Reminiscences on vacuum tube radio engineering, Trevor Wadley, Hendrik van der Bijl, and Otto Brune

Professor Martin Wedepohl
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I received my introduction to radio engineering from Dr. Bozzoli at Wits University, and also of course from Terman's books radio engineering and radio engineers handbook. I also, believe it or not, had a copy of the original book "The Audion", author Lee de Forest. To my great regret it volatilised during one of my transcontinental moves. One of the circuits, which I actually built as a schoolboy, using his hand book, was a regenerative one triode radio receiver which had world reception range. The critical element was the grid leak resistance which was a ceramic disc with two silvered terminals and a pencil line between the two made with a soft 2 B pencil. First a thick line was drawn and then judiciously erased with a sharp eraser until it just stopped squealing, indicating a gain of nearly, but not quite infinity.

In a way we were lucky in those days. Salaries were frozen and because of the blockade in the war one could not buy anything. If you wanted it, you made it. My first crystal set consisted of a spent toilet roll wound with scrap enamelled wire, and a sliding brass bead to change the number of turns. No capacitor was required - the self-capacitance of the coil was sufficient. The crystal was made in my dad's woodwork shop. I melted some bar solder in a crucible, poured some flowers of sulphur to form a sting mess, poured the whole lot into a jam tin of cold water, struck the conglomerate with a hammer. The cat’s whisker was a piece of wire wrapped around the end of a pencil. This was moved over the crystal until a sensitive spot was found. The only "bought" thing was an old-fashioned telephone earpiece, which I bought for a few pence from a scrap dealer.

I was equally fortunate as a PhD student. Our department could not afford a vacuum tube voltmeter amongst others. So I was obliged to make my own using a double triode in a long tail pair (cathode follower) configuration. The detector was a model 7 Avo Meter. All my test equipment during my PhD was homemade - sweep generators, phantastrons etc. My bible was the wonderful MIT radiation series, which was a compilation of the radar work done during the Second World War. By the time my PhD was done I could have made a good living as an electronic instrument designer. The modern students are denied this experience and tend to take things for granted.

I knew Wadley when he was working on his receiver in the early 50's on the roof of the Elec Eng building at Wits - the home of the Telecommunications research lab. An incredible man. At that time, just after the war, money was extremely tight and imports almost impossible because of reconstruction priorities after the war in Europe. He needed a very stable temperature for his oscillator. He made his own by using a jam tin and a cocoa tin with naphthalene wax filling the space between the two. A heater ensured that the Naphthalene was solid on the outside and liquid on the inside. Accurate control was not needed - all that happened that the thickness of the solid part varied. He now took advantage of the very stable latent point of heat of melting Naphthalene and managed to keep the temperature constant to better than 0.1 degree C.

A few years later, during the time I was finishing my doctorate in Manchester, I had a very interesting letter from my father. My father was a professional land surveyor and by that time was Surveyor General of the Transvaal and also the Chairman of the South African Town Planning Commission. In it he informed me that a "crazy cook" called Wadley had claimed that he could measure distance as accurately as angle in an optical theodelite. I wrote back and explained that there had been spectacular technological progress in radar during the war and furthermore that Wadley was a genius. Wadley was sufficiently persuasive that my Dad set up an experiment in which Wadley was asked to measure the distance between two trig beacons, one on Brixton Hill in Western Johannesburg and Klapperkop Fort in Pretoria. This was the most accurately known base in South Africa at that time. Wadley, of course, was not given the distance. The outcome of that experiment changed the world of survey forever. Tellurometer companies sprang up all over the world. The saga did not end there. Over time Wadley found that he was getting a biased error. He had the temerity to suggest that the figure for the velocity of loght he had been given was wrong. He took his assertion to the notice of the powers that be at the National Physical Laboratory in Teddington in England. Again thanks to his bull headedness they agreed to do new mesurements. Surprise, surprise – he was right.

The successor to the tellurometer for very short distances, as you know, uses optical waves from a laser and is standard around the world. Even our local winery, Mission Hill, has one for surveying their vine-yards. I know that Wits awarded Wadley a doctorate. Apparently that was quite a saga. It would be interesting to find out the exact circumstances that I only have on hearsay. I believe that he did not have the mathematical ability to write up the mathematics of its operation, but if my memory is correct Wits allowed one of the top researchers at the Post Office to hole up with him and find out how the Tellurometer worked. This guy then wrote up the mathematics, with Wits approval, and Wadley was awarded a D.Sc. on this basis. The name that comes to my mind is Dr. Davidson, but don't rely on my fading memory. I think Davidson was the man who worked out the transpositions on open wire telephone lines, thereby increasing the capacity of superposed frequency division channels from 12 to 24 saving a colossal amount of copper cost. Again the technique was used all over the world. It turned out that Davidson, or whatever his name was, had invented Walsh Functions ten years before they were first described in the literature. Davidson did the whole thing by pure logic and did not give the functions a name.

Through a second cousin of mine, Karl Wedepohl, a Physics professor at Gottingen in Germany we obtained a day by day diary of my paternal Grandfather, Johannes Wedepohl. The Berlin mission required all their missionaries to do this. My brother translated it into English and edited out some of the lengthy details. My Grandfather established the town of Gutu south of Harare, named after the local chief. The church he designed and had built still stands. It was taken over by the Dutch Reformed Church when he departed for Pietersburg early in the 20th Century. I tried to visit there in 1987 when I was giving some power system lectures at the University of Harare. Unfortunately, there was a shindig taking place between the Shona and Matabele tribes and, to my regret, the authorities would not grant me a permit. Right at the end there is an Appendix about the Wedepohl and Franz families. I translated from an Afrikaans original entitled "The History of the Berlin Synod in Southern Africa". I have a copy and will send you a copy of the entry relating to the Brune family who were part of the same Synod.

Other than electrical engineers, very few people in South Africa are aware of the incredible distinction of one member of the Brune family, Otto. Even I did not connect two names. Otto Brune and his wife used to visit us for Sunday coffee when I was a boy. The last time I met him was in 1961 when he was director of the CSIR. A friend of mine, van Wyk Naude, took me to greet Dr. Brune in his office. The old man was working on a scrap pad. I was electrified when I saw his sketches and the Penny dropped. He was the same Brune who was honoured by Guilleman in one of his treatises on Network Synthesis. In the foreword, this little entry appears: "I dedicate this book to Otto Brune, the founder of Modern Network Synthesis"

He was the second South African in whom I failed to make a connection. As I have mentioned my radio engineering bibles when I was a student were Terman's two books. In them I learned about high efficiency modulators and oscillators for high power radio transmitters, developed in the 1920's, by an engineer called v.d. Bijl. It was many years later that I realized that he was the same man who, by extraordinary vision and foresight, laid out the blueprint whereby a small country could rapidly industrialize itself, and who is honoured in the naming of the city of v.d. Bijl Park near Vereeniging.

Hendrik v.d. Bijl was a genius of the highest order. To electrical engineers, he is seen in one light. To industrialists another. He was undoubtedly the "father" of modern industrial South Africa. Someone once explained to me (I think I was my brother's father in law, Ignatius de Villiers, who was at that time Chief Engineer of Eskom) where his stroke of genius lay. Industrial USA heavily influenced him. Under their law private monopolies are illegal. This was exemplified by the break up of ATT/Bell in between the war years when they were broken in two to create as a rival ITT as a competitor. v.d Bijl recognized the danger of government monopolies with an explosion of inefficient bureaucracy but also recognized that South Africa at the time was far too small to create competing private industries (the economically active population was only about 3,000,000). His genius was to establish a series of commissions which were private, but in which the government owned 51% of the shares. At first sight this would appear to be no different from a government monopoly. But not so. The commission might consist of three government nominees, but there would also be two private members that could scream from the rafters if bureaucratic excess started to develop. It was this factor which led to the extraordinary success of Iscor, Eskom, Phoskor and so on. The liberal party in the UK adopted his structure in the 1960's as the correct way to establish national industries. BP (British Petroleum) was structured the v.d Bijl way and has been a notable success.