

# The Making of a Broadcasting Engineer by Neville Thiele

---

The following article was written by Neville Thiele (1929-2010), one of Australia's leading audio design engineers, and the brother of veteran Australian radio and television actor Leonard Teale.

My brother Len and I were both a great disappointment to our father, Albert, or Bert as he was known. His grandfather Charles (Carl ?) Thiele had emigrated from Hannover in Germany to Hamilton in Bermuda and worked in the Naval Hospital there. His two uncles had both become doctors, one at Aberdeen University, the other with the British Army in India. But his father George was a mere pharmacist. Bert topped his year, with a gold medal, in the first Technical College examinations in Queensland for pharmacists, when they were no longer trained as apprentices, but when his father died in 1915 he had to take over the family business in George Street in the heart of Brisbane, and he was a frustrated doctor for the rest of his life. Doctoring, he believed, was the noblest activity that anyone could aspire to, and he was determined that his sons, at least, would take up the profession.

However he had another passion in life, singing. He had sung as a chorister in St. John Anglican Cathedral and later with the Brisbane Apollo Club. In 1919, he married Maude, the daughter of another pharmacist, Niels Rasmussen, whose shop, about 50 metres away in Ann Street, was one of a successful chain that Niels younger brother, Hans Peter, had built up rapidly after their immigration in the 1870 from Haderslev in Denmark, trading as Herr Rasmussen (sic!) The Danish Herbalist. When Niels died in 1922, Bert took over his business as well, but he lost them both in the Great Depression of 1929.

It was then that he eked out a meagre living, as a locum for other pharmacists who were sick or on holidays, by singing at RSL mokos? songs that Peter Dawson was making famous, like Kipling Barrack Room Ballads, and reciting the poems of Henry Lawson, Banjo Paterson and Robbie Burns. And he trained his two sons as singers also. Len and I found out long afterwards that we had achieved some distinction, notoriety perhaps, at Milton State School concerts from our performance as a duet of a sprightly Italian song, Funiculi Funicula, that was originally a musical advertisement for a new funicular railway up the slopes of Mount Vesuvius.

So by the time that Len was 10 and I was 12 we were quite experienced performers, at school concerts in choirs and as soloists, at amateur hours at the Theatre Royal in Elizabeth Street and at musical soires in friends living rooms on Sunday afternoons.

By this time, in the early 30s, radio in Brisbane was about six years old and trying to be all things to all men. Even small commercial stations performed radio plays, sometimes playlets, written often by local writers. They broadcast music by local ensembles, and on Saturday mornings a couple of hours of community singing from the local picture show? On some Saturday nights, several hours from the wrestling or the local dance hall, anything to provide on-air entertainment, especially if it cost the station little or nothing to produce. On 4BC, Dr. Goddard gave talks on current affairs at 6.30 every Sunday evening, explaining among other things how Herr Hitler was very much misunderstood. All he wanted was the return of Germany colonies, something that every European nation had a right to own and had been stolen from her after the first World War. All Germany wanted was lebensraum - space to live in.

And every afternoon between 5 and 6, all the radio stations broadcast children sessions? with comedies called almost invariably Uncle George or Auntie Mabel, presenting games and competitions for the kids and with children performing. Len and I somehow came to perform in them, singing songs that Father had taught us, Sweet and Low, Schubert Serenade?.

The commercial radio studios that I remember were simple rooms on the first floor above a shop, rather longer than a suburban lounge room, most probably converted from a storage area. At one end was an announcer console with two, sometimes three, gramophone turntables and pickups and a microphone. Down the other end was an open space for artists, with an upright piano, sometimes even a baby grand. Through the control room window the technician, or engineer? had a four-way mixer, a meter for checking levels that needed constant vigilance in the days in those days before peak limiters, keys for switching circuits in and out, and a patch field with patch cords dangling across it, accessing the lines for local broadcasts from churches, theatres, sports grounds and racecourses.

The Western Electric pickups, developed for the sound-on-disc installations of the early alkies? clearly showed their ancestry from acoustic gramophone players. The steel needle, a new one for each playing, was screwed into a chuck mechanically coupled to a magnetic armature where the mica diaphragm of an acoustic gramophone would have been. Their straight arms, more than 30 cm. long, and turntables of large diameter, were designed to play the 16 inch coarse-groove discs of the first earliest alkies? At 33 1/3 rpm, they ran for somewhat more than the 10 minutes of a standard reel of 35 mm. film, and fitted nicely into the 12 minutes 40 seconds format of quarter-hour transcriptions of serial dramas that soon became known as soap operas? so-called after their earliest advertisers, that soon became a staple item of commercial radio programming. Initially they came from the United States, but Australia soon would build up its own thriving industry.

4BC had a 16 inch turntable that used apparently one of the early synchronous motors that had no starting winding so, to start, it had to be spun up to speed by hand. It could be started just as easily in the opposite direction, and play the programme backwards for an allegedly humorous effect.

In those days, the Brisbane stations used two kinds of microphone. AWA supplied Marconi-Reisz microphones, made of a block of marble about 8 x 6 x 4 cm with a shallow depression hollowed out of the front. At either horizontal end of that depression sat two vertical carbon rods, connected to screw terminals on the rear of the block. The depression was covered by a mica diaphragm and filled with polished carbon granules. These quite simple resistance microphones, devised in 1924 for the Reisz Laboratory by the young Georg Neumann who achieved fame later with his condenser microphones, were surprisingly effective, reproducing frequencies to above 7 kHz, and were widely used by Australian broadcasters in the early 30. They were usually hung from a leather strap inside a ring of plated steel. They needed a D.C. polarising source, of course, and inevitably produced some background carbon hiss?

I made up two of them later from a kit, which substituted a block of teak for the marble, and when I measured the surviving one recently it read precisely 600 ohms. A collector of microphones told me once that his Reisz had never worked. He wasn't aware that it needed a battery in series with its input transformer.

The other type was the condenser microphone. I remember it as being supplied by Western Electric though a very similar one was made by RCA. A 15 cm black cube enclosed a 3 valve amplifier and the condenser capsule peeped out from a circular hole on its front face. When our quartet from the Brisbane Grammar School Choir broadcast on 4BH, it seemed that the station had only one such microphone. For our broadcast, the announcer lifted it from its place over his console and carried it gingerly to a large wooden tripod down our end of the studio. Condenser microphones had a reputation for quality, but they were expensive and a studio could not afford to have many, or even several.

The early condenser capsules produced great peak responses at their top frequencies. There was a story in the 40, apocryphal perhaps ?, that when ways were finally found to safely tension a condenser diaphragm tighter so as to lift its resonance higher, and to tame its peak, users found that its less bright sound less acceptable, so they lifted its high-frequency response again, this time with an electrical network, an equalizer. That, so the story went, was the genesis of a standardised high frequency pre-emphasis in American recordings.

The ABC also used these condenser microphones in their studios. It was in 1933, shortly after the Australian Broadcasting Commission had replaced the Australian

Broadcasting Company. We lived at Milton, less than two kilometres from the ABC 4QG transmitter, sited with its studios on the top floor of the State Insurance Office on the corner of George and Elizabeth Streets in the middle of Brisbane. We bought our first valve radio, an Astor Mickey Mouse, in 1935, but before that we listened to radio on a crystal set that Father had built in a cigar box. Cigar boxes, made of a soft scented cedar and readily available, were put to all sorts of uses in those days. The crystal was a chunk of galena, a shiny dark grey-blue lead sulphide mineral, and the radio frequency signal was detected i.e. demodulated, by the junction of the galena with the sharp end of a brass wire, nicknamed a cat whisker? To use it, you explored the surface of the galena with the cat whisker until you found the spot that gave the strongest signal. Once you did this, with our receiver and our aerial slung up to one of the gum trees in the backyard, it produced a grand sound in the headphones. But it was finicky, and the slightest shock, a heavy footfall in the room for example, would lose the signal and you had to start searching for that sensitive spot all over again. Not good for family harmony. But, so long as the cat whisker held that spot, the ABC came in at fine strength, on Sunday afternoons for example, when they broadcast the band concerts from a rotunda in the Botanic Gardens.

And the ABC had a wonderful children session. We were impressionable; of course, my brother Len and I, but we loved it. English actor Captain George Randall and his wife, Brisbane's own Babe Scott, as Cap and Babe improvised a Children's Session for an hour every afternoon from 5 to 6, Monday to Friday. George played himself, Cap, a rather up-tight Englishman. Babe played the gentle sweet-voiced Auntie Dot. But there were two other characters. One was Babe, The Awful Child? *Babe rumbustious alter ego*, in fact. Babe was the half-sister of George Wallace, the great vaudeville performer, and she shared his wonderful inventiveness and wicked sense of fun. The other character never said a word, just ejaculated a fearsome roar from time to time. He was an ogre monster, and they called him Thomas John. For a reason that Len and I could never understand, Father considered this Thomas John in very poor taste. But we thought it all marvellous.

One Saturday morning, Len and I went to a show in Brisbane great new City Hall where the ABC had invited all the listening children to meet Cap and Babe. When the show finished, children were invited to come up on stage and meet the celebrities in person. Len and I, then aged 10 and 12, resolved to go up and ask them did they want singers in their show. We joined the queue of kids, but when we were only about three away from them, my courage ran out. can? I said, scared? Len burst into tears. But you promised? And he shamed me into it. We asked them, and to our delight they said yes!

We joined them several times in the small studio. You approached it through the larger studio which had Grecian pillars, potted palms and a grand piano. But in the

small studio, there was no accompanist, no piano, just us singing a cappella. And the joy of standing in that studio, just us and these wonderful people ad-libbing, making fun for the whole hour ! Babe, once in danger of losing her voice, sucking half-lemons and hurling them across the microphone at George ! That settled it. Now we knew what we wanted to do with our lives. Perform in Radio !

All too soon, of course, our voices broke and we were boy sopranos no longer. At first, we thought we would become announcers. Then, I forget how, we had the chance, at the ages of 16 and 18, to join the Dulcie Scott Players, a small radio repertory company that performed half hour plays on 4BH every Saturday night at 8.30. The scripts came from the United States and often had to be edited severely to make them intelligible to an Australian, well a Brisbane, audience. We weren't saturated then with American culture and habits of speech and thought.

By 1939, 4BH had moved its studio from the single long room above Harrington music shop in Queen Street to a new, quite palatial, suite of studios where 4BC had been before, above Chandler white goods shop in Adelaide Street. Its three studios were on two floors; the master control room and presentation studio were on the first floor and the two others, one of them the drama studio, on the second floor.

The microphone we used for plays was an Altec Lansing Saltshaker. Its cylindrical body was about 10cm long with hemi-spherical ends. The top hemisphere was pierced with holes, hence Saltshaker? It was omnidirectional at low frequencies but became directional at the highs, so announcers spoke directly into its axis. But for drama, it sat vertically with a small circular horizontal baffle, about 5cm. in diameter, perched on top. This made it omnidirectional at all frequencies, and actors and sound effects operators could work all around it. It produced some high frequency lift, sounding quite bright.

A buffer surrounded the microphone, a circular table a metre in diameter, at chest height, with green baize on top, a large hole in the middle for the microphone on its stand and constructed in four quadrants for easy disassembly and storage. Actors performed standing around this buffer with their scripts on the baize top, very careful at the end of each page to gently pull it away and let it slip silently to the floor.

The studio walls were lined with Caneite, made then from compressed bagasse, spent sugar cane fibre from the sugar mills, but made nowadays from pine sawdust. The purpose was of course to improve the acoustics- to reduce the reverberation time. Caneite absorbs high frequencies fairly well, but it is less effective at low frequencies, so it gave the sound in the studio a somewhat forbidding low frequency coloration. This feeling was reinforced by its colour. New Caneite was a pleasant light straw colour but after a couple of years it changed to the dark brown of old newspaper.

Again, Dulcie Scott, our producer, was out of sight in her control room. We found later that in other studios the producer communicated with the actors through a control room window, with waving arm and hand signals. But we had only a little red light on the top of the microphone to tell us when we were n air?

Introductory or segue music, and recorded sound effects, not as effective as we would have liked because the 78 rpm shellac discs contributed inevitably at least a hint of surface noise? or scratch were played from the producer control room. They were not fed to the actors. I never understood why; it was a convention that we simply accepted. We just stood waiting in frozen silence until suddenly the little red light came on and we had to emote instantaneously.

To fade into the distance, an actor simply walked backwards into the boxy acoustic of the studio. More fortunate actors, in the ABC for example, worked on ribbon microphones like the RCA 44BX, where you faded away simply by moving a couple of steps sideways into the dead area of the microphone.

We made our own sound effects whenever we could, the classical pistol shot made by hitting a pillow with a ruler, horses hooves produced by beating your chest ?we had no coconut shells. In one play, set on a sinking ship, there was no spoken part for me, so I handled the sound effects, sloshing water on cue in a tin dish that sat on the microphone buffer.

We learnt a lot about our craft, but realised that we had much more to learn.

After 9 o'clock, after the play and the post mortems on our performances had finished, I often stayed in the control room talking to the technicians, absorbing all I could about the technical side of this magic medium. I was invited to go with the technician to the outside broadcasts of the Wurlitzer organ, that 4BH ran for half an hour from 10.30 on Sunday mornings, from the Regent Theatre. I knew the Regent well, going to the pictures there regularly of a Saturday afternoon. Then it was full of light and people. At one stage, the Regent ran 50-50 shows, a feature film alternating with live vaudeville. I found much later that Sir Ben Fuller had a great company of vaudevillians under contract when their theatre closed. It was during the Great Depression, of course.

Len and I were entranced, watching Ella Shields, ala Impersonator Extraordinaire? performing her famous Burlington Bertie sketch, promenading along the footlights in her dinner suit singing *Burlington Bertie*, *I rise at ten thirty*, and *Buckingham Palace I view* - and wearing a thick make-up aimed at the back row of the theatre but grotesque from our seats in the front row. She would be followed by sketches featuring Brisbane own incomparable George Wallace, "the Boy from the Valley" a

blatant ocker with big wide eyes and a warm heart, in knockabout sketches, gloriously unsubtle. We loved the theatre.

But that was on Saturday afternoon. On Sunday morning the big empty theatre was cold and dark, one bare lamp over the organ console and another for the technician, me and the outside broadcasting equipment that we had lugged from the taxi.

Two telephone pairs connected the Regent to the studio, one for the programme, the other for a telephone and for folding back the station programme during the broadcast to cue us and the organist when the studio announcer had finished his introductions. On the front panel of the outside broadcast (OB) amplifier, a switch enabled us to swap lines if ever there was a fault on the programme line.

I learned all kinds of broadcasting lore from the technicians. One, for example, was that the tinny sound of the chimes from the City Hall clock, broadcast on the hour by the ABC, was picked up by a headphone hung in the tower among the bells. A headphone could serve as a microphone, not a very good one but it generated enough voltage from the great clanging of the bells to feed the studio 500 yards away without an amplifier, and if it was soiled by pigeon droppings or the weather, no matter.

But the ABC was special. It brought us programmes, plays and music from all over the country. On one notable night, we heard the violinist Bronislaw Huberman performing in Melbourne. In Melbourne! And we could actually hear it in Brisbane.

Well, most of the time. At least one programme transmission channel was carried by a special system that I believe was an STC type MO-1. Some long-distance systems simply used the physical spectrum of the open-wire lines, from 50 Hz up to 7.5 kHz, with amplifiers and equalizers every hundred miles or so, but most connections were by carrier-wave systems, that transmitted several channels, telephony or programmes, on the one pair of wires, as were telecommunications systems in general starting in Australia around 1933. The signals were amplitude-modulated on a carrier, just like AM broadcasts, but for transmission on the open-wire circuits, one side-band and the carrier wave were suppressed so as to fit more signals into a given bandwidth and to avoid the distortion that results when the two side-bands suffering different attenuations are demodulated together. At the far end, each signal was demodulated with a fresh carrier that was generated locally. Its frequency was nominally the same as at the sending end but not synchronous with it. Thus all the components of each signal were inevitably frequency-shifted a little up or down, usually less than 5 Hz. This distorted the signal a little, negligibly so in the telephony frequencies between 300 Hz and 3400 Hz, but for broadcasting, whose audible range extended down to 50 Hz, that distortion was sometimes audible.

To avoid this, the STC system MO-1, which used the spectrum available on the open-wire lines above the 32 kHz limit of the 3-channel carrier telephony systems, did synchronise the carriers at the sending and receiving ends. At the sending end, the programme signal was modulated on a 42.5 kHz carrier and its lower sidebands transmitted between 34 kHz and 42.5 kHz. The original carrier was suppressed, but another carrier, whose 34 kHz frequency was firmly locked to it in the ratio of 4: 5 and transmitted at a low level. At the receiving end, that small pilot carrier was used to firmly lock a locally generated carrier in the ratio of 5: 4, which then synchronously demodulated the received signal.

Unfortunately though, that firm lock would occasionally become unlocked. Then the local carrier would drift away a few hundred Hertz from its intended value. The whole rhythmic structure of music would remain, but the pitch of the notes, and with them the melody, became hopelessly garbled. When my brother Len became a relieving week-end announcer on the ABC, driven to work early in the morning in a Commonwealth car!, we learned that being duty announcer on a Brisbane station that relayed a lot of programmes from Sydney for an hour or so at a time, had its perils. The duty announcer, after a heavy night, might have gone to sleep at his console when his cue came for a local announcement.

At one stage, Len was presenting complete operas on Saturday afternoons from large sets of gramophone records. With each side of a 12 inch 78 rpm record playing 4 minutes 20 seconds at most, this could mean playing as many as 14 sides, even if the opera had been abridged to an hour. The records come in special sets with automatic coupling so that the opera could play continuously. Sides 1 to 7 for example, would each be on one side of a different disc. Then side 8 would be on the rear of side 7, side 9 on the rear of side 6 and so on. Thus there need be only one break in the whole presentation.

But that continuity depended critically on the announcer. He had two turntables. With one disc playing, he would run up the beginning of the next on his cueing headphones until he heard the music start, stop it with the needle still in the groove and then run it backwards for a small amount that he judged appropriate to the running-up time for that motor. Then at the end of the previous side, he started the new disc and cross-faded for what he hoped would be seamless continuity. It needed the utmost care. With any misjudgement, the second motor might be, too often was, still running up to speed when the music on the new disc started on-air swooping up to its proper pitch. Add to that the problems of pronouncing foreign names correctly, that the ABC insisted on, such as Czech for Smetana he Bartered Bride? So an announcer preparation included research in a pronouncing dictionary. Presentation of the Saturday afternoon opera could be nerve-wracking.



And in radio plays, if the script called for a reverberant acoustic, in a cave or a great cathedral, which writers often used to add colour. How could you produce it, in the days before electronic reverberation devices? One method was to feed sound to a loudspeaker and a microphone in a stairwell, but there had been an unfortunate experience with a drunken miscreant sleeping in the stairwell who, on being awakened suddenly by the loudspeaker, had contributed some unscripted, very colourful, content of his own. In Brisbane, the whole cast simply repaired to the men lavatory for the scene.

Len and I had tried producing our own radio shows at home. One Saturday afternoon, when our parents were away at the races, we tried out a scheme that we had read about in a magazine. A headphone, it said, can serve as a microphone and if you connected it between the metal chassis and the grid cap of the first audio valve of a radio receiver, you can make your own broadcasts. When we tried it with a short connection, with the microphone near the radio, it seemed a dismal failure. But when we persevered, this time with a long flex from a microphone now in the next room, it worked weakly, but it worked. So we stuck a paper cone, like a megaphone, on to one microphone to produce more level from the announcer and shoved the other up the horn of our Edison Diamond Disc gramophone. We connected the two in series and arranged to short-circuit one or the other with a knife switch that Father had bought to switch the long aerial wire from our crystal set to earth during Brisbane summer thunderstorms. With the knife switch in mid-position, both microphones were open and the announcer could talk over the record. We soon discovered that even the simplest programmes need careful preparation.

As a small boy, Len had stammered; not an encouraging start for a budding announcer or actor. But we read, in the *Queenslander* magazine as I remember, that you could prepare yourself for a radio career by reading aloud from the newspaper for half an hour every day. I didn't but Len did, and when I came home from night lectures at Queensland University, Len would be sitting on his bed meticulously reading out loud.

We were also told, the *Queenslander* again ?, that if you cared about your craft of radio ?and we cared very much - you would have your voice recorded so that you could hear how it really sounded, not that warmer, more pleasant, sound that you hear yourself conducted to your ears through the bones of your head, but the thinner sound that everyone else hears and that mortifies you when you first hear it played back. But how? We couldn't afford to go to a recording studio. Then Alan Denby, one of our Dulcie Scott Players, suggested that we might build our own recording system.

It seemed a wild impossible idea at first, but in the end we tried and, rather to our surprise, succeeded. I had put together two my own Reisz microphones, like the

ones I described earlier. For a cutting head, we attached a gramophone pickup to our Edison phonograph, and pumped 6 watts of audio into it. Edison Diamond Discs were cut with the stylus vibrating vertically, rather than horizontally as in gramophones, so their phonographs included a traversing mechanism that guided the sound box radially across the disc. We bought ourselves a cutting needle and a couple of acetate discs and recorded our voices. We tried ourselves out with all kinds of material - Henry V speech before Harfleur.. *“Cry God for Harry, England and St. George”*. Abraham Lincoln Gettysburg address – *“that Government of the people by the people and for the people shall not perish from the earth”*. Dryden’s Ode for Saint Cecilia Day *“From harmony, from heavenly harmony, this universal frame began..”*

But the piece that we loved best was Henry Lawson story the Loaded Dog? Len spent hours, lounging on our veranda during hot Brisbane summer Sunday afternoons, reading it over and over into the microphone while I adjusted the equipment. As a result, we soon found out that Len was much the better performer and I was better at handling the technical problems. Those intense days started us both on careers that started with radio and audio.

After returning from wartime service with the RAAF, Len went on to a distinguished career as an actor and narrator in radio, television, films and recordings of Australian poetry and songs. He changed the spelling of his name to Leonard Teale after journalists continually mis-spelt it.

However, recording equipment cost money. After losing his chemist shop during the Depression, Father was earning a precarious living as a locum relieving other chemists when they were sick or on leave. I was earning 30 shillings a week, half the adult wage, as a junior clerk in the Commonwealth Bank. So we had to be very careful about spending anything, let alone on recording equipment, and I developed the habit of designing on paper and calculating, as best I could, everything that was needed before we embarked on any purchase.

We soon realized that our recordings were deficient in frequency response, but the standard source of signal for measuring it then was a beat-frequency oscillator. The outputs, one of an oscillator with a fixed frequency, say 50 kHz, and another with a frequency that could be varied from the front panel, say from 50 kHz to 65 kHz, were mixed and the lower of the resulting pair of beat frequencies? from 0 to 15 kHz, filtered to provide a very respectable sine-wave output. But such a device was beyond our means - and our understanding - so we purchased instead a 12 inch 78 rpm shellac est record? The Decca Z718 disc was recorded in 14 discrete bands of sine waves extending from 50 Hz to 6 kHz, which served our purpose well, apart from a little surface noise?

We could not measure directly the signals recorded in the grooves but the Buchmann-Meyer test provided a sensitive assessment of their lateness? i.e. their consistency from one track to the next. When a sequence of tones is recorded on a disc and a light is shone across the resulting set of tracks, the width of the light reflected from each groove is proportional to its signal level, or more properly its recorded lateral groove velocity. When this response is flat across the audio spectrum, the light beams reflected from all the bands are of the same width. Thus I soon found where our recordings were deficient.

As a result, I became fascinated by electrical networks, equalizers, that offered the promise of improving the frequency response of our recordings. My calculations led me to a simple electrical network, the bridged-T, that showed some very useful properties as an equalizer. Had someone else discovered it before me? Probably, but I didn't know. I have found no reference to it before January 1942, when I sent a short paper about it to Amalgamated Wireless Australasia Ltd (AWA), whose publication Radiotronics was the only serious publication on radio that I knew of then.

I was by then in the Army, in an infantry battalion and trained as a machine-gunner, but having just topped a wireless mechanics course at Victoria Barracks in Brisbane. The Army school wanted to retain me there to teach other technicians but my battalion insisted that I return to it in Townsville, from where we were obviously going to New Guinea. I thought that my chances of returning from New Guinea would be rather slim, so I wrote a paper describing the network and sent it to AWA in the hope that, if I couldn't use it, someone else might. To my surprise, I received an answer from AWA Patents Department. More than 30 years later, when the AWA Research Laboratory was disbanded, my friend Ernest Benson gave me a copy of my paper that he had rescued from the Laboratory archives. My hand-written paper had been typed out and my curves and diagrams copied neatly, with the initials J.E.B. Recd. Jan/Feb 1942. I found out later that AWA had wanted to have me released from the Army to work on their radar research, but nothing came of it. To understand why their attempt failed, we must go back a few years.

Through our interest in performing and so frustrating Father's hopes that we might become doctors, Len and I had become involved in little theatre. I had won one of four available scholarships to Brisbane Grammar School, and at the end of my studies there had won one of twenty available scholarships to Queensland University. But I couldn't accept it as a full-time student. The living allowance that went with it was 26 a year. My parents' marriage was falling apart, they divorced in 1943, and I now had to support my Mother. In 1937, at the tail end of the Great Depression, jobs were still hard to find, and I had counted myself lucky to land a job with the Commonwealth Bank.

It was deadly boring work - extracting a thousand loose-leaf ledger leaves from the files every morning, taking them to the girls upstairs who machine-posted the transactions on them, and then sorting the thousand leaves back into their files again in the afternoon. The Bank at least encouraged its staff to undertake tertiary education, but when I suggested Engineering, they were highly unamused. Their attitude was *"You are interested in mathematics. The Bank needs actuaries!"* So I enrolled for a Bachelor of Commerce degree, evening classes at Queensland University. Essentially it was an Arts degree, including Mathematics and majoring in Economics with Accountancy thrown in.

As part of student life, with only 750 students at Queensland Uni. at the time, I took part in the University Revue, or Burlesque and was drawn into other little theatres, Brisbane Repertory Theatre, Brisbane Arts Theatre, Brisbane Shakespeare Society and others. The Dulcie Scott Players presented stage performances also. With the start of the War, there were patriotic pageants in Brisbane great City Hall, for which I read voice-over narrations, over-blown jingoistic pieces they now seem in retrospect, such as:

*Britain myriad voices call Sons, be welded each and all into one Imperial whole. One with Britain, heart and soul. One life, one flag, one fleet, one throne, Britons, unite and hold your own!*

Somehow, I fitted them in with my University studies, all in a hunger for acting experience.

Alec Robertson, my best friend at Brisbane Grammar, had joined the Communist Party. He went on after the War to edit Tribune, the Communist Party newspaper and he introduced me to the Unity Theatre, a left wing group that put on anti-capitalist and anti-war satires. Some of our members were Communists. The rest of us were interested mainly in another lively little theatre group.

I for one shared their passion for social justice, I still do very much, but we had endless disagreements about some of their ideas, the perfectibility of socialist man and the dictatorship of the proletariat. In Economic History at the University, I had studied Karl Max along with Adam Smith, David Ricardo and other influential thinkers on economics, but on trying to read Das Kapital found it turgid and uninteresting. No one ever suggested that I join the Communist Party and I was not interested anyway.

Alec suggested that I see one of the Unity Theatre performances, a scarifying American anti-Nazi play "Until the Day I Die" that they performed in a small hall at Kedron. It affected me deeply. When I think of it now, it still does. So I joined the theatre and was soon, rather to my surprise, given a good part in a play Cannibal Carnival, a marvellous satire on capitalism and colonialism in the South Seas. The

Brisbane newspapers reviled it and stories circulated that there were police in the audience, looking for an excuse to ban it. But to the audience and the cast, it was a great joyous romp, with worthwhile things to say amongst the fun.

Then one day at the Commonwealth Bank, I was called to the Chief Accountant office and told that I was to be transferred immediately to Mackay, about a thousand miles North of Brisbane. Why? To take me away from undesirable Communist influences in the Unity Theatre, he said. What had happened actually though was that I had shown a considerable interest, and that interest was returned, in a girl whose father was a Major in Military Intelligence, the precursor of the Australian Security Intelligence Organisation (ASIO) in allegedly fighting subversion. He didn't like me and wanted me out of the way. He reported to his masters that I was a dangerous Communist.

In the end though, I persuaded the Commonwealth Bank that it was all nonsense. I had good friends who were Communists, but I had no interest in joining their party, and in any case I was my Mother sole support. So I remained in Brisbane until I joined the Army about a year later, but the dossier that the Major had concocted about me remained on someone file, and afflicted my life severely over the next ten years. If you have done nothing wrong, you have nothing to fear is the cruellest of lies. Once a lazy, incompetent, ambitious or malicious policeman has reason to target you, your chance of justice is in jeopardy. And secret police are the hardest to bring to account. I cannot prove that the dossier affected the decision to deny AWA request for me to work on radar research, but more was to come later.

After the wireless mechanics' course that I mentioned earlier, I returned to my 15th Battalion in Townsville and a few weeks later we sailed for Milne Bay. We moved up the coast through Buna and Morobe and into the Salamaua campaign. I was nominally a machine gunner, but when Arthur Learmonth, our Signals Officer, discovered that I could fix equipment problems that the regular signallers couldn't, I became in fact a (quite irregular) signals mechanic. Very often the simplest problems were the most baffling -

When we were at Morobe, on the way up the coast to Salamaua, an interaction, potentially dangerous if we were attacked, connected together inextricably all the telephone circuits between one of our infantry companies, an anti-aircraft gun and the respective headquarters the other side of a lake. I measured the line resistances with the battalion only ohmmeter and traced the problem to leakage from water that had penetrated a cable laid across the bed of the lake and unbalanced the resistances in a phantom circuit. Such a connection can transmit two separate circuits over the one pair of wires without any crosstalk between them, but only so long as the series and the parallel resistances on the two wires are equal. We renewed the cable from our precious stores, paid out behind a boat rowing across

the lake. Our crosstalk problems vanished, the two channels were quite separate and my reputation as a telephone technician was made. Later, during the Salamaua campaign, a vital infantry attack by our D company was delayed, much to the General's fury, when their telephone wouldn't work. I climbed a 2000 foot mountain ridge, carrying my tools and full kit of rifle, 150 rounds of ammunition and 3 grenades against the ever-present chance of ambush, to find that an unplated steel screw, serving as a battery connection in the telephone, had rusted in New Guinea's everlasting wet. With the red rust chiselled off by my screwdriver, the telephone worked again and our company attacked.

We lost radio communication for two days between Brigade headquarters and two forward infantry companies, unable to call for reinforcements if we were attacked. Brigade signallers wouldn't usually deign to talk to battalion signallers, but they found that one of our blokes knew a bit about wireless? I opened up their receiver. The grid clip had slipped off the grid cap of a valve. I pushed it on and we were in communication again.

A weak transmission by earth return telephones between battalion headquarters and infantry companies spread out along the seashore, across the water from Lae, proved to be due to high resistance between earth returns in the beach sand. Quick calculations showed that most of the resistance between earth electrodes lies within only a few metres of each of them. Beyond a few metres from the earth electrodes, the conduction path is so broad that it contributes little more to the total resistance. So we connected the earth wires of each circuit to brightly tinned containers of egg powder and buried them in the wet sand below low water mark, where the salt water ensured a low resistance to earth that improved our telephone transmission wonderfully.

After the Salamaua campaign, when the battalion was recuperating at Lae, I was suddenly summoned to a school for radar mechanics, that the Army needed urgently, at Ingleburn near Sydney. In less than 24 hours, I was on my first flight in an aircraft, a C-47 (military DC-3) flying to Port Moresby over the Owen Stanley Ranges up a valley with hills high above us either side, fairly freezing in our tropical kit as the cold air poured in through the portholes in the windows. Then on to Townsville, Brisbane and Sydney.

I had been in the radar mechanics' school for three weeks when the school discovered that they had a dangerous Communist learning all their classified secrets. I protested that it was nonsense, but to no effect. The school had strict orders to return me to New Guinea immediately. As a front line soldier with 12 months active service, I was entitled to home leave, but the school refused it. I sent a telegram to my battalion requesting it but the Leave and Transit Depot (LTD) in Sydney refused to let me wait for a reply.

However, in telegraphing my battalion, I had asked for a reply to the LTD in both Brisbane and Sydney. Arrived in Brisbane, my journey further north to Townsville was blocked. The Burdekin River was in flood and had cut the railway line between Ayr and Home Hill. Just at the end of a week in the LTD at Yeerongpilly with still no answer from my battalion, I found, by the merest chance, that there was another LTD in Brisbane, at the Exhibition Grounds. I had been to a boring American baseball match there and, on the way out, happened to see a sign "TD Orderly Room"? I went in and asked the orderly room sergeant, "do you have a telegram for Private Thiele?" "Yes", he replied, "where have you been?" I returned to Sydney on leave.

When the battalion had returned from New Guinea and was camped at North Pine, just north of Brisbane, rehearsing for an honour march through the streets of Brisbane in September 1944, I managed to obtain an interview with a major in Victoria Barracks there to protest against my unwarranted victimisation by the secret police. He listened sympathetically enough and pronounced himself satisfied by my explanation, but in the end he was no help at all, warning me only that mud has a habit of sticking?

On a troop train travelling between Brisbane and Sydney, I fell into conversation with a sergeant in Lines of Communications Signals, who told me about the carrier telephony system he was involved with. It was operated jointly by the PMG Department and the Army, and connected Melbourne with Lae via a coaxial cable under Torres Strait.

The Infantry Training Manual assured us that an infantryman's life is 95% boredom and 5% sheer fright -and I can vouch for both. But during the 95% boredom, I had found two-up or poker, soldiers' traditional pastimes, pretty boring also and preferred to spend much of my spare time in New Guinea sitting under coconut palms reading about electrical, what we would now call electronic, engineering. One topic that interested me specially was carrier telephony. The sergeant told me that his unit very much wanted people like me but I would have to initiate any transfer myself. When I put my request to the battalion, the transfer was refused initially, but when I persisted, the Brigadier offered me a transfer to the 29th Brigade workshop unit as a wireless mechanic.

In December 1944, the Brigade sailed to Bougainville, where it was involved again in heavy fighting, pushing south down the road to Buin. But after only a couple of months, a routine order came to all units. The base workshop at Torokina was desperately short of wireless mechanics and any unit with a soldier working as a wireless mechanic but not paid for it, like me, must transfer him to Torokina immediately. And there at last I was recognised and paid as a technician and,

incidentally, in my spare time when I wasn't surfing, performed again in plays on the Army radio there.

When I returned in August 1945 from Torokina, we landed in Brisbane just in time for its two day premature peace celebration, then on to Sydney where, being young and single and so ineligible for early discharge, I spent a year at Concord Repatriation General Hospital where, between recurring attacks of malaria, I helped maintain the headphones at each bed that brought radio programmes to the patients, until I was finally discharged in August 1946.

During that time, my sister-in-law-to-be contrived an interview for me with her boss, the Chief Engineer of AWA. He explained that to become a radio engineer I must first get myself a Science degree, which was the norm for engineers at AWA. But when I applied for a scholarship under the Commonwealth Reconstruction Training Scheme (CRTS), that the Government was offering very generously to veterans who could show that they and the country might benefit from it, the Army officer interviewing me said "Nonsense. A radio engineer must have an Engineering degree". I protested that I had high-level assurance, but of course the officer had the last word. And I am glad now that he did.

I didn't really believe that I would receive a CRTS scholarship. I was sure that the secret police would again manage to thwart it somehow, but I was determined not to spend the rest of my life as a clerk in the Commonwealth Bank. So I also took the examination for the Broadcast Operators Certificate, that qualified me for a possible job as announcer/technician on a country radio station. I also applied for a CRTS course at the famous Art School at East Sydney Technical College, but to start their selection interview the committee asked to see my portfolio. "What?" I asked, "is a portfolio?" - and thus lost the chance of a great artistic career, perhaps.

But in the end I did receive a CRTS scholarship to study Mechanical and Electrical Engineering at Sydney University, the only appropriate qualification then for electrical engineers when most were involved with power stations. I became immersed again, too deeply, in theatre, in University drama and revue, and suffered a rude shock when I failed my Second Year examinations.

CRTS let me repeat the year and this time I passed at the level that would qualify me for an additional Honours year. But CRTS would not fund it, and although I sat in on Prof. Ron Aitchison lectures on acoustics for Honours students, that was all. So I gained only a very ordinary Bachelor degree. My academic distinctions were as Director of University Revue, President of University Players and making some great life-long friends. It might not seem relevant to the making of a professional engineer, but the experience of writing sketches for University Revue, hopefully humorous or satirical but generally bawdy, was a rigorous apprenticeship for technical writing.



When you have put months of effort into writing, rehearsing and finally performing something that you believe terribly clever or funny and it then falls flat in front of an audience, you learn quickly, if cruelly, the need for absolute clarity in all communication.

Performing with University Players led too to the foundation, with other graduates, of the Shavian Playhouse. I was still deeply interested in theatre, in both its performing and technical aspects.

I had supplemented my small CRTS living allowance working as an electrical stage hand at the Minerva Theatre, and was involved also in stage lighting and sound with Peter Finch Mercury Theatre in Phillip Street near Circular Quay and with the Independent Theatre in North Sydney. When the Independent produced "*R. U. R., Rossum's Universal Robots*" in the late 40, the fourth act ended with the sound of the factory klaxon as the signal for the robots to revolt and kill off all the humans. With no suitable sound effect available, I concocted one from a pair of sawtooth audio oscillators, tuned a semitone apart to be as dissonant as possible. The harsh sound blared out through the theatre sound system; then died away, echoing off distant hills. An early synthesizer, a friend said later. Perhaps.

Five of us built up the Shavian Playhouse, that alternated the plays of George Bernard Shaw with other writers, in the hall at the rear of St. Barnabas Church, just down Broadway from Sydney University.

With the little money available, we constructed our theatre in the church hall, making nearly everything ourselves, the front curtain from old flags, our lighting floodlights from kerosene tins, a switchboard of our own design, an analogue forerunner of the later digital stage switchboards, which controlled lighting sources with great flexibility, switching them in and out of three groups. These groups were faded up and down with water dimmers of our own design, in large glass battery containers, their electrodes carefully shaped to smoothly control a wide range of lighting loads, large and small, that usually was difficult using such variable resistance dimmers. I was nominated Technical Director but found myself acting too, notably as Tartuffe in Moliere play, Bluntschli in George Bernard Shaw Arms and the Man and Dunois, Bastard of Orleans, in his Saint Joan. It was all great experience, interacting between technical problems and the techniques and aesthetics of performance.

In the final, third, term of the University third year Engineering course and over the subsequent Christmas period, students undertook work experience, "six months hard labour" we called it. I managed to spend mine in the Postmaster-General (PMG) Department, where I was involved not only in telephony, with the installation of the first of the microwave telephony systems, but also two glorious months in the studios

of the Australian Broadcasting Commission (ABC), whose engineering equipment was, at that time, all operated by the PMG Department.

I was involved with my old love of recording on acetate discs and also sat at the feet, metaphorically, of John Thompson, the great producer of radio documentaries. He was learning, very quickly, the great new possibilities of editing sound on the first of the professional magnetic tape recorders, EMI BTR-1. One of John's projects was an interview with King O'Malley, who had been Treasurer of the federal Labour government that founded the Commonwealth Bank. O'Malley was now aged 93 and rather testy. John had recorded two hours of tape with him and was now editing it down to the standard 12 minutes 40 seconds of a 15 minute programme.

It was not easy. Engineers of the PMG Department had decreed, at a time when PMG engineers decreed and lesser mortals obeyed, that the expensive magnetic tape must never be cut-edited, only dubbed, and John had to make 73 dub edits for his program that lasted 12 minutes 40 seconds. And old King O'Malley was difficult, provoking exchanges with John like -- and he was Who was ?- You know who I mean - But I want to know his name? I told you before - Please tell me again --Who, Holman was crucified by Bruce and Page? John edited out all his own questions, so the whole piece came over as a straight talk by O'Malley. Wonderfully innovative stuff for those days. It was an exciting time. New Year 1951 was the 50th anniversary of Federation and at a celebration, with 21 gun salutes, in a specially rebuilt rotunda in Sydney Centennial Park, Artie Fadden, the Deputy Prime Minister, made a long-winded speech.

The BTR-1 machines ran at 30 inches a second and their 10 inch platters held enough tape for only 22 minutes of recording. Thus long programme segments, symphonies or politicians' ceremonial speeches, required two machines. After Machine No. 1 had run for 20 minutes, Machine No. 2 was started and the same (monophonic) audio was recorded on both for the next two minutes. After another 20 minutes, Machine No. 1 was started again with new tape, the process repeated and so on. When the programme was played back and Machine No. 1 had run a little less than 20 minutes, the operator started Machine No. 2 a little early and listened to the outputs of the two machines on their two loudspeakers. He now gently braked Machine No 2, slowing it down until the two outputs synchronised. Then at a suitable point, a pause for example, he switched over to Machine No 2. And so on. Finding that suitable crossover point often required considerable rehearsal, and from rehearsing the playback of Artie Fadden speech, we came to realise how politicians concoct ceremonial speeches by stringing together great piles of cliches. We rehearsed one such sequence over and over, ending with - what a great British parliamentary democracy can achieve, under the Union Jack? Cue for crossover.

It was also the centenary of Sturt boat expedition down the Murray River to discover how it ran down to the sea. The journey was re-enacted by two actors playing Sturt and his colleague while a crew of soldiers rowed the boat. Mayors of each town they passed on their way down the river wined and dined them of an evening but next morning they had to row on again regardless of weariness or hangovers, to maintain Sturt schedule of a hundred years ago. And ABC journalists were on hand, sending back tapes for editing, with all sorts of tales, the exploits of local heroes and of swamps full of tiger snakes?

At the same time, the Sydney Symphony Orchestra (SSO) under Eugene Goossens was recording John Antill's ballet suite *Corroboree* at the Ashfield Town Hall. Two separate teams recorded it, one from EMI, the other from the ABC, and Dene Barnett, the SSO legendary control operator, was in and out of the recording suite in Forbes Street, desperate for time on the machines to edit some unsatisfactory string entries. He told us later that, for the four sides of 12 inch 78 rpm discs that EMI eventually issued, Goossens chose two sides from the EMI tapes and two from the ABC.

I must have made some sort of impression in the ABC studios, because I was told that I would be welcome, after I had graduated at the end of 1951, to an engineering position there. But during that year, the Federal Government declared a moratorium on recruitment for all Public Service employment, so when I was available, there was no job there.

But by a great good chance, the EMI company, which at that time still held a near-monopoly on gramophone recording - it owned most of the patents. It was offering positions for development engineers in its Special Products Division. Imagining that EMI Special Products could mean some new recording project like the fabulous BTR-1 tape recorder, I applied and to my great delight was accepted.

But when I started work there, I found that this Special Products Division was working in fact on all sorts of devices, some of them far removed from recording, sub-contracting classified military projects, weaponry for the Rocket Range at Woomera. It was cutting edge electronics, wonderfully stimulating for a fresh graduate, telemetering data from rockets that went up for two minutes and then came down in the next two. I needed a deeper understanding of electronic filters and had to acquire mathematics that was new to me, like the Laplace Transform, pretty standard for undergraduates nowadays but quite novel then, and I became effectively the senior engineer of the team.

But after nine months, the very alert secret police discovered that EMI had a dangerous Communist working on their classified projects. My chief engineer, Laurie Betts, was appalled. "Why didn't you tell me?" he asked. "Because it a lie" I told him.

After half an hour talk, very good-natured because we had come to trust each other, he suggested to ASIO that they should seriously check their facts. We heard nothing further after that. No questions. No apologies. Nothing.

I thought then that they must have checked their information and found how false it was, but perhaps it resulted from reports from two of my colleagues who were paid, I found out later, 2.10 a month to spy on their workmates and report on our lunch time conversations. A number of years after, when Freedom of Information was alleged to have become a reality, I wrote to ASIO requesting a copy of my dossier. They replied that there was none. A likely story. Its consequences had been palpable for ten years.

In 1955, after three years of military electronics, and with the start of television imminent in Australia, EMI sent me to its London laboratories for six months to learn how to design television receivers. On my return I led the team that designed their first Australian television sets. The quality of our receiver was recognised to such an extent that it was used for monitoring television transmitters, and also by country television stations for receiving, for re-broadcast, transmissions from the city. It was still in demand, second-hand, right up to the end of monochrome television in 1975.

But on returning from holidays in 1957, I was told that I would no longer head the receiver design team. I had been promoted, my management told me, to Advanced Development Engineer, where I would be responsible for applying new technology to all of the company products. The truth was however that, in management estimation, I had been over-zealous about quality and reliability. The company valued me only for solving the most intractable of other engineers' problems. Whenever I tried to apply new ideas of my own to the company products, it was not interested.

In 1959, I was asked to design a high-quality loudspeaker in which a large 12 inch driver was to be mounted in a box whose basic dimensions, providing 33 litres volume, were already determined. It seemed likely to be, even with my then limited understanding, too small. In spite of my efforts the result was, to my great chagrin, a failure. It boomed horribly around 120 Hz. Our sales people said it sounded excellent on cellos? I knew that it sounded terrible on male speech. But in the process I had discovered that most of the information then available for designing loudspeakers was quite useless.

So I set out to devise a design process of my own, building on earlier work by Leo Beranek, and arrived finally at a procedure that measures the parameters of a loudspeaker driver using simple equipment. Using those parameters the driver can then be matched to the cabinet it is to be mounted in and an accurate prediction made of how they will perform together.

But when I suggested that we patent it, the EMI management dismissed it as an academic exercise of no practical interest? They saw no point in a patent. So I wrote it all up in a paper that was published in the Proceedings of the Institution of Radio and Electronics Engineers Australia in August 1961.

The paper made little impression in Australia, apart from Bob Frater and Cyril Murray, two academics at the University of Sydney, and Ern Benson, who was researching loudspeakers at AWA. Without the benefit of foresight, I was not to know then that in 1964 Richard Small, a young Californian engineer, would show up at Sydney University wishing to undertake research and a Ph. D on loudspeakers. They introduced him to my paper. We soon all became firm friends and Richard proceeded to a great body of fine work that culminated in its publication between 1972 and 1973, along with mine in 1971, in the Journal of the Audio Engineering Society in the United States.

Within a few years the Thiele-Small parameters had become the universally accepted procedure for designing loudspeakers and their enclosures, and we had become celebrities in the audio industry, presented with medals and honours, all over the world. But for the moment, all that I had was deep disappointment. In September 1961, I went for an interview for a position in the Studies and Design Laboratory of the ABC. I started work there in January 1962.

I had become at last, through a strange, painful, wonderful and convoluted process, a broadcasting engineer. Neville Thiele

[With minor amendments, from a paper delivered at the Melbourne conference of the Australasian Sound Recordings Association, August 2007, and published in its journal The Australasian Sound Archive, No. 34, 2008, pp.33-64]. A copy of this paper has been lodged at the National Film and Sound archive, along with a copy of the CD Leonard Teale, Famous Australian Poems.]