# Corneal Transplantation in Australia.

The first recorded successful corneal transplant was done in Brisbane in 1940 by Dr. Walter Gibson. He performed a penetrating corneal graft on a woman who was blind from corneal opacities and cataracts. She was also deaf. Perhaps she had interstitial keratitis but this is not stated explicitly. The case was the subject of a brief report in the Australian Medical Journal in 1941. Other corneal grafts were subsequently performed in Brisbane but not written up. At the time the law did not cover the collection of post-mortem tissues for transplantation. Perhaps this is why early developments in corneal transplantation were reluctantly reported, at least initially.

In 1948 Dr. Peter English, also in Brisbane, reported another case in the same journal, the Australian Medical Journal. The report was detailed and comprehensive and attracted considerable interest. The patient was a colourful war hero which ensured the case attracted media attention when the surgery was carried out in 1945. Sargeant Yua Wiga was a New Guinea national who had been assisting the Australian war effort. His war exploits were legendary and he was awarded the DCM, an award for bravery and valor second only to the Victoria Cross. American intelligence reports claimed that in he had killed 70 heavily armed enemy troupes, 28 in one engagement, armed only with an axe. When he was injured his role had been to illuminate suspected enemy positions with flares. One of the flares turned out to be an incendiary device with disastrous consequences.

The man lost one arm in the explosion and an eye. The other eye was damaged and he was flown to Australia with a white cornea in his only eye. Only a corneal transplant could restore his sight.

The procedure was carried out at military hospital in Holland Park, Brisbane. Peter English, an army officer at the time, was the surgeon and another army ophthalmologist, Jim McBride-White, his assistant. A double-bladed knife was used to cut a square graft. Castroveijo had used this approach extensively in the 1930s.

The graft was indirectly sutured with silk (probably 6.0 black silk) and the lids closed. The lids were opened after about six weeks. There was immediate disappointment. Opening the lids revealed a completely white ocular surface. Fortunately this turned out to be an organizing layer of discharge which had accumulated under the closed lids.
It was readily stripped to reveal a clear graft. The sutures were removed from the cornea at the same sitting.

Corneal transplantation was to become increasingly utilized in the post-war years.

Thomas a'Becket Travers commenced corneal grafting in 1948 in Melbourne. Norman Macleod MacIndoe in Sydney was active in corneal transplantation by1950. Bill Deane-Butcher joined the pioneers a year or two later again. Adrian Lamb and Bob Lintern took up the procedure in Perth around1951.

By this time corneal transplantation came to Australia it was well established in Europe and North America. Because of the war Gibson and English were unable to travel overseas to learn the latest techniques. They kept abreast of the literature, as limited as it was in those times. They also had direct personal communication with international leaders in the field – Gibson with Filatov in Odessa, Russia, and English with Castroveijo in New York. After the war ended travel became easer. MacIndoe and Travers made regular overseas trips and established an interest and an understanding of the process from what they observed on their travels. Bill Deane-Butcher learned from travelling to Melbourne and observing Tom Travers.

The results of these early grafts were poor by today's standards. Patient were in hospital and immobilized for weeks and, according to contemporary reports, only about 20% left hospital with functioning grafts. Gradually the technical aspects of the surgical procedure improved. Initially grafts were retained behind egg membrane with the lids sutured together, later various indirect suturing techniques were employed, and later again direct suturing became possible.

Donor eyes were collected, somewhat haphazardly, from those dying in public hospitals. The procedure for collecting consent was also haphazard. Arrangements were idiosyncratic and organized on a personal basis between the surgeon and the junior hospital staff. Nothing much was written down. The donor graft was cut from the whole eye in the operating room at the time of surgery. These informal arrangements for eye donation persisted into the 1980's.

Corneal transplantation underwent a transformation in the late 1960's. This resulted from advances in technology. The next generation of surgeons after the original pioneers was the first to be trained in microsurgery. The operating microscope was first use in ophthalmology by Dr. Ken Swann in 1948 but it took some time for the approach to be widely adopted. Dick Galbraith was in the first wave of young ophthalmologists trained to use the microscope. After returning to Australia from Britain he worked principally as a retinal surgeon. He had travelled extensively in his training and had friends in the profession all over the world. A friend in the US sent him an early batch of 10.0 nylon which he used for corneal transplantation. He also had early access to strong topical steroids (prednisolone acetate 1%) introduced by Allergan at about the same time. These two products revolutionized corneal transplantation. The results were very much better than anything that had come before and Dr. Galbraith became a busy corneal surgeon almost overnight.

**Australian Personalities involved in Early Corneal Transplantation.**

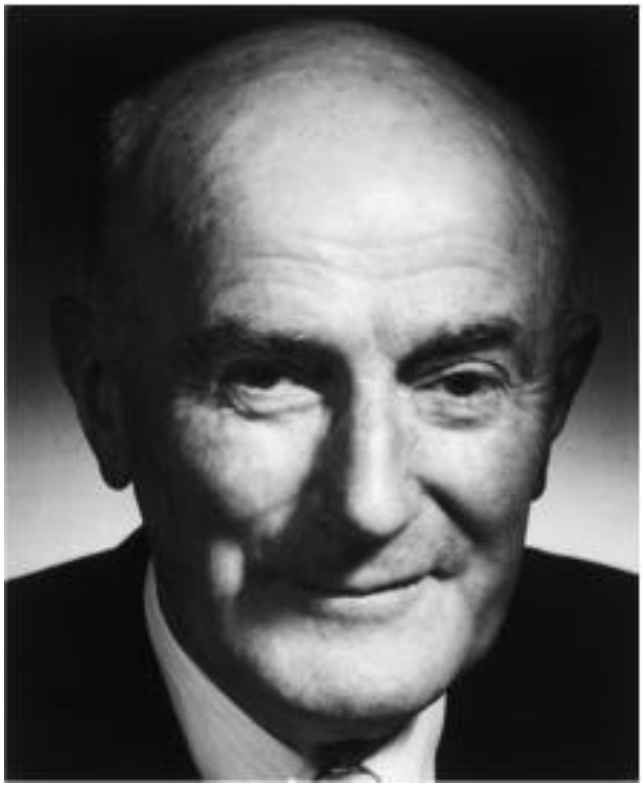
**Walter Lockhart Gibson.** The first reported case of corneal transplantation was done by Walter Lockhart Gibson in 1940 in Brisbane. Gibson had served as a gunner in the First AIF in France where he was gassed in the trenches but was fortunate not to suffer any long-term consequences. After three years in the military he returned to Australia in 1919 and was soon after discharged from the army. He then enrolled at The University of Queensland where he spent one year before transferring to Sydney University. There was no medical school in Queensland at the time. After graduating in 1924 he returned to Queensland and did a year as a resident at Ipswich General Hospital and then headed of to London to train in ophthalmology. On his return to Australia in 1927 he went into practice with his father, John Lockhart Gibson, in Brisbane and ran an independent practice in Ipswich. He also joined the staff of Brisbane General Hospital, the Repatriation General Hospital and the Ipswich Hospital. As well as doing the first recorded successful corneal graft in 1940 he was also a pioneer in retinal surgery. In 1931 he reported a case of retinal detachment cured by "Gonin's operation." This may have been the first successful retinal detachment operation in Australia as it came soon after Gonin's original exposition. He played at least one other pioneering role. In 1927 when he was a Registrar at the Royal Westminster Eye Hospital in London the London press reported the Dr. Walter Gibson had demonstrated a new device for examining the eye, the slit-lamp.

Where did this pioneering spirit come from? In Walter Lockhart Gibson's case it might have been genetic, or at least familial. His father, John Lockhart Gibson who had trained in Edinburgh, was one of the earliest ophthalmologists to practice in Australia. He also practiced pediatrics. Cretinism was a problem in some part of Queensland at the time and Gibson explored treating the condition with thyroid transplants, initially with donor thyroids from animals and later from human sources.

Walter Lockhart Gibson, like his father before him and his son Brian after him, played an important role in developing ophthalmology in Australia. John Lockhart Gibson was a foundation member of the Ophthalmological Society of Australia and subsequently President, as was his son Walter. Walter's son Brian Lockhart Gibson was later to become President of the College that grew out of the Society.

**Peter English.**

Peter English grew up in rural north Queensland. Borne in Goonegerry, near Lismore, in 1904, his family were involved in saw milling, farming and mining. His father also owned the local pub and Peter lived above the bar with his family until moving to Sydney to attend medical school. This was necessary because there was no medical school in Queensland at the time. He graduated in 1927 and after a few years in general practice moved to London for post-graduate studies in ophthalmology. His diaries reveal his exposure to the leading lights of the day: Duke-Elder, Lyle, and Lister amongst them. He was on a trip to Germany when the German troops crossed the Rhine. With the war imminent he returned to Australia. He took up practice in Brisbane but after a short time war was declared and he joined the army. It was when he was a major in the army that he performed a well-documented corneal graft in 1945 on a New Guinea soldier who had been blinded fighting with the Australians. The case received attention in the mainstream media and was the subject of a detailed report in the Australian Medical Journal in 1948. It is a remarkable report not only precisely describing the procedure but with many wise understandings of the biology of the process that were well ahead of their time. His assistant during surgery and a co-author of the paper was Dr. Jim McBride-White who would become a prominent Melbourne ophthalmologist after the war. Dr. Peter English was a highly skilled surgeon but he was more than that. He had a broad range of interests and associations and was highly articulate. He was an effective advocate for a number of causes including the establishment of eye banks. Through his writing and public speaking he was a prominent pioneer in corneal transplantation and eye banking, developing the first eye bank in Brisbane in the late 1940's.



**Sir Thomas a'Becket Travers.**

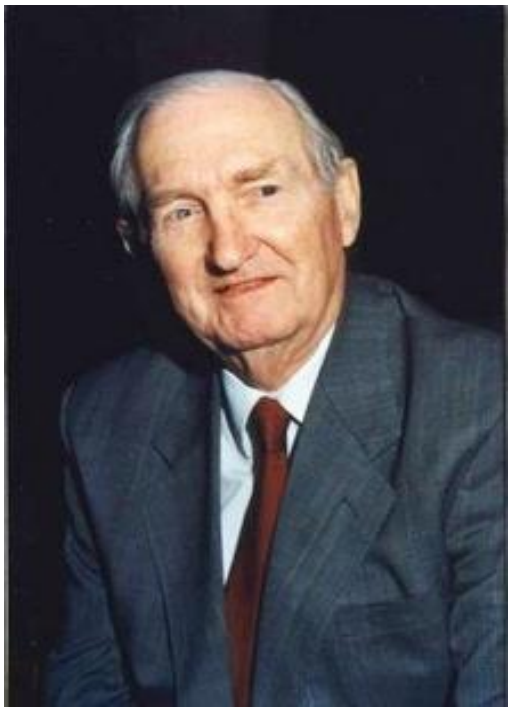
Thomas a'Becket Travers is a legend of Australian ophthalmology. His achievements were many and he was a pioneer of corneal transplantation. He had the family background, name, and social connections of a British aristocrat – and he was knighted in 1972- but he was not entirely in the British mold. He was part of the Melbourne aristocracy but when his friends drove Rolls Royces he drove a Cadillac, he wore snappy American ties rather than club ties, and suede shoes rather than brogues. He loved American things and urged young ophthalmologists to study in the US rather than Britain although he himself had been trained in the UK.

He commenced corneal transplantation in 1948. Always a "comprehensive ophthalmologist" he had established a reputation for his academic work in strabismus. Much of his continuing education came from regular trips to the US and this is probably where his interest in corneal transplantation was sparked.

The circumstances of eye surgery in 1948 were very different from today. Photographs of the operating room at St. Ives hospital from the time he was working there reveal the rudimentary nature of facilities. There was no operating microscope – Travers never used more than near vision (reading) glasses throughout his career. There were no suitable suture materials. Travers used egg membrane under tarsorrhaphy initially, then various patterns of indirect suturing before moving on to direct suturing with silk, 6.0 then 8.0. Donor eyes were collected from public hospitals but the legal control of this process was under the laws governing postmortems. The use of tissues from deceased donors for transplantation was novel with organ transplantation some years off.

Travers had a rare collection of attributes and advantages that enabled his pioneering role in corneal transplantation. He was a gifted surgeon with a reputation for being able to do things that others couldn't do. One person who saw him operate claimed he could "play a tune on an eye with a pair of Jaele's forceps and a Graeffe knife". In his time surgical prowess was relatively more important than it is today. The field has been leveled by surgical technologies. He was also imaginative and somewhat iconoclastic. This helped him develop new approaches to familiar problems. His Royal Melbourne Hospital appointment provided a source of donor eyes.

**Bill Deane-Butcher.** Bill Deane-Butcher was a pioneer of corneal transplantation in New South Wales.
He was not the first person to do a corneal transplant in Sydney,



Norman Macleod MacIndoe preceded him by a couple of years, but he soon had the busiest corneal surgery practice and was the most influential exponent of the operation. He graduated from medical school in 1937 and spent three years as a junior doctor in Sydney before joining the RAAF in 1940. He had a distinguished war career. After the war he trained in ophthalmology at Sydney Eye Hospital, receiving a Diploma of Ophthalmology in 1947 and joining the consultant staff in 1949. Soon after this he was anointed Head of the Corneal Clinic. Eddie Donaldson was at that time setting up specialist clinics at the hospital. He gave Bill the trephines he had bought back to Australia - and the job. He was expected to introduce corneal transplantation to the Sydney Eye Hospital. To this end Donaldson arranged for Bill Deane-Butcher to visit and observe Tom Travers in Melbourne. He made two trips for this purpose, separated by just a few weeks, at the beginning of his corneal grafting career.

Bill Deane-Butcher was a gifted surgeon. In his time only talented surgeons could carry out complicated procedures and having a “good pair of hands” was enough to build a career on. However, Bill had much more than this. Like his contemporary in Melbourne, Tom Travers, he was creative and imaginative. For example he recognized the need to fit contact lenses well – most of the grafts, and certainly the successful grafts, were for keratoconus. Bill was an excellent lens fitter and lathed modifications to the hard lenses himself when they were required. He was an excellent administrator and organizer. For example, he used human hair for direct suturing of grafts. Having noticed that hair from Asians was better than European hair for this purpose he was careful to ensure that there was always a Chinese nurse on the operating room staff at the Sydney Eye Hospital. He was also involved in the eye bank and no doubt used his considerable influence to ensure the law governing anatomy and post mortems was modified to include provision for tissue transplantation.

**Eye Banking in Australia.** Availability of donors underpins all transplantation. There can be no transplantation without donors. Development of systems for managing donor matters has been as remarkable as the development of corneal transplantation itself and every bit as important.

When corneal transplantation was beginning in Australia in the early 1950s the collection of donor corneas was completely *ad hoc*. Eyes were removed from deceased donors in public hospitals. Consent was obtained by telephone and nothing was written down. This activity came laws governing post mortems and was controlled by the hospital administrators who oversaw this sphere of activity. Some were helpful; others were not.

Corneal transplantation began before other forms of clinical transplantation. When the procedure was first practiced in Australia the relevant laws addressed the removal of tissues as part of a post mortem but not for transplantation. An early requirement was an act of parliament to include the removal of tissues for transplantation. This was achieved in Victoria and New South Wales to begin with. Other states followed. These laws operated until the early 1980's when developments in organ transplantation caught up with them. During the 1970's organ transplantation – kidneys, hearts, lungs and liver – became commonplace. With this came the need for more donors, including beating heart donors, and intensive care wards were put under pressure. The existing legislation did not accommodate this approach and the law needed to be changes again to protect prospective donors and the staff involved in organ harvesting. A change in the relevant law was proposed and the organ transplantation organizations were involved in drafting the new legislation. Nobody in corneal transplantation had been consulted and the proposed law reflected this. Corneal transplantation could not go ahead with the law as proposed. For example, the law demanded that those harvesting tissues, including corneas, be medical graduates with five years post-graduate experience– existing practice for organ transplantation but prohibitive for corneas. At the eleventh hour the law was redrafted in South Australia with a set of rules for corneal donation different to those concerned with organ transplantation. An Adelaide ophthalmologist, David Tonkin, who had been Premier of South Australia, assisted in drafting the legislation. The new law was quickly adopted in other states and in some overseas jurisdictions.

One of the reasons corneal surgeons were not consulted when laws governing transplantation were considered by governments and other authorities was corneal transplantation had no common voice. This was not corrected immediately.

Eye banking in Australia when the first corneal grafts were done was rudimentary. Gibson had a working relationship with the mortuary staff in Brisbane but this type of arrangement was never going to provide the material required for the anticipated up-surge in corneal transplantation. The first eye bank in Australia was established by Peter English at the Mater Hospital in Brisbane.

He was active in articulating the need for the facilities and spoke to many Rotary clubs and other service organizations when he was campaigning for funds. The bank was established in the late 1940's. Soon after there was a designated eye bank in the Sydney Eye Hospital and the Royal Victorian Eye and Ear Hospital. These were very informal arrangements without dedicated staff. They relied on ophthalmology trainees to do the collecting and pathology staff to supervise storage. Whole eyes were stored in a moist pot in a domestic refrigerator. Distribution was principally to staff of the hospital and associated private hospitals. Access to donors was minimal. Many surgeons obtained donor eye from other sources. The majority of eyes donated for corneal transplantation came from large public hospitals where they were collected by junior medical staff and distributed directly to surgeons as requested. This was an extremely informal arrangement with little if any safeguards and exposed donor families, recipients and staff involved in "harvesting" corneas to risk.

It was these sorts of arrangements that prompted R. Townley Paton to establish the world's first eye bank in New York City in 1944. He was aware of the need to formalize the consent process, as well as the harvesting, storage and distribution arrangements. He also appreciated the need for good public relations, both to encourage eye donation and raise money. The first blood bank had been established in 1936 in Barcelona, and Paton shrewdly latched on to the public interest generated as blood banks were established around the world. The development of eye banks paralleled blood banks. In the early years there was public resistance to the idea of post mortem donation for transplantation. Executed prisoners at the notorious Sing-Sing Prison were a major source of "donors" for Paton's eye bank in the early years. It would be some time before a similarly comprehensive arrangement for eye banking was established in Australia.

The first Eye Bank and Cornea meeting was held at Flinders in 1982. The first modern and comprehensive bank in Australia had been created there in 1981. This bank, with dedicated staff, formalized consent and collection procedures, used a variety of storage mechanisms with quality controls, and ensured transparent and equitable distribution arrangements. A small number of people from all states who were interested in discussing and exploring these matters met each year in Adelaide to consider issues of common interest. The meeting grew steadily. Almost thirty years later it became the Cornea and Eye Bank Society Meeting and one of the largest subspecialty meetings in ophthalmology in Australia. Despite the humble origins the meeting found a common voice about corneal transplantation and eye banking and this was formalized as Eye Banks Australia (later Eye Banks Australia and New Zealand) in 2003. From the early 1980's until today corneal transplantation has progressed from having no common voice and being disregarded by the transplantation community, to the most organized with one voice and a collection of data about outcomes that is envied by other groups.

The common voice was needed. In the mid 1980's the government took over control of eye banking practice. It did this by handing over regulation of banks to the Therapeutic Goods Administration (TGA). Their regulation was tight but not always based on science. The common voice in eye banking and the combined resources of all the Australian banks ensured regulations were compatible with best practice. These were difficult times for eye banks. The other threat to good practice from this period was the government policy of "user pays." Regulation of eye banks cost money and those involved, eye banks, insurance companies and sometimes patients were expected to pay. A dollar value was put on eye bank services that eroded the altruism of corneal donation.

From the beginnings of corneal transplantation in 1940 until the 1980's the donor end of the transplantation changed very little. Donor eyes were enucleated, put in a jar with some wet gauze in the bottom, and distributed directly to surgeons who had requested them. This approach was referred to as "moist pot storage'. If the pot was placed in the refrigerator at around $4^0$ C could be stored for 48 hours. Around 1980 tissue culture medium was introduced as a storage medium. The cornea with a rim of sclera was excised, placed in the medium, and stored up to 7 days. More recently organ culture systems have been used by some eye banks. This approach can extend the storage period out to three or four weeks. With new approaches to donor storage in eye banks, and evolution of new alternatives for surgery there is a need for real time evaluation of results.

The Australian eye banking community has outstanding data on the outcome of corneal transplants done with corneas distributed by the banks – all the corneas transplanted in Australia. This data is held in the Australian Corneal Graft Registry (ACGR), the largest collection of data on corneal transplantation in the world. The ACGR was formed in 1983 and grew out of the quality control system of the Eye Bank of South Australia. It currently follows around 25,000 grafts done across the country with some grafts followed for thirty years. This data has been invaluable when making a case about eye banking practice to authorities, providing feedback to surgeons, and information on outcomes to patients.

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