CLINICAL AND EXPERIMENTAL
OPTOMETRY

PROFILE

Donald Herbert Schultz

Intellectual, inventor and benefactor 1910–1987

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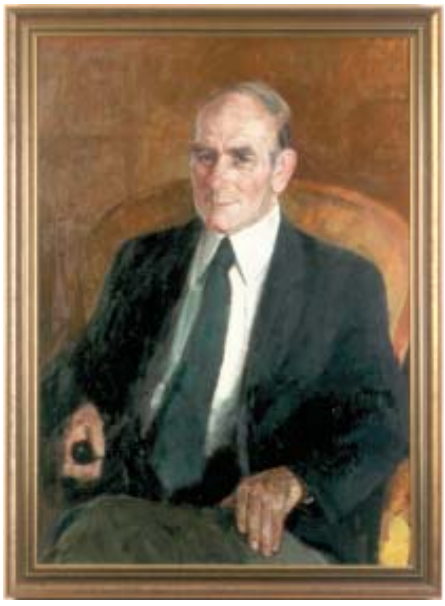
I first met Don Schultz in 1963, at an optometry conference in Sydney. He was a middle-aged, balding man with an immensely kind demeanour. I was an undergraduate, somewhat intense and overserious. I wanted to talk to Don about optics. He wanted to talk to me about some calculations he was doing on the flight of a spinning cricket ball. I learned later that he had been a first-class cricketer and had revisited this problem many times. I also learned that one of the great pleasures of knowing him was his enthusiasm for understanding the world around him.

Later in 1970, when I began work with Don at SOLA International, he was interested in the design of the pouring lip of a jug to eliminate drips and we spent some time on the mathematics of fluid rheology. I still have the copy of *Flatland*[1] that he gave me, which draws on the space-time discussions of Einstein, Lorentz and Whitehead, and which led us on to Sommerville's *Geometry on N Dimensions*[2] and Bertrand Russell's *Foundations of Geometry*.[3] I recall that for a while we were determined to make sense of Reimann's hyperbolic coordinates to describe visual space.

Don was primarily interested in optometry and optics. He developed a remarkable number of optical instruments and machines, for ophthalmic and defence use. He played a fundamental role in the formation and growth of Australia's largest group optometry practice and one of the world's largest ophthalmic lens companies. He was a planner and participator in optometry teaching, research and professional organisation. He was an extraordinarily generous benefactor to vision research.



Don Schultz was born in 1910 and grew up in the small town of Summertown in the Adelaide Hills. As a youth, he was greatly influenced by his uncle, Carl Laubman. Laubman and his friend Harold Pank had formed the optometry practice of Laubman & Pank in 1908. This was a remarkable partnership that combined a commitment to leading edge optometric practice with an emphasis on innovation and intellectual pursuit.

Laubman and Pank were prolific inventors. Between 1919 and 1928 they designed, patented and built lens grinding machinery, a mobile optometry consulting room that they called the Perspectoscope and an instrument for measuring visual reaction times. They developed a production process for the then revolutionary solid one-piece bifocal lenses. Previously, bifocals had been made as two separate lenses cemented together. They introduced the manufacture of artificial eyes to their practice.

In 1927, Laubman and Pank went to Jena in Germany (which had been the home of the Carl Zeiss company since 1846) to study optometry and ophthalmic optics.[4] While in Europe, they delivered to Albert Einstein data on a solar eclipse in Queensland. They went on to the UK, where they represented Australia at the World Optical Conference, and to the United States, where they visited the two major ophthalmic manufacturers of the time, Bausch and Lomb and the American Optical Company.

Don Schultz was indentured as an optical apprentice in the Laubman & Pank practice when he was a young teenager and this environment of enthusiasm, invention and intellect shaped his life.

Optometry was recognised in South Australia by the passage of the Optometrists Act in June 1921,[5] the third such state act to be passed in Australia. Of the first six optometrists to be registered under the act, four were indentured to Laubman & Pank. At the same time, there was much

interest in establishing an optometry course in Adelaide and in 1925, a course was commenced at the University of Adelaide. This course is said[5] to be the first university course in optometry in the British Empire, although it did not lead to a university qualification. The head of the course was the head of the Department of Physics, Professor Sir Kerr Grant. The first year was largely optics, taught by Marcus (later Professor Sir Mark) Oliphant FRS who was later appointed Governor of South Australia. Don Schultz was one of the first students to enrol and in 1929, he became one of the first three graduates of the course. His intellectual prowess and insatiable curiosity commended him to his scientifically distinguished teachers and he remained friends with Kerr Grant and Mark Oliphant throughout their lives.

In 1931, just two years after he had completed the optometry course and at the age of 21, Schultz became the principal lecturer in the course, a position he held for the next 24 years. He taught physical optics in first year, physiological optics in second year and clinical optometry in third year. He also taught optics in the science degree program of the university.

Don Schultz was registered as an optometrist in 1930. By all accounts, he was a good optometrist. Wright[5] says, 'He was a good clinician, indeed for his time he was remarkable'.

Inventor

His interest lay more in lens and instrument design than in clinical optometry. The Second World War forced him further in this direction. There was little optical design expertise in Australia at the time and no precision optical glass manufacturing capability. The war required a supply of optical instruments. An Optical Munitions Panel was formed in July 1940 to co-ordinate efforts around Australia and Schultz was co-opted to work under Kerr Grant at the Weapons Research Establishment in Adelaide. By the time the Optical Munitions Panel was disbanded, after the war in 1945, it had overseen the development and manufacture of 19 optical instruments, including submarine and tank periscopes, range finders and aircraft glide slope indicators, the refurbishment of 17,000 pairs of binoculars and the production of six different types of optical glass. Schultz worked on many of these projects and at the end of the war he transferred several of them to the Laubman & Pank optometry practice.

Don Schultz became a director of Laubman & Pank in 1944 and three years later with David L Pank, the son of Harold Pank, purchased a controlling interest in the practice. David Pank went on to chair the boards of directors of Laubman & Pank and SOLA, as well as several other companies and government bodies and to become president of the major national and international management organisations.[6] It is easy to see a parallel between the partnership of Don Schultz and David Pank and that of their uncle and father.

Don established an Instrument Construction Department in the Laubman & Pank optometry practice, as a base for continuing the wartime defence work and extending into new technologies. The scope of work undertaken gives an indication of his versatility and productivity. The Instrument Construction Department carried out binocular and camera repairs. It made an optical range finder, an aerial photostereoscope, a low f-number Cassegrain telescope with a hyperbolic figure on the primary mirror, Schmidt camera corrector plates and signal lamps for the navy.

In 1952, it made catadioptric cameras for the Blue Streak missile tests carried out by the Weapons Research Establishment at the Woomera Rocket Range. It made a toolmaker's profile projector and an optical device for road marking. It made an innovative biocular catadioptric magnifier for low vision patients, a visual field screener, a Greens-type refractor head and vision screeners for industry and for children's vision. In 1953, it became the first laboratory in Australia to use high vacuum coating technology for optical surfaces. In 1956, it patented a concept for making one-piece industrial eye protectors. With Don's brother, Ross A Schultz, it developed lens processing machines including a lens edging machine and a diamond generator.

It was during this time that Don Schultz became known for his painstaking optical design calculations that were carried out using seven-figure logarithms. There were no electronic calculators and slide rules were not sufficiently accurate. Computers capable of optical design were more than a decade into the future in Australia. Don's book of logarithmic tables was the size of a large novel and an optical design that would today be considered relatively trivial would take thousands of lines of handwritten calculations and sometimes weeks to complete.

In the mid-1950s, events took a different turn. Schultz's attention was drawn to a new plastic material that had been used during the war as a lining for fuel tanks in aircraft. The material, called CR39 (Columbia Resin Batch Number 39) by its manufacturers, the Pittsburg Plate Glass Company, had excellent optical properties and relatively high abrasion resistance. Laubman & Pank had been making plastic ophthalmic lenses for many years by machining them from methacrylate sheet. These lenses were light in weight but were difficult to polish accurately and were very easily scratched. Schultz envisaged casting lenses from CR39 by creating a cavity between two polished glass moulds separated by a plastic spacer, and pouring the liquid CR39 monomer into the cavity and polymerising it. The lenses would take the polish of the surfaces of the glass moulds. He obtained a sample of the monomer but had to find a catalyst to initiate polymerisation. He approached his colleagues at the University of Adelaide, who developed a technique for making benzyl peroxide. This eventually proved unsatisfactory as the polymerised lenses were too soft and too yellow. Schultz went back to the university and was helped to develop a process for making isopropyl peroxy percarbonate, the initiator that was used for the next 20 years to make several hundreds of millions of lenses.

To cast CR39 lenses in large numbers required a great deal of innovative polymer chemistry, physics, mechanical engineering and process control. The problem that confronted Schultz concerned volumetric shrinkage. Molecular bond formation during polymerisation caused the material volume to shrink by 14 per cent.

While this was happening, it had to stay in contact with the glass moulds or the lens would be defective. It was necessary to control precisely the temperature during the curing cycle, to design moulds with just the correct amount of flexibility and to calculate the mould shape change during curing so this could be compensated for in the mould design and manufacture. The initial work to make a plano lens of accurate power and acceptable quality involved a large amount of experimentation and many mould designs. Don Schultz, with his seven-figure log tables and his reams of calculations, became legendary. Later when powered finished stock lenses were produced, each with a different mould configuration, these calculations had to be repeated hundreds of times.

The first CR39 lenses cast by Laubman & Pank were technically interesting but it was not clear whether they would be commercially accepted. In 1959, Don Schultz went to the UK and Europe on a six-month trip to look at the new technology of thin film surface coating and to investigate the potential for marketing the refractor head that he had designed. At the same time, he took some sample CR39 lenses. This trip was to prove the trigger for the growth of an extraordinary company. Schultz returned to Australia enthusiastic about the potential for CR39 lenses.

As a result of his report, in July 1960 Laubman & Pank renamed an existing subsidiary company, Photographic Supplies Limited, as Scientific Optical Laboratories of Australia Pty Ltd (later to become SOLA International Pty Ltd) for the purposes of continuing the binocular repairs and defence optical work, developing the CR39 technology and designing, making and selling optical surfacing machinery with Don's brother Ross. The company initially had nine staff, including Don's nephew Glen Schultz and Noel Roscrow, who as managing director was to become the driving force for growth over the next 25 years. Don Schultz and David Pank were appointed directors. The company was physically separated from Laubman & Pank in 1962 by a move to Black Forest, a suburb of Adelaide and later to Lonsdale in the south of Adelaide.

When Don invited me to join him at Black Forest in January 1970, SOLA had grown to almost 200 people and was bursting at the seams. There was a small office with five desks and no possibility of more, so Don and I shared a desk sitting facing each other. He was a good teacher, supportive and encouraging. His lessons and times of deep thought were invariably accompanied by much smoke from a favourite pipe. His manner was always gentlemanly and imperturbable, although often distracted.

It is fair to say that Don had little interest in the day-to-day management issues of the company. During meetings, it was common to see him covering his papers with pencilled equations and optical diagrams, as he thought about some design problem. He would work for weeks on an instrument, the design of which interested him but which had limited sales potential. His priorities were often decided by social need and he spent a great deal of time thinking about how he could help people with low visual acuity by designing appropriate lenses and reading aids.

At that time, as well as carrying out the CR39 mould calculations, he was working on plastic fibre optics, fully cast CR39 spectacle mounted Galilean telescopes, a periscopic device for pest control workers and the mathematics of complex high order toroidal surfaces produced by cylinder generator surfacing machines. I had access to the university computing facilities of the day and was able to write optical design programs, so generally Don did the conceptual work and I produced the data.

The technology base of the company was broad. In addition to developing CR39 lenses and CR39 sheet, it was one of the first in the world to manufacture commercial helium-neon lasers. It made a servo-controlled Fabry-Perot interferometer for the analysis of solar spectra, particularly in Antarctica. It continued to refurbish binoculars and to make defence optical equipment including periscopes, mortar sights and missile cameras. It made toolroom profile projectors and the low vision aids that Schultz had designed at Laubman & Pank. It made glass plano lenses, finished sunglasses and CR39 rear vision mirrors for cars. It made a visual field screener and two different central field tangent screens.

Perhaps the best-known of Don Schultz's work is the development of the Schultz-Crock binocular indirect ophthalmoscope. Gerard Crock, Professor of Ophthalmology at The University of Melbourne, approached SOLA in 1965 with a prototype of the world's first spectacle-mounted indirect ophthalmoscope. Schultz then took responsibility for designing the instrument for commercial viability. The Schultz-Crock ophthalmoscope received an Australian Design Council award for outstanding industrial design. It remained in production for the next 35 years and many thousands of units were produced and sold all over the world.

Crock approached SOLA again in 1972 with an enhanced model of the ophthalmoscope, which incorporated Galilean telescopes to make retinal surgery easier. This instrument was called the COMIDO (Combined Operating Magnifier and Indirect Ophthalmoscope). In 1975, Schultz and I, with the Department of Ophthalmology, were jointly awarded the Prince Philip Prize for Australian Design for this instrument.

Don's work at Laubman & Pank and at SOLA was not his only interest. When optometry in Australia moved towards a national health scheme in the early 1960s, he chaired the Statistics Committee of the (then) Australian Optometrical Association, which developed the necessary statistics on patient access and fee structures. He was a member of the (then) Standards Association of Australia committees on ophthalmic optics and industrial eye protection for many years. He was a member of the Australian Institute of Physics, the Optical Society of America and the Australian Optometrical Association for 50 years. He attended the meetings of ANZAAS (the Australian and New Zealand Association for the Advancement of Science) for many years, when they were the main forum for optometric research and published several original optics research papers in the *Australian Journal of Optometry*, the predecessor to *Clinical and Experimental Optometry*.

Through the 1960s and 1970s, Don still played occasional cricket and tennis, which he had also played at a high level in his youth. He took great pleasure from his membership of the Savage Club, one of the world's oldest men's clubs (it was formed in London in 1857), in which intellectuals from literature, the fine arts and science met socially over dinner. He enjoyed the company of his wife Joyce,[7] whose zany sense of humour seemed to ever perplex him. In many ways, Joyce acted as a counterpoint to Don; where he was rather quiet and unassuming, Joyce was lively and outgoing.

Generous benefactor

Don and Joyce provided financial support to many causes. In 1979 and 1980 they, along with Eulalie Laubman (daughter of Carl Laubman) provided the fledgling National Vision Research Institute (NVRI) of Australia with an endowment of $350,000, which was central to the viability of the institute. Don provided similar support for research in meteorology at Flinders University, as a gesture of personal support for a friend, while Joyce supported the Red Cross. With a further bequest from Don, the Schultz-Laubman-Schultz Endowment Fund of the NVRI has grown to more than $4.5 million.

Don Shultz retired in 1976. He was awarded Honorary Life Membership of the Victorian College of Optometry in 1980 and the foyer of the main lecture theatre in the Department of Optometry and Visual Sciences is named after him. The portrait of Don that hangs in the foyer and which is reproduced here was commissioned by a group of friends at SOLA in 1980 and presented to him in gratitude. He was a Foundation Member, a Governor and a Life Member of the National Vision Research Institute.

In 1987, Don Schultz was awarded the degree of Doctor of Science *honoris causa* by the Flinders University of South Australia for his contribution to research and scholarship in optical physics over almost 50 years. This was Don's first tertiary qualification. Although he had taught optometry within a university for almost a quarter of a century, the optometry course he completed and taught did not provide him with either a degree or a diploma. Although he was a leading optical physicist for most of his life, he achieved this without formal qualifications and was almost solely self-taught.

At the ceremony at which his honorary Doctor of Science was conferred, he was extremely frail and was not able to speak. He died just a few months later, aged 77. At the time of his death, the optometry practice of Laubman & Pank had branches and consulting rooms in 248 towns and cities,[4] SOLA Optical had manufacturing plants in 11 countries and employed 6,000 people[8] and the NVRI was in its 15th year of world standard vision research. These are lasting tributes to a kind and generous man of great intellect.

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