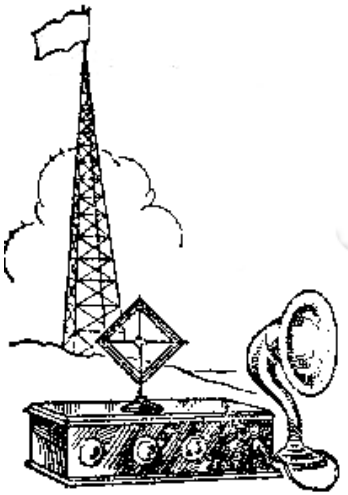

The Carolina Antenna

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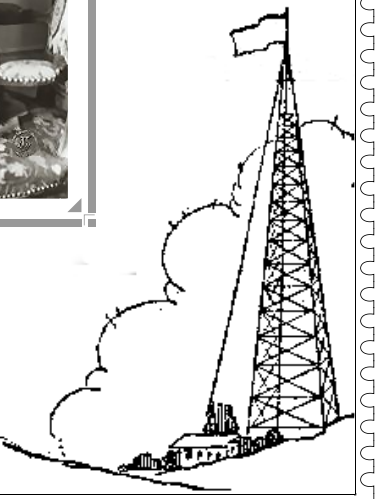


Carolinas Chapter
of the
Antique Wireless
Association

The Carolina Antenna

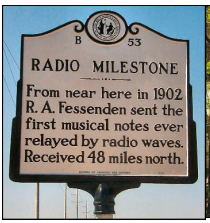
The newsletter of the
Carolinas Chapter of the
Antique Wireless Association

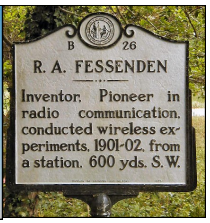
ISSUE # 11 SUMMER 2005 VOLUME 2

Well, it is hard to believe that another great Charlotte conference has come and gone. A special thank you to everyone that worked so hard throughout the year. The addition of the Boyer estate sale added a lot to the Conference.

R A FESSENDEN

Judy and I recently went to the Outer Banks with the antique car club. A must stop for me was a visit to the two historical NC markers commemorating the accomplishments of R A Fessenden. Historical mile marker B53 was found outside Buxton and B26 was found in the shrubs not too far from Fort Raleigh, which is the process of putting together a presentation about Fessenden and his experiments on the Outer Banks. I have received a copy of this presentation and permission to reprint it in our newsletter. Look for it in the next issue of *The Carolina Antenna.*





ARMSTRONG AND THE SUPERHETERODYNE

Starting with this issue we are reprinting an interesting article by Alan Douglas about the Superheterodyne. Because of the length of the article, this will be a two-part feature. So, keep your eye on the mailbox, the next issue is due out late summer.

BARKER

CC-AWA DATES TO REMEMBER

July 30 - Summer Swap Meet
Valdese NC
Oct 29 - Fall Swap Meet
Greensboro NC
Dec 17 - Christmas Party

Rain date is the following weekend. Check the club web page for notices of rescheduling. A decision will be made by 6pm the day before the meet.

CC-AWA Spring Charlotte Conference

By Ron Lawrence

March 24-26 marked another great Charlotte CC-AWA Conference at the Sheraton Charlotte Airport Hotel. The Charlotte show has been on the forth weekend in March for many years now, this was only the second time since the early 80's that Easter fell on this weekend too. I'm sure that this played a big part in the overall attendance being down a little this year. But it sure didn't put a damper on enjoyment that everyone that did attend had.

The Program/Forum sessions on Thursday afternoon were well attended. This was the second year that we've had a special Tube Collectors forum and this year we had a special guest host Ludwell Sibley, who along with his wife drove all the way from Oregon to be with us. Lud & Kirk Cline did a great job of talking about Tube Testers and how to test unusual tubes. Robert Lozier did a slide show of some glass slides that showed early RCA tube production. Jim Oram put on a very interesting talk about German Egnima code machines and his effort to make exact reproduction parts for them. Jim's parts are so exact they're used at the National Cryptologic Museum to keep their Egnimas running.

Thursday evening we had the first part of an estate auction that was consigned to us by the family of Larry Boyer, a retired RCA engineer. Larry who went to work at the RCA labs in Camden NJ just after WW2 had had the foresight to collect early RCA artifacts before they could be destroyed. Along with a very nice collection of mostly 20's radios, the boxes and boxes that we found in Larry's attic were a time capsule of rare radio related paper and catalogs, plus a lot of very rare tubes. The Thursday evening "Tube Paper & Ephemera" auction lasted 4 ½ hours and netted over $14K in sales.

Friday morning we kicked off of first Flea Market session with our now traditional "LeMans Start" where there is no buying selling or trading allowed before 8AM and everyone has to be out of the flea market area before the 8AM start.

Friday afternoon was our second auction of the weekend with radios and other hardware going on the block. A couple of highlights were a "one of a kind" engineering prototype built by GE from about 1922 with all of the original engineers hand written notes and drawings. Another highlight was a

very rare Edison Concert 5" cylinder phonograph with both playback and record heads it's original cover and an Edison 5" wax cylinder. There were a number of members of the phonograph collecting community in attendance to bid on this and several other vintage machines. Total sales for the Friday afternoon auction were just over $30K for a total of over $44K in sales for both.

Friday evening it was time for our banquet followed by an open house to view the items entered in the Old Equipment Contest. Alfred H. Grebe Jr. was a special guest speaker at the banquet.

Ron Lawrence giving Alfred H. Grebe, Jr. a CC-AWA badge

Saturday morning got started early with more Flea Market followed by our traditional end of meet "Radio Rescue" auction which is always a good way to find that last minute bargain before heading home. The Conference wrapped up with our Saturday luncheon and Robert contest report.

Just so you don't think all this was peaches and cream and went off with out a hitch… On Wednesday afternoon the day before the show a group of us met at the mini warehouse in Monroe were we had stored the Boyer estate items since August. We loaded a rented 26 foot U-Haul truck and Robert drove it home planning to drive it to the hotel Thursday morning. Several of us had planned to meet at the hotel early for breakfast and be there when the truck arrived. As I was walking into the hotel lobby my cell phone rang, the caller ID indicated it was Robert and I assumed he was calling to tell me he was leaving home with the truck. I can't tell exactly what words Robert uttered when I answered the phone, but it was very descriptive of the current situation as he saw it. It seems that when he tried to start the truck that morning its starter had jammed and was now brunt up leaving us with a dead rental truck 40 miles away. Robert said he had already called U-Haul about it and was awaiting a return call from them, I asked him to call me as soon as he knew something

new. I recanted the situation to the rest of the breakfast gang and we proceeded to the hotel restaurant. After thinking about the mess for about 5 minutes I called Robert back and told him it was time to be very assertive and to call U-Haul, tell them that we had to have the truck at the hotel ASAP and that they should send a wrecker to tow their dead truck to the Sheraton so we could unload it. The though of having to get another truck, going to Monroe and transferring the load just was not a option, it would have taken the better part of the day and the show was set to start in less that 4 hours at 12 noon. Well the truck being towed by a large wrecker arrived at the hotel at about 12:30PM, just 3 hours behind schedule. A lot of folks jumped in to help get it unloaded in record time and the show went on.

I would like to thank all the folks that stepped up to help with making this event the success it continues to be. All the pre-planning is done by just a couple of people, but it takes many, many good friends to make it all happen during the show, thanks to, RL & Linda Barnett, Gerald Cromer, Ernie Hite and his son Everett Hite, Clare Owens, Tom Houghtaling, Ted Bryan, Ted Miller, Robert Lozier, AWA President Geoff Bourne, our auctioneer (that made it through 3 auctions) Brad Jones, Richard Wayne, Gary Carter and many others whose names I just can't think of right now.

Look for us again next year, 2006 on the forth weekend in March.

CC-AWA CONFERNECE CONTEST

By Robert Lozier

1 - PRE-1920 RECEIVERS & TRANSMITTERS

1st-Bob Slagle, RCA 106B communications receiver. While this receiver was certainly designed before 1920, we suspect that this particular set probably dates from 1920/21 Twenties vintage radios. Bob also received Best of Show

2A. - PASSIVE AND1 TUBE RECEIVERS

1st-Merrill Bancroft for his Splendid one tube set.

2nd-Barker Edwards, Crosley Pup with paper mache & chalk ware Crosley Pup dogs.

3rd-Gerald Cromer for his Gem - tripod base crystal set

2B - 2 & 3 TUBE SETS

1st-Bob Slagle, New Your Coil receiver

2nd-Merrill Bancroft, Boston Scale and Machine Co. receiver

3rd-Gary Alley, Nyaccoflex two tube reflex set with fixed crystal detector.

2C - 4-6 TUBE SETS

1st-Barker Edwards, Radiola Regenoflex

2nd-Gary Alley, Garod RAF

2D - 7 OR MORE TUBES

1st-Merrill Bancroft, Atwater Kent Model 40.

(What ???? a first place for a really common bathtub??? Yeah, but he had the shipping box you never see.)

3A - CATHEDRALS & TOMBSTONES

1st-Imre Vany for his Wings cigarette advertising radios. He also received the **Peoples Choice Award** and a special recognition for innovative display.

2nd-Tom Bourcy, R. H. Macy set

3rd-Merrill Bancroft, Atwater Kent Model 90

4A - MULTIBAND TRANSISTOR RADIOS

1st-Richard Owens, Sony CRF-230

4B - TRANSISTOR RADIOS

1st-Bret Philips, Regency TR-1 with clear plastic back.

2nd-Paul Farmer for his well researched Hoffman P410

3rd-Marty Reynolds, Zenith 800

4C - NOVELTY TRANSISTOR RADIOS

1st-Louie Scribner, USSR made Sstankino Tower

2nd-Barker Edwards for his little set made to look like a vintage tube amplifier

5A - Pre-War Communications & Amateur Equipment

1st-Geoff Bourne, 1939 Philips HMZL 34/K-II receiver with original prints

5B - Post-War Communications & Amateur Equipment

1st-Richard Owens, RME 45 w/ converter, speaker & documentation. Richard also received **Best Presentation** for his RME display

1st-Geoff Bourne for his prototype of a Zenith marine receiver

6 Speakers

1st-Geoff Bourne, W.E. 182AW 'Shawphone'

2nd-Ron Lawrence for his two Bristol horns and Bristol one tube power amplifier

3rd-Gary Alley, Firth Vocaloud

7 Military Radio

1st-Lud Sibley, Soviet Marker Beacon Receiver and Czech Tranciever

6- Ron Lawrence Bristol display

8 - Tube Testers

1st-Geoff Bourne, Bittorf & Funke card type tester

2nd-Gerald Cromer, Weston Model 788 tester

9 Tubes

1st-Kirk Cline, mint Osram Catkin valve circa 1933

10 Advertising

1st-Ron Lawrence, "Miss Majestic" - 1929 scrapbook

2nd-Ron Lawrence for his set of stand-up Sylvania display cards

3rd-Merrill Bancroft for his Majestic banner circa 1929

Senior Class

Pre 1930 to Robert Lozier for his Philips exhibit

WHO INVENTED THE SUPERHETERODYNE?

"THE LEGACIES OF EDWIN HOWARD ARMSTRONG"

PART ONE

By Alan Douglas

Editor's Note: This article was originally published in the *Proceedings* of the Radio Club of America, Nov. 1990, Vol. 64 No. 3. It is reprinted here with permission from Alan Douglas. Part two will appear in the next issue of the *Carolina Antenna*.

Of E. H. Armstrong's four principal inventions—regeneration, superregeneration, superheterodyne, and frequency modulation—the supeheterodyne has always seemed one of the least controversial. "Everyone" knows that Armstrong invented it. He devised it during World War I, patented it shortly afterward, sold his patent to Westinghouse who cross-licensed RCA and the radio industry, and that was that. Some Frenchman named Lévy claimed he was first, but whoever heard of *him*?

All of Armstrong's inventions were involved in controversies. Lee de Forest got legal credit for regeneration (and others might have, with better counsel, notably Robert Goddard [1]). John Bolitho had discovered much of the superregeneration principle before Armstrong, who prudently bought Bolitho's patent before negotiating with RCA. FM had been gathering dust on theoreticians' shelves for decades before Armstrong took it up, but as soon as he had made it worth fighting over, he was beset from all sides. So, if the superheterodyne was his most valuable invention—and it is fundamental to essentially every radio and television made since 1930—it would be surprising if Armstrong had *not* had his priority disputed.

The dispute ended in defeat. In 1928 Armstrong lost his superheterodyne patent in an interference proceeding within the Patent Office, when most of its claims were transferred to a Lévy patent owned by AT&T. Since AT&T was in the same patent pool as Westinghouse and RCA, this transfer had no effect on the industry and attracted little notice [2]. Lévy did not publicly press his claims outside of France, and even there, Armstrong was often credited with the invention.

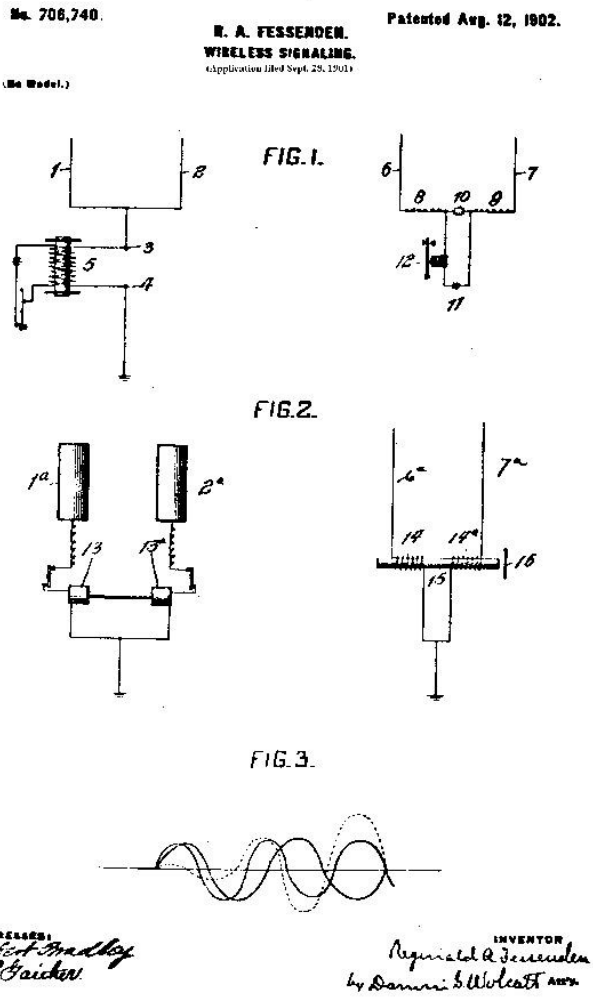
In view of this apparent misappropriation of credit, it is worthwhile to take a careful chronological look at the superheterodyne, to see precisely how it was invented and how it was introduced into practice.

THE HETERODYNE

First came the heterodyne. The

principle of "beats" or difference tones between simultaneous audio pitches was well known since antiquity, but Reginald Fessenden in 1901 was the first to apply the principle to radio transmissions [3]. Originally both radio frequencies were to be transmitted, received with two antennas, and combined in a detector. Later a local oscillator was substituted for one of the transmitter-receiver combinations and the heterodyne as we know it was born. Fessenden himself coined the term, from the Greek *heteros* (other) and *dynamis* (force).

For years Fessenden was the lone proponent of continuous waves, and possessed the only such transmitter, the radio-frequency alternator later perfected by E.F.W. Alexanderson of General Electric. Cyril Elwell followed with his development of the arc generator, the basis of the Federal Telegraph Co. For its detector Federal interrupted the incoming signal at a radio-frequency rate with a rotating commutator. The heterodyne worked better but had to await the development of suitable low-power RF sources: small alternators, arc generators, or vacuum-tube oscillators.


No. 706,740. Patented Aug. 12, 1902.

R. A. FESSENDEN.

WIRELESS SIGNALING.

(Application filed Sept. 29, 1901.)

(No Model.)

FIG. 1.

FIG. 2.

FIG. 3.

Witnesses: Robert Bradley, F. E. Gaicher

Inventor: Reginald A. Fessenden, by Dennis & Wolcott Attys.

Heterodyne detection provided an apparent amplification of the received signal, an important effect since at first no other method of radio-frequency amplification was known (the Audion was used only as a detector for several years after its 1906 invention, not as an audio- or radio-frequency amplifier).

From 1912 to 1915 radio engineers Hogan, Cohen, Latour and Liebowitz attempted theoretical explanations of heterodyne amplification, variously obtaining results of 1.27, 2, or 4 times the ratio of local oscillator strength to received signal strength. Not only did the numbers differ, but there was also disagreement on whether it was true amplification or a result of increased detector efficiency. The discussions in the I.R.E. Proceedings became more and more heated, as the mathematical expressions lengthened. So Armstrong, ever distrustful of mathematics, set out to discover the truth for himself.

With a permanent teaching position at Columbia University as Michael Pupin's assistant, Armstrong had the full use of a well-equipped engineering laboratory. He presented his experimental findings to the Institute of Radio Engineers in October 1916 [4], more or less corroborating Liebowitz's mathematics. Heterodyne amplifications of 100 or more were measurable, which in turn could be increased fifty times in a regenerative circuit connection. But most importantly, by the time Armstrong had finished his work, he was intimately familiar with the practical handling of heterodyne circuitry.

THE WAR

When the United States entered World War I, Armstrong joined the Army Signal Corps and was posted to France. The Division of Research and Inspection had just been created, to evaluate existing apparatus and propose changes, and to inspect equipment being manufactured in Europe for the American Expeditionary Force. Captain Armstrong was placed in charge of the Radio Group of the Research Section.

On his way to France, stranded for three days when fog closed the Channel, Armstrong had taken the opportunity to visit London. Stopping at the Marconi Co. offices, he met Captain H.J. Round, for the war's duration in charge of a chain of wireless direction-finding stations for the Admiralty. Here Armstrong came close to some of the war's best-kept secrets. For, using information supplied by these listening stations, the Admiralty could not only keep continuous track of many German ships and submarines, but had also broken the German ciphers and could read nearly all the messages [5].

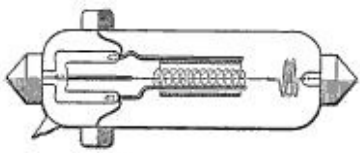
What most interested Armstrong, however, was Round's short-wave equipment. The Germans used low-powered "buzzer" sets for shipboard intercommunication while at anchor in their home ports, confident that they could not be heard more than a few miles on their 200-meter (1.5MHz) wavelength. Round's multi-stage amplifiers however could pick them up, and fix their positions. A small change in position could mean that a ship had moved downriver, getting ready to put to sea (the largest naval battle of the war, the Battle of Jutland, was brought about because of a 1½-degree change in bearing of the German flagship). With advance warning of German sorties, the British could not only ready their

defenses, but ideally hoped to bring the German fleet to action against their own superior forces.

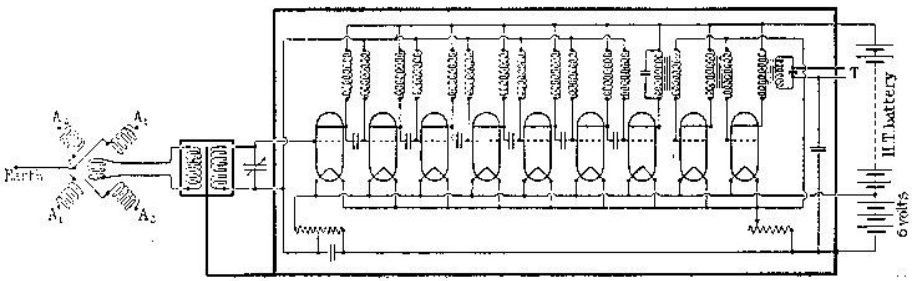
Round had been able to make such short-wave amplifiers operate by designing his own vacuum tube, the V24, with very low interelectrode capacitances. One of his standard amplifiers used eleven V24s in cascade, for a total gain of 2000, and where more amplification was needed, two amplifiers could be connected in tandem. Some direction-finding stations ran as many as 130 tubes, and used prodigious numbers of spares, not to mention battery power, but to the Admiralty the results were well worth the expense [6].

Such quantities of V24 tubes would never be available to the army in France, and no American tube was remotely suitable for this RF-amplifier service, but Armstrong sent the information back to the Signal Corps laboratories for future development. For the moment, the AEF settled on the latest French design by Marius Latour: a four-tube, six-stage model L-3. Armstrong's problem was immediate—the German army was rumored to be using very short waves for front-line communication, waves too short to be picked up on the French receivers.

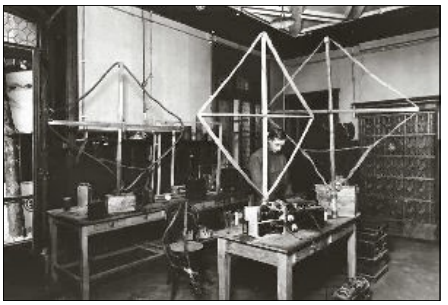
Since one regenerative detector tube would have performed nearly as well as Round's multi-stage creations, one may wonder why this was not done. After all, American hams had been operating on short waves for years (although, to be truthful, very few were anywhere near the legal boundary of 200 meters). Paul Godley's "Paragon" receiver (grid and plate circuits tuned with self-resonant variometers, for regeneration) was well known. H.J. Round gave two explanations in 1920: the multi-stage amplifiers were less microphonic than a single tube, and an oscillating detector directly coupled to an antenna would have wiped out other direction-finding stations trying to pinpoint the same signal [7].



One more bit of knowledge is needed to set the stage for Armstrong's discovery: the heterodyne was not considered suitable for spark reception. Spark signals were somewhat



Round's direction-finding amplier. Coils A1 and A2 were connected to large stationary single-turn loop antennas, 90 degrees apart.



Armstrong's Paris Laboratory
(US Signal Corps Photos)

like present-day AM, in that they were modulated at an audio rate and occupied a large bandwidth. Tuning a heterodyne detector to a spark signal's center frequency was out of the question. Neither the signal nor the local heterodyne oscillator had anything like the necessary stability, and in addition there was no obvious way to tell when zero-beat was achieved. A mis-tuned heterodyned spark signal had a raspy hissing sound, much more difficult to read than an audio tone, and not easily distinguished from interfering signals or atmospherics.

THE INVENTION

As Armstrong later explained it, his conception of the superheterodyne was the result of three chance occurrences. First, he knew all about heterodyne circuitry. Second, his London meeting with H. J. Round had set him to thinking about reception of weak high-frequency spark signals. As he related in 1943, "The third link came months later as I happened to be watching a night bombing raid and wondering at the ineffectiveness of the antiaircraft fire. I may say that night bombing was not very dangerous in those days, either for the man on the ground or the man in the airplane. Thinking of some way of improving the methods of locating the position of the airplane, I conceived the idea that perhaps the very short waves sent out from them by the motor ignition system might be used. The unique nature of the problem, involving the amplification of waves shorter than any ever even contemplated and quite insoluble by any conventional means of reception, demanded a radical solution. All three links of the chain suddenly joined up and the superheterodyne method of amplification was practically forced into existence. Not one link in the chain could have been dispensed with. This, I think, is the only completely synthetic invention I have ever made." [8]

This happened in Paris in March 1918, as he was walking back to his apartment after watching the air raid. Years later he swore he could find in the dark the particular street where the thought had come to him, if set down in the city blindfolded.

The signals were too weak to be detected directly, and had to be amplified. The heterodyne would amplify them, but would lose the natural spark tones. Armstrong already possessed a tuned amplifier and

detector, for long waves. His flash of insight was to use the heterodyne to bring the short-wave signals down to the range of his long-wave amplifier. This heterodyning, it turned out, did not alter the modulation content of the original spark signals, but preserved all the original sidebands and therefore the characteristic tone that allowed each spark transmitter to be distinguished aurally from others. The final detection could now be done by rectification, in the normal manner [9], because there was a large amplified signal available.

That was the invention, but a great

One half of Armstrong's first model, as it was displayed in the Army Communications Museum at Ft. Monmouth, New Jersey in 1980. The right-hand box, the headphone, and the VT2 tubes with the caps resting on them, are all incorrect, but the set has been displayed this way since at least 1954. This model, with its four-tube amplifier box, is shown in its original condition in Radio News, Feb. 1920 (ref.15). U.S. Army photo, courtesy of H.L. Chadbourne.

deal of experimentation was needed to prove its workability. Armstrong proposed the method to his superior Major Buckley in June 1918. Over the next few months, up to the time of Armstrong's French patent application in December, the sequence of events was as follows:

"Preliminary experiments which showed the practicability of the method were made at this time, but on account of the large amount of more pressing work they were discontinued until about August 1. At this time Sergt. Pressley was assigned to work on the reception of undamped waves by this method. In the course of a few days apparatus was set up, and exceedingly good results were obtained. More pressing work, however, in tank radio, for which Sergt. Pressley was required, prevented continuation of this problem.

"The development of the method for receiving damped and modulated continuous waves was the next step. On account of the fact that no men capable of handling the work were available this development was turned over to Sergt. MacDonald, who was regularly stationed at Orly Field, but who volunteered to work on the problem in his own time. The lack of help greatly delayed the development. Toward the middle of August Sergt. Lewis was available and was also assigned on the development. About the middle of September the experimental and developmental work was completed and the problem of putting the apparatus into practical form was taken up. It was decided to use six tubes. Two of these were used in transforming the incoming high frequency to the lower frequency, three for aplifying this frequency, and one for detecting it. This work was placed in charge of Sergt. Lewis, assisted by Sergt. Houck. On account of many unforeseen difficulties and the great amount of

Paul Godley with an experimental superheterodyne. This volume of Wireless Age, one of a complete set, was discarded by the Columbia University Library and might well have been used by Armstrong.

work required to complete the detail design of the various parts, the first model was not turned out until about the 1st of November. In preliminary tests the model gave several thousand times the amplification of the L-3, and the advantage could be increased by the addition of a two-stage audible frequency amplifier. Tests were completed, and it was ready for trial at the front at the time of the signing of the armistice." [10]

PUBLICITY

Armstrong returned to the United States in time to present a paper to the Institute of Radio Engineers on December 3, 1919, outlining his new system. He concluded the talk,

"The new practice of this method involves the use of many known inventions, but in connection with the production of a superaudible frequency by heterodyning I wish to make due acknowledgment to the work of Meissner, Round, and Lévy, which is now of record. The application of the principle to the reception of short waves is, I believe, new and it is for this reason that this paper is presented." [11]

During all of 1920 Armstrong was preoccupied with his regeneration patent, and particularly his legal troubles with Lee de Forest. Having little income to pay his mounting bills, he needed an ally. He is said to have approached the large independent manufacturer Amrad, backed by J.P. Morgan Jr., with an offer of a half interest in his regeneration patent for $500 [12]. But then his attorneys hit upon the idea of licensing all the makers of regenerative ham receivers, and by September had signed up 18 of them, assessing a royalty of 5% of sales

Armstrong's 2nd model. Now in the Smithsonian. (photos by Donald Patterson)

price. At the time, the amateur market was negligibly small, and some licensees were no more than high-school boys working in their attics. The fact that they might grow up to become such firms as Crosley and Zenith was unforeseen.

Westinghouse RA tuner and DA detector-amplifier, designed in 1920 by Frank Conrad and Donald Little

Armstrong found his ally in Westinghouse. Having become involved in radio during the war, and wishing to set up a world-wide communications business like the British-controlled American Marconi company, Westinghouse invested heavily in Fessenden's old company and its valuable patents, only to be checkmated by its rival General Electric. GE, with the Navy's blessing, had formed RCA from the old American Marconi company. RCA in June 1920 had concluded cross-licensing agreements with GE and AT&T and signed exclusive traffic agreements with nearly every important country in the world, before Westinghouse could blink.

Westinghouse executives however were not myopic. Frozen out of the commercial field, they began radio broadcasting to create a market for their manufactured radio sets, and moved quickly to strengthen their bargaining position with RCA and its allies by purchasing Armstrong's regeneration and superheterodyne patents in October 1920 [13]. It is tempting to assume that Westinghouse appreciated the advanced technical features of the superheterodyne and was therefore willing to spend so much money on the patent, but it is more likely that regeneration was the real prize, and that Armstrong insisted on a package deal. The company's broadcast models, already designed and in production, could not be marketed without either a patent license or ownership. Westinghouse made no use of the superheterodyne patent, and for a time neither did anyone else.

In the February 1920 issue of Wireless Age (affiliated with American Marconi/RCA and generally considered authoritative) Paul Godley described Armstrong's system in some detail [14]. Godley had been with American Marconi during the war as its receiver expert. He was a partner in the Adams-Morgan Co., the country's foremost maker of ham receivers, and had been the first to make Armstrong's regenerative circuit work on short (200 meter) waves. Simultaneously the February and March issues of Radio News (Published by Hugo Gernsback and aimed more at young hams & tinkerers) carried lengthy articles by Harry Houck, who had been Armstrong's assistant in France [15].

But other than establishing Armstrong as the originator of yet another advance in radio technology,

these published articles seemed to have little effect. In those days when the average amateur counted himself lucky to afford even one vacuum tube, the idea of running six to eight of them must have seemed quite far-fetched. On October 29, 1920 the Wireless Society of London discussed the superheterodyne, Wireless World in London published a report on November 13 [16], and finally in February 1921 the I.R.E. published Armstrong's 1919 paper. Still no hint that the circuit had any practical civilian uses.

The 1921 A.R.R.L. Transatlantic tests woke people up. The idea that a bunch of rowdy kids with limited equipment, wavelengths, and power, could accomplish what the commercial interests supposedly could not— "get across"—gave these amateurs swelled heads for decades afterward [17]. (Actually, much experimentation with short waves had already been done, and Marconi himself probably knew as much about them as the hams did). QST magazine was filled with the exploits of Paul Godley, who had been sent to Scotland especially for the tests, and who had used — *a superheterodyne*! [18] *Wireless World* for February 4, 1922 likewise ran a long story on the equipment and the results [19]. Superheterodynes began to acquire some mystique. However they were still very expensive. Vacuum tubes for instance cost $5.00 to $7.50, and with tube filaments drawing 1 ampere each, upkeep of batteries alone would break most piggybanks.

POPULARITY

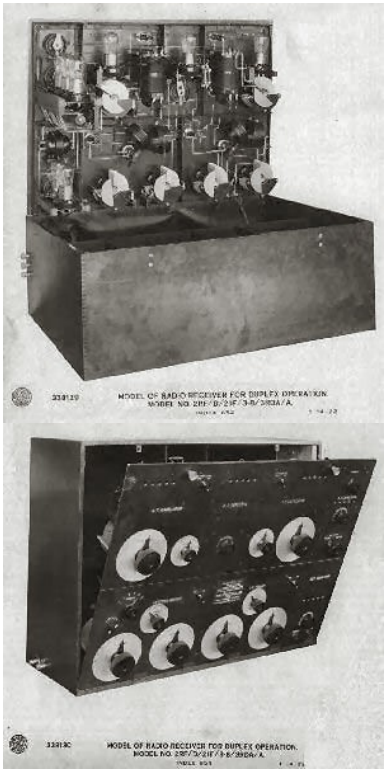
In early 1922 the radio boom hit America. Radio broadcasting, which earlier had interested mainly kids, now began to appeal to a far wider and more affluent audience. Armstrong himself termed his new circuit "the Rolls Royce method of reception" and, as with the automobile, the superheterodyne attracted many patrons precisely because of its expense and complexity.

RCA, which could have sold superheterodynes, refused because Elmer Bucher, its sales manager, insisted that his models must have no more than two tuning controls, to be simple enough for the public to operate [20]. RCA did commission GE to build a commercial model, designed by A.F. Van Dyck in 1921 and installed with appropriate fanfare on the passenger liners Leviathan and America in early 1922. But of course this was far from a domestic radio.

Elmo N. Pickerill in the radio room of the Leviathan, 1923. (Steamship Historical Society photo)

First to cater to the public taste, in RCA's absence, was Charles Leutz, formerly Godley's assistant at American Marconi. Leutz introduced his model in September

1922, updating it every few months with the latest improvements.



He dared not sell complete radios, for fear of a patent-infringement suit, but did a thriving business in blueprints, components, and kits, publicizing his wares in full-page ads and in a popular series of books titled *Modern Radio Reception*. Modern it may have been, but his first model was certainly not for novices; it had six tuning dials and seventeen other controls. Elmer Bucher singled it out as a prime example of what the public did *not* need. Leutz's 1923 model was vastly simpler, and more successful [21].

Meanwhile, in the early 1920s, AT&T was stirring. Its engineers had been using superheterodynes in one form or another for several years, largely for point-to-point experimental reception [22]. AT&T had bought Lucien Lévy's American patent application, in the hope it might be judged fundamental (as noted, and as will be explained later in more detail, it was so judged in 1928). After joining the "radio group" in July 1920 with RCA and GE (Wireless Specialty was admitted in March 1921, and Westinghouse in June), AT&T was cross-licensed under all their radio patents, including the superheterodyne. AT&T moved aggressively into radio broadcasting, supplying most American radio stations with transmitters and studio equipment, and operated WEAF in New York City, unquestionably the country's finest station both technically and in programming. AT&T's executives were seriously considering claiming all radio broadcasting, or at least all sponsored broadcasting, as their exclusive prerogative [23].

Leutz model L, 1922
(Photo by H. L. Chadbourne)

Manufacturing radio receivers for public sale would have been a natural next step; after all, AT&T's foreign affiliates were doing it. And Western Electric was already building receivers to be supplied to broadcast stations as part of their studio equipment. All stations had to monitor the 500 kHz marine distress frequency, and shut down in

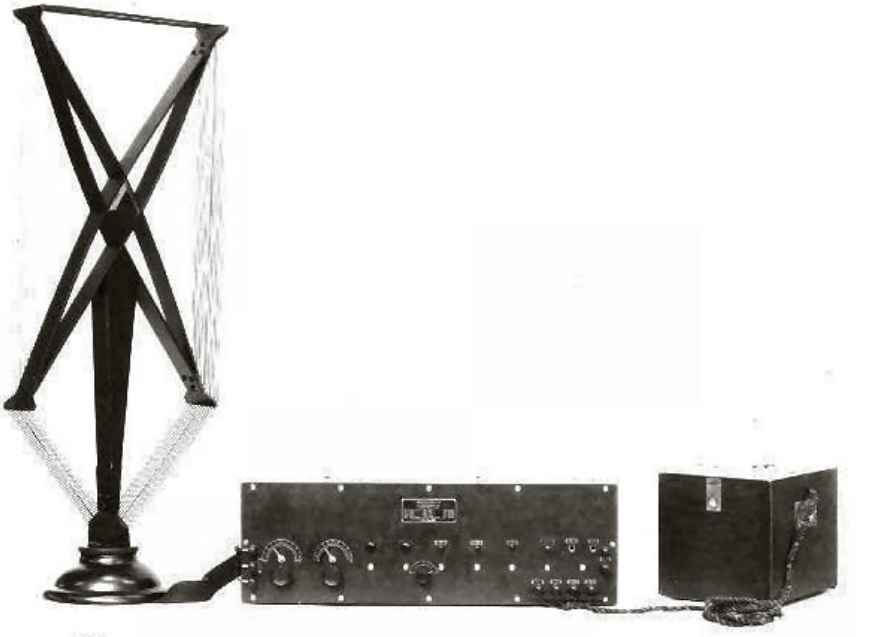
the event of an SOS; they also used the receivers to check their own transmission quality. Basing their design on a portable field-strength-measuring receiver built by the Engineering Dept. in New York, Western Electric's engineers created a seven-tube superheterodyne model 4A by October 1922. One was sent in January 1923 to Dr. Alfred Goldsmith, RCA's Director of Research, and rumors circulated that another was about to be installed in the White House.

The cross-licensing agreements among the "radio group" members had been drawn up before radio broadcasting was thought important, and while some categories such as radio transmitters were carefully defined, the companies' respective rights to build and sell radio receivers to the public were not so clear. AT&T wanted to get its nose into the tent. Its superheterodyne was said to have given RCA's sales manager Elmer Bucher "the jitters" which, considering RCA's archaic model lineup at the time, was probably true. RCA's affiliates GE and Westinghouse, which did all the actual design and manufacturing, had planned more of the same for next year's model line.

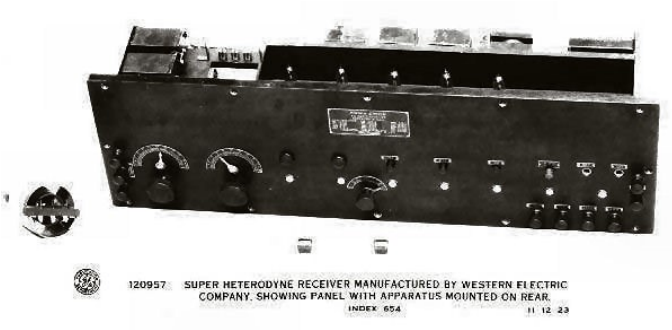
FOOTNOTES

[1] A.E. Anderson, "Robert H. Goddard: Original Inventor-Patentee of the High Frequency Vacuum Tube Oscillator" (unpublished manuscript, 1981)

[2] It would not have affected most of the industry anyway, as RCA did not license other manufacturers under its superheterodyne patents



120956 SUPER HETERODYNE RECEIVER MANUFACTURED BY WESTERN ELECTRIC COMPANY, SHOWING COMPLETE EQUIPMENT.
INDEX 654



Super Heterodyne Receiver manufactures by Western Electric Company

Electron Relay," Proc. I.R.E. 5 (April 1917), pp.145-168.

Western Electric Model 4D

[5] Sir Arthur Hezlet, Electronics and Sea Power (New York: Stein and Day, 1975, pp.83-155.

[6] H. J. Round, "Direction and Position Finding," Journal I.E.E. 58 (March 1920), pp.224-257.

[7] H. J. Round, "Direction and Position Finding," Journal I.E.E. 58 (March 1920), p.240.

[8] Armstrong, "Vagaries and Elusiveness of Invention," Electrical Engineering 62 (April 1943), p.150.

[9] Normally a grid-leak detector would have been used, which amplified as well as detected, but Armstrong had used crystal rectifiers in his heterodyne researches. Any device, worked over a nonlinear portion of its characteristic, would partially rectify an applied signal, and serve as a detector.

[10] Report of the Chief Signal Officer, 1919 (Washington, Government Printing Office, 1919. Reprint by Arno Press, New York, 1974), pp.288-289.

[11] Armstrong, "A New System of Short Wave Amplification," Proc. I.R.E. 9 (Feb. 1921), pp. 3-27. QST 3 (Feb. 1920), pp.5-9, 13.

This paper uses the term superaudible heterodyne, from which superheterodyne is derived. The British tended to use supersonic. Incidentally, the first use of the word superheterodyne that I have seen, is in QST for March 1921 (p.41) but evidently from the context it was in common use by then.

[12] Amrad's boy-wonder president H.J. Power declined Armstrong's offer. Douglas, Radio Manufacturers of the 1920s, Vol.1 (Vestal, NY: Vestal Press, 1988) p.39.

Northern Electric (Canada) model R4

[13] Option purchased on October 5, exercised November 4, 1920, for $335,000 plus $200,000 if Armstrong should win his interference with de Forest over the regeneration patent. The purchase included 4 issued patents and 16 applications, by Armstrong, Pupin, or the two jointly.

[14] Wireless Age 7 (Feb. 1920), pp.11-14.

[15] Radio News 1 (Feb. 1920), pp.403-405, 439; (March 1920), pp.469-471, 508-510.

[16] Wireless World 8 (Nov. 13, 1920), pp.581-583.

[17] DeSoto, Two Hundred Meters and Down (West Hartford, CT: The American Radio Relay League, 1936).

[18] QST 5 (Feb. 1922), pp.7-40.

[19] Wireless World 9 (Feb. 4, 1922), pp.689-694.

[20] Archer, Big Business and Radio, p.92.

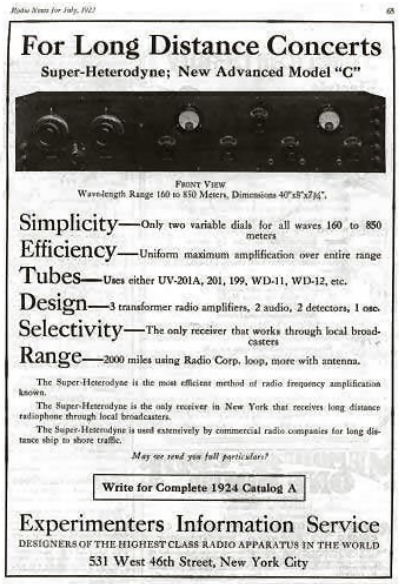
RCA nonetheless marketed its share of complex apparatus. The Radiola VI from this period indeed had only one tuning dial and one bandswitch, but also sported an amplification control and six filament rheostats. It sold for $162.50 without antenna, tubes, batteries, or speaker.

[21] For a detailed story of Leutz's career and radio models, see Douglas, Radio Manufacturers of the 1920s, Vol.2 (Vestal, NY: Vestal Press, 1989), pp.122-131.

[22] Espenschied, Proc. I.R.E. 47 (July 1959), pp.1257-1258.

A History of Engineering & Science in the Bell System. The Early Years (1875-1925) (Bell Telephone Laboratories, 1975) pp.349-465.

[23] [Archer, Big Business and Radio, pp.55, 75-78, 89.



5000 WATTS OF POWER FOR WBT. WILL IT CAUSE PROBLEMS?

By Ted Miller

In the spring of 1928 WBT's power was increased from 1000 to 5000 watts when the transmitter was moved from the Coddington building to the present site. Coddington's farm on Nations Ford Road, some 8 miles from the city.

The proposed increase in power was cause for concern among Charlotte's radio listeners. The following article appeared in Bill Weber's Radio Chat, a column of interest and gossip of interest to Charlotte radio fans, and is copied from the April 22, 1928 edition of the "Charlotte News"

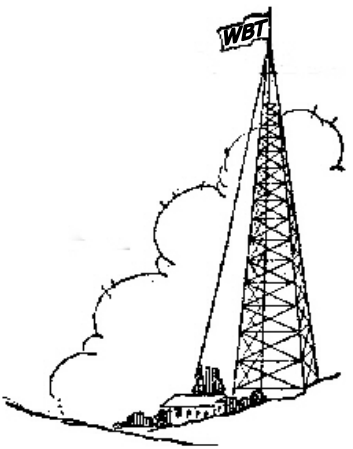
"Quite a few radio fans in this Queen City of ours are about to take up arms against the proposed 5000 watt power allowance of WBT. Their expression of opinion is that with so much power, every out of town station will be blotted out when the local station takes the air.

At first thought this sounds more or less reasonable and, without a knowledge of the gentlemanly character of WBT, the assumption might be correct.

But we have this prediction to make: When 5000 watts power is thrown into Mr. Coddington's aerial, that aerial will be sufficiently far away from Charlotte so that it will tune sharper by far than it does under present conditions. The local station has been repeatedly designed by some of the best minds in the city as the finest asset that Charlotte could possibly have.

We predict that those who are now objecting will be in the front rank when the time for congratulations appears. The local station is in the hand of competent engineers who have at their command the combined resources of the Bell Telephone System, General Electric, Western Electric and Westinghouse.

Additional power means a clean wave channel for this station and consequently it will become more and more valuable to Charlotte and the Piedmont Carolinas.



HAVE YOU HEARD THIS ONE?

Q. What did the television say to the radio?

A. You just don't get the picture!

MY RADIO HEAVEN

By Ron Lawrence

On May 1st. 2005, 35 years ago , I bought my first "antique" radio while in high school. My electronics teacher, Rick Bilbor K4KAV, had brought in some back issues of Popular Electronics for us to read. There was a feature In the July 1969 issue titled "Whatever happened to Atwater Kent".

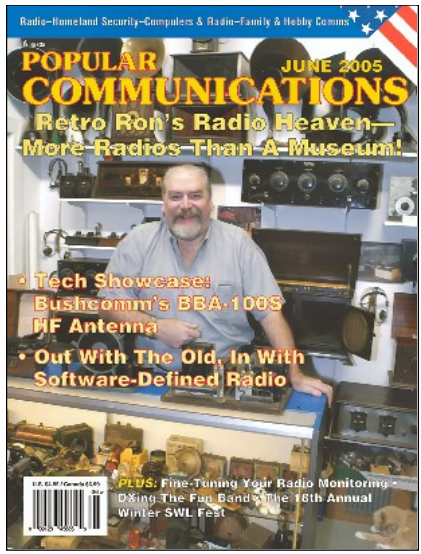
(That original issue of PE is shown in the photo above sitting beside the same AK 20 I bought 35 years ago)

It didn't mean much to me at the time, but a few weeks later I was at a local flea market with my mom. Sitting on the tailgate of a pickup truck just inside the gate was a radio; I recognized it was a 1924 AK model 20 battery set from the article. The dealer was asking $15.00, but I only had $10.00!

Of course mom said, "I'm not going to give you $5.00 to buy an old piece of junk, if you want it tell him you only have $10.00", Well, he took the $10.00. From then on I was hooked not only on old radios, but I also enjoy haggling with dealers over price.

Back in the early 1980s a local newspaper wrote an article about my collection, the writer used this quote that's from Shakespeare I think, "From innocent beginnings do dark obsessions grow." Boy was he ever right.

After 35 years I don't buy many radios anymore. My dream display room that we built in 1990 is more than full, I have radios in my office/ham shack up stairs, there's a radio in the foyer, there are 2 grandfather clock radios, one in the living room and one in the dining room. And there's a Philco mantel clock and a Majestic model 92 in the den. I also have radios on display in two museums in Charlotte, and there's no place to put them if I where to bring them home. My main interest now is collecting tubes, early paper, and Clough Brengle equipment.



Editor's Note: Ron and his collection were recently featured in the June 2005 issue of *Popular Communications*. In Raleigh it must have been a sell out as I had to go to three book stores to get a copy. Congratulations Ron on a great article.