would like to write a thesis; what's your recommendation? He said, "Well, try *Sturmungsdoppelbrechung.*" At that time, I didn't even know what that was. It was a difficult subject because it hadn't been tackled before. I didn't know much of the *Doppelbrechung* [double refraction] in the first place, but to have *Sturmungsdoppelbrechung*! You had a cylinder within a cylinder. There was enough room between the two cylinders to have a liquid, and when you put one of those cylinders in rotation and looked with the microscope through this, you saw *Doppelbrechung*. First, when you see that, it's amazing, but then you say, "How am I going to put that into mathematics?" [laughs] But it was all right.

Hughes: How do you approach a problem such as that?

Boeder: You go first to the literature. You find everything about *Doppelbrechung* and then *Sturmungsdoppelbrechung.*

Hughes: And was there much?

Boeder: Not on *Sturmung*, but *Doppelbrechung* is a physical subject and it's well known. Finally, you know what Professor Prandtl was visualizing, and then you have meetings with him before you come to the result.

Hughes: Did he give you much help?

Boeder: Believe it or not, he impressed me terrifically. In the first meeting that I had with Professor Prandtl, he wrote down what finally became my end formulas, just intuitively. "It should come out something like that." That is genius! That has impressed me all my life, that Prandtl could put down in the first session with me the end formulas, practically. But that's intuition; without making any notes, he put it down. Well, these men, they are terrific.

Hughes: Now, did applied mathematics have a lesser status than pure mathematics?

Boeder: No. Well, many students that like pure mathematics will say yes. [laughs] But one is work and the other is work.

Hughes: Why had you chosen applied math?

Boeder: Because I had gone to Professor Prandtl to get a doctoral problem. I had heard him. He was not a mathematician, but he was a man interested in the behavior of liquids. He was responsible for the theory of *Tragflügel* [carrying surface]. He was known all over Germany because he had written the theory of the *Tragflügel*. *Tragflügel* means, when translated into English, the carrying surface of every *Flugzeug*, airplane. He had written the three-dimensional *Tragflügel* theory. That was tremendous. Therefore, whenever a zeppelin came over Göttingen, it would make a bow to his institute.

Hughes: No!

Boeder: Yes. Well, he was a big man in his field.

Hughes: Were these people approachable for a young graduate student?

Boeder: Yes, I must say, I always was treated with great friendliness.

Hughes: It made no difference that you had started school on the wrong side of the tracks?

Boeder: Oh, they didn't even know that. It was in my file in the university, but they didn't pay any attention to it.

Hughes: They looked at what you could do now.

Boeder: Yes.

Hughes: How many years did you work for the degree?

Boeder: Well, I would say I worked for my degree for four years.

Hughes: You got your doctoral degree in 1931.

Boeder: Yes, 1927 through 1931.

Hughes: Tell me something about the examination.

Boeder: Oh, everybody fears those examinations, especially Billy. He didn't go to the examination, although he was finally told by Professor Tamann (that was his boss, he was a physical chemist), "Your thesis has been accepted. Now, come to the oral examination!" Billy wouldn't go. Tamann said, "I guarantee that you go through [pass]!" Billy wouldn't go.

Hughes: Why?

Boeder: He was afraid that he would be too deficient in the German language, that he wouldn't even understand what they were asking.

Hughes: Yet he had managed to write a dissertation.

Boeder: Oh yes, and that was accepted.

Hughes: So he never got the degree?

Boeder: Never got the degree. He was guaranteed by a man like Professor Tamann, *Geheimrat* Tamann. Do you know what that means? That he would pass and get his doctor's degree if he would make an appearance [at the examination].

Hughes: Why did they guarantee him?

Boeder: Because they knew he would go through.

Hughes: They knew he was good.

Boeder: They knew he was good.

Hughes: What became of him?

Boeder: He inherited the business in Wilmington, but he never went there. He would do everything by phone. They didn't know Billy. He was a queer duck.

Hughes: He never went any further in math?

Boeder: No.

Hughes: Well, let's go back to your examination. How did that go?

Boeder: That went very well. I was examined by a very famous man, a man with a world reputation. He was a physicist.

Hughes: Do you remember his name?

Boeder: Yes [pause]. Sometimes my memory just fools me, and therefore I'm going to give up teaching because that happens in front of the blackboard too, and you cannot afford that in teaching.* I've had glorious days teaching, but I think I have to demand to be released. I have tried it before, and they said, "You can't do that; you can't do that. Whom would we get [to replace you]?"

Hughes: Do you get blanks a lot?

Boeder: I got blanks just now. It is a detriment in concentration and in memory that I fear. But, of course, I am going to be eighty-seven [in April 1989].

Hughes: Yes, and we're talking about things that occurred many years ago. Well, don't worry about his name now. Was he the only person on the committee?

Boeder: No, I was examined by three people in succession.

Hughes: And you had no choice in who they were?

Boeder: No, but I got the famous men there, very good men.

Hughes: Did they examine you strictly in your field of concentration, or mathematics in general?

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* At the time of the interviews, Dr. Boeder lectured on optics one day a week at Eastern Virginia Medical School in Norfolk.

Boeder: No, in physics in general and mathematics in general. But I would say, with nice consideration. They didn't expect the world—fair questions. First, I was examined by Prandtl. He was considered one of the greatest engineers in Germany. He was a big shot and a very wonderful man. And then, Courant. Courant irritated me because when he'd ask a question, he already wrote, and it irritated me that he was writing before I had a chance to answer.

Hughes: You felt he wasn't listening?

Boeder: I had that idea, but he was listening. And then, the third one was a great physicist, a Nobel Prize man, James Franck—the name I was trying to remember.

Hughes: Now, had you met him before?

Boeder: Oh yes. I had taken courses, and practical courses, too, so that I came into contact with him doing experiments.

I took experimental physics. It was a famous course, tremendous people there, and all the *Apparaturen* [apparatus] needed to work there. It's amazing that they had so many *Apparaturen.*

Hughes: Did money come from the state?

Boeder: It was a state university, yes.

Hughes: Well, what happened extracurricularly at Göttingen?

Boeder: Well, I said Billy sat in front of his radio and listened to French.

Hughes: And you?

Boeder: I had different ideas about life. [laughter] I didn't listen to the French very much, although I'm twenty-five percent French.

Hughes: Where does that come from?

Boeder: My grandmother on my father's side was French.

Hughes: Did you take French in school?

Boeder: Oh yes, in the *Seminar*, and English.

Hughes: How was your education at the University of Pennsylvania holding up at Göttingen?

Boeder: Well, it was good I got into the University of Göttingen because of the master's degree I had. My professors at Penn also went to Göttingen.

When Billy said, "I want to go to Göttingen," Professor Hallett said, "Well, Mr. Bond, we *all* would like to go to Göttingen. [laughs] But you just do not have the right equipment for that yet."

Life in Göttingen

Hughes: Were there any other Americans at Göttingen?

Boeder: Oh, there were many Americans. Students came from all corners of the world.

Hughes: Anybody who afterwards became of note?

Boeder: Oh, I'm sure. There were many Russians—people like [Aleksandr Osipovich] Gelfond, a marvelous mathematician. Gelfond was a wonderful guy. He was known already in Moscow to be a first-class mathematician. He was very known as a number theorist. I asked him, "You do number theory. Isn't it Professor Landau that is of interest to you?" He said, "Sure." "So do you have to visit him sometimes?" He said, "Yes, sure. Very often." I asked, "Do you have to play chess with him?" "Every time he wants to play chess!" he said. I asked, "How did you make out?" He said, "Professor Landau doesn't know the game." [laughter] I said, "Wait until I talk that over with Professor Courant's wife, Nina, because she would enjoy that."

I was a little skeptical about that remark, and I went to other friends from Moscow and Leningrad, and there were many at that time in Göttingen from Leningrad and Moscow. I said, "This Gelfond says Landau doesn't know chess. Isn't that a little mean?" One friend said, "What do you mean! Gelfond was chess champion of Moscow when he was eighteen years old!" [laughter] That was Gelfond!

I had him on my motorcycle. You could go from Göttingen south and get into the most heavenly natural beauty. He said, "Oh, I love this motorcycle. When I go back to Moscow, I am *not* going to buy an automobile. I'll buy a motorcycle. It's too good to be just in nature like this, on a motorcycle." And it was true, you know. You have a directness [with your surroundings] with a motorcycle. And we had a good motorcycle; Billy bought the best BMW 750 Sportsmachine. That thing could go. It was wonderful. In one hour, I was in the Harz Mountains.

Hughes: Did you spend most of your social life with Billy?

Boeder: No. Finally, he even wanted to eat dinner alone. And I was not against that.

Hughes: Why did he make that decision?

Boeder: It made him too nervous. He was a nervous kind, and I ate much faster or more slowly—I don't know. At any rate, he wanted to eat alone.

Hughes: Göttingen was a student town, was it not?

Boeder: It was, at least in my time. There were 5,000 students. When you go into Göttingen streets now, as I did last year, there are foreigners. The whole street's full of foreigners coming from the Far East.

Hughes: Do the standards remain as high?

Boeder: I can't judge them, but the likelihood is that to be a Göttingen professor takes something.

James Franck

Hughes: Well, is there anything more you want to say about the Göttingen period?

Boeder: We settled my examination with Franck. Franck was wonderful, really. He was so kind. When he went on a trip, his whole department went into mourning. [laughs] Oh, they loved him.

I think James Franck went to Chicago.* Of course, he was well known; he had a Nobel Prize.

Hughes: Was that before the war?

Boeder: It was after Hitler. When Hitler came in, all these people had to go because they were Jewish.

Hughes: Were most of the mathematicians Jewish?

Boeder: No, not most of them, but of the faculty at Göttingen at the time, Landau was Jewish, Franck was Jewish, Courant was Jewish.

* Protesting Nazi politics, Franck resigned his post at Göttingen and went to Denmark in 1933. He arrived in the United States in 1935 and was appointed professor at Johns Hopkins University. In 1938, he became professor of physical chemistry at the University of Chicago.

The big department heads in those physical and mathematical departments were Jews.

Hughes: Was there any discrimination at that point?

Boeder: No, but Hitler said, "*Raus* [Out]! Get rid of these fellows." And Levy was the first one out. He said, "I don't trust these guys at all!"

Hughes: He was right.

Boeder: Yes. Then many followed, and so Franck went out. They all went out. All of a sudden, there was nothing left in Göttingen. The big shots went to the United States, Scotland, or elsewhere.

Hughes: Was there discrimination against Jews when you were in Göttingen?

Boeder: When it came, we resented that it came. I was sick about how Göttingen was changed by hobnails and *Hakenkreuze* [swastikas]. They took over the world—sickening guys.

Hughes: Do you want to say any more about Göttingen?

Boeder: I will just make one more remark about Franck, what he did here. Franck was the chairman of a committee to consider the atomic bomb and atomic research for the future. He might have been close to Chicago, but not in Chicago. Let's say it was in Chicago; it doesn't matter. His foresight was so good that he predicted exactly what happened for the next twenty, twenty-five, thirty years [in the development of atomic weapons]. His committee predicted exactly how it developed into misery. "If you do that, that will be followed by this misery, and you shouldn't do it." They were against the bomb. "Don't throw the bomb over Japan!" And all these things were Franck. But others didn't listen. That was James Franck—colossal mental ability.

Hughes: Did you ever have personal contact with him after Göttingen?

Boeder: After that, no. I may have seen him in certain meetings, as I have seen Einstein in meetings that I remember at Ohio State. Einstein was interested in the new model of the electron microscope.

Richard Courant

Hughes: Did you have anybody at Göttingen that you would consider a mentor?

Boeder: Well, I think Levy was a mentor, on not so many occasions, but [still] a mentor. And Rudolf Luneburg. They were my direct contacts with mathematics. Courant was a queer duck. For instance, he came out of his house in Göttingen, and he couldn't miss me; I was going the same way. He would go there and I would go here, and we would walk all the way up separately. [laughter].

Hughes: Was that a way of showing his status?

Boeder: No, I don't think so. It was a kind of timidness.

Once, when [Niels] Bohr, the big Danish physicist, was visiting, many people came to hear him. Courant was on the side of the crowd where I was too. I followed him. He had the idea that I wanted to greet him. And he stood aside to let me through, and I said, "How are you, professor?" He was just timid. Courant was a strange fellow in that respect.

Hughes: Were you spending a great deal of your life doing and thinking about mathematics?

Boeder: Yes, especially in a negative way. [laughter]

Hughes: Now, what do you mean by a negative way?

Boeder: Too much.

Hughes: So even social life was permeated by mathematics?

Boeder: I cannot say that was the case. I met Courant, the department head, in simple gatherings of students where he was, of course, the center point of attention. He was all right, perfectly all right, and he allowed pictures to be taken. We sat around Courant, I was on the floor, and others were too, right in front of him. I have that picture. It was a private gathering in somebody's house.

Hughes: Were such gatherings fairly commonplace?

Boeder: Yes.

Hughes: So the professors and students had opportunities to make social contact?

Boeder: Yes, that's true.

Hughes: Except for Courant, did you feel comfortable with the professors?

Boeder: Yes. I was an American, you know. [laughter]

Hughes: Not very long!

Boeder: No, not very long, but already with conviction.

II. EARLY CAREER

Susquehanna University, 1932–1935

[Interview 2: November 10, 1988, American Academy of Ophthalmology, San Francisco, California]

Boeder: I arrived in New York [from Göttingen] with a doctor's degree, sometime in 1931. I took a quick visit to my relatives in the Bronx, just to say hello, because they had been very nice to me. "Pa," who was my first cousin, had furnished the money [for my immigration to the United States]. I had paid them back, of course, very fast. He said, "Why so fast? Take your time, Paul." But I was glad I had.

Well, I made a visit there, found everybody in good health, and went on the following day to the parents and sister, Helen, of the man whom I left in Göttingen.

Hughes: Billy Bond.

Boeder: He didn't want to come home. He didn't want to come for years.

Hughes: Why was that?

Boeder: I don't know why that was. But he loved it in Göttingen. He even loved the beginning of the Hitler time, which I fled. He thought it was rather interesting how the people all became followers of Hitler.

Hughes: Was he sympathetic?

Boeder: No, I cannot say that. For him, it was a matter of interest. He was a viewer of a drama. But he was not sympathetic at all; he was not involved. No, he was an American.

I reported on Billy, and they didn't know that I had come with my doctor's degree. Billy had asked me not to tell his parents. But now, it had no meaning anymore, why keep it quiet? They paid for it, so they should know what they got.

Hughes: Were you headed back to a teaching position in Delaware?

Boeder: I had no teaching position. As a matter of fact, I paid a visit to my professors at the University of Pennsylvania in Philadelphia, and they were shocked when I was back. "Didn't you get our letter?" I said, "I got the letter, but I just wanted to say hello. Is that forbidden? I know that you can't give me a position."

Hughes: That's what the letter had said?

Boeder: The letter had said, "We cannot fulfill our promise, and we cannot hold our faculty. Only full professors are held." They had promised me an assistant professorship if I came back with a doctor's degree. I said, "I understand the letter, I agree, and so on. I am here to just say hello."

Well, Hallett said, "Now, if you want a job in industry, we will give you a recommendation, but we cannot make an appointment [in the department here]." But it was a very good visit because about two or three weeks later, Professor Klein called me at the Bonds' in Hollywood [Pennsylvania]. That's where I lived for the moment. He said, "Boeder, pack your bag. You have a position." I said, "What!" He said, "Yes, in Selinsgrove, Pennsylvania, at the Susquehanna University." I said, "Selinsgrove? Where is Selinsgrove?" He said, "Well, it's near Sunbury, about six miles away."

So now, as suggested by Dr. Klein, I was on my way in no time to get a train to Sunbury, Pennsylvania. I arrived in Sunbury on a miserable night—rain, rain, rain, darkness, wetness everywhere. At that time, one had to take a bus from Sunbury to Selinsgrove—in the night, when you could think of nothing better than your own bed. [laughter] There, I went up the street on which I knew must be the president's house. There was a light, and I went over and put my foot right into water this deep. I rang the bell, and the door opened, and it was evident that he was very much disappointed when he saw me. Really! No doubt about that. He almost withered.

Hughes: Was he expecting somebody older, do you think?

Boeder: He expected somebody who had some decent height, a six-footer, a man that had shoulders, and so on. Here was this little shrimp, and he was obviously disappointed.

He had a beautiful home. His wife was sitting there busy with something. He had the dean of the college there.

Hughes: Were they expecting you?

Boeder: Yes, they were expecting me. They asked me all sorts of questions. I was interrogated as to my life, as to my beliefs. Well, they were Lutherans of the first order. Susquehanna University you can call a school with Lutheran leanings, *strong* leanings. Well, I am a Lutheran.

Hughes: So that was all right.

Boeder: That was all right. [laughs] I was brought up in the Lutheran religion. That did it.

Well, after a lot of questions, the president said, "We, of course, are grateful that you came. We have many applicants." And I thought, you liar. I knew from Professor Klein it was a hurry job. I was supposed to be department head of mathematics.

Hughes: Department head!

Boeder: There were two people in the department already. But, I was the main man, supposedly. The man [my predecessor] left suddenly in the beginning of the semester. So they telephoned the Pennsylvania Department of Mathematics and asked for a fellow to replace him, and I was the fellow. It was luck, great luck.

The president, Dr. Smith, was not convinced. The dean, Dunkelberger, said, "Look, let's you and me go into the kitchen (he was talking to the president) and let's talk it over." They disappeared. Mrs. Smith was sitting someplace in the back. We had a nice conversation. I liked her from the start, and I always liked her.

The dean and the president came back after a while. The president started to talk a different tune completely. He said, "Now, we cannot offer you much. We cannot offer you more than $2,600." I thought I would jump to the ceiling to have a job like that! Two thousand, six hundred dollars, my word! I didn't make that known to them, but my God, how was it possible? To come

here out of Germany and get a job like that! It was just a miracle to me.

"But you have to start teaching tomorrow. You have the seniors tomorrow morning." I said, "That's fine." I was not afraid of that. "You sleep here on the second floor." I said, "That's fine." And soon I stood in front of the mirror and said, "Paul, is it true? I don't believe that this is true!" I couldn't believe it! I mean, it was so enormous to me. I went to bed and slept, and in the morning, I taught the class. I had a great time with the seniors; that was nothing to me at the time. I could easily teach them, whatever subject they had.

Hughes: Had you been given some guidance about what to teach?

Boeder: No, I asked them what they were talking about last, and I followed a little repertoire about what they had. No, they couldn't get me that way. That was impossible. I came out of Göttingen and really knew something about mathematics at the time.

Hughes: You were far above the students.

Boeder: Yes.

Well, it went well. I tried to get them going with their questions and ask them questions. The hour went like nothing. I had a very good, I must say, a splendid office, and I had a good room alone, a desk, everything.

Hughes: What about the other member of the department?

Boeder: Well, there were two more. I didn't think that I could be challenged by them. One was old, and the other was a little younger, but they were both older than I.

Hughes: Why hadn't one of them been made chairman?

Boeder: That would have been a mistake! [laughs] They didn't have the training I had.

Hughes: There was no resentment that you were aware of?

Boeder: No, they didn't show it. If they had it, that was in their own privacy. They fully accepted me.

At any rate, after the one hour of teaching, the president called. He said, "Well, they tell me you're quite a teacher. They're very

enthusiastic about your class." I said, "That's fine, thank you." He was a changed man, the president.

Evelyn Alison Boeder

Boeder: I remember the first faculty meeting I participated in. They had it in the auditorium where you had seats going up and up and up. I took a back seat and saw the whole faculty in front of me. Then I saw a very beautiful profile. I said, "My gosh, this burg is not so bad as I thought it was!" And that was Evelyn. She was professor of French in that college. She was a very pretty girl. I was happy to see her. I found out that she had some going relationship with the professor of English, Dr. Wilson, that was supposed to be serious. When I became a little more intimate with President Smith, I said, "How far has this relationship gone with Miss Alison and Dr. Wilson?" He said, "Well, everything is over but the shouting!" [laughter]

Hughes: And your heart sank.

Boeder: But I invited Evelyn very soon to a little tennis, and I never heard about Dr. Wilson at all.

Wilson was a man I liked very much. He was a very well educated man. We became good friends, no doubt about that. He knew that I would invite Evelyn, and there was no jealousy or anything. The only advice he gave us was, "Evelyn is not the type for you at all." I said, "I'll leave that to myself." [laughter] Well, at any rate, Evelyn and I became fast friends, and we married.

Hughes: How much later?

Boeder: We married in 1935. That was a marvelous marriage. We did a lot together because of Evelyn. I was always satisfied to go to Maine. I liked Maine.

Hughes: Is that where she came from?

Boeder: No, she came from Selinsgrove. I knew her parents. The father I knew before I married her. And the father suddenly died, I don't know why he died suddenly. Then there was the mother and one sister; that is Dorothy. I talk to her every Saturday. She is now in Spartanburg [South Carolina]. [After I retired] Evelyn wanted to go to Norfolk, because her brother, Sam Alison, was married and living in Norfolk and had a house.

Evelyn was *really* an American. Wonderful what she did sometimes.

Hughes: What do you mean?

Boeder: Well, for instance, I was in the wrong lane in Los Angeles. I had to do something, but I didn't want to go right, and I stood there. Everybody—horn, horn, horn. A policeman came to the window and said, "If you didn't have an out-of-state license, you would get a citation right now." And Evelyn said, "What's your name, officer?" I thought I would die! That was so definitely American, and she was not impressed at all [by the policeman]. [laughter] That's marvelous; I didn't laugh then. Evelyn was a true American. She had her rights, and she insisted on those rights. She was never in any way aggressive, but . . .

Hughes: She stood up for you.

Boeder: Yes. She really protected herself and her family. She was a wonderful girl. She died six years ago, cancer. She was professor of French when I learned to know her. She had studied at the Sorbonne in Paris and also in Grenoble. She was well qualified in French; she was fluent.

Hughes: How long did you stay at Susquehanna University?

Boeder: Not very long [1932–1935].

Hughes: Is there more you want to say about Susquehanna?

Boeder: Well, I can only say that I had to earn my money now, and I had to look out that my wife was satisfied financially, and so on. The university didn't pay too much. As a matter of fact, they gave us cuts.

Hughes: Because of the Depression?

Boeder: Yes. The $2,600 was reduced to $2,100, and so on.

American Optical Company, 1935–1957*

Bureau of Visual Science

Boeder: The American Optical Company offered a job that was beyond that in salary, and I reached for it. I was supposed to join the Bureau of Visual Science.

Hughes: How did they know of you?

Boeder: Well, by a German friend who was in that bureau.

Hughes: What was his name?

Boeder: [pause] Julius Neumueller. He was a Bavarian and an optometrist. He went to the Philadelphia Optometric School. He had an enormous respect for the German universities, and when I came back from a German university with a doctor's degree, he wanted to hire me; he wanted me in his department.

Hughes: How had you known him?

Boeder: He played in the German theatre with me. I was a member of the German theatre in Philadelphia.

Hughes: When was that?

Boeder: Well, when I came to Philadelphia [about 1925], I was immediately in that group. I got only eight dollars for every performance on a Saturday.

Hughes: You mean you were acting?

Boeder: Acting.

Hughes: Had you had any experience in acting?

Boeder: Only in school, where we sometimes had a performance. I needed the money. I was working for my master's degree—no source of income except tutoring and eight dollars from the German theatre. And there, I had always, what they call in German, the role of the second lover. In other words, there is a serious lover, and there is a second lover who is always the man who gets the applause and the laughs.

* A further discussion of American Optical Company, recorded on March 21, 1989, has been incorporated here.

Hughes: And these were German plays, given in German?

Boeder: German plays, given in German to a German audience—which is voluminous in Philadelphia.

Hughes: Was this an old organization?

Boeder: Yes, it was an old German club.

Hughes: Now, were you doing it mainly for the money?

Boeder: Oh, I liked it. It was work; you had a new play every week.

Hughes: So you had a lot of lines to learn!

Boeder: Had to learn a lot, yes.

Hughes: This was on top of graduate studies.

Boeder: There was the *souffleuse*. You know what the *souffleuse* is? One who whispers.

Hughes: The prompter.

Boeder: When she got stuck, we were stuck too! [laughter] We had a lot of fun, no doubt about it, and it was a little money. In 1926 when you had eight dollars, you could pay for room and board.

And then the tutoring brought a few dollars more, and I was all right. The worst thing was the tuition. In the University of Pennsylvania, one semester was $200. Now, how was I going to do that? So I went to Professor Klein and said, "I have to quit, because I cannot pay." "Why didn't you tell us that before? Now we cannot say you can get a fellowship or something. Let's go to Dr. Hallett."

Dr. Hallett and Dr. Klein went to the dean and said, "This fellow needs a fellowship now. It's too late, we know that, but just give it to him anyway." And I got it for two years. It was incredible, really. Those Quakers, they're too good.

Hughes: Now, was Neumueller at American Optical when you knew each other in the German theatre?

Boeder: Yes. He had been acting for a long time for the same company.

Hughes: What did he do for American Optical?

Boeder: He had a good position. He preceded me in the Bureau of Visual Science.

Hughes: What was his background?

Boeder: [pause] Thin. [laughter] Well, he was glad to have me. He helped a lot. I owe him a lot.

Hughes: You took his position?

Boeder: I took his position, finally, yes.

Hughes: But not in the beginning?

Boeder: No. I worked for him, so to speak.

Hughes: He had other scientists as well?

Boeder: Well, he had other scientists, although there was only one other who had a doctor's degree, [Robert J.] Beitel. He was also at Dartmouth for a certain time.

Hughes: An optometrist?

Boeder: He started as an optometrist.*

Hughes: What did Dr. Neumueller hire you to do specifically?

Boeder: Well, to take over more advanced thinking in optics.

Hughes: With what purpose in mind?

Boeder: Well, to publish and make his department known in the optical industry—Bausch & Lomb, and so on.

At that time, they had an educational program for the people working for American Optical Company. They had nine zones, and the zones each had perhaps five or six stations in the various cities all over America. I was sent to give talks all over the United States to the people that worked for American Optical.

Hughes: On what subject?

Boeder: On new products, and on the ways to get them going, and so on.

Hughes: Why would American Optical hire a mathematician for that job?

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* Dr. Beitel acquired a PhD and later an MD.

Boeder: They were interested in people that could represent the company. Whether he was a mathematician or psychologist, they didn't care. He was educated; that's what they wanted. So I came to San Francisco and other places, giving talks to the American Optical people. Maybe bifocals alone, or any other subjects that came up.

Hughes: How many people were in the bureau when you first arrived in 1935?

Boeder: There were about four or five.

Hughes: Was it theoretically or practically oriented?

Boeder: For others, it was practically oriented, because they were refractionists. They did a lot of refractions.

Hughes: In the bureau?

Boeder: Yes. They would prescribe glasses.

Hughes: You described your responsibilities at the Bureau of Visual Science as "in charge of Physiological Optics and functional aspects of ophthalmic instrumentation." Now, what does that latter mean?*

Boeder: You have to know that because when doctors of ophthalmology and optometry want to buy something, you have to know the instruments and what the instruments can do.

Hughes: Did you have to learn that?

Boeder: Yes, I had to. I mean, I had to show an instrument if necessary. There were new instruments coming out, such as the space eikonometer, and [you had to know] the refractional part of it too.

Bausch & Lomb

Hughes: Was American Optical the leader in the field?

Boeder: No. They had one rival, if not superior, Bausch & Lomb. Bausch & Lomb and American Optical Company were, in a sense, rivals. But the one was not better than the other.

Hughes: And their products were . . .

Boeder: Very similar.

* Curriculum vitae sent in June 1957 to Alson E. Braley, MD, at the University of Iowa.

Hughes: Did American Optical make microscopes as well?

Boeder: Yes. They bought out a company, and therefore they had microscopes.

Bausch & Lomb wanted to hire me.

Hughes: Did you ever consider accepting?

Boeder: Never.

Hughes: Did they offer you more money?

Boeder: When one of our executives died, I was approached by Bausch & Lomb, by friends of mine. One said, "Now that he is dead, would you be willing to come to Bausch & Lomb?" I said, "No, I wouldn't consider it."

Hughes: Why wouldn't you consider it?

Boeder: I felt loyalty to American Optical Company. Oh, definitely. I wouldn't have changed to Bausch & Lomb, even if they had offered me double the money.

Hughes: Was the executive who died Schumacher?

Boeder: No. Weldon Schumacher was a good personal friend. I had many talks with his father. He was a big shot too, but the son was the president.

Hughes: Was the father also with American Optical?

Boeder: Yes, and he had his son as a boss. [laughter] Weldon was a very good executive.

Hughes: Was American Optical typical in the freedom it gave its scientists to do as they pleased?

Boeder: I don't know, but I must say, they left me alone completely. I could do what I wanted to. I could even arrange trips that I wanted and didn't have to account for them.

Hughes: Was there anybody comparable with Bausch & Lomb?

Boeder: Oh yes, they were in the same boat. I mean, they had the same [type of] people.

Hughes: Was Jack Copeland with Bausch & Lomb?

Boeder: No, Jack Copeland was on his own.* He was a very liked lecturer.

Hughes: On optics?

Boeder: On refraction.

Hughes: Which is different?

Boeder: Yes, it's a special application in optics.

Hughes: So his approach was clinical.

Boeder: Yes, clinical. He was a good man. I liked him. We were good friends, always.

Hughes: But Bausch & Lomb did not have the counterpart of a Paul Boeder.

Boeder: There is only one [laughing] Paul Boeder.

Hughes: I said counterpart, which doesn't mean identical.

Boeder: Well, Bausch & Lomb had very good fellows. I liked them. We were very good friends on every occasion when we could show it, for instance, at the Academy meeting. I always had respect for my counterparts. They were good.

Hughes: They didn't have your education, did they?

Boeder: Not the same, but they had enough to get along and be effective.

Hughes: You said that Bausch & Lomb sold roughly the same products as American Optical.

Boeder: Exactly.

Hughes: So they were head-on competitors.

Boeder: They had everything we had, and we had everything they had.

*Hughes: Except the eikonometer.***

Boeder: Well, they were not interested. They had missed the boat. Kodak was approached by [Edwin Herbert] Land.

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* According to Dr. Robert E. Bannon, Jack Copeland did teach for Bausch & Lomb.

** A discussion of the use of the eikonometer in aniseikonia occurs on pp 49–51, 66–67.

Hughes: Land of Polaroid.

Boeder: Kodak missed the boat too. They were not interested. So Land said, "We'll do it ourselves."

Hughes: Did you know Land?

Boeder: Very well.

Hughes: How did that friendship grow?

Boeder: He came to the American Optical Company, and I had lunch with him, with the other executives, and we had arguments right in front of the executives.

Hughes: He was looking for backing to develop Polaroid?

Boeder: Well, at that time, he wanted good financial backing, or something like that. But he didn't come to American Optical Company for that.

I'll never forget Land. We had an argument, Land and I, and I know I was right. One of our executives later said, "I knew you were right, Paul." [laughs] But he was the only one who said that.

Hughes: Can you remember what you argued about?

Boeder: Yes, I think I can. Land said, "Paul, what would you do in my case?" And we got to the question of showing these three-dimensional pictures to the public with [Polaroid] glasses.

Hughes: Is this cinerama that you're talking about?

Boeder: Well, it was called 3-D.

I said, "What I would do if I were you, I would find out how I could make the observing populace in a theatre more comfortable if they have to sit at the sides, because I imagine that many have a headache after [viewing the screen from an angle]." Land thought that was the dumbest thing I could say.

More on the Bureau of Visual Science*

Hughes: Whose idea was it to found the bureau?

Boeder: Well, I believe it was [Charles] Cozzens's, a very sharp sales manager. Cozzens knew Bausch & Lomb, knew everybody, and knew what the optical business consisted of. He, therefore, knew the necessities that he had to build and fill in. He was a sharp guy.

Hughes: Did Bausch & Lomb have a department comparable to the bureau?

Boeder: Not that I know the name of, but I'm sure that there was one.

The people I knew there were my friends. We met at conventions like Las Vegas [where the American Academy of Ophthalmology met in 1989], and so on. I went to Bausch & Lomb, for instance, in Las Vegas and said, "My gosh, the people are all new to me. How about the old-timers? Are they alive?" I didn't know a single one, and they didn't know me. But there was a time when American Optical Company and Bausch & Lomb came to conventions like ophthalmology, and so on, and we knew each other. We became friends.

Hughes: So it was a friendly competition, at least on a personal level.

Boeder: Yes, it was. No doubt about it.

Hughes: What was the purpose of the bureau?

Boeder: The purpose was to write little instructional papers for the company and clientele and then give educational lectures, as I said. I mean education in the principal parts of instruments and the reason for those instruments.

Hughes: How did you become familiar with the instruments? It was your first taste of ophthalmology in any form.

Boeder: Yes. Well, we had almost everything that the company sold in a special room in the Bureau of Visual Science. You could see what we had to sell and how instruments were used. We were supposed to know how they were used.

Hughes: Was it your responsibility to teach yourself?

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* Dr. Bannon's recollections of topics covered in this section sometimes differ from those of Dr. Boeder. His comments are on deposit at the Foundation of the American Academy of Ophthalmology.

Boeder: Yes, I had to know how they were used and why. But those things were fun at the time. It was no burden to learn that. It was interesting.

Hughes: Who else was in the bureau?

Boeder: The bureau sometimes had a membership of ten men. Some were optometrists. My predecessor was an optometrist.

Hughes: Neumueller, your predecessor as director?

Boeder: Yes.

Bob [Robert E.] Bannon was attracted to the bureau, and he was an optometrist. He was also a member of the Dartmouth Eye Institute [DEI] in Hanover, New Hampshire, where there was an aniseikonic clinic.* I became involved in that because I was with the American Optical Company, and the American Optical Company had to furnish the aniseikonia lenses that had to be designed individually. In order to do that, you had to know something—just what I knew—about those things. I developed a chart which would be used by my secretary for the determination of the lens specifications for a given prescription in aniseikonia. I couldn't do all that; she did it. She found out what kind of lenses, what the front surface should be, whether it should be astigmatic or not, and the back surface, and all that she could determine by just using this chart. The chart was very important.

Hughes: Had American Optical appreciated when they hired you that your mathematical background would help you in this position?

Boeder: Well, they hoped perhaps, because they hired me when I came back from Göttingen.

Hughes: The way I interpreted your earlier comment was that American Optical was interested in having educated people on its staff, but it didn't hire you precisely because you were a mathematician.

Boeder: Yes, but they had to develop things.

Hughes: So your job was more than just product education and training.

Boeder: Well, employees were supposed to deliver.

Hughes: Yes, you were supposed to deliver.

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* Dr. Bannon went to American Optical in 1951 after DEI closed (1947) and after teaching at Columbia University in New York (1947–1951).

Boeder: Oh, no doubt about that. They would have let me go if I didn't deliver.

Hughes: Deliver in the sense of invention?

Boeder: Yes. You had to be on top, otherwise you'd lose your position.

Hughes: And you knew that when you took the job?

Boeder: Oh yes. I was not afraid of it, because after all, I was a product of Göttingen. [laughter] And in Bausch & Lomb, you had the same kind of people working.

Hughes: So there was time in your job for you to think and do research.

Boeder: Oh, no doubt. I had to develop a chart [for aniseikonia screening] from scratch; I had to think how it would be.

Hughes: Of course, I can understand how you could do the mathematical aspects, but how did you teach yourself the ophthalmological principles?

Boeder: Well, in a sense, they are limited, because what can a lens be? A lens has thickness, it has one surface, it has another surface. Is the surface spherical or is it cylindrical? But more you cannot hope for a lens. I have even lens patents. I don't know where they are now and what American Optical has done with them, but I have patents.

Hughes: How soon did you take out patents?

Boeder: Whenever I had an idea. [laughter]

Hughes: Did that happen very quickly after you took the job?

Boeder: No, you had to know at least the fundamentals. The fundamentals, however, I can teach you, bright Sally, in a few days.

Hughes: Maybe yes, maybe no.

Boeder: Maybe yes.

Bureau Director, 1940–1957

Hughes: You were made director of the Bureau of Visual Science in 1940. How did that come about?

Boeder: Because Neumueller left.

Hughes: And you were the logical successor?

Boeder: Yes. Neumueller left, and I was in charge then.

Hughes: What did being in charge actually entail?

Boeder: Well, I must say I don't remember that it entailed more money. [laughter] I never thought American Optical Company paid me too little. How that came about, I don't know, but I got, at that time, a little *Zulage* [salary bonus], but I paid little attention to it, actually.

Hughes: Did American Optical in general pay pretty well?

Boeder: Pretty well. When I think how much I delivered, I think I was overpaid. [laughter]

Hughes: Obviously, they didn't.

Boeder: That's the truth.

Hughes: How did your responsibilities change when you became director?

Boeder: Well, all of a sudden, I had to call the shots. And nobody objected. We got along pretty well, harmoniously. We were glad to have Neumueller out of the way.

Hughes: He was difficult?

Boeder: He could be difficult.

Hughes: In general, were you left to your own devices?

Boeder: Yes. I cannot complain about the American Optical Company. I think the American Optical Company did a lot for me. And I have no regrets. I'm glad I was a member once.

Hughes: It sounds to me as though you were given almost free license to do as you pleased.

Boeder: I was completely free. I could arrange my own trips, and so on, and nobody would say, "Hey, you can't do that." It's amazing. I had an absolutely free hand.

Hughes: What about equipment?

Boeder: The equipment that we had in that bureau was enough to show visitors.

Hughes: For your work, you carried your equipment with you, namely, your brain. You didn't require much more than that, is that not true?

Boeder: Well, perhaps a few drawings. That's why I had no baggage. I wasn't a salesman. They didn't use me as a salesman, I must say that. If they gained sales from me, it was coincidental. But I was not a salesman.

Hughes: You were their idea man.

Boeder: Yes, that's right. They never abused me in that sense—ever.

Hughes: Give me a flavor of what a typical day as director was like.

Boeder: Well, you have to say "hello" to the ones that work for you. [laughs] And they were all nice. I liked them, you know.

Hughes: Had the bureau grown?

Boeder: Well, let me see. I've forgotten now. There are no pictures to back me up, but I think a few additions were made. I had Bannon.

Hughes: What was he doing, specifically?

Boeder: He was doing optometry.

Hughes: Would ophthalmologists and optometrists write to you about how to operate certain types of equipment?

Boeder: No, that was done by our salesmen.

Hughes: What types of questions were asked?

Boeder: Well, the questions come when you are told that the instrument doesn't work anymore. Then you go after what they did wrong. We had a lot of visitors that we entertained. Oh yes, now that

comes back to me. We gave a course. We didn't give a sales course. We gave an informative course about the instruments.

Hughes: Was it hands on?

Boeder: Yes, and then there were always many questions that those fellows had on their minds, and we answered them. Part of it was instruction. We had a nice room where we could meet, and there were blackboards, and so on, and they could smoke a little bit. Finally, we made quite a big thing of teaching in the American Optical Company. People came in, and we gave them courses.

Hughes: How big was American Optical in the forties?

Boeder: I don't remember exactly how many employees they had, but it must have been in the thousands. But it was quite a company. Of course, there were many, many employees all over the country.

Hughes: In all the major cities, would you say?

Boeder: In all the major cities all over the United States.

Hughes: Is that not true any longer?

Boeder: It must be true—unless Bausch & Lomb gave up. [laughter]

Dartmouth Eye Institute, Hanover, New Hampshire

Personnel

Hughes: Soon after you arrived at American Optical, you were temporarily assigned to the Dartmouth Eye Institute where you worked on aniseikonia. Please tell me about the group at Hanover. Who was there, and how had it gotten organized?

Boeder: Well, they needed medical people. They needed people of rank in ophthalmology. And finally, they had an institute there which was second to none.

Hughes: Is there a medical school in Hanover?

Boeder: There is a medical school [Dartmouth], but the medical school did not contribute directly to the eye institute in Hanover very much. Patients came from all corners of the world to be treated [for aniseikonia] at the institute, the eye clinic of Hanover.

Hughes: Beginning when?

Boeder: Beginning in the thirties. They invited people like Alfred Bielschowsky of world reputation, out of Germany. He could hardly speak English when he came, but he was amazing in acquiring English, I must say. He counted on me to take him every night to the movies. He wanted to hear English, and he wanted to speak, at the same time, English with me. Of course, whenever he got stuck, he could talk German, because I was German. Bielschowsky was a wonderful man, really.

Hughes: What was his background?

Boeder: His background was that he had in Germany number one *renommée* [reputation]. I mean, he was known as one of the distinguished ophthalmologists. He was invited first to visit [DEI]. They wanted to take a look at him, and he wanted to take a look at the institute. He was supposed to take over the institute as a director. Well, when he left after the visit, he took me aside and said, "I don't think they want me. I won't be back." I said, "*You will be back*. I'm certain you will be back." [laughter] He said, "No."

Hughes: Why did he have that impression?

Boeder: Well, [Adelbert] Ames, [Jr.] was the man who really founded this institute. He had discovered aniseikonia; he knew what to do with it. Ames was the leading man. He had no doctor's degree, but he simply was an intellectual of the first order. Ames was a Harvard man.

Hughes: An ophthalmologist?

Boeder: No, he was not an ophthalmologist. But he had the intellectual qualities to help the ophthalmologist.

Hughes: So he was more of a research person?

Boeder: Yes, he was a researcher. He had a new idea every week. That's what we said at the time: "That guy is terrific. He has a new idea every week." And he did! In many things. He had the capacity for thinking alone, and he came up with an idea that the others would toss about and follow if it was any good and leave if not.

But Ames was a leader. He was what I would call an aristocrat. He was an aristocrat by nature. There was money in the first place. Ames had money. And in the second place, he had a

beautiful home. It overlooked a little lake [Occum Pond] there in Hanover, New Hampshire. We sat there and talked, and it was interesting to me how his mind functioned. He was a wonderful man.

Hughes: Do you know anything about his training?

Boeder: Well, he was Harvard-bred.

Hughes: Did he have a scientific background?

Boeder: Oh, I don't know that. He had that knowledge all by himself. He was a thinker.

Hughes: The institute was a research institute rather than a clinical . . .

Boeder: Well, supposedly a clinical and research institute.

Hughes: Who were the ophthalmologists associated with it?

Boeder: Well, Bielschowsky I mentioned already. He was attracted to take over the institute. But they also had ophthalmologists like Hermann Burian. They were not afraid of attracting optometrists. Bannon was attracted, and others.*

Hughes: Was that unusual at that time?

Boeder: That was, at that time, unusual. They didn't mind [having optometrists working with ophthalmologists]. Optometrists had the function to examine the eyes of people visiting, and so on. There were a few ophthalmologists in charge. Bannon was not the only optometrist; there were others. They were very good clinically.

Hughes: What was the arrangement with American Optical?

Boeder: American Optical became a necessity. The institute had a new visual anomaly. They called it aniseikonia. I don't know whether you have ever heard that name.

*Hughes: I've heard it from Dr. [Melvin L.] Rubin.***

Boeder: There you are. Aniseikonia literally means not equal [ocular] images. In other words, the eyes must have complicated lenses to equalize the images. And aniseikonia, therefore, had one definite

* See the appendix for a list of others associated with DEI.

** Interview with Dr. Melvin L. Rubin, San Francisco, California, September 6, 1988.

demand on an optical company [for the production of corrective lenses]. Bausch & Lomb was excluded; Bausch & Lomb didn't want it. American Optical said yes.

Hughes: Why did Bausch & Lomb say no?

Boeder: I don't know; they were crazy to say no. I don't know why on earth they didn't want to bother with aniseikonia.

Hughes: So American Optical made the lenses for aniseikonia?

Boeder: Yes.

Hughes: But you were doing more than that?

Boeder: Well, I was there as an American Optical man who observed and helped as much as I could.

Hughes: Then you went back to American Optical with the specifications for the lenses?

Boeder: No, they were sent in and actually had to be interpreted first. When you had to have this kind of a [aniseikonic] correction, how do you build the lens?

Hughes: So that was your part.

Boeder: Yes, it was my part.

Hughes: You had moved to Hanover?

Boeder: I was there a long time and a very nice time. I lived in the Green Lantern Inn. They didn't put me into the big inn, the Hanover Inn. That was too expensive. I didn't mind that at all. I had a very good room in the Green Lantern.

Hughes: How long is a long time?

Boeder: Well, it was more than a quarter of a year. Maybe four months.

I haven't mentioned one who was not an ophthalmologist and not an optometrist. He was Kenneth Ogle. Kenneth Ogle was a research physicist.

The group that worked for Ames at that time was very interesting. We went into the White Mountains together every Saturday and Sunday, and we had marvelous excursions from Hanover.

Hughes: Did most of the Dartmouth group go?

Boeder: No, not more than four or five. Evelyn went along.

Hughes: She liked to walk?

Boeder: Oh yes.

Hughes: Who was usually in the group?

Boeder: [Gordon H.] Gliddon.

Hughes: Was he an optometrist?

Boeder: Yes. At least, he knew optometry; I don't know which school he attended in optometry. He was very well educated.*

Hughes: What was he doing specifically at the Dartmouth Eye Institute?

Boeder: Measuring people for aniseikonia.

Hughes: Was he developing the methodology?

Boeder: No.

Hughes: That had been developed?

Boeder: Yes. All the development that was done there was actually inspired and done by Ames. Gliddon and others were very capable at acquiring what was necessary to use the instruments.

Aniseikonia

Hughes: Would you explain what was thought to be the great importance of aniseikonia at that time?

Boeder: Well, the strangest thing is nobody talks about aniseikonia. It's dead.

Hughes: Now, you mean?

Boeder: Yes.

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* Gordon Gliddon was a lens designer at the Eastman Kodak Company in Rochester, New York and a faculty member of the Rochester School of Optometry. In 1923, Adelbert Ames, Jr. enlisted his aid in designing lenses for aniseikonia. (Bannon RE, Neumueller J, Boeder P, Burian HM. Aniseikonia and space perception after 50 years. *Amer J Optom Arch Amer Acad Optom* 1970; 47:423.)

Hughes: But then, wasn't it?

Boeder: It was just blooming like a new thing. That was in the thirties.

Hughes: Why?

Boeder: Well, because they had developed the special instrumentation to investigate aniseikonia in a patient.

Hughes: What was the instrumentation?

Boeder: The eikonometer. It was an instrument that was built according to Ames's specifications. It was built by somebody else, but he [Ames] belonged to the institute. It was in essence an instrument to measure the images of the eyes. *Eikon* means image, you know, so eikonometer.

Hughes: Explain, please, why the treatment of aniseikonia was supposed to revolutionize eye care.

Boeder: Well, it was new. Many people who had eye problems had the idea that they were not attended to, and here was aniseikonia, which they claimed they had all of a sudden, and something was *done* about the patient's eye problems. That is usually the history of a new method of correcting any eye aberrations that may occur in a patient. When they hear about a new approach in Delhi, India, they come and see. People knew there was something new going on in Hanover, New Hampshire, and they came from all over the world.

Hughes: I still don't quite understand why it was so revolutionary.

Boeder: The size of the retinal image and the comparison of the two images had never been investigated before. The new thing was size difference [in the retinal images] and the fact that differences could lead to symptoms.

Hughes: The treatment was simply . . .

Boeder: Different.

Hughes: Different lenses?

Boeder: Different measurements. They measured the [retinal] images.

Hughes: Can you describe how that was done?

Boeder: Well, it was done in two ways: with an instrument that actually determines the imagery, and then with a space eikonometer.

Ames had developed a room he called the leaf room. He put leaves onto the walls of that room; the inner surfaces were all covered with leaves. The leaves stimulated binocular vision because they were everywhere. People would see entirely different shapes of the room due to their aniseikonia. And that's interesting for anyone to see. A magnifying lens was worn over one eye, and the patient was asked to describe the shape of the room. The room was distorted, and the patient now saw the distortions. When you have aniseikonia, you have these [visual] distortions of the room, and you can describe them. So your description was the investigation of your vision.

Hughes: So what they were doing was measuring the aniseikonia in different patients?

Boeder: Yes.

Hughes: And then treating it . . .

Boeder: With lenses.

Hughes: How was the rest of the ophthalmological world responding to this work?

Boeder: First, they were very enthusiastic. I gave lectures all over this country about aniseikonia. And then, it died. It was too much trouble, too expensive, and so on. The lenses were very expensive because they had to be designed individually.

Hughes: What happened to the group at the eye institute?

Boeder: Well, they dispersed. Ogle went to the Mayo Clinic, Bannon went to Columbia University and then to American Optical Company.

Hughes: Burian went to Iowa?

Boeder: Burian went to Iowa. First, he was with [Walter B.] Lancaster, or a neighbor of Lancaster. They were on the same floor with their ophthalmological offices in Boston, and then he went to Iowa. And so they dispersed.

Personalities

Hughes: Do you care to say anything about the personalities of the people at the Dartmouth Eye Institute?

Boeder: Well, I have indicated that they were ophthalmologists and optometrists. The optometrists were in the majority, actually.

Hughes: And that worked out all right? There was no tension?

Boeder: Well, no tension because of Ames's attitude. There was nothing that would stimulate any jealousy.

Hughes: You said that Ames was an idea-a-minute person. What else about his personality?

Boeder: He was an aristocrat. You immediately had respect for him. This is what I remember at the moment. He would discuss things with you like this: [Dr. Boeder puts one earpiece of his glasses in his mouth and the other in his ear.] When he came into that pose, then you knew he was full steam ahead. [laughter] Yes, that was Ames, and that was predictable. That was always the case.

Hughes: What about Bielschowsky?

Boeder: I got a picture that his sister had painted. Let me say I don't know how much of an artist she was, but it was good. And I cannot understand where we put that picture when we moved! I have never seen it again.

Hughes: You didn't sell it?

Boeder: No! No, I wouldn't have. Never. It had memory value of Bielschowsky. Not only did he take over the eye institute in Hanover but also toured this country and never talked about aniseikonia. When we took a walk on Sundays on one of those he said, "Boeder, tell me, what *is* aniseikonia?" [laughter]

Hughes: How could he be head of that institute and not know?

Boeder: Well, he said *auf Deutsch, "Was ist das aniseikonia?"* He toured the country and gave lectures, and, believe it or not, within a year he had changed the attitude toward [ocular] motility in this country. He talked on motility because he was a motility expert. And he gave lectures, which were published in a green book that

went like hotcakes. He educated the ophthalmologists on the fundamentals of motility, and they were crazy about it.

Hughes: Because the subject was new to Americans?

Boeder: The subject was, in a sense, new because of the presentation by this man. He made it appear much more important than they ever had dreamed it. Well, he was one of the great masters in that field.

Hughes: Why would he be interested in coming to the Dartmouth Eye Institute where the emphasis was aniseikonia?

Boeder: Well, he was Jewish.

Hughes: So he needed a position.

Boeder: He needed a position. In Germany, things were going foul.

Hughes: So it wasn't that aniseikonia was particularly his interest.

Boeder: No.

Oh, he was a lovely man. You know that he died [in 1940], and a cousin of his operated on his brain tumor, in New York. He died during the operation.

Hughes: At a young age?

Boeder: No, he was not young, but that was a terrible, terrible thing.

Hughes: How long had he been in this country before he died?

Boeder: Not more than four or five years. Oh, that was a terrible loss, Bielschowsky.

Hughes: Well, that didn't help the eye institute all of a sudden to lose its director. Did they appoint a new director?

Boeder: I think they appointed, for a moment, Burian.

Hughes: And then did the institute die?

Boeder: Yes.

Hughes: Can you remember when that was?

Boeder: Well, it was dead in the beginning of the forties, anyway.*

Hughes: Was the main reason for the existence of the institute the project on aniseikonia?

Boeder: Yes, it was. It gave the impulse, anyway. The institute was founded because of aniseikonia.

Hughes: Do you know anything about the financial underpinnings of the institute?

Boeder: They had grants. Ames had a relationship with the Rockefellers, and they got grant money.

Hughes: The institute had no financial support from Dartmouth?

Boeder: No, not that I know of.

Hughes: So your perception is that it was Rockefeller money that supported the institute?

Boeder: Yes. The Ameses were neighbors of Rockefeller. They were intimate with the Rockefellers.

Hughes: Did the ophthalmologists at the institute teach in the medical school?

Boeder: I'm not certain.**

Hughes: So it was really incidental to the institute that the medical school was even in the same town.

Boeder: As I understand it, yes. A very loose connection, as far as I know.

Hughes: The institute didn't need the clinical connection?

Boeder: No, it was not a medical school that could have helped.*** The medical school could only be benefited by the reputation of the institute.

Hughes: Well, you said that in those few years in which aniseikonia was in its heyday, patients came from far and wide.

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* The closing of the Dartmouth Eye Institute was officially announced on May 10, 1947. (Burian HM. The history of the Dartmouth Eye Institute. *Arch Ophthalmol* 1948; 40:163.)

** According to Dr. Bannon, the ophthalmologists at DEI were on the medical school faculty.

*** Dartmouth Medical School at the time consisted only of the first two years of medical instruction.

Boeder: From far and wide! It was remarkable.

Hughes: You mean literally from around the world?

Boeder: Yes, they came from all sorts of places. It showed that people here and there have eye troubles that are not attended to where they live. And when something comes up that they hardly understand such as aniseikonia, they say, "They may help me." And if they have money, they come.

Hughes: Well, what kind of visual problems did the patients perceive themselves as having?

Boeder: Well, when you have, let's say, an interference with your binocular vision, that leads to headaches. You do not see things correctly, which you can find out when you take one look into the leaf room of Ames. You should have seen that leaf room.

Hughes: Are there pictures?

Boeder: Oh, Bannon. He's the source of that. Definitely.

More on American Optical Company

Physical Layout

[Interview 3: March 21, 1989, Dr. Boeder's Apartment, Norfolk, Virginia]

Hughes: Tell me a little about the physical layout of American Optical in Southbridge.

Boeder: There was a complex of buildings that you can visit today, a big building, an office building, and then behind that the various departments—lens grinding, another department here, and another department there. They had all their special houses, where they did their work in that complex. And I think that's still the same. I don't see why that should be different.

Hughes: Where was the Bureau of Visual Science?

Boeder: The bureau was in the office building on the one floor called the sales floor.

Hughes: But the bureau had nothing to do with sales, did it?

Boeder: No. I was in the back with my bureau at the time, off the sales floor. I had a very nice setup there, I must say. They thought since the visitors are coming always to the bureau, it should look good. And so, I had a very good-looking outfit there.

Hughes: Was there laboratory space?

Boeder: Yes, but the laboratory space was almost only a refraction room.

Hughes: What else was there?

Boeder: We had, well, call it a shop, where you could make additions or repairs to any instrumentation that was of interest to you.

Hughes: With the thought that these changes might be incorporated in the design?

Boeder: Yes.

Hughes: Would you provide some of the theory for those changes?

Boeder: I provided very little. I only said, "That's no good." But I did not actively make suggestions how it should be.

Hughes: That wasn't seen to be part of your job?

Boeder: No.

Hughes: What were you doing when you weren't teaching the instructional course?

Boeder: If I may say so to you, I was reading a great deal at my desk, and I was answering letters. The answering of letters was difficult for me. I was not a fluent dictator of letters. The young girls who took the notes were much faster. It irritated me. It was too fast for me. Usually, I wrote out myself what I wanted. In general, I had a good life there, no doubt. I learned a lot because there was time to look up things. It was a good life.

The Wells Family

Hughes: Did you know the Wells family?

Boeder: Oh yes, very well. I liked Ruth very well. Ruth was the wife of our president, George [Burnham] Wells. She was consistently charming. Nothing of a high-flying attitude. Ruth was a real, wonderful lady.

Hughes: I believe she's still alive, is she not?

Boeder: Ruth is alive.*

Hughes: Are you in touch?

Boeder: Well, sometimes I've called her, but I've given that up too. But those things, they go for a while, and then they are all over.

Hughes: The ties become too thin, don't they?

Boeder: Too thin. But I have never changed my esteem for her.

Hughes: She apparently was a considerable force in the foundation of Old Sturbridge Village.

Boeder: She was practically the only force. She had a tremendous vision there. I give her a lot of credit. Ruth made Sturbridge possible. That's what I think.

Hughes: Was it created out of nothing?

Boeder: Yes.

Hughes: Was it her idea initially?

Boeder: Not the details, but she had a vision.

Hughes: Is it the Wells family money that supports Sturbridge?

Boeder: Yes, and she persuaded them to give money. Without Ruth there would not be a Sturbridge.

Hughes: What was her husband, George, like?

Boeder: Well, he was a bon vivant. He had seen the world. His education was good; it was Harvard.

Hughes: What was his administration of the business like?

Boeder: I had never felt his hand. He was accessible; if you wanted to see him, you could.

Hughes: He's been dead a long time, hasn't he?

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* Ruth Wells has since died.

Boeder: A long time. Of course, they lived the high life. Not Ruth, but the men.

Hughes: Where did the philosophy of the importance of research stem from?

Boeder: From [Edgar D.] Tillyer.

Hughes: Who was Tillyer?

Boeder: Tillyer was in charge of the Department of Research.

Hughes: What was his background?

Boeder: He was attracted to the American Optical Company from the Bureau of Standards.

Hughes: In Washington?

Boeder: Yes.

Hughes: Did he have formal training?

Boeder: He had training, which you have to have to be in that bureau and actively contribute to the bureau. He was a smart guy.

*Hughes: I read that Tillyer revolutionized ophthalmic lens manufacture.**

Boeder: It could be. [interruption]

Hughes: From skimming the book on the Wells family, I learned that George, who was president during your tenure, was never completely sure that he really wanted to be president of American Optical.

Boeder: That's right.

Hughes: Did you ever talk to him about it?

Boeder: I think so. He was not interested. He didn't want it.

Hughes: Why was that?

Boeder: Well, it was not his dish. I don't know what he wanted, really.

Hughes: Why did he continue to be president?

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* *The Wells Family. Founders of American Optical Company and Old Sturbridge Village.* Privately printed, Ruth Dyer Wells, Southbridge, MA, 1979, pp. 179.

Boeder: Well, that I don't know. Because it was there. George B. Wells, President, American Optical Company, Main Street Office.

Hughes: Perhaps, too, the family obligation, because it was very much a family business, was it not?

Boeder: It was completely.

Hughes: How were the Wellses in regard to their employees?

Boeder: I suppose mixed. I have no complaints, but I don't think everybody would feel that way.

Hughes: I know for many a year, they resisted unionization. But that's what most of the capitalists in this country did then.

Boeder: If you were in favor of unions, you'd better get out.

Hughes: That was true even in your day?

Boeder: Oh, sure.

Hughes: What was the atmosphere of Southbridge, which must have been very much dominated by American Optical?

Boeder: Oh, so much so. Evelyn was sick when she saw Southbridge. She had married me when we didn't know Southbridge. She wouldn't have married me if she had known Southbridge before.

Hughes: Well, I'm not so sure about that.

Boeder: When she came into that town, she was disappointed. But she adapted. We had a very nice home that we built. I bought the land from the Wellses. They didn't overcharge, I think, and we built the house whose painting you can see in the hall.

Hughes: Were there any cultural activities?

Boeder: There was golf. [laughter]

Hughes: Is that where you took up the sport?

Boeder: Yes.

Hughes: For want of anything else to do?

Boeder: That's right. Have you ever heard the name, Marsters?

Hughes: The championship, you mean?

Boeder: No, no, no. [Alton K.] Marsters was vice-president of the American Optical Company. He was one of those guys who went from American Optical Company to Bausch & Lomb.

Hughes: Persona non grata.

Boeder: Well, Bausch & Lomb made him vice-president there immediately. I don't know how he did it.

World War II

Hughes: What happened when the American involvement in World War II began? That must have affected production.

Boeder: I got one of those buttons, a little lapel insignia.

Hughes: For wartime production?

Boeder: Yes.

Hughes: What sorts of products were being made for the war?

Boeder: Everything was needed. Of course, they had also other things for protection of the eyes.

Hughes: Were there any products that were particularly developed for the war?

Boeder: I don't know. I doubt it. They had enough to do to keep up the manufacture of what was already in demand. I don't think there were any things that had to be done, except do better and better and for the same purpose. American Optical had a special safety section. That was the section that was especially in demand by the armed forces.

Hughes: Was American Optical considered part of the war effort? Consequently, employees did not have to serve in the military?

Boeder: I don't know. I was too old already. Others were taken when they were needed. The young people, they were taken.

Hughes: As a German, did you ever feel any resentment during the war from chauvinistic Americans?

Boeder: Very few times.

Hughes: Can you think of any instances?

Boeder: I don't have more than one case, but I can't explain what it was anymore.

Hughes: Were your feelings about the Nazis well known? Of course, you were an early dissident.

Boeder: Yes, they were well known. I had more against the Nazis than others had. Much more.

Hughes: You had seen them up close.

Boeder: I hated the Nazis. The Nazis were outrageous guys. How the Germans can change, I thought, in no time. But I suppose it's true for any group.

Hughes: And you saw also what disaster was wreaked on the mathematical faculty at Göttingen.

Boeder: They destroyed everything they had. They had a faculty in Göttingen that was second perhaps only to Paris. Perhaps. I cannot understand that kind of mentality, I cannot.

Hughes: Would you have considered staying in Germany if it hadn't been for the Nazis?

Boeder: No, I would have always gone back to America.

Hughes: What attracted you?

Boeder: I left Germany because I couldn't get to first base after finishing school.

Hughes: That was because of the economic circumstances in Germany?

Boeder: Economic, yes. My father was so happy that I had the chance to go. And I had the chance to go because my relatives responded to my request to take me over and furnished the money.

Hughes: But if the Nazis hadn't come to power, and if the economic circumstances had been different, would you still have been attracted to the United States?

Boeder: Well, I couldn't be attracted to the United States, because I didn't know it. I was glad to get *away* from something.

Hughes: Yes, I see. It wasn't so much that you were going to the United States.

Boeder: No, I couldn't judge that.

Hughes: But you could, the second time.

Boeder: The second time, yes.

Hughes: Was that then a deliberate choice?

Boeder: America was for me the goal at that time, 1931. Of course, at that time, the Nazis came up in Germany more and more. I hated the Nazis. I found out how the Jews must feel. I had a foursome for tennis in Göttingen, and, well, there were three Jews, and I was the only non-Jew.

We were having a last set of tennis at the courts in Göttingen. Beautifully located. The public could see us because there was a nice road higher than the courts, and they could just stand still and then see the whole thing when they walked on that road. I don't know how they recognized that I was playing with Jews. But the outrageous behavior from the people, especially the young people walking on that road! They said, "Hep! Hep!" That's against the Jews. "Hep! Hep!"

Hughes: Did they think you were Jewish too?

Boeder: Who knows. I have now a feeling how a real Jew must react to this *disgusting* behavior. I hate the Nazis. The Nazis were terrible. I was glad that they got it in the neck.

Hughes: How did your family survive that era?

Boeder: They survived. They didn't protest either way. They got through. I know that they were not anti-Jewish.

But I saw things in Göttingen at the time, and I said, "I'm glad I'm getting out." The Jewish persecution started when I was there, way before I left. Oh, I've seen the scenes there, you know. Just disgusting. I was glad when I was finally on the boat to America.

An Honor From American Optical

*Hughes: I found a letter in Iowa that was written to you by Weldon Schumacher.**

Boeder: How did you get that letter?

Hughes: Dr. [Thomas A.] Weingeist found some old letters of yours.

Boeder: He gave it to you.

Hughes: I have a copy, which is dated November 1, 1975, so it is after you had retired from Iowa [1971].

"Henry Burnett has told me that you are to be honored at the University of Iowa. There is little that I can contribute to the learned group who will be there to present a plaque to the University in your honor."

Was that a plaque that went up in the department?

Boeder: That was given by the company to the university.**

Hughes: Mr. Schumacher continues: "I truly believe you are unique among the thousands who have contributed to the advancement of Vision. I recall my awe at the prestigious knowledge of the Neumuellers [sic], Beitels and Boeders of the Bureau of Visual Science as I worked trying to learn to make a simple, single-vision lens in Lensdale. This awe and wonderment never left me, even when I became president of the American Optical Company."

What is this simple, single-vision lens that Schumacher refers to?

Boeder: He meant the simplest possible lens that a man can need.

Hughes: Now, as I remember, he was the first non-Wells family member to become president.

Boeder: Yes, that's true. And his father was under him all of a sudden. But nevertheless, I thought it was a very good choice, this guy Weldon. Weldon had something in his head.

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* Department of Ophthalmology records, University of Iowa.

** The plaque reads: Honoring the Contributions to Physiologic Optics of Paul Boeder PhD, University of Göttingen, 1931, Director, Bureau of Visual Science, American Optical Company, 1935–1957, Professor of Ophthalmology, University of Iowa, 1957–1971. Dedicated to the University of Iowa by the American Optical Company, November 14, 1975. (Inscription courtesy of Robert E. Bannon.)

Hughes: Where is Lensdale?

Boeder: It's part of the [American Optical] complex in Southbridge.

More on Aniseikonia

Hughes: You have mentioned a relationship between the Dartmouth Eye Institute and American Optical. Was it simply that American Optical was making the instrumentation that was necessary for measuring aniseikonia?

Boeder: No. American Optical Company made the instrumentation, yes. But the idea was that the lenses should be ground; they were special lenses. They were supposed not to just correct optical deficiencies, but they were also supposed to be aniseikonic. In other words, they were supposed to be lenses that would eliminate an existing difference in the two eyes as far as size recognition and so on.

I was the one in charge of designing those lenses in American Optical Company. I had to make a chart. First, they had a man that had a chart that was a museum piece. His name was [Arthur F.] Dittmer. When I came to Dartmouth, he was already there. He had developed a chart that was so long that he had it on two rolls, and he could manipulate a certain position that he wanted into view by pressing a few buttons. It was an enormous chart on which he read what kind of surfaces the aniseikonic lenses should have.

Hughes: So one took the measurements and then read from the chart what corrective lens should be made?

Boeder: Yes. The surface of these lenses was determined by means of this chart.

Hughes: Was this the first time that the attempt had been made to correct aniseikonia?

Boeder: Yes, and the last time, too. [laughter] That's the fact.

Hughes: Do you think that the lenses actually did achieve their purpose?

Boeder: Oh yes. Some were wild about those lenses.

Hughes: Could you tell in a scientific fashion whether you actually had achieved equal images?

Boeder: Yes, that was easy. But you had to have reports what it actually did to the patient, and only the patient could tell you that.

Hughes: And, of course, that was subjective, wasn't it?

Boeder: Yes. Some were happy. At that time, the call went out: "Go to Dartmouth. They can correct aniseikonia."

Hughes: Were people aware of discrepancy in retinal images?

Boeder: Well, no. They only knew that they were uncomfortable. When they heard about Dartmouth—that they had special lenses—they came from the farthest corners of the earth.

Hughes: I understand there's quite a heavy psychosomatic or psychological aspect to aniseikonia.

Boeder: Well, yes, but there is also actual suffering.

Hughes: Can you explain why?

Boeder: You just know that a person having a certain discrepancy as far as image information for the two eyes is concerned is very unhappy. When they are measured and get new lenses, they are happy. And that was about it. In 1932, 1933, Dartmouth was known not only in the United States, but everywhere.

Hughes: Were you aware of the Dartmouth Eye Institute before you ever became associated with it?

Boeder: No. And actually, it grew when I moved in, not because of me, but during that time.

Hughes: Because of the interest in aniseikonia.

Boeder: Yes.

Hughes: I understand that differences in retinal image-size had been recognized before, but what Ames discovered is the discrepancy need not be very large to have physical effects. Was that one of the discoveries?

Boeder: Yes, that sometimes it was so small that you almost couldn't believe it. And then, after four or five years, interest in aniseikonia died completely.

Hughes: Why?

Boeder: I don't know. I don't know why those things happen. Aniseikonia was a vogue almost, and then it died.

Hughes: It was supposed to be the answer to every eye problem, wasn't it?

Boeder: Yes. That was not the case.

Hughes: Is it taught in the optometry schools?

Boeder: I suppose, yes.

Hughes: An ophthalmology resident wouldn't know about aniseikonia?

Boeder: Hardly, no.

Hughes: Is some of that because the methodology is rather complex?

Boeder: Yes, you have to have special instrumentation. You have to have an eikonometer, a [retinal] size-measuring instrument.

Hughes: Now, what does that mean?

Boeder: Well, it means that differences of images when you compare one eye with the other eye may lead to symptoms and suffering.

Hughes: I've seen the term "size lens."

Boeder: A size lens means that it has a certain amount of desired magnification.

Hughes: So the term is not specific to aniseikonia?

Boeder: Oh yes. It's used in the correction of aniseikonia. Nowhere else.

Hughes: And how does it differ from an ordinary lens?

Boeder: It has a prescribed magnification, instead of only the power. You have to distinguish between the power of the lens, which is actually a measurement of the focal length of the lens, and size is the magnification. The magnification was, before Dartmouth, of no consequence to anyone. They didn't think about the size. Size correction was introduced by Dartmouth.

Hughes: Could you describe the actual measurement process, the use of the eikonometer?

Boeder: Well, there are certain kinds of measurements. For instance, Ames was not interested in measuring with lenses. He asked

questions, putting a patient in front of a room that had certain dimensions. He let the patient describe the room.

Hughes: Was this the leaf room?

Boeder: Yes.

Hughes: Now, was this a full-sized room?

Boeder: Yes, it was a full-sized room. The patient sat right in front of it and saw the distortions that were introduced by size differences in the two eyes.

Hughes: How could Ames get at that by questioning? How could it be precise enough to then make a corrective lens?

Boeder: He said, "How do you see the window in this room?" And they'd say, "What window?" [laughs] By questioning, the distortions were revealed to him.

Hughes: But he could do that precisely enough to then arrive at a measurement for a lens?

Boeder: No, no. The lens was coming later. Then, he would put them in front of an instrument that actually measured the [retinal image] size differences.

Hughes: Now, that's the eikonometer.

Boeder: Yes. This difference in size, either horizontally or vertically, is actually seen because of differences that are either introduced or originate in the eyes.

Hughes: Was American Optical the only company making the eikonometer?

Boeder: As I mentioned, Bausch & Lomb was approached first, and they said they were not interested.

Hughes: Why was that?

Boeder: I don't know. Bausch & Lomb has sometimes made some very strange decisions. Bausch & Lomb had a much better reputation at the time [than American Optical].

Hughes: Why did Bausch & Lomb have a better reputation?

Boeder: Well, I don't know. How do reputations come into existence? It is the clientele that talks about Bausch & Lomb: "Where do you go?"

"Bausch & Lomb." Bausch & Lomb was an excellent firm. I would say, at the beginning, American Optical Company didn't have the reputation that Bausch & Lomb had. Therefore, Ames went to Bausch & Lomb. But he got the cold shoulder there, and American Optical Company took up the eikonometer by default. It was good for American Optical Company. They added people that could deliver the goods.

More on Dartmouth Eye Institute

Hughes: Did Dr. Neumueller have in mind when he hired you that you would become associated with the eye institute?

Boeder: Oh yes.

Hughes: As soon as you were hired, you went directly to Hanover?

Boeder: I was sent to Hanover to learn what they had at the eye institute. I had a happy time there. Evelyn was with me; we were just married. We had a marvelous time.

Hughes: And American Optical . . .

Boeder: Paid the bill.

Hughes: Did the company also provide some support for the eye institute?

Boeder: Yes. That was a good idea.

Adelbert Ames, Jr.

Hughes: What provoked Ames's interest in aniseikonia?

Boeder: I don't know what provoked it, but he had made certain observations, and he wanted to follow through. And he needed some assistance to get him through. Ames had a wonderful brain.

Hughes: Was he able to see the practical and the theoretical side of problems?

Boeder: Well, once he knew that he could affect the sight and the well-being in vision, he knew that he could do something.

Hughes: Did you have much direct interaction with Ames in terms of your work?

Boeder: No, he wouldn't understand it. He was not interested. He was on a higher plane. [laughter]

Hughes: Do you think the medical profession was skeptical because a nonphysician was working in a field in which he had no formal training?

Boeder: You are right. That was certainly true to a large extent. But those who were close to him saw something when they looked at Ames, even Burian. Burian had a good education in Europe and was brilliant, fast, and so on.

Hughes: Do you mean quick-minded?

Boeder: Quick. And he knew it. But he had respect for Ames.

Hughes: Burian recognized Ames's brilliance?

Boeder: Oh, he recognized it, and we talked about it, too.

Hughes: I read an interesting article by Dr. Burian on the Dartmouth Eye Institute. He stated that towards the end, Ames lost interest in the work of the eye institute, at least in its clinical division, and he became much more interested in psychology and sociology. Would you agree?*

Boeder: It was true, because they didn't give him enough attention. They rejected him.

Hughes: Physicians?

Boeder: Yes. Burian often said to me, "Ames has a brilliant idea every week." And Burian meant it, because he thought he [Burian] should have one himself once in a while. He recognized that Ames was productive.

But Ames turned away from the institute, because they didn't really follow him. He expressed that to me: "They don't want what I suggest." He just was not adulated at all. And it's true that Burian admitted Ames had something, and I too thought Ames was a very good man. But all those working in the eye institute that had a medical education just didn't follow him.

Hughes: What direction would he have liked the institute to go?

* Burian HM. The history of the Dartmouth Eye Institute. *Arch Ophthalmol* 1948; 40:165.

Boeder: I don't know what he had in mind, but he had visions in regard to the institute. I knew that he was disappointed, because he expressed it to me.

Hughes: Did anything come of his psychologically oriented work?

Boeder: Not that I know of.

Hughes: How did he end his career?

Boeder: Well, not unhappy. I don't really know what he finally thought. He got more and more philosophical. Finally, he got a little bit strange, he wanted to do something for the entire world.

Hermann M. Burian

Hughes: Burian was working on aniseikonia at the institute.

Boeder: Yes, but he didn't measure much aniseikonia. Actually, he wasn't that interested.

Hughes: Well, what was he doing there?

Boeder: Well, he was on a higher plane. He was a man who was really a medical man.

Hughes: Did you work with him?

Boeder: No. I couldn't work with him, and he couldn't work with me, because he had a very strong opinion about the old masters. Everything he looked at had to be tested: what would [Ewald] Hering say? The men that he really liked and respected were the old-timers, the old guard.

Alfred Bielschowsky

Hughes: Let's talk about Bielschowsky, who first came to the United States in 1934.

Boeder: Yes. The man who recommended to make Bielschowsky the head of the institute was Lancaster.

Hughes: How had Lancaster known him?

Boeder: Lancaster only knew that there was a great ophthalmologist in Schlesien [Silesia, Poland]. Lancaster was interested in the eye institute, and he wanted a big chief for the eye institute, and Bielschowsky came. Well, Bielschowsky was, as a human being,

as a scientist, and as a leader in his field, a great man. No doubt about that.

Hughes: Was he a familiar name to you before?

Boeder: No, but that was not his fault. That was my fault because I didn't know much about the big shots in Germany. I knew that he was a good man. He was invited to lecture in the United States at the request of Lancaster.* We were good friends. I was close to him when we were at Dartmouth.

Hughes: Dr. Lancaster said in his obituary of Bielschowsky:

*"His writings [on ocular motility] were the most widely read in America. [G.S.] Savage ignored physiology, or rather he invented his own physiology to fit his theories, as do some American writers of prominence today, indifferent to the work of other investigators. Bielschowsky was spreading the doctrine of sound physiology, which in time will crowd out the weeds of false doctrine so widely prevalent in America even yet. To be sure, the country had a few sound teachers, notably [Alexander] Duane; moreover, [George T.] Stevens was the father of the whole field of heterophoria. Nevertheless, when Dr. Bielschowsky completed his first tour of the United States in 1934[,] he was not only disappointed but appalled at the ignorance of American ophthalmologists in the field of binocular vision and ocular motility. It is hoped that there will be a whole crop of teachers on whom his mantle will fall."***

Now, there are several things that I was hoping you would comment on. First of all, do you know this Savage that he refers to?

Boeder: Only by name.

Hughes: What did he mean by, "Savage ignored physiology, or rather he invented his own"?

Boeder: I don't know his work.

Hughes: Then Lancaster refers to, ". . . American writers of prominence today, indifferent to the work of other investigators." Do you know whom he was thinking of when he wrote that?

Boeder: Well, it is likely that he was thinking of many people. That's usually the attitude of the half-*gebildet* [educated]. When

* According to Dr. Lancaster, the invitation came from Arnold Knapp. (Lancaster WB. Alfred Bielschowsky 1871–1940. *Arch Ophthalmol* 1940; 23:1354.)

** Ibid, 1357.

Bielschowsky first came, he was *the* man in this country. And he lifted the level of knowledge in motility in half a year.

Hughes: Why had the field been ignored in the United States?

Boeder: I don't know. But I know this, that he came with a little green volume,* and that was distributed, and that went like wildfire. He lifted, singlehandedly, the level of knowledge of motility in half a year.

Hughes: That short?

Boeder: Oh, yes!

Hughes: He was lecturing far and wide?

Boeder: Lecturing everywhere, and what he said was gold to these people.

Hughes: And this green book was what he had written?

Boeder: The green book, I believe, was originated by him, but that is a guess. I know only that the green book was looked at as though it was the last thing in this world. [laughs]

Hughes: And it was on ocular motility.

Boeder: And I think it was the work of Bielschowsky.

*Hughes: Did he continue to lecture far and wide when he came permanently to the United States in 1937 to become director of the Dartmouth Institute?***

Boeder: No, but he did a tremendous job. And the book did the rest. I have heard again and again people saying, "He actually lifted motility to a higher plane in our country."

Hughes: Where was his work particularly taken up?

Boeder: All over the United States. It was really a renaissance, you know. And that one single man can do that!

Hughes: Was ocular motility a facet of a resident's training before Bielschowsky came on the scene?

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* Bielschowsky A. *Lectures on Motor Anomalies of the Eye*. Chicago: Ophthalmic Publishing Company, 1938, 1939; Hanover, NH: Dartmouth College Publications, 1943.

** At the time of his death, Dr. Bielschowsky was professor emeritus on leave of absence until 1941 from the University of Breslau. (Lancaster WB. Alfred Bielschowsky 1871–1940. *Arch Ophthalmol* 1940; 23:1354.)

Boeder: Yes, but not like it was after Bielschowsky.

Hughes: What was he actually doing that was different?

Boeder: Well, he taught them what motility meant to the eye and why it exists. If they understood, then they knew that they should watch the muscles of the eye a little more closely.

Hughes: Had he done considerable research in the field?

Boeder: Yes, he had been a contributor. He was an expert, no doubt about that.

Hughes: How did Bielschowsky take to the informality of American students?

Boeder: Very well. Every night I had to be at his room [at the Hanover Inn] in time to go to the movies with him.

Hughes: Every night?

Boeder: Every night. He wanted to learn English.

Hughes: What did your wife think of that?

Boeder: My wife was not there.

Hughes: I thought you said she went to Hanover.

Boeder: We went to Hanover after our marriage.

Hughes: This happened in 1934, the first time Bielschowsky came to the States?

Boeder: Oh yes.

I went together with Bielschowsky on a Sunday morning walk, and, all of a sudden, I took a few steps and I turned a front flip. [laughter] He said, "Do that again!" I really had him wondering what was happening.

Hughes: Did he know that you were a gymnast?

Boeder: No, we didn't talk about gymnastics. But at that time I was in good form, and I could land on my feet and walk on as though nothing happened.

Hughes: I would imagine that American medical students were much less reverent towards a professor than Bielschowsky had been used to in Germany.

Boeder: Oh, that's why we went to the movies. Now, before the picture started, there was a revolution going on in the theatre, loud, and things were thrown, and so on.

Hughes: The students dominated the theatre?

Boeder: The students dominated. It was really a madhouse. The students of Dartmouth are known for their lack of discipline. All of a sudden, Bielschowsky had a rotten apple thrown at his neck. He took it in stride. He liked the informality in America. The *Geheimrat* with a rotten apple in his neck. But he was wonderful. He wanted to accept them as they were. No questions asked and no foul remarks made. He wanted to appreciate the American way—and he did.

Hughes: How did he teach American medical students?

Boeder: Well, of course, he didn't have much time to give to freshmen. His teaching was on an advanced level.

Hughes: Dartmouth was just the first two years of medical school?

Boeder: I think you're right.

Hughes: Did he teach at the medical school?

Boeder: No.

Hughes: So he was strictly at the . . .

Boeder: Strictly at the institute.

Hughes: And you told me before that there was no relationship between the institute and the medical school?

Boeder: That's right.

Hughes: They were completely independent.

Boeder: Yes.

Hughes: So even people like Hermann Burian, who was a practicing ophthalmologist, had nothing to do with the medical school?

Boeder: No. The medical school was reaching for the institute because it had a growing reputation, but they never really absorbed it.

*Hughes: So the real reason that the institute was where it was, was because Ames had originally sought out Dr. [Charles A.] Proctor of the Department of Physics at Dartmouth.**

Boeder: You're right. Proctor and Ames wrote a paper on the eye, and that was the start.**

Hughes: Did Bielschowsky have any influence on your thinking and your future research interests?

Boeder: No. I didn't know what my future was at the time. Finally, I was capable of doing some things that today I cannot understand anymore. I was pretty good at that time.

Kenneth Ogle

Hughes: Another name that I've seen associated with the Dartmouth Eye Institute is Kenneth Ogle.

Boeder: Oh, Kenneth Ogle. Why did he die so young?

Hughes: How old was he?

Boeder: Well, he was younger than I, and he died many, many years ago and left a family.

Hughes: What was Ogle's particular interest at the Dartmouth Eye Institute?

Boeder: He was doing vision research.

Hughes: Was he theoretically minded?

Boeder: He was theoretical-minded, and he was not at all bad. He could do things that Ames wouldn't be interested in, would not do. But Ames was Ames, and Ogle was Ogle. Ogle had many qualities that were very good, very good. He liked to finish a job, and he did finish jobs that Ames left. All that was true.

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* Lancaster WB. Alfred Bielschowsky 1871–1940. *Arch Ophthalmol* 1940; 23:1354.

** Ames A, Jr, Proctor CA. Dioptrics of the eye. *J Optic Soc Am* 1921; 5:22.

Walter B. Lancaster

Hughes: Well, what about Walter B. Lancaster?

Boeder: Walter B. Lancaster was an organizer. There were two ophthalmologists in Boston of high rank: Lancaster and [Frederick Herman] Verhoeff.* Verhoeff was a real scientist. I mean a man who made a mark. For instance, people have noticed that in this country there's a Verhoeff Society. There's not a Lancaster Society.

*Hughes: There's a Lancaster course.***

Boeder: There's a Lancaster course. And that's exactly the difference between the two. Lancaster was gifted as an organizer in ophthalmology, but not as a contributor to ophthalmology. But he was a gifted man to lead people, to do things, to get together a course, and to give a course to the country. That's Lancaster. Verhoeff wouldn't have bothered. That was not his line. Verhoeff was a scientist and was bright. There you have the two who were idols in Boston.

Hughes: Did they get along?

Boeder: No.

Now, once I was standing just behind them at a meeting that was arranged by the New England Ophthalmological Society. I heard every word they said. Verhoeff asked a question: "Now, tell me what is this, and this, and this?" Talking about contact lenses. And this man from New York said, "Well, I'm sorry, Dr. Verhoeff, but I don't know." Verhoeff didn't like that at all. Well, he came with another question. That man had to say the same thing. He said, "I'm sorry, but . . ." "Well, my gosh, you don't know anything," Verhoeff said. "You've wasted our time." And Lancaster said softly, "Shut up, that's not true. He didn't waste our time." Well, Verhoeff did shut up.

They say one day a woman ran out of Verhoeff's office, and he after her. And he said, "Madam, I didn't say that you are an idiot. I said you acted like one!" [laughter]

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* For more on Verhoeff, see *David G. Cogan, MD: Howe Laboratory of Ophthalmology at Harvard Medical School, Massachusetts Eye and Ear Infirmary, and the National Eye Institute.* Ophthalmology Oral History Series, A Link With Our Past. Interviews conducted by Sally Smith Hughes, PhD, The Foundation of the American Academy of Ophthalmology, San Francisco, and The Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 1990.

** The Lancaster Course in Ophthalmology.

Verhoeff was outspoken. But once he found his master. The master was a boy from South Boston. He was a little squeamish when he was examined by Verhoeff. Verhoeff said, "Hold still a moment, you little b.....!" And that boy said, "Oh, shut up, you old son of a b.....!" [laughter]

Hughes: I would like to have seen Dr. Verhoeff's expression. [laughter]

Boeder: I wasn't present, but I got the story from a man who worked with Verhoeff.

Hughes: Tell me Dr. Lancaster's role at the Dartmouth Eye Institute.

Boeder: Well, he was, of course, the big shot at the eye institute. Lancaster was a good ophthalmologist and well known.

Hughes: How did he come to be there?

Boeder: Interest on his part. There was something going on, and he knew that he could make some contributions, and he did. Lancaster became what you call the unofficial head of the institute.

Hughes: But only after Bielschowsky's death.

Boeder: Yes, that's true. But he was, nevertheless, in the background all the time. He was more of a leader of that institute than Bielschowsky. Bielschowsky couldn't do what Lancaster did, in many respects.

Hughes: Well, then in 1940, upon Bielschowsky's death, Lancaster did become official director.

Boeder: Yes.

Hughes: But it only lasted less than two years. Do you remember some of the problems of that period?

Boeder: What happened after the two years?

Hughes: Lancaster left.

Boeder: Oh yes, Lancaster left because he resented the fact that his papers were altered by Ogle. He didn't like that at all.

Hughes: Was Ogle a coauthor?

Boeder: No, but Ogle was in charge of publications. Ogle did a lot of fussy work. Lancaster resented anything that was changed by another hand, what he had written.

Hughes: I also understand from the paper that Dr. Burian wrote on the institute that more and more power was being taken from the hands of the director. In fact, Lancaster was never named director. He was named chief of staff. And that implied, I understand, less power than Bielschowsky had had as a director. The administration of the institute was moving in to a greater degree than it had under Bielschowsky. Many of Lancaster's ideas, including his idea to start what later became known as the Lancaster course, were frustrated. Do you remember any of that?*

Boeder: Yes, definitely. Lancaster had an idea that what later became the Lancaster course should be in the institute. And he couldn't believe that they didn't see that.

Hughes: Now, who's "they"?

Boeder: One was Ogle. Ogle was never compliant.

Hughes: Did Ames play any role in these problems?

Boeder: No. Ames said to me once, "They don't want me; it's all right with me. They don't want to listen to me." And he was independent, whether or not there was a cooperative spirit.

Hughes: But surely it wasn't just Ogle that caused Lancaster to leave.

Boeder: Well, there were other people. One was Gliddon.

Hughes: What was his role?

Boeder: Gliddon also thought everything was not Lancaster.

Hughes: Did Burian have a role?

Boeder: Burian had a role, but he was not interested in leaving or objecting to Ogle and Gliddon. It was not of any interest to him.

Gliddon was a fellow who liked to be accepted by everybody. He tried to please and get fellows to appreciate him.

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* Burian HM. The history of the Dartmouth Eye Institute. *Arch Ophthalmol* 1948; 40:163.

Hughes: Lancaster died in 1951, just before the publication of his book on refraction and motility. Are you familiar with that book, and could you comment on it?*

Boeder: Well, I have no idea now what it is anymore, but I knew about it. I saw it, and I didn't admire it.

Hughes: Was it a strictly clinical approach?

Boeder: It was an approach by a man who didn't know much optics.

Hughes: Was it used?

Boeder: No.

Hughes: What text was used for learning optics?

Boeder: They used Paul Boeder. [laughter]

Well, there was a time I really think there was only one teacher in the United States in optics, and it was I. It's true. I made it very simple. Students liked it, loved it, and I gave them the goods as painlessly as possible.

Hughes: What about the other names in American optics that preceded you by a generation or so? I'm thinking of Verhoeff and Edward Jackson.

Boeder: Oh, well, they were great ophthalmologists.

Hughes: But were they great optics men?

Boeder: No. They were much more concerned about the side of ophthalmology that requires knowledge of life and tissues, and so on.

Hughes: Not the physical aspects.

Boeder: No, not the physical aspects.

Hughes: Well, how would you summarize the state of American optics when you came into the field?

Boeder: I think the state of optics at [Eastman Kodak in] Rochester was first class.

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* Lancaster WB. *Refraction Correlated with Optics and Physiological Optics and Motility Limited to Heterophoria.* Springfield, IL: Charles C. Thomas, 1952.

Hughes: Who was at Rochester?

Boeder: Well, they were people that were comparable to [those at] Zeiss. They were big in optics. Rochester had a school of optics. That school was not negligible.

Hughes: In the history paper that Burian wrote on the Dartmouth Eye Institute, he pointed out that there was tremendous potential for the institute in terms of its clinical possibilities, research, and as a teaching center.

Boeder: That's right.

Hughes: Why weren't these potentialities ever realized?

Boeder: Well, the institute didn't start the teaching. The Lancaster course was started in Boston and became an educational force in this country. It started early.

Hughes: In 1946, I believe.

Boeder: And then, the same year, we went down to Florida and gave the same course. There, I remember I had one student who was very good.

Hughes: [Arthur] Jampolsky?

Boeder: Jampolsky! He was a bright student there.

Hughes: Well, he, to a certain extent, has followed along in your footsteps, has he not?

Boeder: Yes. I like Jampolsky, that enthusiasm that he has.

Hughes: How has he followed on in your work?

Boeder: I don't know how much teaching he is doing. I think nobody was in the position I was. You have to be in a position to actually go through the country on an expense account. And I was. So I could say, "Yes, I'll come down to Louisiana. Yes, I'll come down to Tulane." I could say, "Yes, yes, I'll come for a few weeks," and so on. I was sent by the American Optical Company and Iowa. I was a free man there, and I could accept invitations. And the invitations certainly came fast and furiously. I had a wonderful time, just traveling in the country from coast to coast and from south to north. It was a remarkable experience.

Arthur Linksz

Hughes: Arthur Linksz is a name we haven't mentioned in connection with the Dartmouth Eye Institute.

Boeder: Arthur Linksz was a member of the eye institute; he was a well-educated man. Very well. Very cautious in what he said, always.

Hughes: Now, when you say well educated, are you thinking primarily in science?

Boeder: He had been through the European education. He was educated in Prague by [Armin von] Tschermak-Seysenegg, and Prague was the high [top] school of ophthalmology because of Tschermak. So men like Arthur Linksz and Hermann Burian studied under Tschermak.

Hughes: I had the feeling when you were talking earlier about Dr. Burian that you felt that he had an undue loyalty to these masters.

Boeder: To the old masters, yes.

Hughes: And an unwillingness to change, to adopt new ideas. What about Linksz?

Boeder: Linksz didn't have that same loyalty to the old masters. He appreciated them, but he was not like Burian, who thought you must be wrong if you were not like the old masters.

Hughes: Did you notice these problems at the Dartmouth Eye Institute? Or did it become clear only later at Iowa?

Boeder: Well, I didn't know all the problems when I was in Hanover. But I knew many of them. I had the advantage that I wasn't ever after anybody's job. It's a wonderful situation to be in.

Hughes: I saw the title of a paper that Arthur Linksz wrote in 1959, which was called "Aniseikonia: With Notes on the Jackson-Lancaster Controversy." Do you know anything about that controversy?*

Boeder: I'm not very much familiar with the controversy that they had. [Edward] Jackson had a wonderful name [reputation], and offhand I would say that Jackson was right. [laughter] However, Lancaster was a very good personal friend of mine and vice-versa.

* *Am J Ophthalmol* 1959; 48:441.

I visited him and he appreciated it. He was alone; his daughter was in San Francisco.

Lancaster died when he was eighty-eight years old. Many people that knew him, maybe they would say, "Well, Lancaster, is he still alive?" [laughter] Something like that, you know. He was forgotten, a man who had been written off. I was aware of that possibility, and I went to Boston, took sixty miles of an automobile ride to visit him. I made a point of it. And he was always so glad that somebody bothered about him. I believe one should make a note of that because when people grow old, as Lancaster was getting to be old, they are written off too soon.

So I made a point of seeing him, and I never regretted it. I just asked over the phone, before I went to his room, "Would you like to go to the movies?" "Oh, I would love it." So we went to the movies, had a grand time, and he appreciated it. And one day I came and I heard this voice over the telephone, and it said, "Come up." I said, "All right." He had a room in the Harvard Faculty Club. He was in bed. I said, "Doctor, are you sick?" He said, "I'm well taken care of. Come sit on my bed. I want to talk to you." And he talked, and talked, and talked. I am so chagrined that I didn't sit down later and write from memory what he said. He was most interesting in his review of his own life. Not at all a strong voice at the time; he was not well. That's why he wanted me to be close. He started out [his reminiscences] when he was in Vienna. In Vienna, he attended discussions, and he was impressed.

Hughes: Do you remember who his teachers there were?

Boeder: Big shots like [Karl] Lindner. They were very big men. He was impressed by the discussions they had on ophthalmology. He said, "We must have the same thing in Boston." From that time on, he was aiming to teach. He began what is today the Lancaster course. He made up his mind; he said, "If they can do that in Vienna, we ought to be able to do that in Boston."

That's the way he talked on his death bed, you might say, because it was only another week before he was gone. But it was a long talk, and I wrote to his daughter and said, "I'm so sorry I didn't make notes, because it was just a wonderful visit I had with your father." He talked about his youth, what he enjoyed, and so on.

The First and Second Lancaster Courses

Boeder: He gave the first Lancaster course, you said, in 1946.

Hughes: Yes, right after the war.

Boeder: I'll never forget that. He had no trouble at all getting lecturers, of course. He was a big shot. A letter to anyone he wanted was enough to get him into Boston. So he had an excellent faculty, and the course that he had planned was a huge success in Boston.

Hughes: Do you remember who else taught that initial course?

Boeder: Yes. Burian and maybe Linksz.

Hughes: What would Linksz have been teaching?

Boeder: I don't know exactly what he taught.*

Hughes: But not optics.

Boeder: No, not optics.

I took over the optics right then and there. I was invited to do that, although I got it only by default. The course was planned by Lancaster, and he had given himself a three-hour-a-day lecture, for a week. That was too much. I knew he didn't know that much optics. The afternoon before the course was to start, I got a phone call in Southbridge from Lancaster. He said, "Paul, you have to do me a favor." I said, "Dr. Lancaster, if I can do you a favor, I certainly am going to do it." He said, "You have to start teaching tomorrow." I said, "What? [laughs] Where?" "Well, I'm supposed to go on, but I'm sick. I can't do it. You have three hours [a day to lecture]."

Well, I'll never forget. I said to Evelyn, "Goodbye, I'm going to take the car. I'm going to lock myself in at the hotel, and I'm going to prepare a lecture of three hours." That was a terrible thing. I've forgotten now where we were. We were in a famous location—a stage, pretty small blackboard. I'll never forget that I faced a full audience. I don't know how many. They were sitting there, waiting for me to start. And I was on a leash for the first time; I had never been on a leash.

Hughes: You mean with a microphone?

* According to Dr. Bannon, Arthur Linksz taught physiology.

Boeder: [laughing] Yes. The blackboard was small. And I started to teach optics. Well, it went all right; they gave me a tremendous applause.

Hughes: You talked for three hours at a stint?

Boeder: Talked for three hours, and then the next day again.

Hughes: Had you gone back to the hotel and prepared for the second lecture?

Boeder: Oh, sure. I worked like a beaver.

Hughes: Were you reading optics texts, or was this all coming out of your head?

Boeder: I made notes of what I knew.

Hughes: From your head.

Boeder: Yes. I tried to make it coherent and simple. It went all right. Professor [Joseph] Igersheimer was there. I said to myself, "Why did he come here? Why did he have to check up?" He was a darling, anyway; he was a wonderful guy. He wanted to hear what I had to say. But I was so shocked when I saw those people of rank that I never even aspired to.

Hughes: Now, who was Igersheimer?

Boeder: Well, he was a well-known ophthalmologist in Boston.

After four or five [lectures], they gave me really a tremendous applause. I was stupid enough to tell Lancaster, who considered me a rival; he wanted to teach optics, you know. I forgot that, and I said, "They certainly gave me a tremendous applause." He fired me immediately. [laughter]

Hughes: He fired you, but only temporarily, because didn't you teach optics the very next year of the Lancaster course?

Boeder: Of course. Lancaster said, "Now you realize that I want to teach optics." I said, "Yes." "You're young. You can teach in your life a long time yet."

Hughes: But did he teach it again?

Boeder: Well, he said we have to go down to Florida and give the course again. Same year, near Christmas. And that's where I met Jampolsky.

Hughes: Why had Lancaster chosen Florida for the course?

Boeder: I don't know why; he wanted to be warm, I believe.

Just before it was time to go down to Florida, he said to me over the phone, "Paul, would you mind coming along?" And I said, [laughing] "I would love it." He said, "You see, I want to teach, you know that, but I get too tired to." He was getting older. I said, "I'll be there, and you can teach. You go ahead. You're the boss." We went down there, and actually I gave at least sixty percent of that course. He was tired after he had lectured. He was flattened out on his bed when I came in; he was just like death. It was too much for him.

Hughes: That must have been difficult for you because it wasn't really your course. How did you integrate what you were saying with what he had already said?

Boeder: I didn't care what he said. I looked at the blackboard when he talked, and I discovered there was a terrible mistake there.

Hughes: What did you do about that?

Boeder: Nothing. I disappeared. It wasn't my business.

Hughes: Did the students only get sixty percent of the optics course that they should have gotten?

Boeder: Well, that may be, because Lancaster didn't know enough optics, not the essentials. We had always a little fight about that. He thought you should teach optics absolutely without mathematics, and I said optics is a mathematical subject and you have to have mathematics. You take only the essential, the simplest things, but you have to have mathematics to make them understandable. He was against it. "I want to teach optics completely without mathematics." "It can't be done," I said. But I didn't argue with him.

Hughes: How did you handle the mathematical component of optics?

Boeder: I gave so little that anyone who had ever had a little bit of mathematics could understand it. It was a few symbols, like U plus D = V. That's the only mathematics I taught. And I explained carefully what U and D and V mean.

Hughes: Because of the nature of your audience, you felt compelled to reduce the mathematical content of optics.

Boeder: To the least minimum.

Hughes: And yet your first love was, and presumably still is, mathematics.

Boeder: I wonder about that because I have never considered myself a mathematician.

Hughes: Why?

Boeder: Because I knew Hans Levy in Berkeley, and I know what a mathematician is.

If you knew a mathematician and then looked at me, you'd say, "Oh, I see, there's a tremendous difference." But look at Hans Levy, Berkeley professor, a personal friend since 1927. Oh, he was a wonderful boy.

Hughes: Did you talk mathematics with him?

Boeder: Couldn't. I was not on the same plane. It's impossible to be with a man who could do so much that in Berkeley [at the memorial service] they talked for two hours on what he did.

Hughes: So he was one of the greats.

Boeder: He touched every important field in mathematics. He got the Wolf Prize. That's just as though he had a Nobel Prize.

Hughes: Who awards the Wolf Prize?

Boeder: I have no idea. He had to go to Jerusalem to accept it. It's the highest honor in mathematics.

The Translation of Tschermak's *Introduction to Physiological Optics*

Boeder: I must read you Duke-Elder's words [about my translation of Tschermak].*

"The Committee on Optics and Visual Physiology of the American Ophthalmological Society, the Academy of Ophthalmology and Otolaryngology, and the American Medical Association have done

* Von Tschermak-Seysenegg A. *Introduction to Physiological Optics*, translated by Boeder P, PhD. Oxford: Blackwell Scientific Publications; Springfield, IL: Charles C. Thomas, 1952.

a service by translating the second edition of Tschermak-Seysenegg's book into English. The German original appeared in 1941, but the book is still fresh and valuable . . . . The original German text was by no means easy reading, nor indeed is this translation." I got a kick out of that. "But few could have conveyed the sense of the author in more readable and fluent English than the translator, Dr. Paul Boeder." [laughs] I think that's really wonderful. Stewart Duke-Elder.

Hughes: You couldn't get a higher authority in ophthalmology.

Boeder: [laughing] No, I couldn't.

Hughes: Why had you decided to translate Tschermak?

Boeder: The committee on optics had invited me to do it.

Hughes: Why did the committee think it was important to translate Tschermak?

Boeder: Because Tschermak had a tremendous reputation in Europe. Every man who studied ophthalmology in Europe had to go through Prague. The man who wanted the translation was Lancaster. He asked me to do it.

Hughes: By then your English was strong enough to translate difficult German?

Boeder: Oh, yes. I had translated so many other books already, for my own sake, just for the fun of it. I translated when I traveled.

Hughes: In your head?

Boeder: In my head.

Hughes: How long did it take you to do the Tschermak?

Boeder: Well, the Tschermak was difficult. Sometimes I had the whole evening destroyed with one little footnote.

Hughes: How long did it take? Years, then?

Boeder: No, it didn't take years. Lancaster was amazed how fast it went. He gave me the job at the Academy meeting in December [1951] in Chicago, and I started immediately. And then I surprised Lancaster. I said, "Dr. Lancaster, that will be my present to you

for your birthday." "What?" he said. "The eleventh of May?" I said, "Yes." He was thrilled.

Hughes: And you had it ready by then?

Boeder: Oh, sure.

Hughes: Were you doing it in the evenings?

Boeder: Yes.

Hughes: How was it received by ophthalmologists?

Boeder: Well, of course, they bought it. I don't think they read it. [laughter] Duke-Elder was right; it's not easy going.

*An Introduction to the Mathematics of Ophthalmic Optics**

Hughes: Tell me how you came to write the book on mathematical optics.

Boeder: Let me think why I did that. I think, and this is not far-fetched, there was a kind of competition going on for books in the American Optical Company. Nobody, I think, asked me to write that little book.

Hughes: Well, then, why did you decide to do it?

Boeder: Because of this competition that was going on with books within American Optical.

Hughes: Was American Optical encouraging its employees to write books?

Boeder: No, I wouldn't say that. But there were several departments that suddenly came out with books. For instance, on reading. Reading was a big subject in the American Optical Company. It attracted a man who was very much interested in that important subject. He was a Texan, and his name I should know, but it's not right on the tip of my tongue.** Since those books came out, that must have been one of my incentives to write on mathematics.

Hughes: Did American Optical give you time off to write the book?

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* Fall River, MA: The Distinguished Service Foundation of Optometry, 1937.

** The name Dr. Boeder was trying to remember was Earl Taylor.

Boeder: No.

Hughes: When did you write it?

Boeder: At home. That book was very, very much appreciated by optometrists.

Hughes: What about ophthalmologists?

Boeder: Oh no, they didn't want to bother.

Hughes: I noticed it's published by the Distinguished Service Foundation of Optometry.

Boeder: That's right.

Hughes: How does that tie in?

Boeder: They gave the money for this publication. Oh, I got a gold medal too.*

Hughes: What is the Distinguished Service Foundation of Optometry?

Boeder: It's a foundation within optometry. It exists today, I'm sure.

Hughes: To encourage publications?

Boeder: Well, they had learned that optometry might benefit from activity like that.

This book was very much appreciated by people that needed it.

Hughes: Was it used in the optometry schools?

Boeder: No, but they were eager to get hold of a copy to own.

Hughes: Practicing optometrists read it?

Boeder: Yes.

Hughes: Did it make a difference to your career at American Optical?

Boeder: No. I got some appreciation, but nothing really vital.

Hughes: I know your thesis was related to optics, but you really hadn't gotten into it in the applied sense until you joined American

* The inscription on the medal reads: "Boston 1937. For distinguished service to optometry. Awarded to Paul Boeder, PhD, by the Distinguished Service Foundation of Optometry."

Optical in 1935. You'd only been at American Optical two years before the book was published. How did you pull all the subject matter together in such a short period of time?

Boeder: Is there that much in there? [laughs] Well, I don't know anymore why I was crazy enough to write that little book. I knew that the optometrists would benefit, because they should have the knowledge and didn't have the knowledge.

Hughes: You were writing it for them.

Boeder: The Distinguished Service Foundation.

Hughes: But with optometrists in mind as an audience?

Boeder: Oh yes.

Hughes: Were you trying to downplay the mathematics?

Boeder: No, up-play. That book is full of problems that should be solved by anyone who is interested enough to do them. It is a discussion of how to handle, with a little mathematics, certain problems. The mathematics is minimal.

Hughes: A pure mathematician wouldn't be interested in it?

Boeder: That's it. Hans Levy wrote a review of this book. He couldn't believe that anything like that could have anything [of value]. Hans was a rare mathematician, a wonderful mathematician.

Hughes: Did he criticize the mathematical aspects of the book?

Boeder: No. The book was entirely unnecessary for him—such a little bit of mathematics, that's ridiculous he thought.

PHOTOGRAPHS

Ludwig Wilhelm Boeder

Anna Schubert Boeder

Max

Hedwig

Clara

Eda

Paul

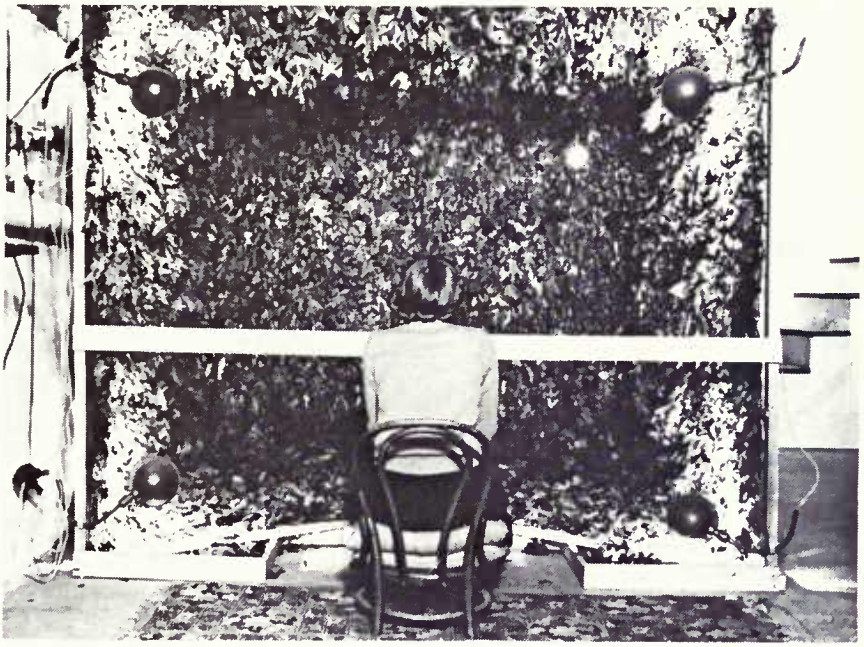
The Boeder Family
c. 1906
(not pictured are Toni and Hansi)

Paul, soon after his arrival in the United States, with relatives Leo and Julia, 1923

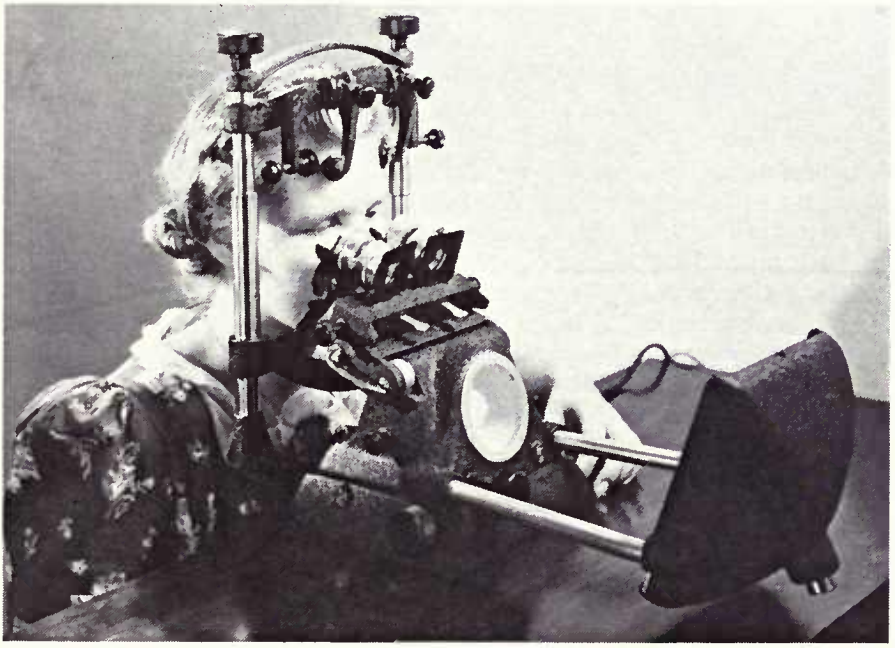
Evelyn and Paul Boeder, June 1935

The Dartmouth Eye Institute, 1941 *Front row:* Leo F. Madigan, Gordon H. Gliddon, Walter B. Lancaster, Adelbert Ames, Jr., John Pearson, Elmer H. Carleton *Second row:* Wendell Triller, Hermann M. Burian, Henry A. Imus, Kenneth N. Ogle, Arthur Linksz, Isabelle Andrus, Robert E. Bannon, Camilla Hubscher, Rudolph T. Textor *Third row:* Irving E. Bender, Milton R. Thorburn, Ruth Humble, Helen Heartz, Leon E. Straw, Donald W. McKechney, Ellen Shattuck *Back row:* Barbara Jordan, Arlene Jenney, Mary England, Mary Beebe, Isabel Dickinson, Barbara Holden, Rosamond Scott, Norma DesRoches *(Photo courtesy of Robert E. Bannon)*

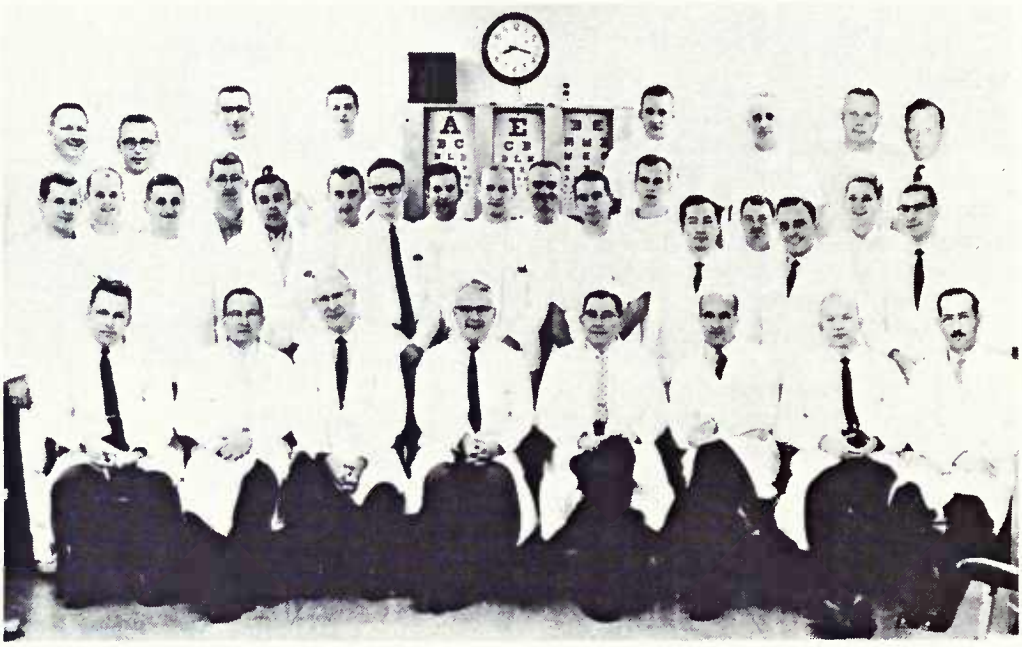
Alfred Bielschowsky



The leaf room
Dartmouth Eye Institute
(Photo courtesy of Dartmouth College Library, Special Collections)



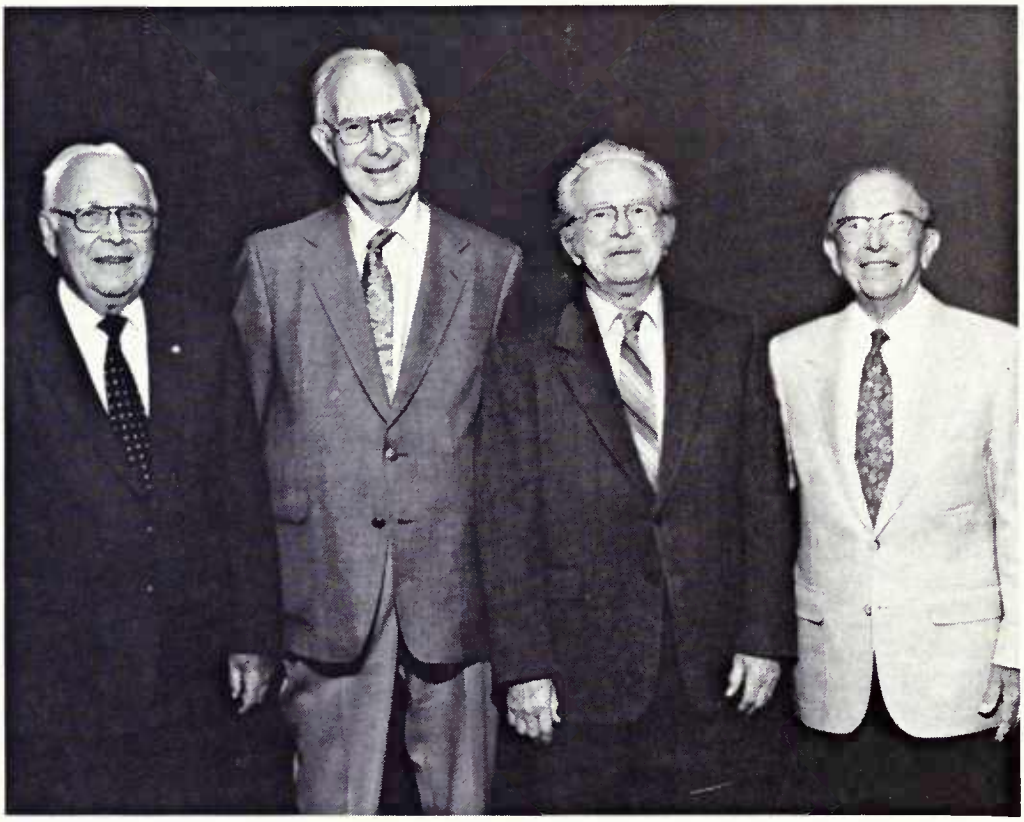
The eikonometer
(Photo courtesy of Dartmouth College Library, Special Collections)



Department of Ophthalmology, University of Iowa, 1963
Front row: R.C. Watzke, Paul Boeder, P.J. Leinfelder, A.E. Braley, H.M. Burian, Frederick C. Blodi, E.C. Furguson, M.F. Armaly *Second row:* E.M. Schaeffer, N.M. Rozansky, J.A. Stuart, J.T. Pearlman, R.S. Baller, W.H. Coulter, H. Inoue, P. Baloglou, S. Salamoun *Third row:* H.D. Fenske, J.W. Dickensen, C.N. Jepson, H.S. Thompson, J.M. Hersey, J.C. Yarbrough, R.F. Gates, R.A. McKay *Back row:* J.R. Lynn, B.E. Spivey, M.L. Mazow, R.R. Widner, C.E. Boylan, O.A. Wiegman, R.V. Despain, G.K von Noorden
(Photo courtesy of H. Stanley Thompson)

Scene at Hermann Burian's strabismus clinic, University of Iowa, 1964
Front, center, Dr. Burian; seated to his immediate right, Dr. Joseph Leinfelder, then Dr. Donald Doughman; to Dr. Burian's immediate left, Dr. Richard Raskin, and then Dr. Jerome T. Pearlman
(Photo courtesy of H. Stanley Thompson)

Paul Boeder and Frederick C. Blodi, University of Iowa, 1970
(Photo courtesy of H. Stanley Thompson)



Alson E. Braley, P.J. Leinfelder, James Allen, and Paul Boeder
(Photo courtesy of H. Stanley Thompson)

III. THE DEPARTMENT OF OPHTHALMOLOGY, UNIVERSITY OF IOWA, 1957–1971

Appointment

[Interview 4: March 22, 1989, Dr. Boeder's Apartment, Norfolk, Virginia]

Hughes: Whose idea was it for you to come to Iowa?

Boeder: Burian's. He went first.

Hughes: Why did he want you to come?

Boeder: I think Burian was the one who worked for that. I don't know the circumstances anymore. It was a long time ago. But the first thought that comes to my mind is Burian.

Hughes: Do you think he hoped to do research with you?

Boeder: I don't know.

Hughes: Was it in your mind that you would do research with him?

Boeder: No, not in my mind. I had met [Alson E.] Braley, and I was attracted to Braley. Braley wanted me to come—of course, under conditions that would not decrease any budget of his department. How that came about, I don't know any longer, but a few executives of the American Optical Company and Braley and I had a dinner.

Hughes: In Southbridge?

Boeder: I really don't know where it was. It was certainly not in Southbridge. Braley was not in Southbridge. The executives liked Braley.

Hughes: Schumacher was probably one of those executives, wasn't he?

Boeder: At that time, he was president.

Hughes: Do you think he was at the dinner?

Boeder: No, he was not there. He was not a man who would go to dinner with others. He was a little shy. He had this idea about ophthalmologists, that they were better than he and knew more. Read that letter from him.*

Hughes: Had you been thinking of leaving American Optical?

Boeder: I thought of it all the time, perhaps. [laughter]

Hughes: So you always had your eye open for . . .

Boeder: For teaching in a nice institution and not being in American Optical Company.

Hughes: So you never really liked being in industry?

Boeder: No. I think it's a terrible thing if you want to teach, I mean if you have academic attractions.

Hughes: Why did you take the job in the first place?

Boeder: Well, I came back from Göttingen, and on the street I was hired by Neumueller, who wanted me in his Bureau of Visual Science.

Hughes: But why didn't you wait for an academic position?

Boeder: It was attractive, what he offered.

* Weldon Schumacher to Paul Boeder, November 1, 1975. Department of Ophthalmology records, University of Iowa.

Previous Teaching at Harvard Medical School, 1950–1957

Hughes: Now, you had been teaching at Harvard?

Boeder: Many years.

Hughes: First as a lecturer and then as an instructor. From 1950 to 1952, you were an instructor in ophthalmology, Harvard Medical School. In 1953, you became lecturer in ophthalmology. Had you ever considered a permanent position at Harvard?

Boeder: Once, but it was just transient.

Hughes: You mean nothing came of it?

Boeder: I had met the dean. There was one man I liked, that's why I had that idea [to teach at Harvard], and that was [Edwin B.] Dunphy [Chairman, Department of Ophthalmology, Harvard]. The dean wanted a meeting with Dunphy and me, and we had a luncheon at the faculty club. I'll never forget that. The dean asked me questions. I said, "Well, I'm not really interested in research, I have to admit. I would like to teach." That didn't go over with him so well. He wanted papers coming out. But I didn't care. I had said that with conviction; I didn't want to change it at all. I think the meeting with this dean made evident to him that an assistant professorship was too much of a deal for Harvard. He changed the appointment from an assistant professorship to instructor.

Dunphy said, "Well, I didn't promise a professorship; you know that, Paul. That's too much." I said, "I'm not disappointed, Dr. Dunphy. I'll take what they offer. If they offer an instructorship, I'll feel better about it." He said, "Then let's take it." He was relieved.

Hughes: The difference between the instructorship and the assistant professorship was research?

Boeder: No, it was rank.

Hughes: Yes, I know that.

Boeder: That blew it, actually, because I was not interested in research; I was interested in teaching.

Hughes: If you had taken that position as assistant professor, it would have meant leaving American Optical, would it not?

Boeder: Oh, yes.

Hughes: But the instructorship and the lectureship you could do along with your position at American Optical?

Boeder: Right.

Hughes: Was the course very much like the one that you taught at Lancaster?

Boeder: Yes, it was very much like it. They all needed that.

Hughes: You taught residents in ophthalmology at Harvard Medical School?

Boeder: Yes, for many years.

Hughes: Somebody told me that this position at Harvard was simmering at the same time that you were considering going to Iowa, and because the Harvard situation was slow in developing, you eventually decided to go to Iowa.

Boeder: I felt better with the Iowa deal. Get away from Harvard, yes.

Hughes: Because there was more teaching at Iowa?

Boeder: Yes, and I liked the atmosphere better there.

Hughes: What was there about the Harvard atmosphere that you didn't like?

Boeder: Well, the emphasis on research. Those questions didn't come up in Iowa.

Hughes: Yet you did research at Iowa.

Boeder: Minimum. I did thinking, really.

Hughes: Do you distinguish thinking from research?

Boeder: Yes.

Hughes: What do you mean?

Boeder: Well, thinking is without actual instrumentation.

Hughes: Isn't thinking what most mathematicians do?

Boeder: Well, that's what I wanted. Mathematicians think all the time.

Hughes: But Harvard wasn't satisfied with that.

Boeder: They wanted me to do some research. The dean asked about my research interests. I said, "I cannot get into that. I'm interested in teaching."

Hughes: Why did you feel that so strongly?

Boeder: Because I didn't have the conviction that I could do it.

Hughes: The research?

Boeder: Yes. I didn't have interest in that so much, you see. My interest was to have a class in front of me.

Hughes: Well, that you got.

Boeder: I had many classes. [laughs] I believe I had many more classes in front of me than any man living in the United States—and I liked that.

Appointment (continued)

Hughes: Why did Dr. Braley want you to come to Iowa?

Boeder: I don't know. He thought I was a great man. Well, any department head who doesn't have to pay for people coming is interested. [laughs]

Hughes: It was a wonderful deal.

Boeder: Yes, a wonderful deal. I went to Iowa City [the University of Iowa], and American Optical paid my full salary.

Hughes: Had Iowa ever done anything like that before?

Boeder: Not that I know of.

Hughes: To put it very crassly, what was American Optical hoping to get out of the arrangement?

Boeder: *Renommée* [reputation].

Hughes: They obviously had a lot of faith in you.

Boeder: Yes. Well, I really must say I feel grateful to American Optical Company, because we had our full salary and had a grand time in Iowa City.

*Hughes: And yet, as I understand it from talking to people such as Dr. Rubin, there was no stipulation that your subsidy from American Optical be publicized.**

Boeder: That was the wonderful thing about it, really.

Hughes: The students probably weren't even aware that that was the arrangement, would you say?

Boeder: No.

Hughes: In July of 1957, an agreement between American Optical Company and the University of Iowa established the American Optical Company Chair in Physiological Optics. This chair was established with you in mind. Was there any thought of continuing it after you retired?

Boeder: This chair never assumed reality.

Hughes: Why didn't it fully materialize?

Boeder: Well, I went anyway to Iowa, and I didn't have that additional pressure of a chair.

Hughes: Were you happier without the chair?

Boeder: I was happier without it.

Hughes: Do you think that's why it didn't materialize?

Boeder: Sure. There was no pressure from me to give me a chair.

Hughes: What would have been the difference?

Boeder: Well, it's a matter of the title. I was satisfied without a chair. But I disappointed the American Optical Company. They never knew that I didn't have an American Optical chair. They didn't go into the details. I didn't pressure about that at all. They

* Rubin interview, September 6, 1988.

hoped for the best, that's all. They wanted prestige. It never really came about in the way they had visualized it.

Hughes: They would have liked to have had a chair because it would have given them more credit?

Boeder: Yes, and maybe they even talked about having a chair there. It didn't matter to me.

Hughes: How widely known was it that American Optical was underwriting your position at Iowa?

Boeder: In Iowa it was known.

Hughes: Well, was there any precedent for industry to fund positions in academic ophthalmology in this way?

Boeder: I don't know how far-flung that is in the United States, but it had happened. This was not a unique case.

Hughes: Do you think, in general, over the years, that American Optical was satisfied with the relationship with Iowa?

Boeder: Yes, in the sense they trusted me. If I was satisfied, they were satisfied.

Hughes: What ties did you retain with American Optical?

Boeder: Friendly.

Hughes: Did you become a consultant for American Optical?

Boeder: Never. They never asked me about anything. Weldon Schumacher was a personal friend of mine. He was president, and he didn't ask me any personal questions. He wouldn't ask about my work. I didn't ask him about his work.

Hughes: Do you think there was ever a consideration by anybody in the administration at American Optical to discontinue the support?

Boeder: No. No, I couldn't think of that possibility even. The Wellses wouldn't have done anything [to discontinue the support]. They were glad, in the same way that Weldon was, that I was there in Iowa.

Hughes: They must have thought very highly of you.

Boeder: They did. There was a time when they wanted me actually to take over the research department in the American Optical Company. I told them that I was not interested.

Hughes: What became of the Bureau of Visual Science when you left?

Boeder: It had a slow death.

Hughes: Did somebody step in as director?

Boeder: Not that I know of. Bannon was the man who would have liked to have been given the position. Actually, Bob Bannon would have been a much better choice, you know, because he was interested in all of that field. I didn't love it so much. I was his boss, because I was the director. But I never played boss. Never. That was not my game.

Hughes: In 1961, Schumacher wrote to Braley, saying: "One of my biggest business disappointments was our inability to use fully Paul's practical, analytical talents. This was one of the major reasons for our seeking an opportunity for him with you in the University, Department of Ophthalmology." What did he mean when he said that American Optical failed to use your practical, analytical talents?*

Boeder: Well, it was because of a man by the name of Tillyer. Tillyer was in charge of the research department in the American Optical Company. American Optical had Tillyer's name on their lenses—Tillyer lenses. Didn't mean anything, but it meant a lot to him and the company too. Tillyer was not dumb; he was good. In many respects, he did a lot for the company. He didn't understand anything about research or connections, but he had a name. And Tillyer came from a very good institute, the Bureau of Standards. I told you that before. Tillyer was no slouch.

Hughes: So what was Schumacher referring to?

Boeder: He couldn't remove Tillyer.

Hughes: But you said you didn't want the position.

Boeder: No, I didn't want it. I said that to vice-presidents in American Optical Company, and they must have finally given the message to the president. I was not interested in a position like that. I didn't have the conviction that I would be a very good successor to Tillyer. Tillyer had done a lot for the company.

* June 15, 1961. Department of Ophthalmology records, University of Iowa.

Hughes: In addition to the lenses?

Boeder: Well, the lenses were named, but, in a sense, he had a going concern in this research department. I cannot name now their various projects anymore, but honest work was being done there. Tillyer was a master. Tillyer was not bad. But then, of course, his reputation could never be questioned, because they had Tillyer lenses. It was a big thing in the trade. It was supposed to be the best lens made.

Hughes: Were they?

Boeder: No. They were just as bad as Bausch & Lomb's lenses. [laughs]

Hughes: Bad in what sense?

Boeder: I mean not any better and not any worse. A lens is a lens.

Hughes: How were they claimed to be different?

Boeder: By force. [laughs] They were not different; they couldn't be different. A lens is a lens.

A lens is the combination of two curves. Now, the curves have to be chosen correctly. A lens has to have a certain quality, not only in the center, but at the periphery too.

Hughes: What was Tillyer claiming to do differently?

Boeder: Tillyer was not claiming anything.

Hughes: So this was just an advertising gimmick?

Boeder: For him it was a wonderful thing that everybody talked about Tillyer lenses. It was not a bad idea to call them Tillyer lenses in American Optical Company. It was good for the company. The executives didn't know what it meant, actually, but Tillyer lenses became an entity. The product was an entity. [laughter]

Hughes: Did American Optical give you extra money for your travel expenses when you were teaching the courses around the countryside?

Boeder: I must say in that respect I owe a lot to American Optical Company. They never questioned my expenses for the courses. I didn't cheat, but I could plan a trip, and they just wrote it up. I owe to American Optical Company an amazing amount of

freedom of planning. I had a good time with the company because they left me alone. They didn't interfere.

Whenever I could, I took Evelyn, and we had a marvelous time. We had a good life with the American Optical Company, there's no question, because of this utter freedom and absence of control. The treatment I got from American Optical Company was first class.

Hughes: Did your thinking about optics change in any way when you moved from industry back into academia?

Boeder: That was always a principal desire of mine. I knew I owed a lot to American Optical Company, but I never loved it. In other words, it was industry. "Beware industry," that's what I always said to Evelyn. "Let's get out of industry; let's go to academe. Let's go and be a faculty member in a good school." That was my ambition. Always. It was a different atmosphere. The atmosphere in a company like the American Optical Company or Bausch & Lomb, wherever you have industry, is completely different from academia. And I was not happy in an industrial situation. I was longing for an academic position. And when the time came to make that possible, I certainly grabbed it. It was a wonderful change. The change to Iowa was a marvel. What a difference!

Hughes: Well, tell me some of the differences.

Boeder: Well, in the first place, there are bosses that you had to always consider.

Hughes: At American Optical.

Boeder: Yes. In every industry. There's a vice-president of this, a vice-president of that. In American Optical Company, it was a family affair. Tillyer had one of those bosses—a kid, because he belonged to the family of the Wellses. But Tillyer didn't mind; he actually liked the Wellses. But the boss was a kid that didn't know one-tenth of what Tillyer knew.

Hughes: When you got to Iowa, did you have any particular relationship with Burian?

Boeder: Yes, but only on a social basis. I was on my own. I did a lot for him at the time.

Hughes: What was he working on?

Boeder: Publications.

Hughes: In binocular vision?

Boeder: I don't know; I'd have to look up what he did. But whenever he was in trouble to express this, just a curve that he had to draw, he was at a loss. He came into my office very often. "How do you do this, how do you do that?" I was happy to tell him. It was all elementary things and matters of course.

Hughes: Did a lot of people come in for advice like that?

Boeder: Yes, in Iowa City, I was the man they went to when any problem arose. It's a strange thing. My office was the office of a consultant.

Hughes: Did you realize that was going to happen when you took the position?

Boeder: No, but I didn't object to it when I was there. It was not only Burian who came, but others came in—wanting to know this, wanting to know that. Especially one friend whom I've lost sight of. He's now in Washington, DC.

Hughes: Is that [Mansour] Armaly?

Boeder: Yes, Armaly.

Hughes: I understand that he was interested in glaucoma, and that one of the things you helped him with was on probability studies for its occurrence?

Boeder: Anything that required simple mathematics, I did for Burian and for Armaly, and so on. They came to my office, and I was busy. In a sense in Iowa—this may be a little exaggerated—I was the *Hausmutter* [housemother]. [laughter]

Hughes: How did you feel about that?

Boeder: Well, I enjoyed it. I knew that they were awkward and a little bit green.

Hughes: Did you help the residents with research projects as well?

Boeder: My office was open to anyone all the time, and I didn't mind when they came in and wanted to talk about things. At some times, I thought I was the housemother. I could help them in formulating a plan of action that they should naturally take.

Hughes: And the residents did indeed come in as well as the staff members?

Boeder: Oh, sure. I had a very good office. It was open to anyone. It was used. I was the man to confide in.

Physiological Optics

*Hughes: There's a letter that you wrote to Dr. Braley in June of 1957, just before . . .**

Boeder: Just before I left for Iowa.

Hughes: That's right. You start out by saying:

"Since, except for a delightful meeting in New York, I have had no direct communication with you in regard to the possibility of joining your department of ophthalmology, it seems appropriate that I should outline briefly those areas in which I should like to serve your department.

There is, above all, the area of ophthalmological education: the teaching of physiological optics.

My extensive contacts with ophthalmology and my teaching at medical schools have convinced me of a growing educational need in physiological optics, that is, visual optics and visual physiology. As far as I know, there is no medical school in the country where the graduate student in ophthalmology can find adequate training in these basic sciences. Ophthalmology takes almost no part in modern visual research which is done by teams of full-time scientists: visual physiologists, psychologists, neurologists, biochemists, and physicists in research laboratories of university departments, the armed forces, and industries, usually on government grants. The progress made under these

* June 10, 1957. Department of Ophthalmology records, University of Iowa.

accelerated conditions finds the ophthalmologist totally unprepared; he has not been sufficiently trained to comprehend the research reports that flood the scientific journals. Turning to textbooks for help usually adds to his disappointment, because basic concepts are lost to him in mathematical formulation."

Why was there no adequate training in physiological optics in the United States?

Boeder: Nobody was interested in the teaching of it. Burian also didn't teach.

Hughes: Verhoeff and Jackson were too old at that point?

Boeder: Well, they were primarily already the big leaders in ophthalmology. Verhoeff was a pathologist. They went to him when they wanted to know exactly what was happening to an eye of a certain patient.

Hughes: But not for optics.

Boeder: No. He was a great pathologist.

Hughes: Yet he did have interest in optics.

Boeder: Well, he had enough brains to realize that optics would help him here and there, but his interest definitely was in pathology. And today, there's a Verhoeff Society trying to keep the tradition alive. He was a big man. I would say there were two big ophthalmologists—Verhoeff and Lancaster. They could not even like each other, and they were both in Boston. Lancaster had abilities and interests that Verhoeff had no moment for. Lancaster was a leader, a man who thought of the Academy as a body that had to be improved, constantly to be established again and again. He did the right thing and was a leader in ophthalmology. And the other [Verhoeff] was an ophthalmologist who had an interest in pathology. There's quite a difference.

Hughes: Then what about Jackson?

Boeder: Jackson was a great man. I don't know much about Jackson. I only know his name . . . and I listened to the Jackson Lecture whenever I went to the meetings at the Academy. Jackson was a man who was admired by both Lancaster and Verhoeff.

Hughes: Was there anybody else interested in optics in this country?

Boeder: Oh yes. There were even optometrists who were much more interested in it than ophthalmologists. The man that I couldn't name to you the other day was a wonderful man, a good friend of mine, in Columbus, Ohio.* He was actually the director of a group of optometrists, but he was much more than that. He was a scientist of rank. He was not as interested as I was in the teaching of optics, but he was a very good optical man.

Hughes: Getting back to this quote from your letter to Braley, why didn't ophthalmologists take part in modern visual research?

Boeder: They have no time.

Hughes: But what about the ophthalmologists in academic departments? There'd be more incentive there to do research.

Boeder: Yes, but they do not have the desire to do it. They want to do ophthalmology, and if they can, they would go and have a practice. And the practice is their livelihood, and it's a handsome livelihood.

Hughes: What about the possibility of there being an intimidating effect?

Boeder: On whom?

Hughes: On the ophthalmologist. I mean, optics is a rather mathematical subject. Would that not deter ophthalmologists from getting involved?

Boeder: That's why the field was wide open for me. Nobody was interested in the same thing. The thing that I did was this: be as simple as you possibly can at the blackboard, and let them [ophthalmologists] understand a few things in optics. That was my sole and most effective weapon. They didn't learn a lot of optics from me, but they were surprised that it was simple and interesting. And that's why I was invited [to give optics courses] again and again. My word, I got invitations I couldn't accept—three or four places at the same time.

The field was wide open to have a very elementary introduction into optics. I made sure that everybody understood what I said. And you see, that's the teaching style that I learned in Hamburg. I went to a teaching institution that was a *Seminar* [training college for teachers]. Whatever you say, let the students understand it; then they like it. And that's what I did. And I had

* Melvin L. Rubin (telephone conversation, June 1990) and Robert E. Bannon (letter, June 1990) suggest that the man in Columbus was probably Glenn A. Fry, PhD.

success teaching optics. They liked it. And everybody wanted me to come to teach. I had a wonderful life telling the simple story again, and again, and again. [laughter]

Hughes: How did you keep your enthusiasm?

Boeder: Well, when you get appreciation as I got, how can you lose enthusiasm? I just enjoyed what I did, and I got a lot of compliments about it. And they wanted me, and they understood some things in optics for the first time. It was fun. The door was wide open. Many could have done it who knew more optics than I. I was not an optical expert; I was an optical elementary teacher. That's true.

Hughes: Did you ever have the desire to go further in optics?

Boeder: Never. That was good enough. [laughs]

Hughes: You said off tape that from seventy to eighty percent of an ophthalmologist's income comes from refractions and the treatment of visual problems.

Boeder: Yes.

Hughes: I know optics is not refraction, but there are relations there.

Boeder: Yes. Well, you see, refraction requires some optical knowledge. You find out about the vision of a patient. In order to do that, you put lenses in front of his eyes and see what he can do and how he reacts. That in itself is an optical procedure, because every lens has a certain power. You do it with spheres—that's the simple way—and then you find out about the astigmatism that the patient may have. The refraction is to find out how a lens can be prescribed to improve the patient's vision and his visual symptoms, which in many cases can be corrected. The patient can get headaches and so on, if things are not right. A refractionist can do a lot for a patient.

Hughes: Before you came along to teach both optics and refraction—

Boeder: I didn't teach much refraction.

Hughes: Wasn't there a refraction clinic at Iowa?

Boeder: Yes, but I didn't teach any refraction. Bannon taught refraction because he was a refractionist.

Hughes: He would teach at the Lancaster course?

Boeder: Yes.

Dave Guyton was the best student I ever had. I had him first in the Harvard class that I taught. He's a good-looking man, he is a wonderful man, and he is a marvelous teacher. I recommended him [to teach] in every course that I gave, and they took him.

Everywhere the optics teaching's going on, he is there. I have letters: "Yes, you were right. He's a wonderful man and a wonderful teacher. But we miss you." [laughs]

Hughes: So he became your successor?

Boeder: He's my successor. He was the best I ever had. He's doing the Harvard course,* he's doing the Stanford course,** he's doing the Lancaster course—everything.

Hughes: You said off tape that he knew more about optics before he began your course than most ophthalmologists when they finished it. Had he been doing some reading in optics?

Boeder: I don't know, but I had the impression that man is already better informed than those that would finish this course. I had that impression, and it was right. He was just very good. He had his head on his shoulders correctly, and he has shown that he can live up to my expectations. In San Juan they said, "Oh, you should continue [to teach]. Don't give it up." I said, "I have to give it up. You'll get a man you will like better, and you will rejoice that you have him." And all that was true. They were wonderfully satisfied every time with Dave. He was just so good.

Optometry

Hughes: May I read you another section of the letter that you wrote to Dr. Braley?

Boeder: Yes.

Hughes: "Optometric associations of several states have seized upon this weakness in ophthalmological education and have claimed the field of vision for themselves to the exclusion of ophthalmologists. Though such claims will fail, it cannot be denied that the

* The Harvard Basic Science Course in Ophthalmology.

** The Stanford Basic Science Course in Ophthalmology.

instructional courses in physiological optics in optometric schools, especially at Ohio State University and the University of California, are on a very high level, and that significant contributions to visual science have been made by their research laboratories."

Boeder: Well, you see, that's a good letter. And that was actually true, what I said there. There were men in California and in Ohio State that were just brilliant. Much better than we had in the optometric schools. I went to an optometric school for a while, in Philadelphia. It was a waste of time.

Hughes: Why was it a waste of time?

Boeder: Because I knew all that.

Hughes: Did you finish the course?

Boeder: No.

Hughes: Were you thinking of becoming an optometrist?

Boeder: Yes, sometimes I have regretted that I didn't stick to that, because optometrists make so much money. But those regrets are not deep.

Hughes: Do you think you would have been satisfied with optometry?

Boeder: No. [laughs]

Hughes: You say in the letter to Braley that the optometrists claim the field of vision for themselves, to the exclusion of ophthalmologists. And then you go on, ". . . such claims will fail."

Boeder: Well, yes, they can't get the better of the ophthalmologists in this country.

Hughes: Why?

Boeder: Well, because the ophthalmology people have a much better reputation. People want to be treated by an ophthalmologist—they have better training.

Hughes: Ophthalmology nowadays feels the optometrist to be a threat.

Boeder: That's true, because they let them be a threat. Some ophthalmologists don't go into the real knowledge that they should have. No doubt about that.

Hughes: So your feeling is that if ophthalmologists had adequate training in optics and refraction, they would have no problem with optometry?

Boeder: No problem. Absolutely not.

Hughes: So your answer to the problem is education.

Boeder: Education.

Hughes: What do you think is the proper division of labor between ophthalmologists and optometrists?

Boeder: They should work together, as they do in many cases.

Hughes: And the optometrist should do what?

Boeder: The optometric work. And let the ophthalmologist do the pathology, and so on, where they are certainly much better qualified than the optometrist. The optometrist is a dispenser of lenses, and the ophthalmologist should be on a higher plane.

Duties

Hughes: In the same letter, you outlined a course in physiological optics as ideally you would like to have it structured.

Boeder: I was pretty conceited. [laughter]

Hughes: You were telling Dr. Braley what you intended to do at Iowa, I believe.

Boeder: Oh, I see.

Hughes: ". . . I have, for a long time, envisioned the creation of a course in physiological optics of such quality that it might serve as a model for other medical schools. In brief outline, such a course would start with a discussion of image formation in the eye, ametropia, astigmatism, their measurement and correction by means of ophthalmic lenses; the optical properties of retinoscopy, ophthalmoscopy, and other ophthalmic techniques. This optical part, which is important as a preparation for the practice of

refraction, must be followed by comprehensive discussions of visual physiology; the basic processes of vision itself in the retina and the central visual pathways up to and including the cortex; that is, important aspects of vision, such as light, color, and space perception should receive full treatment."

Did you indeed do that in the course at Iowa? Or anywhere, as a matter of fact?

Boeder: I had given them, in a sense, some of the tools, because I showed you the book that I translated, the book that had an enormous body of admirers in Europe—Tschermak-Seysenegg.

Hughes: Did enough American ophthalmologists read it to make a difference?

Boeder: No, I don't believe they did.

Hughes: So the courses you were giving were all the more important because ophthalmologists weren't getting optics in any other way.

Boeder: That is true. Because they didn't read my translation. As Duke-Elder said, it's not simple reading.

Hughes: When you agreed to do the translation, did you hope that ophthalmologists would indeed read it?

Boeder: I still hope that they will read it, because it would be a wonderful boost of their own knowledge. That book is good.

Hughes: The final quote from this very good letter:

"Another important area is, of course, the area of visual research. Although I cannot speak here with the same authority as in education—having had only evaluating, organizing, administrating, and cooperating rather than first-hand experience with it—"

Boeder: That's what I told the dean at Harvard.

Hughes: ". . . I should like very much to help create a research unit in physiological optics devoted to specifically ophthalmological problems. The modern trend of teams doing visual research in large laboratories cannot and should not be reversed, but it must be realized that, nevertheless, the area of specifically ophthalmological visual research, which should aim at uncovering relationships between anomalous visual performance and pathology, and at the improvement of old and the

development of new diagnostic physiological optical methods, remains practically untouched. This important work will not be done by the scientists in other visual laboratories because, even if their interest in such problems were strong, they usually lack the great advantage of ophthalmological departments, namely, the easy access to human clinical material. At present, the abundance of material that the clinics could make available to physiological optical research goes largely unseen; none of the many cases treated for retinal detachment, glaucoma, etc., is systematically studied in regard to changes in visual functions. Such studies should be made whenever possible because they may uncover relationships which, in turn, may lead to solutions of more basic problems."

Boeder: I wasn't that dumb, was I?

Hughes: No. [laughter]

Boeder: Those things are just as actual today as they were then.

Hughes: Were you able to do much?

Boeder: No. We tried to do that and told ophthalmologists, you have to do this and that. They were too busy to do anything.

Hughes: But you did have a research unit at Iowa, did you not?

Boeder: Call it that. I don't know. I was a constant consultant of people that were in trouble in Iowa.

Hughes: You didn't have a laboratory?

Boeder: No. I didn't want it, either.

Hughes: So you had an office, and you thought, and you consulted with whomever came in, and you taught.

Boeder: That's right. I taught, and taught, and taught.

Hughes: Well, I know you attended rounds, but I don't know how frequently.

Boeder: Every day. I looked at eyes with them too, and so on. Of course, I did that.

Hughes: Did the clinical exposure affect your thinking?

Boeder: No, it just embellished my knowledge that I had about the eye and what can happen to it.

Hughes: Did you contribute on those rounds?

Boeder: Never. I was not called upon to discuss the cases that I saw.

Hughes: But perhaps questions would be addressed to you.

Boeder: Hardly. No, they were the big shots. They were real, active ophthalmologists. They knew it all. [laughter]

Hughes: But surely there must have been areas in which you could have contributed.

Boeder: Well, some, yes, and special discussions came up, which actually came up because Braley wanted to know more. Braley would ask questions of the group, you see, that required some explanations [from the group].

Hughes: Well, what about [Placidus J.] Leinfelder?

Boeder: Leinfelder was entirely different. He didn't say much. But one thing I must say about Leinfelder—Leinfelder was the brains of the department. He had more brains than anyone around. He was an intelligent man. When he said something, it was *Hand und Fuss*. What he said had hand and foot. [laughs] I had a tremendous admiration for Leinfelder. Leinfelder was a thinker, Leinfelder had a brain. He didn't say anything for the show of it, ever. I'm so sorry that you didn't see him when you were in Iowa City.*

Hughes: Well, of course, he was right there at the top of my list, but I was just too late.

Boeder: He had ill luck; he fell down the stairs several times.

The Department

Hughes: He spent his whole career at Iowa.

Boeder: Oh, yes. He wanted to be chief. I don't know the history; Braley was chosen. There was always a little black spot in the relation

* Leinfelder died in 1988, shortly before the interviewer arrived in Iowa City to conduct interviews with Dr. Boeder's former colleagues.

with Leinfelder and Braley. They got along because they were gentlemen, but you couldn't erase what had taken place.

Hughes: Braley was at the College of Physicians and Surgeons in New York when he was offered the chairmanship at Iowa.

Boeder: He came from New York, yes.

*Hughes: He had been a resident at Iowa, and he went briefly to New York. I understand that there was division in the search committee about who was going to succeed C. S. O'Brien.**

Boeder: That's right.

Hughes: Leinfelder was a consideration, and the second man was Jimmy Allen.

Boeder: Yes, it was Jimmy Allen.

Hughes: Jimmy Allen eventually left, because the tension was so great.

Boeder: You're right. I remember that now.

Hughes: Braley, who had not been mixed up in this fray, was brought in, or so I heard the story. But maybe there's more to it than that.

Boeder: Well, not much more. I think that's the general trend of the development there.

Hughes: Why Leinfelder was passed over, I don't know.

Boeder: I don't know that, either.

Hughes: Of course, who's to know what they were looking for? Maybe after C. S. O'Brien, they—

Boeder: [laughing] They wanted a gentleman. Leinfelder was, in my estimation, *the* man in Iowa City.

Hughes: Braley, I understand, relied heavily on him, because at one point Braley was away a lot. He was consulting in Washington, and when he left the department, he left Dr. Leinfelder in charge.

Boeder: That reminds me that Braley was a man who did the right things for Leinfelder. Anything that could possibly offend Leinfelder, he would avoid. And he handled Leinfelder just marvelously. So

* Interview with Dr. H. Stanley Thompson, Iowa City, Iowa, January 20, 1989.

well that Leinfelder told me once Braley was really trying his best. He never let the slightest thing come up that would offend Leinfelder. Leinfelder was his baby. I must give him a lot of credit for how he handled the situation with Leinfelder. And Leinfelder appreciated that. He told me personally that Al Braley did everything he could to appease him.

Hughes: Tell me your impression of Dr. Braley as chairman of the department.

Boeder: Braley was a nice man, and he had peace with everyone in the middle of America. And you couldn't say anything mad and bad about Braley, because he wanted you to be happy, and he tried to make you happy. So he was really a man who was not finally chosen to be a target.

Hughes: Dr. Braley told me that he didn't get along very well with the dean of medicine at Iowa, who was Norman Nelson. Do you know anything about that?*

Boeder: No, not much. But Nelson was a difficult man. If he couldn't get along with Braley, that's a black mark for Nelson. Braley was a man who tried to accommodate everybody.

*Hughes: Well, apparently at one point, Dr. Nelson told Dr. Braley that he should reduce the Department of Ophthalmology to one staff member.** [laughter] Now what was behind all that, I don't know.*

Boeder: I don't know either.

*Hughes: Dr. [Hansjoerg E.] Kolder described you as "seminal."****

Boeder: And what does it mean, seminal?

Hughes: He meant you were very important for the development of some of the residents' research projects.

Boeder: Oh, now I know—a man who can start something to bloom.

Hughes: Yes, exactly.

Boeder: Well, that's amazing. I didn't know that. [laughs]

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* Interview with Dr. Alson E. Braley, Coralville, Iowa, January 21, 1989.

** Braley interview, January 20,1989.

*** Interview with Dr. Hansjoerg E. Kolder, University of Iowa Medical School, January 19, 1989.

He is a good friend of mine, I know that. I like my friend Kolder. He's a decent, wonderful man. He can be very definite sometimes, which is the only criticism that I can make of him.

Hughes: Do you agree with him that you were seminal for the development of some of the residents?

Boeder: No. That is a surprise, and I take it with a chuckle. It's cute, but I don't think that I'm seminal. I haven't got that much ability. But he must have found it himself, because I don't know how else he would have come to that strange conclusion.

Hughes: In 1967, Dr. [Frederick C.] Blodi became chairman of the Department of Ophthalmology at Iowa. Do you know who else was considered?

Boeder: I hope nobody else.

Hughes: Why do you say that?

Boeder: Well, he was a good choice. Very good. I don't know how he got it, but he got it. I was happy about it. Blodi—you met him—is a good man. And Otty is good, too. His satellite is Otty, and she is so unusually wonderful. Gladys [Burian] once said about Otty, "Iowa City would be nothing without Otty." [laughs] Otty has a quick mind and a quick tongue. She is just one of those bubbling things. She's opinionated and a fighter and never annoying. Always amusing. [laughs] I like Otty.

Hughes: Did Dr. Blodi make changes when he came in?

Boeder: I don't think so. I don't remember, but it couldn't have changed.

Hughes: Well, it was 1967 when he became chairman.

Boeder: My God, I was already there ten years. Well, I was happy about Blodi. Of course, I never had any ambitions to become a leader there. That was the strength of my position; I didn't want anybody's position.

Hughes: Did you like being a bit detached from the politics and from ophthalmology?

Boeder: I would do the politics always in my own office, because people came and talked about politics and their problems. [interruption]

Hughes: There were some people at Iowa when you were there that we haven't mentioned much. One of them is C. S. O'Brien.

Boeder: O'Brien I didn't know much. When I came, he wasn't there. He was only in the discussions that had come up. In Florida, he gave a party and left me out. That was not fair. He knew that I was a department member at that time.

Hughes: Do you think he felt that the university should not be associated with industry? Could that have been the motive?

Boeder: No, I don't believe that. I bet he didn't even know my background [with American Optical Company].

Hughes: Did you know Jimmy Allen?

Boeder: Yes, I knew him, but I didn't have many dealings with him.

Hughes: What about Gunter von Noorden? He was a resident of yours, wasn't he?

Boeder: Yes.

*Hughes: He's written a book on binocular vision.**

Boeder: Yes, that was written by Burian and Gunter. I have it here. He gave it to me.

Hughes: Well, another name is that of Lee Allen.

Boeder: Lee Allen was a very handy, all-around fixer. He could do anything.

Hughes: He also was a medical illustrator, was he not?

Boeder: He could illustrate beautifully. He was not a painter, but he could make a sketch. He had always a special picture to contribute to the gathering that we had at the time of Christmas.

Hughes: He was a scientific illustrator?

Boeder: Marvelous.

Hughes: Did he have formal training?

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* Von Noorden GK. *Burian-Von Noorden's Binocular Vision and Ocular Motility*, ed 3. St Louis: CV Mosby, 1985.

Boeder: No, I don't think so.

Hughes: What was his position in the department?

Boeder: I don't know. He was a full member.

Hughes: He was not an ophthalmologist, was he?

Boeder: Oh no, but he was a very handy man. He was needed there. He could do many things.

Teaching Optics

Hughes: Would you describe the Lancaster course and the others that you gave? I'm assuming that they were all roughly the same.

Boeder: Oh, absolutely the same.

Hughes: Tell me how you proceeded.

Boeder: [laughs] I talked about optics.

Hughes: Well, I know, but how did you introduce it?

Boeder: I'll tell you exactly how I introduced it. I made a drawing: these are rays of light coming from an optic point, let us say. These rays of light diverge in pencils. If they hit a surface that has optical power, they are changed.

Hughes: What do you mean by "optical power"?

Boeder: An optical power is a surface of glass. Then the divergence may be changed. It may be diminished, it may be increased, depending upon the form of the surface. We'd talk about a lens. A lens has two surfaces. "For our purposes now," I would say at the blackboard, "regard the lens as thin. It has no thickness. Let this vertical line be a lens. It has certain powers. It may have plus, it may have minus powers. It has plus powers if it's convex. It has minus power if it's concave."

Now, when this divergent pencil of light—it's coming from one point—is incident on one of the surfaces or the whole lens—let's talk about the whole lens, indicated just by a vertical line—it's changed. Now, why? What is changed? The power of the pencil of rays of light, which is divergent, is not constant at every cross section which you may draw. It depends upon the length from

the optic point to the cross section of the pencil you have chosen. That power, you only know now that we defined it as minus. But by how much minus? Well, that depends upon how far you are away from that point. The minus is very strong here. This distance is small. Here, the minus is less. But let us say it has one meter distance, that optic point that you have in mind. Then the divergent pencil of rays of light issuing from that point at one meter is minus one diopter, let's say. Now, what do you think it is when you go only halfway to that fifty centimeters. Half a meter. Do you think there's much more minus or less minus?

Hughes: I'd say more.

Boeder: That's right. How much more?

Hughes: Half more.

Boeder: Double.

Hughes: Right. Double.

Boeder: And in this way, I get the idea that with every cross section of that pencil of rays of light which you choose, the power is different. When it's one meter from that lens, we say it is minus one at the lens. The incident rays at the lens are minus one. Now, if the power of the lens is expressed in diopters, let's say it happens to be one diopter. A diopter is one over one meter. When we have decided that the rays of light incident at the lens have a power at the point of incidence of minus one, then if we know the power of the lens, we just add the power of the lens to the incident rays, and we have the most important little mathematical relationship in optics. We have the incident light; we call that "U." The lens itself has a certain power, "D." It might be one diopter, two diopters, it may be minus two. And then you add these two, then you get a certain result. And that result is what we call the image rays at the lens. They have a certain power, U plus D. Now you have the most important optical relationship that we are going to encounter. We have U plus D is equal to V. That's the only mathematics that I ever used in my courses.

Hughes: Really?

Boeder: Yes. With that you can do a lot.

Hughes: In the course of these lectures, did most of your students keep up with you?

Boeder: Oh yes. And I made sure; I asked questions all the time. I made certain that they realized that this is a very important relationship. It's the most important relationship that we are going to learn about optics.

Hughes: They were probably relieved to know that it was so simple.

Boeder: It was so simple. [laughs] They said, "What is U?" Well, U was the dioptric power of the incident pencil of rays from an optic point. "What is D?" D is the power of the lens itself that's being struck [by the rays]. You say it's an infinitely thin lens, but it has power. The result is the image rays, counted from the lens. With that we can do very many things. And we did.

Now, what can you do with it, when you have understood one lens? Let's say there are two lenses, each apart. Measure the distance between them. How can you find the incident rays at the second lens? That's easy if you have understood what was said in the very beginning. Then you go from there. The same thing happens.

Hughes: Did you feel that your students were interested in the subject?

Boeder: Oh yes, because I asked, asked, asked questions.

Hughes: I ask that because I have gotten the impression from talking to several people that most residents did not and do not approach optics with great enthusiasm. Were you able to—

Boeder: To overcome that?

Hughes: Yes.

Boeder: Yes, I certainly could, because for the first time they could do a little more than what they had been doing, with certain assumptions that were permissible. Infinitely thin, that's an abbreviation. Stick to one lens instead of going from surface to surface, which is more difficult. If only the first surface is considered, and the second surface, then you have two surfaces that you have to treat like two different lenses. So I took all these infinitely thin lenses first and gave a lot of examples.

Hughes: Did you give problems?

Boeder: Yes.

Hughes: Homework?

Boeder: Homework always. They always had an assignment.

But you can make optics like this very interesting to them. There's just nothing to it, you know.

Hughes: Was it information that they could immediately use?

Boeder: Well, yes. If I gave them problems, they'd better use this information.

Hughes: Could they use the information in medical practice?

Boeder: Well, they understood something that they had been dealing with for some time but never understood. Now they knew what was happening. It was a revelation to them.

Yes, I think optics is very interesting. If you teach it, you'd better believe that, because if you cannot make it interesting for the students, they won't go for it. But if they find all of a sudden they can do it, well, that's all right. As I indicated, start with the simplest things—with rays coming from one single optic point. I said, "Take any point in the wall. Every point in the wall sends rays into your pupil, every point you can consider." And everything became clearer to them. I think they liked it because it's so simple.

Hughes: What did you like about teaching residents and physicians?

Boeder: Well, to see the light in their faces when it dawned on them that optics is actually rather simple. You can make it so that it is nice. It's a wonderful thing. Optics is interesting.

Hughes: Dr. Kolder described your teaching method as Socratic. Would you agree?*

Boeder: I don't know what Socratic means. Socratic means, I hope, clear.

Hughes: I think it also involves participation on the part of the student. You pulled the students into the discussion. You weren't just lecturing at them.

Boeder: Oh, I pulled them, I pulled them, I tell you. And it's easy to pull them when they can give simple answers. They like to give answers.

Hughes: Did you ever use teaching aids? Slides?

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* Kolder interview, January 19, 1989.

Boeder: No, hardly ever.

Hughes: Why was that?

Boeder: Well, slides are just pictures; I can do better drawing at the blackboard.

Hughes: Did you continue to find it stimulating to give these courses?

Boeder: Everything was stimulating to me when I saw lights on their faces.

Hughes: And you always did?

Boeder: Always did. And I said, "Now, do you have any questions?" I answered their questions, of course, if they had any. And if they were asking questions that were not lucid enough for anyone to understand, then I'd say, "Well, what exactly do you mean, now? Do you mean this? Do you mean that?" No, I never had any trouble. I liked it. It was the most *elementary* thing you could possibly do.

The assumption is that rays of light come from any point you look at. Take a point, and why do you see that point? Something must happen. That point must send you a message. How? Divergent rays of light from any point. You couldn't see it otherwise.

Now, this divergence can be changed by dioptric power. Let's say a lens has a power of one diopter. You define one diopter as one over one meter. So that takes much, much repetition, again and again. This point is one meter away. This is half. How about one-third? Where is the power greatest? And so on. At a power surface, or a lens if it has power, the incident power on the lens changes. If you say the lens is assumed to be infinitely thin, then you say what comes out of it is changed. And you come back to U plus D is equal to V. That's the fundamental formula.

Hughes: That's the image of the rays at the lens.

Boeder: Yes. And when it comes to a point again, there's the optical image. And my gosh, if they cannot learn that in half an hour, there must be something wrong.

Hughes: Well, what did you do for the rest of the course?

Boeder: For problems, you go to two surfaces of the lens. First you say, there's no distance between the two surfaces. So call it infinitely

thin. The lens has a certain power. It has one diopter, two diopters, three diopters, half a diopter, anything you want. But it changes the incident rays to a pencil of rays, and that's image formation itself. You come from a point, an optic point; you end up on the other side of the lens again with a point, because all of the rays, we have assumed, will go and intersect at that point. But if they don't, if they are parallel, where do you think the image is? At infinity. So that lens has just canceled completely the incident power.

But when you say that lens has a minus power, and the rays come in, as you have assumed, from an optic point that was in front of the lens, then negative power is incident at the lens. If the lens now has minus power, then minus is added to the minus. And then where do you think the point that you call an image point is now? It's in front of the lens.

In this way, you can do a lot. That's elementary optics. Once you have understood that, you have understood a lot of optics. It's U plus D is equal to V. That is your equation. And we're not going to add much to that. It's always the same. Well, they got the point. I'd set up problems, distribute pages of examples to be worked for tomorrow. They could do it in no time, and they did it in no time. The introduction to optics couldn't be done simpler. I've long thought about that. U plus D is equal to V is your equation. If you know that equation, you know optics.

Then, finally, we come to mirrors. Now, when you think of a plane mirror, what happens? The mirror, if it has no power because it's a plane mirror, it can do only one thing—throw back rays. [laughs] There you have the beginning of the mirror. Then you go to the convex and the concave mirror, and so on, and see what they change. Now, convex and concave change the incoming rays in a different manner. It's easy if you know what they actually do with rays, coming parallel, let's say. If it is a mirror and it has a concave surface, what do you think would happen? They guessed right. Concave and convex mirrors, they easily took it. And that's a big step in optics.

Hughes: Why would mirrors be important in ophthalmology?

Boeder: Well, because every surface is a mirror as well as a power. The cornea is a surface. It is a mirror surface as well as a power surface.

Hughes: Because it's reflecting?

Boeder: Yes. It can give you reflected images.

Hughes: And the same with the lens?

Boeder: Yes. Everything.

Hughes: Well, then, do you have to figure in the reflection?

Boeder: You have to tell them what you have selected for the problem, because the cornea can do both. It can work as a mirror and can work as a power surface. You have to tell them that you want the cornea to be the power surface. If it's a power surface, then the power D is added to this U. And if it's a mirror, what happens? Then the rays do not get into the eye.

Hughes: They get reflected. But when an ophthalmologist is doing a refraction, need he take into account that—

Boeder: No, no. This is the beginning of optics, and it is the optics that he should know.

Hughes: But he doesn't have to apply the—

Boeder: No, no. He entirely has a different idea. He wants to see what is wrong with the whole system, and therefore he looks into the eye and finds out what he sees himself. And if he can improve that image for himself, then he has a certain clue to say something about the eye itself as a whole system. If he looked into the eye, and he told the patient, "Look straight ahead," then he has eliminated accommodation, and he uses the eye now as an unaccommodated system.

When you talk about accommodation, you have to define what that is. The eye can accommodate; it can change its power in one direction. If he accommodates, he adds plus power. If he does not accommodate at all, he adds no power. And so on. The whole thing is always the same thing. Rays of light, if understood that they come from the eye and the eye does not accommodate, then the rays will go through the eye in such a way as an unaccommodated eye will allow the rays to go through. Now, if the eye, not accommodating, changes the rays in such a way that the image point which corresponds to the optic point in the retina which is under investigation—let's say the center of the fovea—if the fovea has sent rays out of the eye in such a way that there is an image point in front of the eye, and the eye has not accommodated, well then the eye is a myopic eye. If the point is not in front of the eye but in back of the eye, then it's a hyperopic system. I think these simple optical facts, they are delightful.

Hughes: What was the major point you were trying to get over? This formula?

Boeder: That was the first two, three hours, pounding that formula—U plus D is equal to V. And many examples, so that they could do it in a dream. And it's always the same—object, power, image.

Hughes: As simple as that.

Boeder: It's as simple as that.

Hughes: What other major points were you trying to get across?

Boeder: Well, finally, you check the cornea all by itself, so that they know the cornea has a tremendous power. It is the most powerful surface in the human eye. It accounts, I don't know now for how much, but it's enormous. If you know the cornea, and have taught them that it has a power that cannot be changed—it's always the same—then you have understood the plus power of the cornea a little bit.

Then you go to the lens in the eye, and that has much less power, but it has something that is very valuable. It can be changed in power by the accommodation. Then you go, "Where's the accommodation? What happens under accommodation to the lens?" Those things we'd have to discuss, because it's actually that the surface of that lens becomes more flexed the more power you accommodate. I think optics is very simple if you introduce very simple initial problems.

Hughes: You were teaching basic optics.

Boeder: And how! [laughter]

Hughes: Do you think that students came to the course expecting more clinical emphasis rather than your strictly basic approach?

Boeder: They wanted to learn optics.

Hughes: Yes. So they knew beforehand that it wasn't going to be an applied approach.

Boeder: No. That's an entirely different field.

Hughes: So they knew what they were getting into?

Boeder: Well, yes. I made sure they knew that we were going to talk about elementary optics.

Hughes: How much variation did you experience from class to class in the response of the students?

Boeder: The response of the students is never homogeneous. There is always one guy that stands out, like Guyton. You know that he already knows everything that you have to say in the first of ten lessons. There are others that are lost and have to be helped. There are tremendous differences. But I have had very good students, and I was always satisfied with my classes, even in San Juan.

Hughes: Did you hand out any material to your students?

Boeder: Yes, I gave little booklets, let's say, three, four, five, eight—I don't know how many—stamped together for the optical course.

Hughes: I saw something by you at Iowa called "Review of fundamental mathematical operations." Was that one of the handouts?

Boeder: No. I may have given that out but not because I wanted to teach optics.

Hughes: It was nothing to do with optics?

Boeder: It could have been used as a part, but what you saw was something else. I could go into my office and find what I distributed at the beginning of the course.*

Hughes: Was it a summary of the lectures?

Boeder: It was always what I had talked about.

Hughes: And it was always the same?

Boeder: Always the same.

Hughes: Did you modify the course over the years in terms of its structure or content?

Boeder: Only in that I gradually gave them more. I was invited for a week, or for two weeks, or for three weeks, so the course couldn't be the same.

Hughes: And, of course, you were at Iowa four months a year.

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* "Notes on Visual Optics" by Paul Boeder, PhD. Dr. Kolder gave the interviewer a copy, which he described as having been used over the years in Dr. Boeder's optics courses. The copy is on deposit at the Foundation of the American Academy of Ophthalmology.

Boeder: Four months.

Hughes: So did the students at Iowa get more optics?

Boeder: Well, if I actually taught them three months, I certainly got more done. Optical problems always came up at rounds in the morning. Braley especially was interested, and I'd get it again and again.

Hughes: He would address questions to you?

Boeder: Yes. He even said, "Give us the goods, give us the goods."

Hughes: Give me an example of what sort of question he might ask of you.

Boeder: If there arose a problem on rounds, he said, "I'll let Paul give you the meat of the matter here." And I would try to give them the meat of the matter. That was Braley.

Hughes: But it was always strictly optics.

Boeder: Optics. I didn't talk about any other things.

Hughes: You didn't talk about binocular vision?

Boeder: Oh yes.

Hughes: You consider that part of optics?

Boeder: Oh yes, that's an important part of optics.

Hughes: Did your course have a laboratory component?

Boeder: Yes.

Hughes: What went on there?

Boeder: We had optical benches where students could actually execute these problems with lenses and with light.

Hughes: This was true wherever you gave the course?

Boeder: Oh yes.

Hughes: You insisted on it.

Boeder: Yes, if they gave me the time. I had benches in San Juan and in America.

Hughes: So you considered that the hands-on experience was important?

Boeder: Oh, I certainly did. And it's enjoyable for the class to see that [what I had said could be demonstrated].

Everything worked out; it was actually true [what I had said].

Hughes: I imagine they liked that.

Boeder: Oh, sure they did. I insisted on benches when the course was big. At Harvard we had benches, of course, and at San Juan we had benches. The Lancaster course has benches.

Hughes: Were you able to have benches at the shorter courses?

Boeder: Well, if I came just for a week, let's say, to Tulane, they didn't have those things. Then I'd have to stick to the blackboard.

Hughes: As a result, did you feel the students at the end had not quite as secure a grasp of optics?

Boeder: Well, if you have the actual demonstrations and practical problems, that's very helpful. If that is not done, what you have to show them at the blackboard has certain limitations.

Hughes: Let's now talk about where you gave these courses. We talked some about Lancaster. What came next? Was it the courses at the Academy?

Boeder: Oh, my courses at the Academy were independent of my real interest. They were given as special courses. I gave usually two courses at the Academy. One was on aniseikonia, and the other was a practical introduction to optics—something like that.

Hughes: These were much shorter courses?

Boeder: Well, they were only hours.

Hughes: You gave those courses—well, I guess not the aniseikonia—

Boeder: With slides.

Hughes: . . . for something like twenty-five years, didn't you?

Boeder: I don't know how long I was at the Academy with courses, because there came a time when I no longer gave any courses.

Hughes: I have down that you taught at the Academy from 1942 to 1967.

Boeder: Well, that's a long time.

Hughes: That is twenty-five years.

Boeder: At that time, we always got a luncheon. The whole gang that taught had a lunch.

Hughes: Who was first to set up your teaching at the Academy?

Boeder: Lancaster. I think I owe also my honorary membership to the Academy to Lancaster.

Hughes: Speaking of Lancaster, in 1948, just two years after the first Lancaster course, he organized a course in orthoptics, in cooperation with the American Orthoptic Council.

Boeder: I had nothing to do with that.

Hughes: Was that perhaps because of his daughter?

Boeder: Perhaps it was because of his sidekick at that time, our friend Hermann Burian.

Hughes: Why do you say that Burian was a sidekick of Lancaster?

Boeder: In Boston, they had offices on the same floor.

Hughes: I didn't know there was any particular association between the two.

Boeder: Oh yes, it was strong. Lancaster thought a lot of Hermann; he thought of him as an authority.

Hughes: Was that the reason that Burian was invited to teach in the Lancaster course?

Boeder: Oh yes.

Hughes: What did he teach?

Boeder: Motility.

Hughes: How did it come about that you began to teach optics at Harvard?

Boeder: It came about because they wanted the same that I gave at the Lancaster course.

Hughes: Do you remember who it was that invited you?

Boeder: I can't remember his name at the moment, but he was in charge of the Lancaster course for a while.*

Hughes: I want to hear about the other courses that you taught. The institutions that I know about, and there may have been others, are Yale, Columbia, Penn, New York University, Ohio State, Indiana, Tulane, University of California in San Francisco, Emory, Iowa, and the College of Augusta.

Boeder: [Malcolm N.] Luxenberg invited me to Augusta. I had Luxenberg as a student somewhere; it may have been Iowa.

Hughes: He's a great admirer of yours.

Boeder: Yes, he's really a nice guy.

Hughes: Well, is there anything to be said about these various courses?

Boeder: All the same.

Hughes: Was there any place that you particularly enjoyed teaching?

Boeder: There were many. I liked Harvard, sure. I liked Augusta. I was invited to Augusta because it was at the time of my birthday, so I've had very many birthdays celebrated in Augusta.

Luxenberg wondered whether I would come to Augusta. I said, "I'll come to Augusta under certain conditions. Number one, I want to see the Augusta golf course. Secondly, I want to come at a time when the blooms are out. And he said, "Granted! All's arranged." So I came.

Hughes: Did you try to play golf wherever you went to teach?

Boeder: No. I was interested in golf because Augusta is where they have the Masters [Tournament].

Hughes: So you didn't play. You just wanted to see the Masters.

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* Parker Heath directed the course from 1950 through 1965. He was succeeded by Henry F. Allen, and then in 1991 by Frederick Jacobiec. (Flyer on the Lancaster course, courtesy of Robert E. Bannon.)

Boeder: I didn't play at all. But I was the luckiest; I had a picture taken with Jack Nicklaus.

Hughes: How did the Puerto Rico course arise?

Boeder: Oh, that was arranged by Braley. He went to Washington, DC very often, and somebody asked there, "Can you get Boeder in that course?" Al said to me, "Do you want to go to San Juan? They want you there." It was Al that arranged it.

Hughes: That became a very popular course, didn't it?

Boeder: Oh yes, I liked it very much. I liked the whole gang.

That reminds me, in the Stanford course we had a lot of Canadians.

Hughes: Why did they come to that course particularly?

Boeder: Well, because it was close.

Hughes: Oh, the Canadians on the West Coast.

Boeder: Yes.

Hughes: Did you have Canadians at Colby?

Boeder: Oh yes. We had 150 students at Colby.

Hughes: A big class! Was that a disadvantage in teaching optics?

Boeder: No.

Hughes: Were you ever nervous before starting a course?

Boeder: Once I was nervous and that was when Lancaster had called me the night before.

Hughes: I don't blame you. That was the only time you were nervous?

Boeder: Yes. I was really nervous then. When I saw Dr. Igersheimer there, I said [to myself], "Get out, get out. What do you want here?" But it all went well. The students were appreciative.

*Hughes: Dr. Kolder told me that the basic science course in ophthalmology in Puerto Rico was taught in English and then translated into Spanish.**

Boeder: Yes.

Hughes: He felt this was an advantage, because the students could usually understand some of the English, so they virtually got the course twice.

Boeder: Yes, I told him that. I could understand enough of what the translator would say in Spanish, that I could correct him. Well, that's easy, of course; I knew what he should have said because I knew what I had said. And the class was always so tickled, you know. [laughter]

Hughes: When did you start taking Spanish?

Boeder: When I was in San Juan, I got interested. Here's my book.

Hughes: I noticed, yes. How fluent are you?

Boeder: I'm actually a fluent reader, but a fluent speaker, no.

Hughes: Well, you would be if you put yourself in the circumstances.

Boeder: I hear Spanish every Sunday and I'm amazed how little I understand. That is not true for my reading. I have read all ten books of [José] Ortega y Gasset. And do you know why?

Hughes: No.

Boeder: Because I learned more Spanish from him than from anybody else. Ortega y Gasset had an absolutely perfect knowledge of Spanish. Of course, he was a professor at twenty-two years old, in Madrid. He was a genius. I like Spanish so much because I read Ortega y Gasset. It is such a wonderful ability that he shows in Spanish.

Hughes: Did you discover him yourself?

Boeder: Yes, and I have the books there. I've read every one of them. I'm even tempted to read all those books again because Ortega y Gasset is my big hero. I love his Spanish.

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* Kolder interview, January 19, 1989.

Hughes: Well, you taught optics at Iowa, and you also had a refraction clinic?

Boeder: No, never.

Hughes: I heard, and I can't tell you the source now, that you taught the principles of refraction.

Boeder: Well, that may be true that I taught the principles of refraction, but I had no clinic where I did refractions for students. I had read so much, and I also wrote on the instruments that were used. I wrote a paper on the binocular ophthalmoscope.

Hughes: Is it difficult to use?

Boeder: Well, if you know the principles, you can do better. I got a wonderful little compliment from Mel Rubin. Mel Rubin wrote also on the optics of the indirect ophthalmoscope.*

Hughes: [reading inscription on Rubin's paper] "Paul, without you there would be nothing! With utmost respect and admiration, Mel."

Do you think you're responsible for Dr. Rubin's interest in optics?

Boeder: No, no, I tell you, he was an unusual student. He was good.

Hughes: He also, as you doubtless know, was an optometrist.

Boeder: Yes, sure, I know that.

Hughes: How was your time structured in terms of teaching when you were at Iowa?

Boeder: I traveled out of Iowa to the various medical schools that had invited me.

Hughes: Weren't you gone more than you were at Iowa?

Boeder: I was gone a lot from Iowa.

Hughes: How did the time go when you were at Iowa to teach the residents?

Boeder: Oh, there was enough time left for Iowa.

Hughes: Were there certain times in the year when the department knew you were around and could schedule the residents for teaching?

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* Rubin ML. The optics of indirect ophthalmoscopy. *Surv Ophthalmol* 1964; 9:449.

Boeder: I scheduled it myself.

Hughes: Was it always at the same time of year?

Boeder: No.

Hughes: It depended on what your other obligations were?

Boeder: Yes. I was away from Iowa a lot. The total freedom that my friend Braley gave me, I always was thankful for that.

Hughes: Wasn't that a condition of your coming?

Boeder: No. He left me alone completely, and I felt that I didn't offend him. That was a wonderful thing.

Hughes: Of course, he doubtless recognized that you were very good for the department.

Boeder: Actually, he contributed to the volume of my teachings. He sent me to San Juan.

Hughes: Did he have anything to do with the other teaching appointments?

Boeder: Well, I don't know exactly, but I know only that I wouldn't have gone to San Juan by myself.

Hughes: Your most recent teaching assignment has been at Eastern Virginia Medical School, which you only last year [1988] gave up. How did that appointment originally arise?

Boeder: Well, I can tell you that in a few words. I had a student in Atlanta by the name of [William T.] Humphrey, and he became head of the department at the Eastern Virginia Medical School here. When he knew that I was in Norfolk, he said, "How about it?" Well, I couldn't say no to him.

Hughes: You began to teach there in 1980.

Boeder: I gave up in 1988. I actually said, "I'm through."

Hughes: Had you finished the course?

Boeder: Oh yes. I didn't want to go on another year. Then the residents called me up; they wanted me to come back. I said, "You'd better talk to the boss." I had an arrangement with the boss.

Hughes: How many physicians do you suppose you taught over the years?

Boeder: Well, I can only make an estimate, but my estimate comes to about 9,000. You see, we had 150 every year at the Lancaster course. And when you consider all the institutions where I was invited, it comes to over many thousands. That will never be done again. Never.

Hughes: What is your feeling, now that your teaching seems to have stopped, about the future of optics in this country?

Boeder: The work that I did will never be done again because it was so unusual that I had the time to do it. No man, I don't think, will ever do that again. Too much.

Hughes: Do you think you inspired interest in optics?

Boeder: Oh yes, I inspired interest. I received invitations from many medical schools that must have heard from others what I was doing.

IV. MISCELLANEOUS TOPICS

Papers

Image Formation in the Eye

Hughes: *Paul, the first paper of which I have a copy is "Image Formation in the Eye," which you published in 1944.* You were at American Optical, of course.*

Boeder: Gee, that's an old thing.

Hughes: *I think Bob Bannon sent me that.*

Boeder: He shouldn't have done it.

Hughes: *Why do you say that?*

Boeder: Well, it's almost ancient history, demonstrating the lily-shaped caustic.

Hughes: *I am interested in the opening statement:*

*"In his de Schweinitz Lecture,** Dr. Walter B. Lancaster revives the challenge contained in Gullstrand's classic work on the image formation in the eye. This challenge represents a criticism of such elementary concepts as focal points, paraxial (collinear) imagery, and the conoid of Sturm, which Gullstrand pronounces as 'fundamentally false' when applied to the eye."*

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* *American Optical Vision* 1944; 28:4.

** *Arch Ophthalmol* 1943; 30:167.

Why did you open with that comment?

Boeder: I have no idea what I did in March 1944. I must have been crazy. [laughter]

Hughes: I doubt that.

Boeder: Do you know what the year is now? It's 1989.

Hughes: I know. That was some time ago.

Do you care to comment on that paper in any way?

Boeder: I don't know yet. I have to study this first. [laughs] You see, I made, at that time, some wooden models of caustic surfaces. I wonder what happened to them.

Hughes: You probably left them at American Optical, didn't you?

Boeder: No.

Hughes: What is the model pictured in the paper demonstrating?

Boeder: The image formation of the eye. It's interesting, but nobody wants that now.

Hughes: Why do you say that?

Boeder: Well, because Gullstrand has been dead for a long time. Now Walter B. Lancaster is also dead. They're all dead. [skimming paper] My, I was young in 1944.

Hughes: You were forty-two.

Boeder: I still had some hair. I don't even remember having ever seen this paper.

Hughes: It appeared in Vision, *which was a publication of American Optical. Who received that magazine?*

Boeder: Every good customer. Gosh, I don't ever believe that I could annoy people to that extent.

Hughes: What do you mean?

Boeder: Who wants to get into this mess!

Hughes: Do you think the paper was something that you dreamed up, or were you asked to write it?

Boeder: I don't know how I got the phony idea that people ought to know something about image formation in the eye. I suppose I had to justify my existence at American Optical Company.

[continuing to read paper] This is interesting. But to whom? To me, it's interesting.

Hughes: You don't think it would be to others?

Boeder: No. Maybe 1 out of 20,000.

Spectacle Correction of Aphakia

Hughes: Well, what about this paper "Spectacle Correction of Aphakia," published in 1962? I've got that as well.*

Boeder: [laughs] You poor soul. Well, you can see how straightforward that is. And the lenses are already out, because it's aphakia.

Hughes: Were ophthalmologists aware of the need for exact placement of cataract lenses in front of an aphakic eye?

Boeder: Well, if they were not, they certainly should have been because every millimeter counts.

Hughes: It was also important, apparently, to center the lenses in respect to the visual axes. You state that as well in the paper.

Boeder: Sure, it was all correct.

Hughes: You must have suspected that ophthalmologists weren't universally doing this or you wouldn't have bothered to write the paper.

Boeder: That's a kind assumption. [laughter]

Hughes: Are the intraocular lens and the contact lens solutions to the problem of vision distortion in aphakia?

Boeder: The intraocular lens should be very good.

Hughes: And the contact lens?

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* *Arch Ophthalmol* 1962; 68:870.

Boeder: Not necessarily.

Hughes: Paul, is there anything more you want to say about spectacle correction of aphakia?

Boeder: No.

Anomalous Retinal Correspondence and the Response Shift

*Hughes: Well, I think you will want to say something about anomalous retinal correspondence and the paper you wrote refuting it.**

Boeder: There is no such thing as anomalous retinal correspondence.

Hughes: Please tell me why you believe that.

Boeder: Well, the response shift occurs when a certain element in the retina is stimulated by the image of an objective point out in space. But the response that is elicited happens at a distance from that particular stimulated element.

Hughes: How did you know that?

Boeder: Well, I can only tell you in a simple version of formulation what is meant. The response shift occurs when the response for a stimulation of one element of the retina is happening at a distance from that element.

Hughes: But why should that be?

Boeder: I don't know. It's a phenomenon.

Hughes: Why was the response shift controversial if you think it's so obvious?

Boeder: Well, it was not controversial. You can only demonstrate that what is actually happening wouldn't happen without it. Suddenly, the squinting eye has some useful vision. That can only happen if the response to a stimulation is at a certain distance from the stimulation.

Hughes: It was because of the response shift that you rejected anomalous retinal correspondence?

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* Anomalous retinal correspondence refuted. *Am J Ophthalmol* 1964; 58:366. See appendix.

Boeder: I simply said anomalous retinal correspondence doesn't exist, because even the squinter has useful vision because of a response shift.

Hughes: But so many ophthalmologists seem to have been wedded to the idea of anomalous retinal correspondence.

Boeder: Yes, well, ask them what they mean by anomalous retinal correspondence.

Hughes: But you were saying, from the little I understand, that this was a natural response.

Boeder: Well, it's not a natural response. It is something very unusual. It is a response shift. It's not a normal thing; it's a response shift that happens in cases where it becomes very necessary to lead to some normal vision.

Hughes: But is it not true that anomalous retinal correspondence was believed to be an adaption that was learned only with time, whereas the response shift was an almost immediate adaption?

Boeder: A response shift too takes time to develop. This is explained in the paper.*

Hughes: Could you spell out why the theory of the response shift was revolutionary? I mean, it was in contrast to existing theory.

Boeder: Well, the existing theory was not at all clear. Anomalous retinal correspondence was a term that was never well defined to the satisfaction of anyone. It could not be described clearly. Normal retinal correspondences meet between the two retinas—this is a normal correspondence.

Hughes: But you were not looking upon the response shift as an abnormal response, were you?

Boeder: No. The response shift was necessary for vision.

Hughes: It was using normal retinal correspondence, not anomalous.

Boeder: The fact is that there's only normal retinal correspondence.

Hughes: Is there a way of substantiating the response shift in a clinical setting?

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* Boeder P. The 'response shift.' *Doc Ophthalmol* 1967; 23:88.

Boeder: Yes, only with resulting useful vision that a squinter has.

Hughes: Yes, but that probably would not satisfy somebody who espoused anomalous retinal correspondence. I think an ophthalmologist would want substantiation before he rejected the existing theory and adopted your theory.

Boeder: Well, the theory of anomalous retinal correspondence is nowhere defined.

Hughes: Is there any research that could be done in patients that would definitively demonstrate the response shift?

Boeder: Oh, I think the response shift makes it possible for a squinting eye to produce a good visual effect. I don't think you can go further than that.

Hughes: Were there ophthalmologists who understood and went along with your theory?

Boeder: I really don't have a theory. I used the response shift to make plausible the vision resulting in the squinter.

Hughes: But nobody else had come up with that theory before you. And that was your contribution.

Boeder: Well, maybe a contribution; I don't claim much.

Hughes: You described a phenomenon that no one else previous to you had described.

Boeder: Yes, because I found it very handy to have the response shift as an explanation of normal vision in the squinter.

*Hughes: Well, one thing some ophthalmologists apparently thought was wrong was that the response shift wasn't clinically substantiated.**

Boeder: Of course, that's what they can say with tremendous force, because they were clinical ophthalmologists and I wasn't. I have to look at the book and see what Gunter said.

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* Von Noorden GK. *Burian-Von Noorden's Binocular Vision and Ocular Motility*, ed 3. St. Louis: CV Mosby, 1985, p. 256.

Hughes: Let me ask you about the paper on the response shift which was written in German. The content is roughly the same. Did you add anything new?*

Boeder: No.

Single Binocular Vision in Strabismus

[Interview 5: March 23, 1989, Dr. Boeder's Apartment, Norfolk, Virginia]

*Hughes: I found another paper related to the response shift, called "Single Binocular Vision in Strabismus,"** Could you tell me how this paper supported your theory of the response shift?*

Boeder: Well, things happened that were explained by introducing what was called anomalous retinal correspondence. And I said, "No. It's a response shift." Then I showed in detail how the squinter has single binocular vision because of the response shift. So the response shift was very important to me at the time.

In my resumé there, I state that single binocular vision in concomitant strabismus is analyzed under the hypothesis—*hypothesis*, you see; I'm careful always. I say, "under the hypothesis"; I didn't say the response shift is a reality. This is achieved with response shift in the deviating eye. Normal retinal correspondence is always inviolate, you might say. The regularly occurring suppression areas were retinal scotomas. And the resulting division of the binocular field between the fixating eye and the deviating eye are shown to be direct consequences of the response shift.

These well-known facts of squint vision, therefore, constitute the most powerful additional evidence in support of the existence of a response shift. Abnormal retinal correspondence, which I never touched, I mean, that was normal retinal correspondence in concomitant strabismus.

Hughes: Why had previous thinkers thought it necessary to postulate anomalous retinal correspondence?

Boeder: They couldn't possibly accept anomalous retinal correspondence as normal, because they didn't have the response shift. The response shift became to me, demonstrably, the possibility to

* Boeder P, Burde RM. Die Verschiebuhg der Sehrichtungsantwort. *Jahreskurse für die Praktische Augenheilkunde* 1980; 6:37.

** *Am J Ophthalmol* 1966; 61:78.

explain what happens in vision with a deviant eye. And that's pretty good, to have a hypothesis that makes analysis possible.

Hughes: It sounds to me, from what you said yesterday, as though anomalous retinal correspondence was almost a wastebasket. It was a concept that nobody could really define.

Boeder: A definition of anomalous retinal correspondence was never given. You can only define it as a deviation from the normal situation. And when you want to explain it, then you take the hypothesis there must be a response shift. Now, it's very difficult, I think, for anyone—that's why it was never done—to make plain what anomalous retinal correspondence is. Well, you could say that that's when binocular vision occurs with the squinting eye. If you want to analyze it further and make it plain, then you have to introduce the hypothesis there must be a response shift. But you can't explain it.

Hughes: Is this a problem that Bielschowsky addressed?

Boeder: No. Bielschowsky was an analyzer of vision when he had a patient in front of him. He was an expert in what kind of phenomenon occurred.

Hughes: Don't you think it is relevant that you are a mathematician and the other people that had considered this problem of the response shift were ophthalmologists, and consequently they didn't have the mathematical training you have?

Boeder: That is, in a sense, true. That is the underlying reason, because these people knew a lot that I didn't, but when I wanted to make an analysis, I had knowledge that they didn't have.

I have a profound esteem for the man [Bielschowsky] with whom I took walks in Hanover. He had my admiration, but I knew, in this contact with him, that he had his limitations. That doesn't subtract from his prominence and his ability to make contributions.

Hughes: The response shift was a hypothesis that could not be arrived at by just looking at patients. And that's what these ophthalmologists were doing.

Boeder: That's a very good observation. They couldn't, because they didn't go into the details that I did, to finally explain it so that it satisfied me. I found I could do that only if something happened *komisch*, something extraordinary, and that was the response shift.

Hughes: And yet there are clinical experiments that could be done to verify the response shift, which had not been done. Is that not the case?

Boeder: The clinician can only ask the patient what he can and cannot see and where he can see it. This information must then be analyzed and coherently described. Then you need something that you didn't have before—the response shift.

Harms did not theoretically arrive at the places where the retina is blind, that is, those scotomas. But he found them and measured them. He did much more than I could possibly do. He actually had a series of squinters that he studied, all on a practical basis. He investigated what happens. He came to find one scotoma; I call it the Harms' scotoma. He was the one who found it, measured it, and so on. Always in the same place. So just through observation, he came to those conclusions, because he had many patients. He was wondering why there always was one spot in the retina that was blind. That was a tremendous contribution. He was a very good man. [Gunter] Mackensen and the whole Tübingen department were outstanding, but from the clinical point of view.

I arrived at that in a different way, through analysis. I had to have a response shift, and with it I could explain that there must be two blind spots. And I did more than that. I investigated theoretically the whole vision along the retina. Harms said, "We knew all that." That's true. They had observed it practically in many patients. I would never say that I had done that. Mine was simply an analysis for which I needed the response shift to explain what happens. So I had my fun, and they had their fun, but we were talking about the same thing. They never were antagonistic, Harms and Mackensen.

Harms and Mackensen were, in a sense, glad that what they had found experimentally could stand some analytical investigation. If you investigated analytically, you came to the same observation. That strengthened their observations, and they didn't object to it at all.

Neutralization at Infinity in Streak Retinoscopy

Hughes: Shall we talk about neutralization at infinity?

Boeder: I wrote that paper with Kolder.* He took the clinical side. I think it's not an insignificant paper. Ophthalmologists took the investigations of patients' eyes from a point that was not well

* Boeder P, Kolder HE. Neutralization at infinity in streak retinoscopy. *Arch Ophthalmol* 1984; 102:1396.

chosen. And I said, "Why don't you make it infinity? Then you don't have to make adjustments." That was essentially it.

Hughes: Why had streak retinoscopy traditionally not been done at infinity?

Boeder: Because it had not been analyzed. Ophthalmologists did the right thing every time. But it was not necessary to do more work.

Hughes: Their method was unnecessarily complicated.

Boeder: Yes. Therefore, why don't you go to infinity, and you don't have to calculate at all.

Hughes: Why did you choose this problem?

Boeder: I started out with an analysis of what they were doing. It became evident to me very fast that they had the light point at the wrong place. A much better place was at infinity. And that's why I wrote that paper. My friend Kolder tried it out and said, "That's fine." There was no change in the approach to retinoscopy. But when they were through, they had to make a calculation, subtract something from their findings. That was unnecessary with the point at infinity.

Hughes: Do ophthalmologists now do streak retinoscopy at infinity?

Boeder: I don't know. They don't look at those papers. They don't like to read those dumb papers that were written by people who had not the slightest idea. [laughs] Well, that's life, you know.

Hughes: Kolder became coauthor because he was a friend of yours and had listened to you talking about this problem?

Boeder: Yes, and he understood what I had done, and he agreed to it, and he tried it out, and it worked. So he took the clinical part. And I think it was wonderful that he did because it gave the paper a tremendous boost.

Hughes: Are there any drawbacks to using neutralization at infinity?

Boeder: No, only advantages. Ophthalmologists had the light come from a distance for which they didn't want to correct. Why infinity? Why do I say that? I actually mean distance. What they do in retinoscopy, they investigate the vision of a man who must be able to see at a distance. You don't go to an ophthalmologist and say, "I want to see somewhere." You say, "I want an eye

examination." He will find out first how do you see at a distance, six meters. So he wants to have a correction at a distance.

Now, I said infinity. That's perhaps confusing to some, because infinity, that's just a distance; six meters is infinity. When they have the instrumentation, their retinoscope in particular, at a distance of, let us say, this far from the eye, and at a point in the instrument itself where they really are not interested in what the vision is, because they want at infinity at that distance, then I say why not immediately have the finding at a distance? Then you don't have to subtract anything.

When they have it at half a meter, then they have corrected for half a meter. But what they really want is for six meters. Therefore, they have to go from half a meter to six meters or infinity. And that means that the findings must be corrected by a subtraction of minus two. Why do that?

But ophthalmologists are doing streak retinoscopy today exactly as they did before. They haven't changed things. That paper didn't change it.

Cooperative Action of Extraocular Muscles

Hughes: Was Bielschowsky responsible for your interest in ocular motility?

Boeder: No. For me, ocular motility is a word.

Hughes: Really? I thought that you worked on the extraocular muscles at Iowa.

Boeder: Well, I analyzed the possible movements of the eye and which muscles contribute to that.

Hughes: Isn't that ocular motility?

Boeder: Well, that is ocular motility, but that is an analytical job which I had put into pictures, and which were very and are still very appreciated by everyone who's interested in motility. I told them with graphs exactly what this muscle did and what that muscle did.

Hughes: How did you make your determinations?

Boeder: I don't know anymore. Sometimes I go over work and I say, "My gosh, I was smart at that time." [laughter]

Hughes: The work was done from a theoretical standpoint?

Boeder: Oh yes, and it was correct. It was so logical. They had never seen drawings like that that made it so plain what happened. I think it's especially the paper that I had published in Britain.* That paper was very well received.

Hughes: Did you have to study the eye in order to do this work? Or was it strictly mathematical?

Boeder: I would say it was theoretical. It had nothing to do with actual measurements. But the analysis was correct. I knew where the muscles were inserted at the eye and where they were on the other end.

Hughes: How did you get that information?

Boeder: That is from a publication by a very good man, a German, [Alfred Wilhelm] Volkmann. He gave me what I call the basis for my calculations.

Hughes: How did you know of his work?

Boeder: I don't know anymore how I knew it, but I knew that it was one of the best papers written on the subject.

Hughes: Was his paper the inspiration to take the work further?

Boeder: Yes. I had all the means that I needed to make an analysis. [scans paper] Now these drawings were very important.

Hughes: Tell me why.

Boeder: Well, you see, this is a field that goes from minus thirty degrees to plus thirty degrees. [points to graphs] Then for every muscle, the medial rectus in this case, I calculated what it could possibly do and put it down in a graph. I did that for every eye muscle, and that was a revelation.

Hughes: This work had practical significance, then?

Boeder: For ophthalmologists, yes! Tremendous significance. They knew what the muscle can do and cannot do. That's graphically indicated here, what the muscle can do and not do. See, there are six muscles—superior oblique, inferior oblique, and medial rectus. And here are the lateral rectus, superior rectus, and inferior rectus, the whole on one page. Duke-Elder accepted this paper for publication.

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* Boeder P. Co-operative action of extra-ocular muscles. *Br J Ophthalmol* 1962; 46:397.

The British considered what came out of the United States as secondary.

Hughes: But Duke-Elder himself recognized the paper's importance.

Boeder: Yes.

Hughes: The analyses you made on the extraocular muscles, as I understand them, produced a different interpretation of their action from the accepted dogma.

Boeder: They didn't have much of a dogma. That's a very important analysis. I had no trouble at all sending the results to Duke-Elder, and immediately it was published.

Hughes: [David A.] Robinson has a theory on the contribution of the extraocular muscles. How does it differ from yours?

Boeder: I don't know, but I know I didn't do anything wrong. Well, I know it's correct, and I know that Duke-Elder wouldn't have accepted the drawings if they hadn't been instructive.

Hughes: The drawings that you refer to are actually graphs, aren't they?

Boeder: They are graphs, but for every muscle. Every muscle was analyzed.

Hughes: Dr. von Noorden made a comment in his book on binocular vision: "From his graphs, Boeder reached some important and original conclusions about the cooperation of the muscles of the two eyes." And then he goes on to reiterate what you had found about the abducting and adducting action of the various extraocular muscles.*

Boeder: He was very much impressed about that. [laughs]

*Hughes: Yes, and he concludes by saying, "Boeder's theory is supported by several clinical observations."***

Boeder: Good for him. That could not have been written in the lifetime of Hermann. [laughing] He wouldn't have allowed it.

Hughes: Had there been a previous theory?

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* Von Noorden GK. *Burian-Von Noorden's Binocular Vision and Ocular Motility*, ed 3. St Louis: CV Mosby, 1985, p. 59.

** Ibid, p. 61.

Boeder: No. I'm really a little bit satisfied with that analysis. They had previously only vague ideas of what the muscles would do. Those drawings are unique in the history of ophthalmology. And they are good. There's no doubt about it. Nobody had done it before.

Hughes: Have those findings been applied clinically?

Boeder: I don't know. Ophthalmologists don't read those things, and they have very little possibility to understand anything like that.

Hughes: Because it's mathematically based?

Boeder: Well, a drawing like that, they're just nonplussed. They do not really spend some time to learn something that's right in front of them. They get scared when they see those things. I cannot belittle those drawings. I think they are very important to these men. But they have to look at them once in a while. I know that was good work.

Hughes: Did you ever have trouble getting a paper published in a journal?

Boeder: No, they never rejected anything or even postponed anything.

The Retina Foundation

Charles L. Schepens

*Hughes: The next subject is the Retina Foundation.**

Boeder: I was president [of the board of trustees] of the Retina Foundation for twelve years.

Hughes: I know you were, and I want to know why.

Boeder: Because I was in the American Optical Company, and the man who wanted to have me close was Schepens, because for him that meant more money from the company. It was nothing else.

Hughes: Did he make that very clear?

Boeder: No, but it was very clear to me.

Hughes: How had you met Schepens?

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* For Dr. David G. Cogan's views on the Retina Foundation and the development of the indirect ophthalmoscope, see the oral history on David G. Cogan in this series.

Boeder: Well, it must have been in Boston.

Hughes: Somebody told me that you were somehow involved in bringing Schepens to this country. Is that true?

Boeder: No.

Hughes: You didn't know him right after the war?

Boeder: Well, I may have known him right after the war, but I don't remember that I did anything in getting him over here. I got him only into the American Optical Company, in a certain relationship, but no more.

Hughes: Why was American Optical interested in supporting Schepens?

Boeder: Because I was so convinced that he could help us in the planning of ophthalmological instrumentation.

Hughes: For use specifically in retinal operations?

Boeder: No. All [kinds of instrumentation].

The Binocular Indirect Ophthalmoscope

Hughes: You recognized his engineering talent?

Boeder: Well, I thought he must have had it when he had that binocular indirect ophthalmoscope. But then I found out he knew people from England. It was not his idea.

Hughes: The common story is that he invented the indirect ophthalmoscope.

Boeder: He learned indirect ophthalmoscopy in London. And they gave him an instrument. No, he did not invent it.

Hughes: Was he the one that introduced the instrument to the United States?

Boeder: Yes, and to the American Optical Company.

Hughes: Did American Optical make an indirect ophthalmoscope?

Boeder: Yes.

Hughes: And Bausch & Lomb as well?

Boeder: No, I don't think they bothered.

Hughes: That was quite a source of income for American Optical, was it not?

Boeder: No. Well, it's true they had an instrument that Bausch & Lomb didn't have, but it didn't tip the financial scale one way or the other.

Hughes: What kind of an impact did indirect ophthalmoscopy make on ophthalmology?

Boeder: A good impact. It was an instrument that, sure, it came out of England, but it was something American ophthalmologists didn't have here. It had certain properties that they learned now to use for the first time. So it was a good deal for America and American Optical Company.

Hughes: It was a good deal for American ophthalmology in the sense that much more of the inner eye was visible?

Boeder: Right. It was a good thing, and a new method was introduced with the instrument.

Hughes: It was fairly complicated to use, however.

Boeder: It took a while to make it very useful to ophthalmologists because they didn't have a thing like that before.

Hughes: Were you aware of resistance?

Boeder: No, I wasn't.

Hughes: What was Lancaster's opinion of indirect ophthalmoscopy?

Boeder: No opinion. He didn't use it.

Hughes: Well, that was true of quite a number of the old guard, wasn't it? Didn't they feel that they were doing well enough with direct ophthalmoscopy?*

Boeder: Precisely. Precisely.

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* On the subject of direct and indirect ophthalmoscopy, see: *Dohrmann Kaspar Pischel, MD: American Links With Germanic Ophthalmology. Retinal Detachment Surgery, San Francisco.* Ophthalmology Oral History Series, A Link With Our Past. Interviews conducted by Sally Smith Hughes, PhD. The Foundation of the American Academy of Ophthalmology, San Francisco, and The Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 1987.

Hughes: But that wasn't quite true, was it?

Boeder: No, it wasn't quite true. They were satisfied, and when a man is satisfied, you can't sell him something new.

Hughes: So was it a matter of teaching the younger generation?

Boeder: Yes. The old-timers, they're hard to sell.

Hughes: Did you yourself have to be familiar with the indirect ophthalmoscope?

Boeder: I was familiar with it, and I could demonstrate, and so on, but since I had no clinical experience at large, I was just an outsider—always.

Hughes: Am I right in thinking that the indirect ophthalmoscope was essential to some of the surgical techniques that Schepens developed for repair of the retina?

Boeder: Well, they saw more than they did before, and in that sense it was something they should have.

Hughes: Was it Moorfield's that developed the indirect ophthalmoscope?

Boeder: Yes. How did you know about Moorfield's?

Hughes: I just guessed.

Boeder: *Du bist gebildet.* [You are knowledgeable.]

Hughes: Well, it's a major name in British ophthalmology. You don't have to be too intelligent to think of it.

Boeder: You have to be informed. Impresses me.

Hughes: It was somebody at Moorfield's then that had developed the indirect ophthalmoscope.

Boeder: Who exactly, I don't know.

Chairman of the Board, 1950–1962

Hughes: Let's get back to the board of trustees of the Retina Foundation. What exactly were your responsibilities as chairman of the board?

Boeder: We had meetings, and a certain agenda had to be made for such meetings. As president, I had to make that. Then I had to lead the discussion.

Hughes: What sorts of issues were you considering?

Boeder: The meetings, you mean, what were they all about?

Hughes: Yes.

Boeder: We met, of course, because we wanted to discuss certain things, but I don't know anymore. I had the chairmanship there because I was the president. Schepens was the man who really was the motor for that organization. I said, "Well, listen, I don't want to be too much associated with this, because I feel out of place. Don't make me a treasurer, whatever you do." Schepens was in the act of getting the Retina Foundation together under a name.

I said, "Don't make me a treasurer, I have to tell you that."

Hughes: Why didn't you want to be treasurer?

Boeder: Because I didn't want to get into any finances for that organization. Schepens said, "No, you are not going to be treasurer. You are going to be president. The president has nothing to do with this financial bit."

Hughes: Do you remember who else was on the board?

Boeder: I only remember the faces but not the names. I'm sorry. Schepens, of course.

Hughes: Were they ophthalmologists?

Boeder: No, they were friends of Schepens and the people that did a lot for the Boston interests in ophthalmology and other interests they had. They were people that were able to talk to rich people and get money for anything they wanted.

Hughes: Would you say that Schepens was interested in having them on the board because of their financial connections?

Boeder: Always.

Hughes: Well, he was very successful.

Boeder: I should say. Schepens got what he wanted.

Hughes: How aware were you of what he was doing in retinal surgery in this period? You were chairman from 1950 to 1962.

Boeder: Well, he had a surgical practice. And he had a lot of money coming in. He didn't hesitate a moment to ask for a thousand dollars for an operation. My own doctor in Southbridge said, "I saw Schepens. My word, I had to pay $1,000!" He couldn't believe it.

Hughes: Did you know about his surgical innovations?

Boeder: Yes, he introduced the scleral buckling procedure. But he had learned those things in London.

Hughes: Was there controversy about Dr. Schepens' innovations in retinal surgery?

Boeder: No.

Hughes: People accepted them?

Boeder: Oh, yes. He didn't even want to join the American Academy of Ophthalmology.

Hughes: Why was that?

Boeder: I don't know. I said, "You cannot live here [in the United States] without that membership. You have to go to the annual meetings, and so on." "No," he said. "No." Well, finally he did.

Hughes: What is he like as a personality?

Boeder: Smoothie. He wants to please. That's his approach to people. Usually, he does. He's a nice-looking ophthalmologist, and he has the gift of gab. So in most cases, he's successful in what he really wants to accomplish.

Hughes: And what does he really want to accomplish?

Boeder: To be appreciated, to make a mark.

Hughes: In the period when you were chairman of the board, can you remember any important issues that came up?

Boeder: No.

Hughes: What was the board doing, advising Schepens on financial matters?

Boeder: No. Schepens was part of the board.

Hughes: What was the board doing?

Boeder: Running and advising the Retina Foundation.

Hughes: On scientific matters?

Boeder: No. On how to get money, and so on.

Hughes: So it was a financial advisory board?

Boeder: That would be the best title that I can think of at the moment.

Hughes: So you weren't sitting on the board because of your scientific background. You were sitting on the board because of your connections with American Optical.

Boeder: That's right. There were hopes attached to that. They were successful to a certain extent. Schepens got more money from the American Optical Company than from anything else, I think.

Hughes: And this was support for the Retina Foundation?

Boeder: Yes. That money went directly into this foundation.

Hughes: Would you care to say something about Dr. Schepens' relationship with the Massachusetts Eye and Ear Infirmary?

Boeder: Dunphy was so unhappy that Schepens was there because it actually destroyed the harmony of his department completely.

Hughes: Yet Schepens had made considerable contributions while he was at the infirmary. He was responsible for setting up the retina service at the infirmary, and he certainly was making contributions in terms of indirect ophthalmoscopy and in retinal detachment surgery. Perhaps it wasn't the easiest of things to dismiss such a man.

Boeder: No, it was not easy.

*Hughes: Were the Retina Foundation and the other institutions that Schepens eventually founded, competition for the infirmary?**

Boeder: Well, you can say that it was natural that the patients who wanted to be treated would go there, because Schepens didn't keep his merits under the table.

Hughes: You stepped down from the board chairmanship in 1962. Why?

Boeder: I had had enough, I suppose.

Hughes: There was not a decisive event.

Boeder: No.

Hughes: How much time did you spend on the Retina Foundation?

Boeder: None.

Hughes: Well, you must have had to go to meetings.

Boeder: Yes, but I'm not aware of myself actually leading this organization. I had the title of board president, but it didn't amount to anything for them or for me.

Memberships

Boeder: I got to be a member of the Academy [in 1951].

Hughes: Was it because of [Derrick] Vail?

Boeder: No, it wasn't. He didn't know a thing about me. But he introduced me. He said, "I'm told that you did something." [laughing] He didn't give me a very nice compliment, but I didn't mind it at all; I got my membership, which was *very* important for me at the time.

Hughes: Please explain why.

Boeder: Because I was still at American Optical Company.

Hughes: So you needed the credibility?

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* For more on the retina service at the Massachusetts Eye and Ear Infirmary and the Retina Foundation, see the oral history of David G. Cogan in this series.

Boeder: Well, I needed something that the people in the optical industry didn't have.

Hughes: Who made your membership possible?

Boeder: Lancaster. I owe that to him. I mean, I couldn't say this is what I know for sure, but I know that Lancaster did it. No other would have done it.

Hughes: Do you think that your teaching career would have been as extensive without that affiliation?

Boeder: I don't think it made much difference. It was nice to have, but people don't look at that so much.

Hughes: Why was it important, then?

Boeder: It was important because I was still in the American Optical Company.

Hughes: So it was important in the eyes of ophthalmologists that you had this association? Is that what you're saying?

Boeder: It was important that there was somebody in the American Optical Company who was an honorary member of the Academy.

Hughes: So it was important to the American Optical Company.

Boeder: That's it!

Hughes: Did the Academy membership have something to do with your appointment at Iowa? Do you think because you had these credentials, American Optical was willing to underwrite you for all those years at Iowa?

Boeder: Well, it was good for the Department of Ophthalmology at Iowa, because I didn't cost them anything. That's always good. It was resented by some, but not by the majority.

Hughes: Have you ever belonged to scientific or medical societies aside from the Academy?

Boeder: I was always a member of the American Association for the Advancement of Science.

Hughes: Did you go to meetings?

Boeder: Yes.

Hughes: Any other memberships of note?

Boeder: I went to ophthalmological annual meetings.

Hughes: I know you went to the Academy, but where else did you go?

Boeder: That was enough. One of the big titles for me was that I was a member. I got the Distinguished Service Award [1988].

Hughes: That was for your years of teaching at the Academy, was it not?

Boeder: That is what it meant, yes.

Hughes: Who do you think was responsible for arranging the award?

Boeder: Mel Rubin and Bruce [Spivey].

Hughes: You know that for a fact.

Boeder: Oh yes. Nobody else could do it.

The Paul Boeder International Symposium

*Hughes: I saw a reference to a publication entitled, "Cataracts: Proceedings of the Paul Boeder International Symposium."**

Boeder: There was a whole volume I can show you. It's amazing.

Hughes: Who was responsible for naming that symposium after you?

Boeder: I don't know.

Hughes: Do you think perhaps it was Dr. Kolder?

Boeder: He may have had a hand in it. [interruption; Dr. Boeder goes to get the book.]

Hughes: So it was Dr. Kolder.

Boeder: Yes.

Hughes: Did you attend the symposium?

Boeder: Yes, I even spoke at the symposium.

* Kolder HE (ed). *International Ophthalmology Clinics*. vol 18, no 2. Boston: Little, Brown and Co, 1978.

Hughes: Do you remember the subject?

Boeder: Maybe I said, *"Ich bin unschuldig."* [laughter]

Hughes: "I'm not guilty." So you didn't give a paper.

Boeder: Yes, I gave a paper.

Hughes: Oh, here it is: "Review of Aphakic Correction by Lenses."

Boeder: [laughing] Outrageous.

Patents

Hughes: Do you hold any patents?

Boeder: I had some patents in the American Optical Company.

Hughes: In the company's name?

Boeder: I had to put them over to the company, yes.

Hughes: What were they on?

Boeder: On lenses. George Wells thought the patent was very important. He didn't know what it was, actually.

Hughes: Important in what sense?

Boeder: For the company. He was just being nice.

Hughes: What was the lens?

Boeder: I had two patents assigned to the company. But I couldn't tell you what they were. It was a long time ago.

Hughes: Did you ever make any money from those patents?

Boeder: No.

Hughes: It went to the company?

Boeder: Went to the company.

Hughes: That's standard practice in industry?

Boeder: Standard. You work for the company, you turn in the work—those things that you invent.

Hughes: Did you have any connection with Dr. Jampolsky's Optical Sciences Group?

Boeder: I was invited to the meeting recently, and I think I was there before and had a discussion. So I must have talked there once, but that's years ago. I don't know when it was. Yes, I have had some experience with them.

Hughes: What is the Optical Sciences Group?

Boeder: They're interested in optical science. I don't know what their agenda is; I was not a member. I was a visitor.

Hughes: What kind of a group is it?

Boeder: I think they're interested in publications. The members want to publish. I really don't know.

Hobbies

Hughes: Dr. Spivey mentioned your BMW motorcycle. I know that goes back a while, to when you were a student in Göttingen.*

Boeder: Yes. It was a beautiful BMW 750 Sportsmachine. That thing had an acceleration that was unheard of. At that time, there was not much in the way of traffic on the big roads in Germany. There came another motorcycle, and then when you made a sign, then he knew that you wanted to race. That's when I went, "Whizzzz!" They couldn't get me even with a Harley-Davidson.

Hughes: How fast do you suppose you went?

Boeder: The acceleration was tremendous. I could go 130 kilometers. I think I could go beyond that, but I never went more than that. That was enough for me.

Hughes: Were you a bit reckless in your youth?

Boeder: Well, I was too reckless once that I remember. I was never reckless again. I was going from Göttingen straight to another city. I saw a *Lastwagen* [truck] coming right into this road. I couldn't bring the motorcycle to a standstill so fast [fast enough].

* Interview with Dr. Bruce E. Spivey, San Francisco, California, December 14, 1988.

This fellow who was driving this wagon noticed that I came along at an idiotic speed, and he just went straight into the ditch to save me.

Hughes: You were lucky. That taught you a lesson.

Boeder: [laughing] That taught me a lesson, I tell you. How stupid can you get?

Hughes: Well, you were young.

Another of your interests is golf. You were pretty good, weren't you?

Boeder: Well, never good. Braley could beat me anytime.

Hughes: Did you play a lot?

Boeder: We played a lot together. And Evelyn did too. Braley and some other fellows, four people, maybe twice a week we met at the country club. I play every time I go to Iowa. At least that was true until recently.

Hughes: Bruce Spivey tells a funny story. Apparently you gave him some golf instruction, and then the two of you went off to the course, and he promptly shot a birdie. Do you remember that?*

Boeder: It was much better than that. We came to hole number six, and I said, "Now, you have to be careful. If you go too far on your first shot, you have to go over a gully and you may get in trouble." And he said, "Where's the hole?" "The hole is over the trees there in that direction." And he said, "Well, why don't I hit the ball in that direction?" I said, "You have to have a tremendous hit to get clear because you must go over a lot of trees." He said, "Oh, I'll try." My gosh, that fellow! He hit that ball and we found it on the green. I mean, that's outrageous! [laughs] It was an enormous hit. The only time that I have ever seen that done. That was Spivey. He is a strong athlete. I said, "Well, I don't give you a lesson. You give me a lesson." The nicest part was Bruce. He takes that in his stride. He's not even surprised. [laughs] Wonderful, wonderful.

* Spivey interview, December 14, 1988.

Achievements

Hughes: What do you consider to be your greatest achievement?

Boeder: In what line?

Hughes: Whichever line you choose.

Boeder: Well, I think of many things. Of course, there was a time when I was a gymnast and took every opportunity to show I could perform. That was a gymnastic achievement to take a forward flip and come back to a stand. I told you I showed that to Bielschowsky. He was impressed. Before he left, he wanted to see me do that again. That would be physical achievement.

In the way of publications, I would choose as my best, the analysis of the action of the extraocular muscles.

Hughes: More so than the response shift?

Boeder: Oh yes! The response shift was a hypothesis and I could do a lot with the response shift, but the work I did for the muscles was perhaps the best I have done. In my estimation, it was an important observation. Now, there is another achievement; I need not belittle it. I went to Göttingen and got my doctor's degree there.

Hughes: Magna cum laude.

What have you most enjoyed in your professional career?

Boeder: Teaching, I think. I enjoy teaching. And I have done it to an enormous extent. I like to teach optics. I gave a very simple introduction to optics, and the students all enjoyed it. They talked about it, and, therefore, I got invitations everywhere, almost. They would say, "We can understand what he says. He doesn't go over our heads at all." It was really for children, what I had to say. [laughs] And the students appreciated it.

So, if you ask me, "What did you like best?" Teaching—teaching these men that wanted to learn a little bit so they could understand optics. It's nice to satisfy them.

Paul Boeder, the teacher
(Photo courtesy of David Guyton)

APPENDICES

CURRICULUM VITAE

Name Paul Anton Kurt Boeder, PhD

Date of Birth April 25, 1902

Place of Birth Hamburg, Germany

Education

Teachers Seminary, Hamburg	Teaching Diploma	1923
University of Pennsylvania	MA, Mathematics	1926
University of Göttingen, Germany	PhD, Magna cum laude Applied Mathematics	1931

Professional Experience

Lecturer in Ophthalmology, Eastern Virginia Medical School, 1980-1988

Professor of Ophthalmology, University of Iowa Medical School, 1957-1971

Lecturer in Ophthalmology, Harvard Medical School, 1953-1957

Instructor of Ophthalmology, Harvard Medical School, 1950-1952

Chairman, Board of Trustees, Retina Foundation, 1950-1962

Director, Bureau of Visual Science, American Optical Company, 1940-1957

Member, Bureau of Visual Science, American Optical Company, 1935-1940

Professor of Mathematics, Susquehanna University, 1932-1935

Instructor of Mathematics, University of Delaware, 1926-1927

Honors (partial list)

Distinguished Service Award, American Academy of Ophthalmology, 1988

Honorary Fellow, American Academy of Ophthalmology, 1951

Distinguished Service Award, The Distinguished Service Foundation of Optometry, 1937

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ANOMALOUS RETINAL CORRESPONDENCE REFUTED*

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PRELIMINARY CONSIDERATIONS

In monocular vision, it is assumed that every retinal receptor unit, stimulated by the image of an object point, gives rise to a subjective visual direction along which the visual point is seen or externalized. Each direction is differentiable from all others and has a fixed relationship to the eye. We may think of the totality of monocular visual directions as a pencil of directions issuing from a single point, say, the center of the eye.

The most important direction is the principal visual direction which is distinguished by the fact that the visual point seen on it usually has our special attention; it is "looked at directly," or "fixated," and all other visual points are referred to it, namely, as being to the right or left, above or below it.

Normally, the principal visual direction is associated with a retinal receptor unit of the central fovea and we may, therefore, think of it as the central direction in a distribution of directions the density of which, greatest in the vicinity of the principal visual direction, falls rather rapidly for increasingly peripheral visual directions, in conformity with the increasing spacing of the associated retinal receptor units. Since the discontinuous retinal structure is also a basic determining factor of visual acuity, the latter and the density of visual directions are correlated.

When the eye rotates to assume a different fixation, it is as if the whole pencil of visual directions rotates along, with no change in the relative orientation of its members. A stationary object point whose retinal image gave rise to a certain visual direction in the first position of the eye, gives rise to a different visual direction in the second, since the image has moved to a different retinal region. If there is to be no apparent motion of the visual point, the two successively elicited visual directions must lead to a sufficiently equal directional localization; in other words, the so-called egocentric direction of the visual point must be essentially independent of the orbital posture of the eye.

It becomes necessary, therefore, to differentiate between a visual direction and an egocentric direction. A direction is called a visual direction when it is referred to the eye, more specifically, to the principal visual direction which is as if fixed to the eye. The same direction is called an egocentric direction, if it is referred to the body, more specifically, to the "straight-ahead" direction which we shall regard as fixed in space, thus restricting ourselves to the case where neither the body nor the head is allowed to move, but only the eye in its socket. To clarify the situation, it will suffice to consider merely the fan of visual directions of the right eye in the horizontal visual plane (fig. 1). Let v be any visual direction, that is, the angle which a visual direction makes with the principal visual direction, and let r be

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the angle through which the eye has rotated from the primary position, in which the principal visual direction coincides with the straight-ahead direction. Then, e, the monocular egocentric direction which corresponds to the visual direction v, is given by the equation

$$e = v + r.$$

This simple relationship tells us, in the first place, that egocentric directions, on which we depend for spatial orientation, are compounded of visual directions and an ocular "posture component," which means, that in addition to the image information received through retinal receptor units, the visual cortex must receive information regarding the posture of the eye, in order to turn a visual direction into an egocentric direction. More precisely, as abnormal situations show, it is not the actual posture of the eye that determines the egocentric direction, but the reflex innervations released to the muscles to produce this posture. Thus, if the signal has been given for a certain rotation, r, but the eye, because of a paralysis of an extraocular muscle, can execute only an r′ smaller than r, the egocentric direction does not correspond to the actual ocular posture and leads to "past pointing." In another case, where no signal has been given for the change in r, but the passive eye is pushed left or right, stationary objects seem to move.

If $r = 0$, $e = v$; that is, the egocentric directions are identical with the visual directions. If e is to remain constant, though r is not, v must vary in such a way as to cancel the change in r. This requires a distribution of visual directions which is spatially so well co-ordinated that a stationary object point which, in a certain position of the eye, elicits the visual direction, v, can be fixated by rotating the eye through an angle equal to v.

If r is constant, but v is not, e varies with v, and the stimulus object cannot be stationary. If v is zero, and r is variable, e varies with r, and this is the case of fixating a moving object.

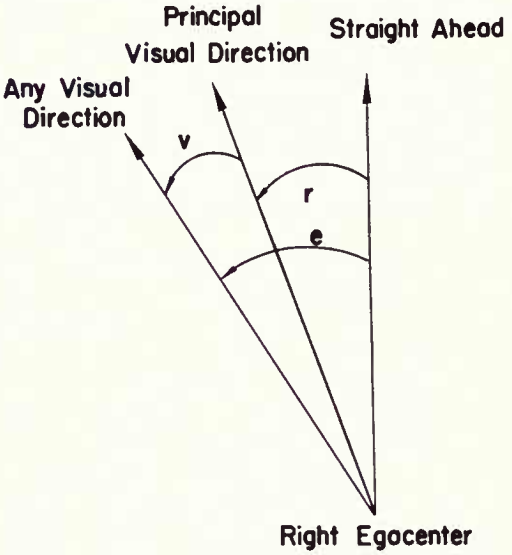

Fig. 1 (Boeder). Showing the monocular egocentric direction, e, as the sum of the visual direction, v, and the rotation of the eye, r.

In binocular vision, we do not have two monocular egocenters, the left and the right, but one and only one, namely, the binocular egocenter which may lie anywhere between the two eyes or even in one of the two eyes, depending in some measure on ocular dominance.

The pencil of binocular visual directions issuing from this center is formed from the two pencils of monocular visual directions as follows: every pair of corresponding monocular visual directions, that is, directions associated with corresponding retinal elements, forms a binocular visual direction. Thus, the principal visual direction of the left eye unites with the principal visual direction of the right eye to form the binocular principal visual direction. In this process, the two monocular visual directions give up their individuality by rotating, so to speak, about their point of intersection toward each other until they coincide and go through the binocular egocenter, the total rotation corresponding to the angle of convergence of the eyes.

In a similar manner all other binocular visual directions, also called "common directions," are formed, each pair of corresponding monocular visual directions accounting for one binocular visual direction. It follows that on every binocular visual direction there are two visual points, one stemming from the left eye, the other from the right eye. These points rival with each other for recognition, since only one of them can be seen at any given time (Verhoeff).

An object point whose retinal images stimulate a pair of corresponding monocular visual directions is seen single in the binocular visual direction formed by the pair. The aggregate of all such object points is called the horopter.

An object point whose images fall on noncorresponding or disparate retinal elements stimulates two noncorresponding monocular visual directions which do not unite in a binocular visual direction, but each of which forms a binocular visual direction with its corresponding partner in the other eye. The two visual points originated by such an object point lie, therefore, on two different binocular visual directions, which they have to share with visual points which generally belong to two different nonhoropter points.

It follows that one of four things may happen to a nonhoropter point:

1. If each of its two visual points wins its rivalry, it may be seen double, or (2) in apparent singleness and "depth" relative to the horopter.

3. If only one of its visual points wins its rivalry, it is seen single.

4. If both of its visual points are defeated, it is not seen at all.

In normal binocular vision, the eyes are directed to the point of attention until it has become the "principal" horopter point which is seen along the binocular principal visual direction. Other object points are seen either at the same subjective distance as this point of fixation, then they are also horopter points, or farther or nearer than it, then they are nonhoropter points. In general, there is no consciousness of "physiologic diplopia," unless a special effort is made to detect it.

In any change of fixation, this process is repeated: the new point of attention becomes the principal point of the new horopter, with the result that binocular vision always appears to be single.

This is no longer true in cases of squint where the point of attention cannot be made the principal horopter point because of a deviation of one eye. The object of attention is far removed from the horopter; it has, therefore, widely disparate retinal images, and since attention is on it, rather than, as normally, on the principal point of the horopter, the doubling of the object of attention as well as that of other objects in the field of view, may become noticeable.

As long as there is binocular vision, binocular visual directions are formed invariably in the same manner, namely, through the union of corresponding monocular visual directions. In other words, retinal correspondence remains inviolate and, consequently, there is always a horopter, even though it is "virtual" in exotropia. However, in contradistinction to the horopter of normal binocular vision, the squinter's horopter is far removed from the objects of attention, for which he is, therefore, said to have diplopia, although the existence of such diplopia is, of course, subject to binocular rivalry.

"Anomalous" retinal correspondence

It is a well-known fact that in certain cases of concomitant strabismus, the squinter attains some degree of single binocular vision in spite of the fact that the objects of attention are imaged on highly disparate retinal elements.

Many theories have been proposed in explanation of this phenomenon, the "classical" and generally accepted one being that of anomalous retinal correspondence, accord-

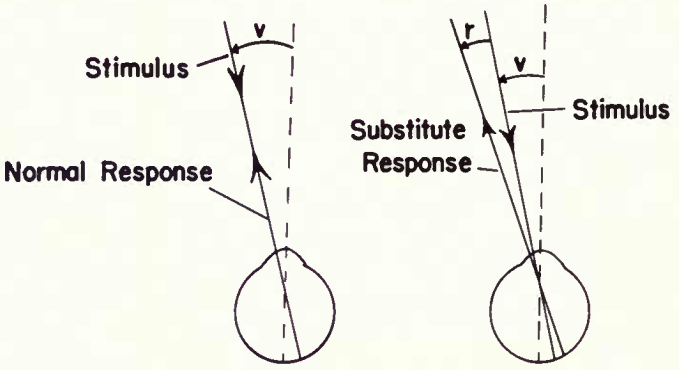

Fig. 2 (Boeder). The left drawing shows schematically a proper directional response; the right one shows a "substitute response" as it occurs, for instance, in "past-pointing."

ing to which corresponding retinal elements lose their associated common (binocular) visual directions, and disparate retinal elements acquire common (binocular) visual directions. The assumption is, therefore, that even fixed, innate relationships such as monocular visual directions and retinal correspondence occasionally give way when abnormal visual conditions seem to demand it.

An assumption of such gravity can, however, be avoided, and the single binocular vision of the squinter can be accounted for with normal retinal correspondence remaining intact.

To show this, let us first assume that a normal eye has rotated normally into the primary position in order to fixate a stationary object point. The (monocular) egocentric directions for all stationary objects in the field of view are then given by $e_1 = v$. For instance, the fixated object point, for which $v = 0$, is seen in the egocentric direction $e_1 = 0$.

Secondly, let us assume that another eye is also in the primary position, but only because it was unable, owing to a paralysis, to execute an ocular rotation, r, for which the proper innervations had been issued. In this case, the egocentric directions for the same stationary objects as before are $e_2 = v + r$; that is, the objects appear displaced in the direction of the intended ocular rotation (past pointing).

If we did not know of the unusual temporary state in which the eye finds itself, and if the effect lasted long enough for an examination of directional responses, we would call them "anomalous" because stimulation of the central fovea would elicit a directional response $+r$, that is, the visual point would not be seen straight ahead. We would have to stimulate the retinal element that normally responds with the direction $-r$, to cause the observer to say that he sees the light straight ahead, and that he is looking directly at it. In other words, we would then have located the eccentric retinal area which appears to have acquired an anomalous principal visual direction.

More generally, we can express the finding of the hypothetical examination as follows: if we stimulate the v-receptor, the directional response is not v, but $v + r$. The v-receptor seems to act as though it were the $(v + r)$-receptor. However, no retinal receptor can respond with the visual direction of another; the directional response of a retinal receptor is innately and immutably its own. It follows that we have no other choice but to conclude that, owing to the unusual state of the eye in the second case, this is what happens: if the v-receptor is stimulated, the response is the visual direction which is exclusively associated with the $(v + r)$-receptor; the $(v + r)$-response is "substituted" for the v-response (fig. 2).

We may state this conclusion as follows: Nonexecution of a "commanded" ocular rotation r, that is, one for which the proper

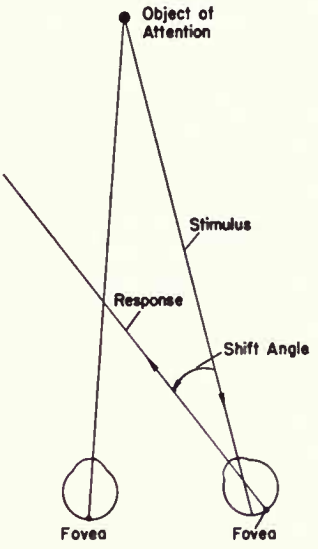

Fig. 3 (Boeder). Showing the "response shift" in the squinting eye. The eccentric fixation area receives the stimulus, to which the (foveal) principal visual direction responds. The binocular egocenter is assumed to be in the left eye.

innervations have been issued, results in visual directions having substitute directions which differ from the former by the angle, r. More briefly we may also speak of this as a "substitute response" or a "response shift" of angle r, which occurs simultaneously for the entire retina.*

We now assume that it may happen, say, in a case of concomitant esotropia, that nearly equal amounts of convergence innervations have been frustrated over and over again in the squinting eye until the resulting directional substitute responses have become established conditioned responses. If the frustrated convergence innervations correspond to the existing stable deviation, such a case would be classified as one of "harmonious anomalous retinal correspondence." This would be done on the basis of special tests which seem to show that the two foveas no longer correspond normally, and that an extrafoveal region of the deviating eye seems to have acquired a common visual direction with the fovea of the other eye.

However, this is a misconception. What actually happens in this case is that the eccentric fixation area of the deviating eye receives the stimulus, to which foveal visual directions respond by way of substitution, and the union of these with the (normally) corresponding foveal visual directions of the nondeviating eye results in the single binocular vision of the squinter (fig. 3).

The eccentric fixation area of the deviating eye and the fovea of the other eye have been singled out merely for the sake of clarity of discussion; the response shift applies to the entire retina of the deviated eye, and substitute visual directions of all stimulated retinal regions co-operate with the corresponding visual directions of the other eye in accordance with normal retinal correspondence.

The single binocularity of the squinter cannot, however, be attained without severe visual sacrifices. In appraising the impairment, let us first consider how the monocular vision of the deviating eye is reduced by the response shift. Visual impairment in the deviating eye is clinically well known, although its origin is not. The fact, therefore, that it can be shown that the response shift, by its very nature, invariably induces amblyopia, constitutes convincing proof of its existence.

In photopic vision, the distribution of visual directions corresponds to that of the cones in the retina, and this distribution is schematically represented in Figure 4. The curve has a high maximum in the region of the fovea from which it descends on both sides first rapidly, then more gradually, and finally very slowly.

If a response shift exists in esotropia, the nasal peripheral visual directions readily find their substitutes among the denser population of more centrally located visual directions, whereas these, in turn, cannot all find substitutes for themselves in the sparsely populated temporal part of the periphery.

* From a neuroanatomic point of view, the incoming sensory impulses must reach areas 18 and 19 before such a sensory substitution can take place.

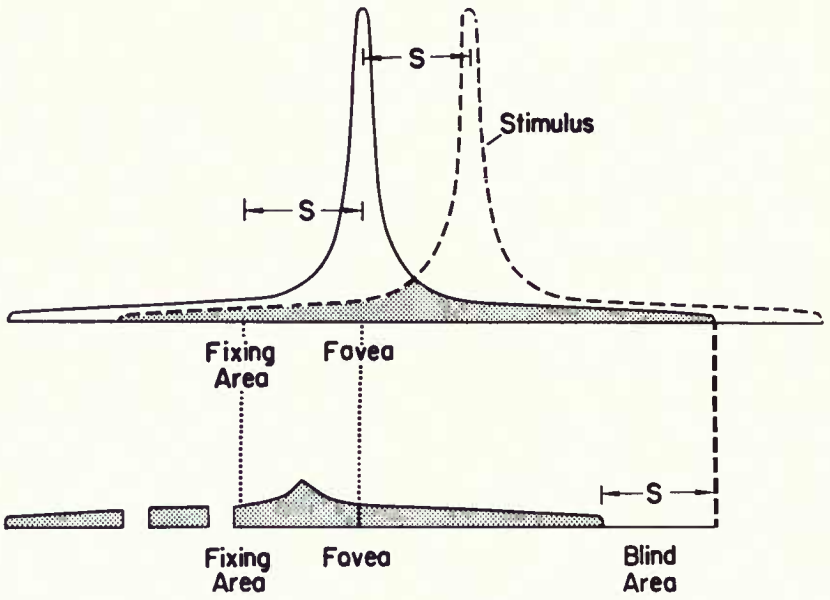

Fig. 4 (Boeder). The upper drawing shows a schematic representation of the distribution of cones (visual directions) in the retina. The shaded area represents the distribution of responding cones in case of a response shift in esotropia. The lower drawing shows the resulting strabismic amblyopia, the area of maximum sensitivity, the "two" blindspots, and the blind (temporal) peripheral area of the retina.

For instance, it has been estimated that the area of 45-minute radius surrounding the central fovea contains about 25,000 cones; whereas a similar retinal area 15 degrees from the fovea has only about 1,500 cones. The ratio of these two cone populations is, therefore, about 16 to 1. Assuming the angle of the response shift to be 15 degrees, this means that only one of 16 foveal visual directions have to substitute for the peripheral visual directions of the fixation area; and, on the other hand, only one of 16 foveal visual directions can find substitute directions in the diametrically opposite part of the retina. About 15 of 16 foveal visual directions are lost in the response shift, with the consequence that the visual functions of the fovea of the deviating eye have been reduced to the level of those of the vicariously responding peripheral area.

The dotted curve in Figure 4 allows a convenient comparison of stimulated retinal areas and their respective substitute areas in case of a response shift of angle s. The common (shaded) part of the two curves represents the distribution of the responding cones. It is at once clear that it is particularly the central part of the retina that is impaired; it has been rendered functionally amblyopic by the response shift (strabismic amblyopia). Indeed, a good estimate of the new distribution of retinal sensitivity can be obtained as follows:

If we think of the entire retina as a circle, it is as though a symmetrical central strip of the width of the response shift is cut out, and the temporal part is pushed over to join the nasal part. This places the most sensitive retinal area midway between the fixation area and the fovea; in other words, in the deviating eye, the eccentric fixation area and the area of maximum acuity are separated by half the shift angle (fig. 4).

It follows further that the angular extent of the sensitive part of the retina is a full shift angle smaller than the retina. This means that the extreme temporal periphery is blind, because still farther out there are, of course, no more visual directions which could respond by way of substitution.

Moreover, since the blindspot can neither provide substitute visual directions nor stimulate such, there are functionally two blindspots in the retina of the deviating eye (fig. 4).*

In scotopic vision, no such prominent area of sensitivity as the fovea is in photopic vision can be levelled by the response shift, because there is no such area. Acuity is almost uniform in the entire retina, except for the fovea which is blind. The response shift, therefore, has little or no detrimental effect on the scotopic vision of the deviating eye. Indeed, it would be interesting to find out whether a foveal response, which is a near-threshold response in the normal eye, is strengthened by substitution in the squinting eye.

It is already clear from the preceding discussion that only a very much impoverished single binocularity can be attained by the squinter. In comparison with the normal, this is especially true for the fixation areas which are directed at the object of attention. Assuming again a response shift of 15 degrees, the ratio of binocular visual directions carrying image information from the deviating eye is only one to 16 directions which would exist in a normal case, and some of this information has to win over information from the nondeviating eye in normal binocular rivalry before it can lead to stereopsis. Even at best this stereopsis can only be of low degree because of the sparsity of binocular visual directions. Fifteen of every 16 visual directions of the normally functioning fovea of the squinter's fixating eye have no responding corresponding partners in the deviating eye and, therefore, cannot co-operate in stereopsis; on the contrary, they could help in drowning out any manifestations of binocular co-operation. Such manifestations should, however, become demonstrable if the information stemming from one eye is labeled by means of a color filter.

There is, of course, no binocular co-operation with the fovea of the fixating eye, if the fixation area of the deviating eye happens to coincide with the blindspot, a possibility which cannot be excluded. In such a case, the squinter would certainly not fixate with this blind area in monocular and dissociated vision, but "view" the object of attention with a different retinal area. However, he would have to point the blind area at the object of attention in order to have single binocular vision in the periphery. Thus, it is the posture which the deviating eye has in single binocular vision that defines the fixation area. It has already been pointed out that it is not the retinal area of most acute vision; now we can add that it may even be blind.

The squinter's peripheral single binocular vision is relatively much better, although it always is below normal because of the losses resulting from the response shift. The squinter has, of course, a horopter in accordance with normal retinal correspondence.

The phenomenon of monocular diplopia which occurs in strabismus under treatment has been called the most formidable "stumbling block" to theories of squint vision, because it was virtually impossible to explain how a single retinal receptor could produce, all by itself, two different directional responses simultaneously. The response shift removes this dilemma; in accordance with it, one visual direction in monocular diplopia is the re-emerging proper response of the stimulated receptor, whereas the other is its lingering substitute response, associated with a receptor which is separated from the stimulated one by the shift angle. Monocular diplopia thus provides most convincing evidence in support of the response shift.

Summary

Analysis of the clinical phenomenon of "past pointing" is taken as the basis for the paper's principal proposition, namely, that anomalous retinal correspondence does not

* In case of exotropia, the "functional" blindspot occupies a more or less central position, depending on the shift angle.

exist, but that even the squinter who attains single binocular vision uses normal retinal correspondence. He does so by means of a "response shift," a conditioned reflex, in which stimulation of a retinal receptor elicits a directional response associated with a receptor which is separated from the stimulated one by the shift angle. Strong confirmatory evidence is seen in the fact that strabismic amblyopia of the deviating eye, monocular diplopia, and other visual phenomena of the squinter can be shown to be immediate consequences of the response shift.

University Hospitals.

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LETTER

Paul Boeder to William C. Frayer, MD, of the Scheie Eye Institute, regarding the early years of the Lancaster Course in Ophthalmology. (Courtesy of William C. Frayer)

28 Aug '88

Dear Bill [Frayer],

Your request to jot down a few of my thoughts about the early years of the Lancaster course brings to my mind, first of all, an unforgettable afternoon I spent with Dr. WBL [Lancaster] in his room in the Boston Harvard Club, a few weeks before he died. My telephone call from downstairs had evoked a rather faint, "come up." When I entered his room I was shocked to find him sick in bed; I expressed my concern. "I'm all right," he said, "and well taken care of. Come a little closer, sit on my bed, I want to talk to you." Reaching (repeatedly) for nitroglycerine, he began to speak of his experiences late in the last century in Vienna where he had attended a series of ophthalmological sessions. These had impressed him so favorably that he resolved to help initiate something like it in Boston.

Back in Boston he outlined a course of ophthalmological lectures which he offered to the Harvard Medical School. It was declined. Undaunted, he concluded: "I have to provide myself with the opportunity to teach." (These were his words.)

He saw the first opportunity for this when the second world war came to an end. He offered an ophthalmological "refresher course" to the ophthalmologists who were returning from the theaters of war. As a high-ranking Boston ophthalmologist, former president of the Academy, etc, he had no difficulty in enlisting a first class faculty for the course. It had to be given in Boston in the late afternoons. He had assigned to himself 2–3 hours of lecture on 11 consecutive afternoons; his subject was Physiological Optics, which he intended to teach without any mathematics.

On the evening before the course he called me on the phone: "Paul, I have to ask you a favor. I have a cold; cannot start teaching tomorrow as planned; you have to take my place." It scared me stiff! "Evelyn," I said to

my wife, "I have to drive to Boston this very minute, lock myself in a room at the hotel, and prepare a 2 hour lecture for tomorrow afternoon."

Never shall I forget that first afternoon. From the huge stage with a small blackboard I looked at about 180 ophthalmologists, most of them in uniform: captains of the Navy, colonels of the Army, etc. Believe me I did not feel like telling a joke at the outset. And this perhaps for 11 days? — Yet, when I had finished those days, they gave me a really wonderful hand. I was stupid enough to tell all this to WBL. He fired me immediately, saying "You were much too mathematical."

WBL decided to stage a repeat performance of the Boston course in St. Petersburg, Florida the same year, close to Christmas. When the time came, he asked me whether I would be willing to come along. He explained: "I want to teach — you are young and will have plenty of opportunity to teach in your life. However, if I should get tired, you'll be there to take over." I was happy.

He did tire — he was past 85! I had to take about 60% of his schedule.

Originally he had planned to have all subsequent courses in Florida, but he changed his mind because, at that time, black ophthalmologists were not welcomed at our hotel. He moved the 3rd Lancaster course to a junior college near Portland, Maine, where he made me a full-fledged faculty member.

The directorship of the course was taken over by Parker Heath who moved the course to Colby College where it has been ever since. Henry Allen replaced Parker Heath.

You asked me what the Lancaster course has accomplished. Well, a course that year after year has attracted about 150 discerning young ophthalmologists has, of course, accomplished tremendously much! Obviously, it filled a need for advanced ophthalmological education and continues to do so successfully. It deserves an A+.

About myself: I'm still enjoying some teaching in Norfolk; namely, the ophthalmological residents of the Eastern Virginia Medical School. It's love!

I'd like to play some golf; but my partner is in a retirement home; see him briefly every Saturday.

I miss my dear Evelyn every day — already more than 6 years!

My best wishes to you!

Sincerely,

Paul

INTERVIEWER BIOGRAPHY

Sally Smith Hughes

She graduated from the University of California, Berkeley, in 1963 with an AB degree in zoology, and from the University of California, San Francisco, in 1966 with an MA degree in anatomy. After completing a dissertation on the history of the concept of the virus, she received a PhD degree in the history of medicine from the Royal Postgraduate Medical School, University of London, in 1972.

Her previous positions have been postgraduate research histologist, the Cardiovascular Research Institute, University of California, San Francisco, 1966–1968, and medical historian conducting the NEH-supported History of Medical Physics Project for The Bancroft Library, 1978–1980.

She is presently an interviewer on medical and scientific topics for the Regional Oral History Office at the University of California, Berkeley, and for the Department of the History of Health Sciences at the University of California, San Francisco. She is the author of *The Virus: A History of the Concept.*

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