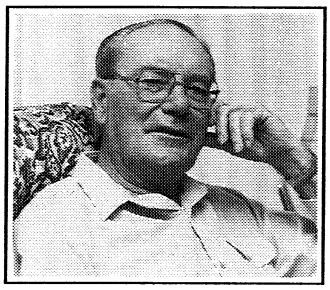

When I Think Back...

by Neville Williams

Howard Kingsley Love: From pioneer VK3 amateur to equipment manufacturer - 2

Having done much to promote amateur radio in the 1920's, Howard Love set up his own factory in the 30's and made a significant contribution to the war effort in the 40's, by way of communications and radar equipment. Behind the scenes was an on-going interest in the application of ferrite particles to radio frequency circuits — leading ultimately to the Kingsley 'Ferroclad' and 'Ferrotune' technology.

The development of the KCR11/AR7 communications receiver was described last month. The demand for this receiver went well beyond the RAAF, which had initiated the project. KCR-11's were also supplied to other units of the armed forces and to the Australian Civil Aviation Department.

A special version for the Army, designated 'Aust Reception Set No.1' had an engraved brass panel with a black background to minimise reflections. The receiver and its coil drawers were fitted into a typical khaki Army carrying case, with a separate matching case for the power supply.

Another special version for the Dutch Navy required a front panel lettered in their own language. Altogether, some 3200 AR7 type receivers were supplied, posing a major problem for Kingsley to secure the requisite materials and components for their construction.

George Neilson recalls that HK's former secretary Mollie Malone was entrusted with chasing up supplies. She did a splendid job but, for her, it climaxed once the materials and components for a specified number of receivers were safely on the shelves. While she obviously knew they were there to be used, she seemed almost to resent it when assemblers fronted up for another kit of parts: "I hope you realise how difficult it was to get these parts!"

Thinking back over the AR7 era, George Neilson said that Les Eastwood and Ivan Harvey joined the staff as sheet metal professionals, while Charles Mutton and Jack Kling, well known in the Melbourne radio industry, released John Bremner by taking over AR7 testing and adjustment. Ken Boole of the Aeronautical Inspection Directorate did much to keep the supply lines moving, while Tom Heywood and his mate Laurie Buckingham "were the core of the wiring line", later moving into the Design Lab.

In his book Australian Radio, the Technical Story 1923-83, former STC Engineer Winston Muscio discusses Australian wartime communications receivers, mentioning specifically the STC A679-3, the AWA AMR-300 and the Kingsley AR7. Of these, the STC receiver used switched coils, the other two plug-in coil drawers. He says that, in terms of performance, anecdotal evidence favoured the Kingsley AR7 — but also suggested that it was less well proofed against a tropical environment.

RAAF leads the way!

One of Kingsley's contacts at RAAF Headquarters was Flight Lieut. Jack Parr, who was well known around the Melbourne radio trade, prewar, from his component manufacturing business in Chapel Street, Windsor.

Early in the war, he and a corporal lost their way in a truck in the Western Desert, ended up on the wrong side of Bardia, were arrested by the Italians and duly imprisoned. Some days later, the Allies overran Bardia and the Italians decided to surrender — but to whom?

Ah yes, the two prisoners!

That's how the allied invaders were amazed to see a column of about 3000 Italians marching towards them, headed up by an Italian General, an Australian corporal and Jack Parr from the RAAF!

In the post-war period, when truckloads of military radio equipment were being auctioned off to disposals dealers, I myself, along with countless other hopefuls, kept a sharp lookout for such receivers amongst the clearances; but they were apparently snapped up before reaching the bargain tables. Yet, says Winston Muscio, there was little postwar demand for Australian communications receivers at normal market prices, and production was virtually abandoned.

Unofficial consultants

While the proximity of the Military Establishment to the Kingsley factory made it easy to keep in touch — as also did the intense patriotism of HK — it made it easy for military personnel to 'drop in' from time to time to discuss their problems and bright(?) ideas.

In some cases, the problem or proposition didn't get beyond the consultation stage — but still took up engineers' valuable time. In other cases, research was involved, even getting to the prototype stage, for which it was doubtful whether the Kingsley organisation would ever get paid!

Someone from the RAAF, for example, approached Kingsley with a problem of occasional fade-out when receiving Morse Code signals. Such a problem can arise if switching on the BFO generates a spurious AGC voltage, thereby de-sensitising the receiver. To overcome this, normal practice when using the BFO is to switch off the AGC and revert to manual front-end gain control.

In this case, the so-called 'fading' was

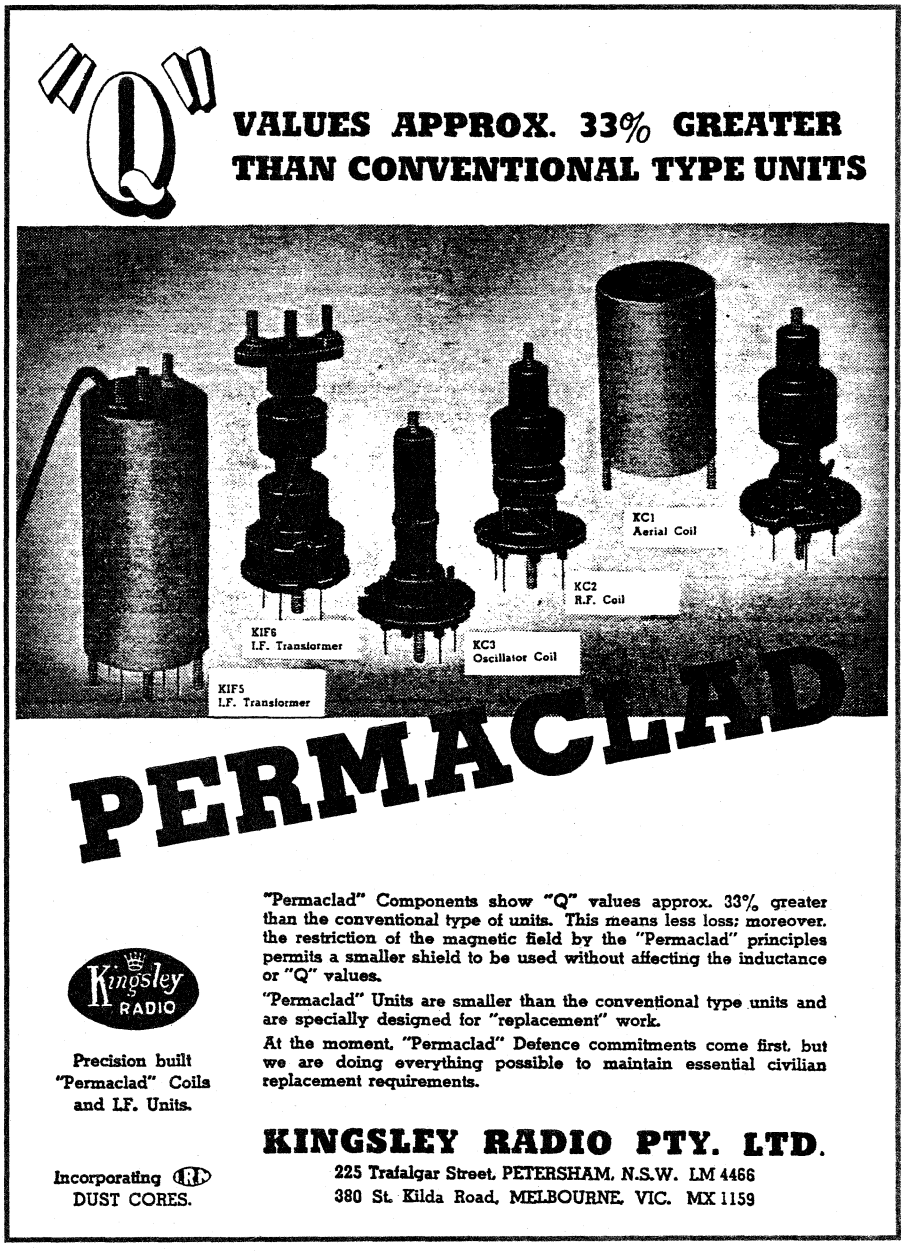

Fig.1: In R&H for July and August 1945, Kingsley advertised 'precision Permaclad' coils and IF transformers as smaller but more efficient components for civilian replacement purposes. The advert warns that supply is subject to Kingsley's committment to defence production.

shown to be due to cyclic peaks in signal strength, causing receiver overload and 'blocking'. The elegant response to this problem was to provide a separate IF channel, to generate an AGC voltage independently of the detector, and to provide a choice of AGC time-constants to suit the circumstances.

To meet the need, Kingsley had to add an outrigger chassis to the rear of a normal AR7 to carry the extra IF channel and facilities.

In the same context, the RAAF also became involved in experiments with diversity reception, using pairs of AR7's set up a few kilometres apart, with 'phone lines linking their respective detectors and AGC systems. Assuming differential signal-fade cycles at each site, the receiver intercepting the strongest signal at any one time would supply the dominant audio signal, at the same time reducing the gain of the other receiver via the common AGC line.

Tanks very much!

But the RAAF was not alone in seeking factory cooperation, with the Army requesting assistance to adapt a Reception Set No.1 to provide a direction finding capability. George Neilson said that this involved considerable modification to the aerial input circuit, to accept the output from a D/F (Direction Finding) type antenna. The job ended up in George's lap and, to avoid disrupting normal daytime production, it was tackled on an overtime basis, giving ready access to the machine shop. He set about making six of everything, in the expectation that the Army wanted six D/F compatible receivers.

When the first receiver was ready, George and a couple of staff members took it into the Domain Gardens opposite the factory to test it in an open-air situation.

As it happened, an officer from the Victoria Barracks, heading home in a St Kilda Road tram, spied a group of civilians fiddling with something that looked suspiciously like an Army Reception set. He could hardly wait to get home to alert his peers. Very shortly afterwards, George and his mates were accosted by a group of Military Police, who were most curious to know "Wot's goin' on 'ere then?" or words to that effect.

One memorable situation arose when allied tanks in the Western Desert were being mistakenly fired on by our own planes. The Army dreamed up the idea of the planes requesting identification by means of a special transmitter. If the tank received the signal, it would supposedly release a puff of coloured smoke through its exhaust — a novel form of IFF (Identification Friend or Foe) system.

Kingsley's liaison was with a certain Captain of the Tank Corps, who telephoned one particular morning, explaining that he was to be picked up sharp at midday. A few minutes before 12, he pulled a pair of overalls over his immaculate uniform and headed for the door immediately he heard a loud rumbling in the street outside.

He was most certainly being picked up — by a Matilda tank!

Hi-Tech 'dog-boxes'

As for the smoke signal, nothing came of it — even though Kingsley Radio had been encouraged to pursue the radio link to the prototype stage! Fortunately, however, some of the consultations did prove more rewarding.

On another occasion, they became aware that Kingsley Radio was to score an upgraded machine shop. The upgrade would include a couple of new lathes — large and small — and a special shaping machine.

In its wake came a stack of drawings for what Kingsley was told was an 'RDF' unit. Only later did they realise that they had become involved in a top secret radar project.

The components concerned, which were purely mechanical, were manifestly for UHF equipment and presumably had

to do with antenna switching. Because of their kennel-like shape, they were identified in factory speak simply as 'dogboxes'.

To the technical staff, the 'dogboxes' contained what were apparently two resonant cavities, sequentially tuned by motor-driven rotating capacitor plates. A supplementary cam mechanism operated conventional automotive breaker points, presumably to provide some kind of a synchronising signal. Says George Neilson:

"It was full of beautiful brass machining and screw adjustments".

As another apparent spin-off from radar, Kingsley was advised by the Government in 1941 of a need for Australian industry to get involved in the manufacture of polystyrene. HK decided to take the hint and put a call through to an old friend, Noel Featherstone, who had at one time been involved in the manufacture of resistors at Continental Carbon. He and another industrial chemist from Sydney — George Bennett — joined the staff and set about designing a pilot chemical plant for the purpose. Unfortunately for Kingsley, Taubmans in Sydney got a head start and the project was dropped. However, other applications were in sight for the latent chemical expertise.

Postwar planning

Around 1943, the Government began to advise manufacturers engaged in defence work that they could expect Government orders to taper off and should therefore begin to plan their activities in the post-war period.

To Howard Love, it was apparent that the time had come for him to focus his attention on ferromagnetic technology, with a view to specialising in the supply of high performance IF transformers, tuning coils and integrated tuning systems. With this in mind, he made moves to add Lay Cranch to his staff, because of his technical background and his exposure to the components market through Crown Radio in Sydney. As it turned out, he also added to the staff Laurie Fitzgerald, who had been Cranch's co-designer. In fact, the stage had been set for a ferromagnetic revolution back in the early 1930's, with the adoption of an industry standard intermediate frequency of 465kHz, or thereabouts, instead of 175kHz.

As explained in this column for November 1991, an increase in the IF made it possible to do without an RF or preselector stage in urban domestic superhets. But this was with some loss in selectivity, especially noticeable when the design incorporated AVC or AGC (automatic volume or gain control).

In an effort to minimise the loss in selectivity, manufacturers sought to identify anything that might increase the 'Q' of the windings, including the use of multi-strand 'Litz' wire.

The most promising development, however, came with the realisation that a core or 'slug' containing ferromagnetic particles would allow a desired inductance to be achieved with fewer turns on the winding — therefore with proportionately reduced winding loss and higher 'Q'.

Ferromagnetic cores

By way of a bonus, it became evident that IF transformers could be tuned or 'aligned' by screwing the cores slightly in or out of the windings, thereby obviating the need for adjustable — and sometimes trouble prone — trimmer capacitors.

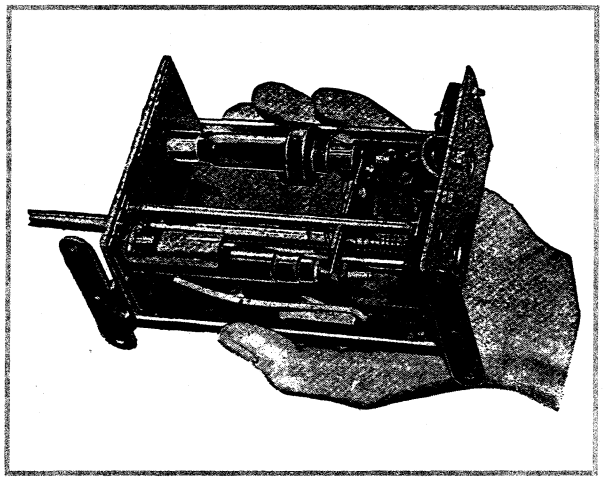

Fig.2: A pre-aligned 'Ferrotune' front end, as advertised in R&H for December 1945: 'Kingsley Does It Again — Another Major Technical Development'. It offered straight line tuning from 540 - 1650kHz with each revolution of the tuning knob covering 100kHz.

There was no secret about the basic concept, but manufacturers were not exactly forthcoming about their research into the physics and chemistry of ferromagnetic materials or how best to process them. Like other manufacturers, Kingsley Radio had to find its own way through the maze.

According to the Lay Cranch interview, Howard Love had a long term strategy in relation to ferromagnetic cores. He included them as soon as practicable in his normal 465kHz IF transformers. His next major step was to place ferromagnetic cups around the outside of the windings, thereby permitting the use of relatively small aluminium shield cans without compromising the 'Q'. His reasoning, as advertised, was that small IF transformers would fit in with the trend to more compact receivers, as well as their increased adaptability as replacement components in existing receivers undergoing service.

Beyond IF transformers, Howard Love was looking to the day when ferromagnetic cores would offer sufficient permeability at higher frequencies to warrant their application in broadcast band tuning coils. Beyond that — the shortwave bands!

The real climax would come with cores large enough to cope with ferromagnetic tuning: tuning would depend, not on a ganged variable capacitor, but on a self-lubricating mechanism of sintered bronze, sliding cores in and out of suitably proportioned coils. For good measure, Howard Love sensed that ferromagnetic cores could well find a role in the production of filter inductors, as required for carrier telephony systems.

Two places at once?

In his interview, Lay Cranch represents himself as an integral part of this whole development:

GH: *"So you developed this and your permeability tuner, using a fairly standard superhet circuit...?"*

LC: *"Yes, it was a Colpits Oscillator set, but what we had to do was to get the permeability up..."*

Trying to explain this involvement, I face the problem that the December 1945 issue of *The Australasian Radio World* carries an illustrated full page advertisement for a Kingsley Ferrotune unit. It follows that the development had to have been done while Lay Cranch was still in Sydney, serving in the RANVR and as nominal manager of Crown. George Neilson confirms this impression, with the observation that Lay Cranch's account of such events could only have been written 'from afar'.

Having in mind that Lay Cranch and Noel Featherstone presented a lecture on sintered bearings to the IRE Sydney Division in that same year, it is reasonable to assume that Lay had kept in close touch with Howard Love during the intervening years and had, indeed, shared in the exercise 'from afar'.

With hindsight it also seems likely that, when Howard Love sensed that he was

being pushed to the limit by his dual management and technical involvement, Lay Cranch was the logical person to enlist as Chief Engineer — so that he could shoulder the latter half of the burden. He understood where Kingsley had come from and in which direction it was headed!

So back t o George Neilson's story:

Ferromagnetic powder

George says that Kingsley had been depending on a separate small Melbourne company for their early ferromagnetic cores, but faced a possible crisis when their supplier experienced difficulty in keeping up with the demand. In an effort to boost their output, Howard Love had apparently sought to inject new capital, and/or to take them over — without much success.

By way of raw material, they had been purchasing the 'detritus' — waste particles — from the grinding operation of an engineering firm producing piston rings. Literally 'sweepings from the machine room floor', the waste was sieved to remove cigarette butts and other extraneous rubbish before being subjected to a reduction process in a high-temperature muffle furnace. This involved placing the sieved rsidue on a tray in a sealed 25cm diameter steel tube, mounted in the centre of the furnace.

Hydrogen was fed through a small tube sealed into one end of the 'oven' and the surplus burned off from an exit tube at the other end. En route, the hydrogen would react with any oxygen present in the detritis, along with other 'muck'. By monitoring the burn-off flame, an operator could tell when the reduction process was complete.

The residue was then processed in a 'rubbing mill', a device 'rather reminiscent of a dough mixer'. Its role was to rub off sharp corners from the iron particles so that, when later coated with an insulating binder, there was less chance of corners projecting though the binder and making metal-to-metal contact between the particles — especially when the mix was forced into heated dies in a hydraulic press.

Facing the supply problem, Howard Love's answer was to set up a new company called Metals Disintegration Pty Ltd, primarily to develop and produce ferromagnetic products for its parent company. His choice of raw material was iron oxide powder called *haematite*, which also needed to be processed in a reduction furnace and a hydrogen atmosphere to absorb the oxygen. In place of raw powdered oxide, the residue was predominatly powdered iron particles.

While Kingsley had what Lay Cranch described last month as their own 'hydrogen bomb', they had no rubbing mill and couldn't purchase one. By then a member of the lab design staff, George Neilson says that it fell to his lot to fabricate one. For those who are mechanically inclined, I repeat George's description of his brainchild, verbatim:

"It consisted of a cast-iron cylinder with hemispherical ends, in which were mounted bearings. Mounted on spindles at each end were propeller-like paddles which were driven by chain drives at slow speed, in opposite directions."

"A rectangular box extension was for loading and unloading, and in operation this was closed by a rectangular plunger with lever and heavy weight applying considerable pressure to the powder."

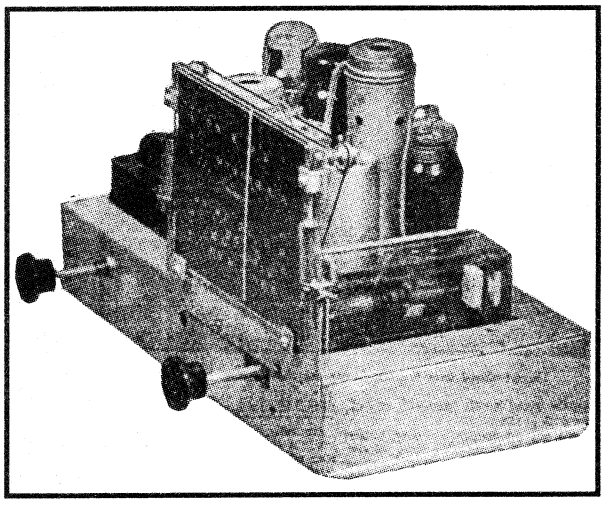

Fig.3: An up-to-date prototype Kingsley-designed 4/5 valve superhet receiver as featured in R&H for May 1946. The Ferrotune assembly is mounted through the near end of the chassis in a position that might otherwise have been occupied by a tuning gang and shielded aerial and oscillator coils.

"Eric Patching, an industrial display artist on the Kingsley staff and an expert in clay modelling, helped me design the paddles. One of each was propeller-like for circulating the powder; the other was paddle-like to rotate the powder and achieve the required rubbing action."

"In operation, considerable heat was generated and the cast iron mill was surrounded by a water jacket for cooling."

"The device proved completely successful."

After processing, the iron particles were mixed with dissolved polystyrene — serving as a binder — then dried, subjected to further milling and finally injection moulded using an eight-ton pressure hydraulic press. The finished cores, of which over 20 were required in each AR7 receiver, were marginal for the purpose because the ratio of iron to binder was rather low.

Iron/antimony alloy

In the quest for a better product, HK went to America and signed agreements with a firm called Polydoroff, which owned patents covering an improved type of ferromagnetic core. Starting with haematite, they added a small quantity of antimony during the reduction process, to obtain an alloy which offered reduced magnetic losses. In turn, the alloy was coated with a phosphate to provide the necessary insulation.

With better cores available, Kingsley subsequently found itself facing a shortage of air dielectric trimmers, of which 28 were required in the five coil boxes supplied with each AR7 receiver. HK decided that the obvious course was to evolve a design and either manufacture them in-house or contract them out.

George says that, once again, he copped the job and took advantage of earlier lab work with steatite and formaldehyde resin. He was fortunate also in being able to consult with a Melbourne company — a one-time manufacturing jeweller, which had been switched to wartime micro-production of a quite different kind.

Between them, they came up with an eminently satisfactory air trimmer with a notable refinement — stops which indicated to the operator that a trimmer, obscured from view, had reached either limit of its adjustment.

At about this time two of HK's ambitions for ferromagnetic devices materialised. One was the production of toroids and pot cores with adjustable slugs for the then PMG, to use in connection with carrier phone systems. It led naturally to the production of precision inductors, to PMG specifications.

The other development was a prototype variable-inductance tuner, in which George Neilson says he had a key role. That this was not an impossible proposition was evident from a small medium-wave receiver which HK brought back from the USA. While proving a point, it also dramatised how *not* to go about it, if the result was to compete with the conventional system!

A LOAD OF GARBAGE...

Like other wartime manufacturers, Kingsley Radio had to find their way around unexpected material shortages. A key component in one of their products was a long, insulated screw made from Erinoid, a casein material which became unavaible at one stage.

To their intense relief, someone realised that a satisfactory substitute could be made by purchasing a certain size and kind of knitting needle, cutting a thread with a die and then parting it into pieces of the requisite length.

The residue which ended up on the floor — long, curly swarf and off-cuts was ultimately swept up by the cleaner for disposal in the incinerator.

As it happened, the knitting needles were made of cellulose nitrate, so that the swarf translated roughly into 'gun cotton'.

When the cleaner ultimately put a match to the rubbish, he had hardly turned his back before there was an almighty explosion — which fortunately blew the lid off and did no other damage, except to the cleaner's composure!

Practical problems

George says that it proved difficult enough to develop a coil/core configuration that would offer a 9:1 variation in inductance, and hence a 3:1 variation in frequency.

It was even more difficult to avoid the situation where the stations tended to crowd together at the high frequency end of the tuning dial. Last but not least, the distribution of ferromagnetic particles would have to be uniform from core to core, if aer/osc/dial tracking was to be uniform from one tuner to the next.

In fact, compressing the ferromagnetic mix from either or both ends of a tubular die had the effect of concentrating the particle density of the core at one or both ends of the rod. As well, it tended to align the particles with their greatest dimension at right angles (i.e., side-on) to the direction of the field.

In consequence, Kingsley had to rearrange the process to load and compress the particles from the side. This achieved more uniform density and aligned the particles end-on to the field — the preferred orientation — but it also necessitated a grinding operation to ensure that the rods were uniformly round over their whole length.

Unfortunately, it did not prove practical to grade the permeability of the core in the way that capacitor plates are shaped to achieve a linear frequency scale on the tuning dial. It therefore became necessary to cut a variable pitch thread in the lead screw driving the cores.

In the hand-made prototype tuner, a pencil line was inscribed on the 1/4" lead screw, which was tediously transformed into an Acme drive thread by a toolmaker using a hacksaw. Subsequently, a Hercus bench lathe was set up to produce duplicate leadscrews in a semi-automatic operation.

Without going into explicit detail, George indicates that the oscillator was made to track the signal frequency circuit(s) by padding the oscillator with an extra inductor, copper tabs and a conventional trimmer. When the tuners went into quantity production after the war, they found ready acceptance.

In the meantime, Kingsley had become involved in the manufacture of copper powder for use in porous bronze bearings. This involved a plating operation using a low voltage 1500 amp generator, and they found themselves cheek-by-jowel with 2x1" busbars in lieu of wire conductors. They also learned the hard way how not to demagnetise the auxiliary DC field generator when switching off.

In another better-forgotten episode, Kingsley was contracted to produce aircraft equipment which had been developed by the RAAF. The equipment failed its acceptance tests because of a power supply fault and ended up in a three-way contest in the High Court involving the RAAF, Kingsley and the transformer manufacturer.

It transpired that the RAAF had used a Variac to determine the required transformer voltage, losing sight of the fact that a practical transformer to fit in the equipment would exhibit a much higher internal impedance...

George Neilson says that he resigned from Kingsley after the war to set up his own business but, while he supplied test equipment for their production line, he was not otherwise a part of their postwar activities.

At this point, the story of Howard Kingsley Love must revert to Lay Cranch's account, in the June issue, of his sudden death and the consequent demise of his company, in 1948. But in a phone conversation, George said that he understands HK's death was due to heart failure, brought on by overwork.

He added that HK was a natural motivator, and whenever the staff saw him touring the factory with a Director in tow, they were pretty sure that he would be 'selling' a new proposition.

When HK passed away so suddenly, the Directors simply couldn't cope with the idea of Kingsley Radio operating without its founder. So, to the dismay of Lay Cranch and its staff, they wound it up! ❖