Waves, Enigma, and the Coventry Myth

British Intelligence in WW-II

Bob Thomas, W3NE

Throughout the second World War, German strategic messages were encrypted prior to transmission by an ingenious machine so effective that absolute secrecy was literally guaranteed. The device, dubbed "Enigma", was an electro-mechanical machine, somewhat like a typewriter in appearance, with a keyboard for entering messages and illuminated letters for displaying output text. In the encode mode, plain language messages were typed on the keyboard and coded ciphers appeared on the lights. The machine was so diabolical because every time a letter was entered on the keyboard, the encryption code changed. For example, when the "E" key was pressed, the lights might issue a "J", but when "E" was pressed a second time, the output would be a different letter, "W" for example. Similarly, decryption of an encoded message entered as a code cipher at the keyboard in the form "FFFH," might be decoded as "GUNS." Very clever, but what the Germans didn't know was that the British were able to assemble a close approximation of a genuine Enigma machine using code wheels stolen by Polish patriots from their Nazi occupiers. The quasi-Enigma machine was not perfect, requiring anywhere from a few hours to several days to decode a message, but it enabled British intelligence to read German wartime messages intercepted by radio or smuggled to England from agents on the continent. Furthermore, and most importantly, the Germans were oblivious *for the entire duration of the war* that the British were routinely reading their most confidential correspondence!

Intelligence information related to air defense, particularly from decoded Enigma messages, was routinely forwarded to Reginald V. Jones, a brilliant physicist who was Scientific Officer to the Military Intelligence Service. One such fragment of information came shortly after the start of the war from a conversation overheard between two captured German prisoners of war, in which the term *X-Gerät* (Translation: *X-Apparatus*) was mentioned. Interrogation of the prisoners along lines suggested by Jones revealed only that X-Gerät was a system of bombing apparatus employing radio pulses. Jones deduced that the "X" implied crossed beams, but he recognized that locating a target with the precision being achieved by Luftwaffe bombers would require exceedingly narrow beam widths which were beyond comprehension at that time. While Jones was ruminating over this puzzle, several new clues surfaced, all centered around the German word *Knickebein* (literal translation: *Croocked Leg*). First, a Luftwaffe pilot's notes found in his downed aircraft listed beam headings and included a reference to "Radio Beacon Knickebein;" messages from the French and Belgian underground mentioned construction of Knickebein installations and included sketches of large antenna structures; further interrogation of prisoners established a vague association between X-Gerät and Knickbein; and finally, deciphered Enigma messages increasingly carried references to "Knickebeins" with data for beam headings to strategic English cities from locations in France and the recently overrun Low Countries and Norway. Jones coalesced all these clues into a simple explanation of what the Germans were up to. Specifically, he determined that X-Gerät was a system of narrow radio beams emanating from Knickebein transmission sites on the continent. These beams intersected over English target cities and conveyed information to the bomber navigators which enabled them to fly along the beam and when to commence bombing. Beyond that basic framework, however, no one knew how the system really worked. For his effort, Jones was derided and personally humiliated by many top members of the British military and scientific establishment who refused to acknowledge existence of long range navigational radio beams as postulated by this young upstart. After all, the RAF didn't need "beams" to locate their targets; they relied on good old dead reckoning and celestial navigation! (In truth, the RAF had a controversial record of bombing accuracy at that stage of the war.). Meanwhile, thousands of British lives were being lost every day from the fearsome accuracy of the Third Reich's blistering air attacks

The answer to the remaining questions were eventually revealed by examination of a receiver found in a Heinkel 111 that had been shot down over Scotland. The receiver's Type Plate identified it as a "Blind Landing Receiver," equipment routinely found on aircraft around the world for aid in landing in bad weather using the well known Lorenz two-beam system. Lufthansa had used a nearly identical design on its commercial airliners in 1934! Nothing seemed out of the ordinary about the receiver, until Jones received an intelligence report of a secretly monitored conversation between German prisoners who were mocking their captors for overlooking the secret to X-Gerät when it was right under their noses. This prompted Jones to personally ask the engineer who had performed lab tests on the captured receiver if there was anything unusual about it. The reply was, "No, although it is much more sensitive than needed for blind landing." There it was – the Germans had disguised the secret beam receiver with a bogus Type Plate. Jones had successfully unlocked the mystery of Nazi beams! The maelstrom of controversy that surrounded Jones and his beam theory did not subside, however, until Winston Churchill settled the matter with finality in a crucial meeting during which Jones' persuasive argument so impressed Churchill that he prevailed over his stubborn opposition.

Final details of X-Gerät were quickly discovered. Frequency range, determined from the captured receiver's tuning range, was found to be 30 to 33.5 MHz. Monitoring by British aircraft within that range revealed exact operating frequencies, modulation characteristics, and approximate location of Knickebein stations. Precise locations of the stations and further details of antenna construction were obtained by aerial photography from risk-laden reconnaissance sorties flying through enemy flack directly over the stations. Knickebein antennas radiated two narrow Lorenz beams from a dipole radiator with a reflector spaced one-quarter wavelength away on each side. Each reflector was broken at its center, with relay contacts. By sequentially energizing one relay then the other, the narrow transmitted beam would shift very slightly to one side or the other, resulting in a radiation a pattern shaped like two overlapping petals of a flower. One petal was modulated with a 2-kHz dash signal, and the other modulated with 2-kHz dots. When an airplane flew exactly between the two beams, on the central overlapping section, dots filled-in spaces between the dashes, creating a continuous tone. If the plane deviated off-center in one direction dashes were heard, and in the opposite direction, dots were heard. The central beam, where the steady signal existed, was only 0.6 degrees wide, providing a path only 400 yards wide over a typical English target city. Each Knickebein antenna assembly consisted of a large array of radiators and reflectors mounted on a turntable so it could be pointed with precision to the selected target, precision so great that compensation was required to correct for the minute error introduced by the slight flattening of the earth's surface at the poles.

A basic X-Gerät system employed one Knickebein to transmit a Director Beam along which a bomber flew, while a second Knickebein, located several hundred miles away, transmitted a Cross Beam that intersected the Director Beam over the target. In actual practice, the system was much more sophisticated than that. A second "Reserve Director" was transmitted in case the main beam failed; and as many as three Cross Beams intersected the Director to accurately define the approach to the target. Additionally, bombers did not ride the Director Beam the entire distance from their home field to the target; they initially followed a Secondary Director until they had nearly arrived at the target, then suddenly changed course to get on the main beam in a "crooked leg" path, a maneuver from which the term *Knickebein* was derived.

Now that the principle of the beam system was thoroughly understood and accepted, the British began to jam X-Gerät beams with noise generated by commandeered medical diathermy machines. They later transmitted false dot and dash tone signals from ground stations, disorienting German bomber navigators and throwing the Luftwaffe into confusion. If all that were not enough, the RAF was now able ride along a Director beam right to a Knickebein transmitter site with obvious results. Of course, the Germans quickly realized that X-Gerät was no longer viable, and so they initiated a new round of Teutonic ingenuity.

Evidence of a new technology was beginning to appear in the sudden rise of Enigma traffic bearing references to *Wotan*. What could it mean? Jones puzzled over this new terminology, but it was not until he consulted a former university colleague, an outstanding German scholar, that its significance became clear. According to German mythology, Wotan was leader of all the gods, and he had only <u>one</u> <u>eye</u>. That was it: one eye – *one beam!* Support for the single-beam theory came from another decoded Enigma message in which an attack ordered against a British military installation assigned only a single station to transmit a guidance beam. During the raid, German bombers were not very accurate in azimuth, but their range accuracy was quite good. British listening stations began to monitor transmissions from 40- to 50 MHz, where they discovered Lorenz right/left beams similar to those of X-Gerät but, in addition to dot–dash modulation, the single Director Beam was modulated by a pulse. Subsequent examination of a captured airborne system and pilot's log revealed that the plane detected the pulse, then re-transmitted it back to the ground station on a different carrier frequency. The round-trip pulse delay was converted to a distance at the ground station and then relayed by voice to the bomber's navigator. This system also had a refinement using a second set of frequencies that enabled the plane to return to base by a route different from its outbound flight.

One of the countermeasures used against Wotan in the London area was to tune-in the bomber's re-transmission of the pulse on a ground-based receiver, then re-radiate it back to the plane on the German ground station carrier frequency. This process introduced additional delay (from the bomber to the British receiver and back to the plane) that caused an error in the distance calculation, throwing the bomber off-range. Brute force jamming was also employed, but a more sophisticated tactic was to transmit false range information to the bomber by overriding the German communications channel with a local ground-based transmitter. The pilot never knew for sure if he was getting genuine range instructions from his base or bogus ones from the British, with the effect that he could believe neither! Wotan was effectively neutralized by these ploys, and was finally abandoned, but it didn't matter much because by then the Soviet Union had entered the war and German offensive resources were transferred to the Eastern Front. The tide had turned in the Battle of Britain, and Germany concentrated technical development on radar defenses, upon which Jones continued to direct his skills and ingenuity with the same zeal as he had against the beams.

One of the most poignant stories to emerge from World War-II tells of a deciphered Enigma message revealing Luftwaffe plans for a massive air attack on the city of Coventry on the night of November 14, 1940. According to the story, this information was forwarded to Churchill who had to decide either to evacuate Coventry, in which case the Germans would immediately realize the British had broken the Enigma code, or to do nothing and sacrifice the lives of hundreds of innocent Coventry civilians to preserve a crucial strategic secret. The story relates that Winston's anguished decision was to preserve Britain's secret knowledge of Enigma; Coventry was brutally attacked, nearly destroyed with over 1400 casualties. It's a gripping story, but Churchill's dramatic role is a myth with no substance whatever. What follows is the chain of events as they actually occurred.

The German bomber command typically transmitted Enigma messages each afternoon with a coded list of target cities and Kneickbein frequencies to be used for raids that night. These messages were ordinarily decoded within a few hours by British Intelligence and forwarded to R.V. Jones, who had developed a keen sense for determining actual target city code identities. Thus, target 51 might be Derby, home of Rolls Royce, major producer of aircraft engines, target 52 the industrial center of Birmingham, and so forth. He generally was able to alert the Fighter Command as to probable targets for that night, as well as the time of the attack within ten minutes, bomber speed and line of approach, altitude, and the anticipated Knickebein beam frequencies so defense forces could be prepared and jammers preset to the beam frequencies.

A number of tragic lapses occurred on November 14 that doomed Coventry. On the afternoon of that day, cryptographers were unable to decode Enigma traffic in time to provide Jones hard data he needed to make informed predictions for that night's raid. Later, when the Knickebein beams were turned on in preparation for the raid, British monitoring aircraft made frequency measurements as they flew along the beams, but not with sufficient accuracy for Jones to do any more than make an educated guess as to which were the Director and Cross beams. In any case, his best estimate was forwarded to Fighter Command who set the jammers in accordance with Jones' recommendations. That night a massive Luftwaffe armada flew right through confused British air defenses to wreak havoc on Coventry. Decoded Enigma data finally became available the next day, and it supported the guess Jones had made the night before! If that were true, and jammers set accordingly, how could Coventry have sustained so much damage? An investigation disclosed that, while the carrier frequencies had been set correctly as advised by Jones, the dot–dash tone modulation frequency of the jamming signal had been set to 1.5-kHz, NOT to the 2-kHz employed by the Knickebein beams! The error had arisen by a series of misadventures too convoluted to relate here, but in any case, they led to the destruction of Coventry despite the accuracy of Jones' predictions.

With regard to Churchill's knowledge of an impending attack on Coventry, he certainly could have had no inkling that city was a target since the related Enigma message was not decrypted until the day after the attack. Furthermore, Winston had departed from London on a trip to a country retreat on the afternoon of November 14. As he read his file of Enigma reports during the course of his trip, he came upon a message indicating London was to be subjected to air attack that night, whereupon he reversed his journey and returned immediately to London, as it was his policy to never leave the City and its people when an air raid was expected. So much for the Coventry Myth.

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HISTORIC RADIO ON THE INTERNET

BROADCAST REGULATION THROUGH THE YEARS

Bob Thomas, W3NE

A fascinating collection of monographs related to radio broadcasting regulation has been posted on the Internet by Thomas H. White, a radio researcher and historian of high caliber. Though primarily concerned with many fascinating aspects of broadcast station regulation during the pioneering era of 1920 to 1934, his work also touches on recent events, recounts some notable events in broadcasting, and provides in-depth histories of several individual radio stations. One never knows how long a valuable resource such as this will remain available on the Internet, so I decided the safest thing to do was to print material of greatest personal interest. When the printer finally stopped, I had over 150 pages devoted to 13 topics, all presented in a concise, authoritative manner.

The most definitive essay in White's collection, "Building the Broadcast Band," is a 28-page description of the transformation of broadcasting from its chaotic, unregulated early days, through increasing government intervention, and on to a disciplined, mature entertainment business. The stability of Westinghouse business practices was a significant positive force in this maturation process, as the company garnered public acclaim and became a respected influence in government circles, in contrast to that scamp DeForest, who once again fell into disrepute from his shady deals. The basic structure of the broadcasting, including decline of dedicated weather and farm market frequencies, evolution of precise frequency assignments (in 10-kHz channels), a new appreciation of skywave propagation, establishment of classifications and power ratings, and numerous other elements of the medium wave (AM) band – many of which survive today – were established in a series of National Radio Conferences. White accompanies all these developments with interesting vignettes and trivia that portray the agonizing process of turning chaos to the order we enjoy today.

Authors often have a "specialty" that tends to dominate their writings, and in that regard,. White leaves no doubt that his "special interest" is broadcast station call letters. No less than four of his articles are devoted exclusively to that topic: "Three-Letter Roll Call" is a fifteen page database of three-letter call signs, tabulated first by city with date of issue and eventual disposition, and again chronologically with subsequent actions, from May 1921 (WJZ) to as recently as March 1997 (KSD). "Mystique of the Three-Letter Call Signs" is similar to the previous monograph, but with discussion and data on FM and TV, including two maps depicting distribution of three-letter stations. "K/W Call Letters in the United States" is a detailed exposition, illustrated with handsome colored maps, on the original mixed-up geographical distribution of K and W call letter assignments, the attempts to rationalize them on a uniform West/East basis and the exceptions that survive to this day (KYW, for instance) or have been permitted to rise anew (WWLS, Oklahoma in 1981). He additionally summarizes this data in a state-by-state listing. Whew! Finally, "United States Call Letter Policies" traces evolution of station identification from the pre-radio era of ship visual identification (consisting of a national flag followed by four flags corresponding to a letter of the alphabet – sounds familiar). Radio call signs evolved from that early custom. Various oddities are included in this historical recitation. For instance, it was only a fluke that KDKA was so-named due to a temporary practice during a brief interval in 1920, in which KD_ _ calls were issued consecutively to broadcast stations and *ships*. Because of luckless timing, Westinghouse was assigned KDKA to their pioneer Pittsburgh station, which just happened to be sandwiched between two ships, *Montgomery City* (KDJZ), and *Eastern Sword* (KDKB). A few months later the Bureau of Navigation reverted once again to segregation of calls for land-based stations from the pool of three-letter calls, enabling Westinghouse to secure the more desirable call WJZ for their New York station. Great reading!

Other topics covered by Mr. White include a huge data base of pioneer initial call assignments and subsequent license modifications; a description of International Radio Week Tests, in which most stations remained voluntarily silent to permit Transatlantic reception tests by engineers and the public in the U.S. and Britain; temporary station grants; copies of actual Commerce Department Bureau of Navigation radio licenses of historic stations; a scholarly treatment of "The Battle of the Century" (the Dempsey-Carpentier fight) broadcast by WJY, which explores the crucial role of radio amateurs of the day, the circumvention of AT&T's miserly land line restrictions, and a critique of the revision of history committed by David Sarnoff & friends and, most recently, by vaunted author Tom Lewis; and "Frequency-to-Wavelength Charts" based upon two different assumptions for the speed of light (300,000 m/s and the more accurate 299,820 m/s) which, while seeming elementary, in fact illustrate the major reason for confusion today in determining the operating frequency from the "equivalent" wavelength of early radio stations

Thomas White very generously refers us to another source of information, "Jeff Miller's Broadcasting History Collection." This resource (which can be easily accessed as a "Link" on White's Web page, has a wealth of information by various authors on such topics as "meanings" of requested call letters of the 1920s, history of New York City calls, slogans used by radio stations of the 1920s and 1930s, UPI Wire reports, and complete lists of stations in existence for many of the years between 1922 and 1946. There is similar, though somewhat narrower coverage of FM and TV stations, as well as individual articles by various authors on a plethora of interesting topics.

There is a certain amount of duplication in White's many monographs, apparently due to their having been written early in 1997 and subsequently refined, expanded, and re-organized into their present form to enable each monograph to stand on its own. However, in recent correspondence with Mr. White, I have been informed that he intends to update his material to the latest information available, and extend the content of "Building the Broadcast Band." In the meantime, Thomas White's material, and that of Jeff Miller, will captivate enthusiasts of early broadcast history, and will provide historians with a rich source of reliable information.

URLs for accessing this material are:

"United States Early Radio History," by Thomas H. White"

http://www.ipass.net/~whitetho/

Jeff Miller's Broadcasting History Collection

http://members.aol.com/jeff560/jeff.html

AUTOMATIC CYLINDER COCKS

Bob Thomas, Blue Bell, PA

In his letter published in M.E. No.4252, Colin Roberts expressed interest in "automatic" cylinder drain cocks. My personal experience with these clever devices goes back to 1979, when I fitted them to my 2.5" gauge Baltimore and Ohio 4-6-0. The idea was passed to me by my father, who had successfully used a larger version (Figure1) on his 1" scale 4-4-0 for many years. The basic concept came to us from Bill Van Brocklin, a prolific New England builder of over thirty 3/4" scale locomotives, most of which employed his automatic cylinder cocks. On his drawing (Figure 2), Bill recommended them for engines with cylinders up to 1.5" bore, although they have been applied to locomotives with even larger cylinders. Most importantly, Bill cautiously recommended them only for engines with slide valves to avoid a possible disaster with piston valves should the drains fail be "automatic" – of which more later.

At first glance, these drain cocks might be expected to perform like snifting valves, simply closing rapidly upon initial application of pressure and preventing free exit of water. In practice, however, when condensate is present there is enough turbulence of steam and water in the valve chamber to bounce the ball around, preventing it from seating permanently until all the water droplets have been cleared. The combination of a small ball in a long, large diameter horizontal chamber, enhances the effect of this turbulence. When starting out for the first time after initially raising steam, it is prudent to open the regulator slowly – just as it is with manually-opened drain cocks – allowing the driving wheels to turn slowly for a few revolutions until all condensation is expelled. From then on, whenever the regulator is opened after a short stand, the drain cocks can be heard emit a short "pff-fft", and are thereafter silent and tightly closed. Bill's tests indicate the drains will close with approximately 5-pounds pressure. The reference to snifting valves above has some relevance to automatic drain cocks in that they also function to admit air to the cylinders when the engine is drifting with the regulator closed. That might or might not be a good thing because air directly enters the cylinders and cools them somewhat, however, on the positive side, free coasting is enhanced due to the release of cylinder compression.

The smaller version (Figures 3 and 4) used on my ten-wheeler was described in the National 2.5" Gauge Association *Newsletter* in 1980. Note that they are "backward" from Bill's, with a thin ball seat permanently fixed to the outside edge of the body and the rather bulky hex plug screwed-in from the back. That makes them less conspicuous on small engines, although somewhat more difficult to construct. For 3/4" scale and larger locomotives, the Van Brocklin design, in addition to being more straightforward to construct, would be preferable because they are easier to maintain if the balls need to be replaced.

My 2.5" gauge locomotive is built to typical LBSC dimensions of 13/16" bore and 1.125" stroke with 3/8" diameter stainless steel ringless *piston* valves lapped in drawn bronze liners. Despite my flagrant disregard for Bill's well founded advice, as well as my own reservations about using them with piston valves, the automatic cocks have never failed to drain condensate properly and without a hint of hydraulic lock, nor have they ever opened improperly in twenty-five years of passenger hauling service. That is not an endorsement for applying them to all piston valve engines, especially large ones, but they have worked flawlessly on my small passenger hauling locomotive.

Fabrication of the two styles of drains is similar. However, assembly of the smaller type is slightly more complicated, so it is the one that will be described. The best approach is to make certain parts one at a time, initially using a full length of stock to facilitate handling. The partially machined part is then cut off the parent length for final machining. The procedure I used is as follows:

1. Chuck a length of 1/4" diameter bronze rod and face the end for the drain cock body.

2. Remove rod from chuck. Drill a 1/8" diameter hole 1/8" deep in the side of the rod using a fixture to accurately position the hole. Temporarily leave the rod full length; do not cut off body at this time.

3. Chuck a length of 3/16" diameter bronze rod and turn down end for 5-32"-40 thread 1/8" long. Drill a 1/16" diameter hole 3/8" deep. Cut off about 5/16" from end. Hold unthreaded section tightly in a collet chuck and turn 1/8" diameter spigot, using fine feed, for push fit into body. If a collet chuck is unavailable, make a stub chuck tapped 5/32"-40 to hold the short piece for this operation.

4. Push bush spigot (step 3) into body (step 2) and silver solder.

5. Once again chuck the length of 1/4" rod with partially completed body on its end. Drill .093" diameter about 1/2" deep. Tap six threads in hole with 1/8"-40 tap.

6. Cut off body assembly 1/2" (full) from faced end of rod. Reverse in chuck and turn length to .343".

7. Drill body.141" diameter and finish hole to .234" depth with a .141" D-bit or a drill with end ground flat. Remove from chuck and run 1/8"-40 tap through previously-started threads at end of body.

8. Repeat all above for required number of drain cock body assemblies.

9. Make a plug from 3/16" A.F. hex rod (brass may be used). Thread one end 1/8"-40 x for .109 length, allowing shoulder relief to permit drawing up plug tightly in body.

10. Chuck 3/16" diameter rod. Drill and ream 1/16" diameter hole about 1/4" deep. Turn shoulder 0.141 diam. x .032" long. Part off to 1/16" total length. Biff valve seat with a 3/32" ball.

11. Push valve seat (step 10) into body (step 7) and then soft solder. To avoid applying excess solder, first hammer solder to about 1/64" thickness, then snip off a very small piece (about 1/16" square) and apply to heated and fluxed body/seat assembly.

12. Lap seat with a 3/32" ball, using scouring powder or automotive rubbing compound for abrasive. The lap is made with the ball epoxied to the end of a short length of rod or tube. Twirl the rod between fingers as ball is pressed against the valve seat.

13. Thoroughly clean body, drop in a new stainless steel ball, then screw-in and tighten the end plug.

14. Try each drain cock individually in a pre-tapped cylinder hole. If necessary, run a 5/32"-40 die over bush to extend threads so that drain cock screws into cylinder tightly and with desired orientation.

Although the photos show our drain cocks oriented for side-discharge typical of U.S. prototypes, more polite forward-discharge can be easily achieved with appropriate position of the outlet hole. In any case these fittings can be recommended where unobtrusive cylinder drain cocks without mechanical linkage are desired, and where reasonable care in locomotive operation is exercised.

FIGURE 2

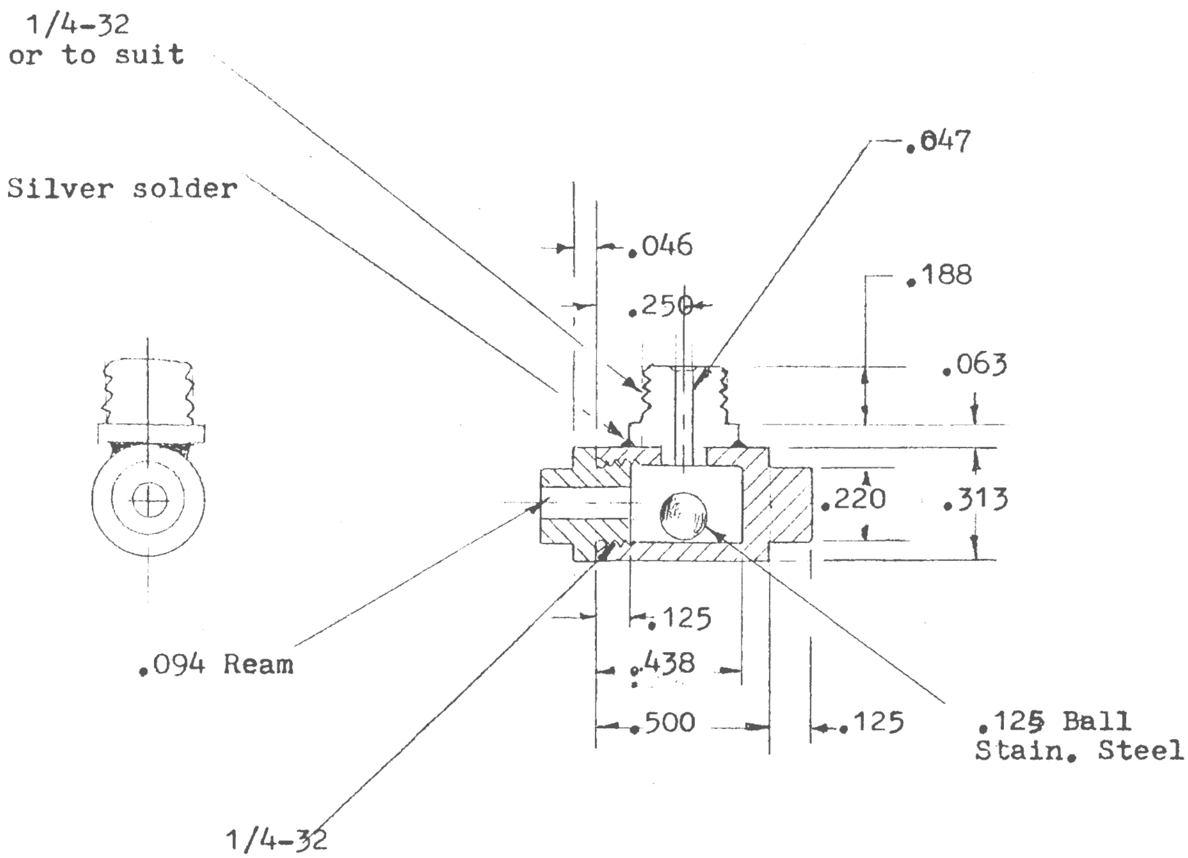
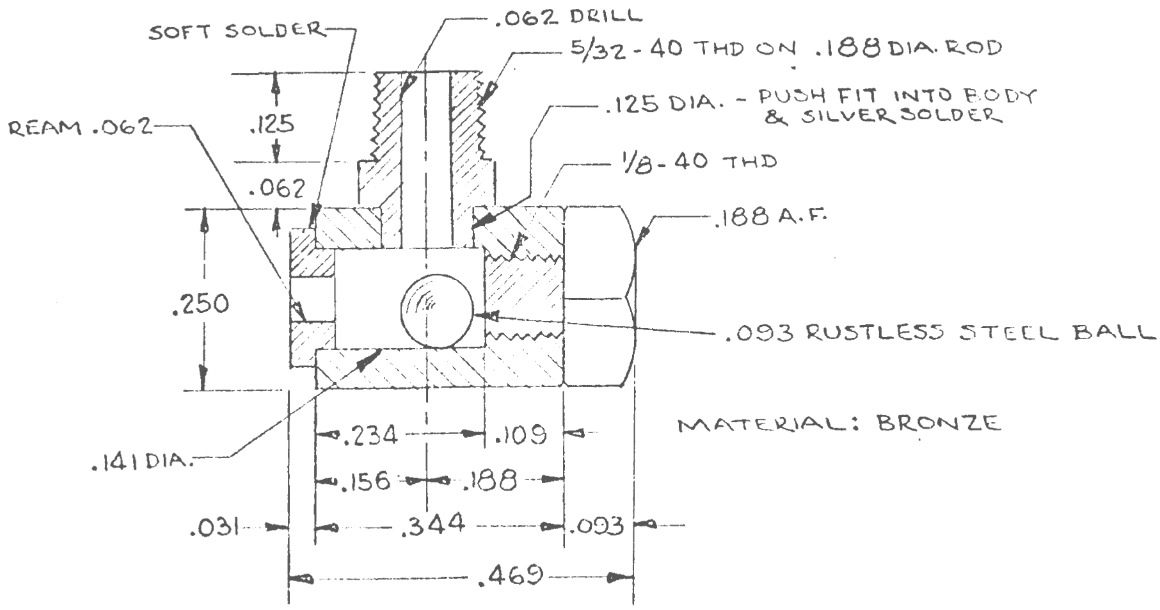

1/4-32
or to suit
Silver solder
.047
.046
.188
.250
.063
.220
.313
.125
.438
.500
.125
.094 Ream
.125 Ball
Stain. Steel
1/4-32

FIGURE 4


SOFT SOLDER
.062 DRILL
5/32 - 40 THD ON .188 DIA. ROD
.125 DIA. - PUSH FIT INTO BODY & SILVER SOLDER
REAM .062
.125
.062
1/8 - 40 THD
.188 A.F.
.250
.093 RUSTLESS STEEL BALL
MATERIAL: BRONZE
.141 DIA.
.234
.109
.156
.188
.031
.344
.093
.469

The "Other" Morse Code

by Bob Thomas, W3NE

Hams who have passed a code test when they obtained their license go on to enjoy the hobby, either enthusiastically embracing CW or steadfastly ignoring it. In either case, many do not realize the code we learned is but one of two versions of Morse Code. Morse-coded messages initially used dot-dash combinations to represent whole *words*, rather than individual letters and numbers, requiring a lookup table for translation, thus precluding its use for the extensive vocabulary of general communications. Morse (or more likely his associate, Alfred Vail) recognized and overcame that limitation by assigning a unique combination of dots, dashes, *and their spacing* to each letter, number and punctuation mark, all optimized specifically for the English language. The Germans later devised another code, optimized for their language that exhibits superior reliability under adverse conditions encountered in wireless and undersea cable. The German code was adopted throughout the world and thus became known as "International" or "Continental" Morse; it is the code used today in ham radio. The "other" Morse code, "American Morse," continued to be employed by U.S. by railroads and landline telegraph companies. In addition to being as much as twenty percent more efficient for the English language, American Morse possesses a much richer character set for punctuation, accented letters, and special characters like the dollar sign, making it best suited for domestic personal messages and press transmissions.

Eleven of the twenty-six letters are different in International and American Morse codes, e.g., di-dah-dit, represents the letter ***R*** in International, but ***F*** in American Morse. While International Morse always has the same width of spacing between elements in a character (equal to the width of one dot), American Morse element spacing can be anywhere from one-half to two times a dot width! For example, American Morse letters ***I*** and ***O*** are both represented by dit-dit, but one letter is distinguished from the other only by virtue of ***O*** having a space between its two dots three times as long as in the ***I***. It is not easy to be bilingual in the two codes, especially when the operator has to depend on the click-clack of a sounder, but coastal station operators relayed traffic from Western Union (American) landlines to ships at sea (International). American Morse is more difficult to learn than International, but good operators can handle 35 wpm.

The need for telegraph initially was greatest on railroads. Schools specializing in telegraphy proliferated, but a more common entry path was tutoring by a relative or sympathetic railroad station agent. Upon gaining sufficient proficiency, the railroad gave a newly-minted Morse operator a one-way ticket to a station down the line where there was an opening. If they were hired, fine; if not, they had a long walk back home. Note the lack of reference to the gender of the new hopefuls; women and girls were almost as likely to be attracted to the field as men and boys. Most telegraph operators remained on the job for life or were gradually promoted upward through railroad ranks, even as high as President in some cases. Some prominent exceptions who abandoned the profession for fame in other pursuits were Gene Autry, Andrew Carnegie, Richard W. Sears (...Roebuck & Co.), Thomas Edison, and Chet Huntley.

The advent of teletype and centralized traffic control on railroad systems eliminated opportunities for American Morse operators just as recent developments have relegated International Morse to obsolescence. Many ex-American Morse operators now satisfy a craving for their old passion with membership in the Morse Telegraph Club (MTC). The MTC quarterly news letter publishes lengthy articles and vignettes by old time American Morse operators describing significant historical events and biographies of legendary personalities. But members of MTC do not only live in the past; they have organized a world-wide system of dialup American Morse telegraphy, by establishing telephone nodes that can be accessed over residential telephone lines. More than two hundred dialup nodes are maintained in the U.S. and Canada. Local key/sounder dc-loops in members' homes are converted to tones by obsolete 300-baud modems that are connected by phone line to the nearest dialup node, similar to an internet connection. A landline "telegraph" conversation can then be conducted between one or more distant enthusiasts. In addition to casual contacts and nets, low- and high-speed code instruction is conducted every week. Programs and interface circuits are available for computer-generated American Morse instruction on a sounder.

Both Morse codes have made significant, if not crucial, contributions to society. As we witness the gradual fading of interest in "our" code, we can take heart in the likelihood of its continued existence, as exemplified by the success of American Morse enthusiasts in preserving the "other" code.

Author's Note: This article was originally published in the April 2002 issue of the Delmont Radio Club Ragchew, *Bill White, K3KLK, Editor. It is based upon articles published in* Dots and Dashes, *newsletter of the Morse Telegraph Club,* http://members.tripod.com/morse_telegraph_club/, *and Morsum Magnificat,* http//www.morsum.demon.co.uk/

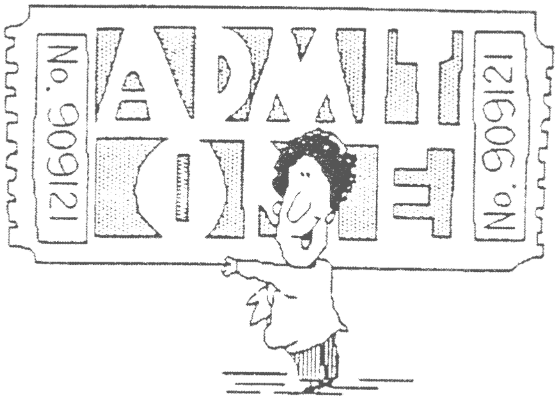
Delmont Radio's

Rag Chew

DELMONT RADIO CLUB

Club Station K3JJO 147.165 MHz PL 162.2

April, 2002 BILL WHITE K3KLK



Come enjoy April's luncheon with friends with similar interests at your favorite radio club.

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Our Bob Thomas, W3NE Reveals the Story of The "Other" Morse Code.

Bob Thomas, W3NE

Hams who have passed a code test when they obtained their license go on to enjoy the hobby, either enthusiastically embracing CW or steadfastly ignoring it. In either case, many do not realize the code we learned is but one of two versions of Morse code.

Morse-coded messages initially used dot-dash combinations to represent whole words, rather than letters, requiring a lookup table, this precluding its being used for the extensive vocabulary of general communications. Morse (or more likely his associated, Alfred Vail) recognized and overcame that limitation by assigning a unique combination of dots, dashes, and their spacing to each letter, number and punctuation mark, optimizing specifically for the English language.

Please turn to page 2

John F. Williamson, W3GC, ex-3GC

Jack Williamson, co-founder of Barker and Williamson Company, died suddenly on March 19, 2002. He was 95. Licensed as 3GC in 1921, Jack grew up with spark but enthusiastically embraced early tube technology. He worked part time at the family hardware store in Ardmore, PA while attending Haverford School. Encouraged by his mother, he arranged window and counter displays with radio parts and equipment. Jack's knowledge of radio and his freely-given advice attracted workers from the Autocar truck manufacturing plant, located across the street from the store, who came during lunch breaks and shift changes for his counsel – and to buy parts for their radios! The young fellow soon acquired a widespread reputation for his abilities, to the extent that none less than Atwater Kent and his engineers made several visits to solicit Jack's technical advice on AK products during their design and pre-production stages.

Jack studied electrical engineering at Drexel Institute for three years but was forced to withdraw at the onset of the depression. Meanwhile, Barrie Barker (W3DGP) had to relinquish his job as a machinist at his family's textile mill due to drastic loss of business. Jack and Barrie had been friends for years so, with no employment prospects, and in spite of the dismal economic climate of 1934, they launched a new business to manufacture RF coils for amateurs. Their first products were made in an unused corner of the Barker mill, where they had a lathe for making air-wound coils using processes devised by Barrie. Jack went on the road with samples and product displays to radio stores and any gathering of hams where there was a prospect of attracting customers. As the product line expanded and became widely accepted by the ham fraternity, Barker and Williamson Co. garnered name recognition throughout the emerging communications industry. Thus, just before Pearl Harbor, B&W was approached by Hallicrafters engineers who had been frustrated in their attempts to design an antenna tuner for the BC-610 that could match short antennas to Signal Corps specifications. Within one week, Jack and Barrie completed the design and construction of a prototype tuner for presentation to Army engineers at Ft. Monmouth. The model was accepted and, after refinement to accommodate extreme environmental conditions, a production contract was awarded to B&W for the tuner to be known as BC-939.

The fledgling company grew rapidly following that initial military contract, moving on to contracts of ever-increasing complexity. Furthermore, the reputation for excellence established by B&W in pre-war days followed them into military circles, where the company was frequently sought out for critical jobs. B&W made a successful transition in the post-war era with new business from both military and ham radio sectors. Notable in the amateur line were their venerable coils and transmitter variable capacitor products, Model 5100 self-contained all-band transmitter and companion Model 51SB ssb adapter, a variety of auxiliary equipment, and the Model 6100 crystal-synthesized ssb transmitter. These and other original B&W amateur radio products are still avidly sought by collectors of vintage ham radio gear. Barrie's health began to fail in the early 'sixties, forcing him to retire, but Jack continued operating the firm until its sale in 1964. In later years Jack concerned himself primarily with contract matters, but he remained influential in the amateur product line and he was never above helping out in the shipping department. He was an active ham throughout his involvement with the company and continued to operate on local VHF nets until recently.

Jack Williamson was a successful, dedicated entrepreneur in the field he loved. A man with an imposing physical frame, outstanding social grace and absolute devotion to family, W3GC was never without his friendly, outgoing charm – always eager to discuss current events or spin a yarn from his rich career.

de W3NE

Telegraphy in America

Bob Thomas

When he sent the immortal message, "What God hath wrought!" Samuel F.B. Morse set into motion a new era in communications. Construction of the first telegraph line, between Baltimore and Washington, had not come easily; Morse had intended it to be buried underground next to railroad tracks, but nepotism and inept management by his partners responsible for construction caused long delays and cost overruns, forcing him to fire the nefarious rogues and resort to stringing wires overhead on wood poles. Performance of the line suffered at first due to poor insulation where wires were attached to the poles until Ezra Cornell (important contributor to telegraph and later founder of Cornell University) solved the problem by suggesting common glass door knobs for insulators!

Exploitation of telegraph was anything but explosive, extending through nearly ten years of development before being adopted by railroads, the press, and newly established common carriers, notably Western Union and Postal Telegraph. Morse-coded messages initially used dot-dash combinations to represent complete words in a cumbersome scheme incorporating a look-up table of over two hundred items. Morse's assistant, Alfred Vail overcame that limitation by assigning a unique combination of dots and dashes to each letter, number and punctuation mark, according to its occurrence in the English language. A German later devised a different code, optimized for the German language, that exhibited superior reliability under adverse conditions encountered in wireless and undersea cables. It became known as "International" or "Continental" Morse, and is the code used by our armed forces and radio amateurs. Vail's code, "American Morse," continued to be used by U.S. by railroads and landline telegraph companies. In addition to being as much as twenty percent more efficient for English language transmission, American Morse possesses a much richer character set for punctuation, accented letters, and special characters like the dollar sign, making it best suited for press and personal messages. It's not easy to be bilingual in both codes, especially when one depends on the click-clack of a sounder, but experienced operators in costal stations were able to relay traffic from Western Union (American Morse) landlines to ships at sea (International).

The initial need for telegraph was greatest on railroads. Schools specializing in telegraphy were established, but a common entry path was tutoring by a sympathetic railroad station agent. Upon gaining sufficient proficiency, the railroad gave a newly-minted Morse operator a one-way ticket to a station down the line where there was an opening. If they were hired, fine; if not, they had a long walk back home! Note lack of reference to the gender of these new hopefuls; women and girls were almost as likely to be attracted to the craft as men and boys. It could be a romantic profession, especially among itinerate operators, known as "Boomers," who led carefree, nomadic lives, seldom staying in one town more than a year before packing their key in its box and moving on. Most telegraph operators remained on the job for life or were promoted through railroad ranks, even to President. Some prominent exceptions who left the profession for fame in other pursuits were Gene Autry, Andrew Carnegie, Richard W. Sears (...Roebuck & Co.), Thomas Edison, and Chet Huntley.

The advent of teletype and centralized traffic control on railroad systems eliminated opportunities for American Morse operators just as new developments recently relegated all International Morse to obsolescence. Many ex-operators now satisfy a craving for their old passion with membership in the Morse Telegraph Club (MTC). The current President is a Canadian lady retired from the Canadian National Railway where she began at age seventeen. A quarterly news letter publishes vignettes by old time "brass slingers," articles about significant historical events, and biographies of legendary personalities. But members of MTC do not just live in the past; they have organized a world-wide system of dialup telegraphy, by establishing locations that can be accessed over residential telephone lines, not unlike Internet Service Providers. There are over two hundred of these in the U.S. and Canada. Key and sounder circuits in members' homes are converted to tones by obsolete computer modems, similar those found in today's computers, that are connected by phone line to the nearest dialup location exactly like an internet connection. A landline "telegraph conversation" can then be conducted among two or more distant enthusiasts. In addition to casual contacts and multi-operator networks, low- and high-speed American Morse code instruction is conducted online every week. So you see, Morse telegraphy is definitely not dead – it continues to thrive among the young at heart!

References: Dots & Dashes, Morse Telegraph Club; http://members.tripod.com/morse_telegraph_club/ and *Morsum Magnificat,* http//www.morsum.demon.co.uk/

The "General" Is Coming!

David Sarnoff Visits the RCA Camden Plant

By Bob Thomas, W3NE

When the President and Chairman of the Board of a company says he intends to visit your facility, there is an immediate air of excitement and preparation, especially when it is 1952 and that top executive is the legendary David Sarnoff. Contrary to the views of various individuals outside the Corporation – especially among the "Edwin Armstrong-Could-Do-No-Wrong" fringe – the General was held in high esteem by RCA employees. After all, it was largely his foresight, business acumen and shear determination that drove RCA to enormous success; this was reflected in our loyalty to him and his goals, and we did everything possible to make him happy.

Sarnoff made frequent trips to his playground, the Princeton Labs, but only occasionally traveled to the hinterlands of Camden. Thus when it was announced that we were to be blessed by his presence, a flurry of overdue activities was set in motion. Desk tops were cleared of months' worth of paper accumulations (which were usually stuffed, out of sight, in file drawers); haywire in development models was straightened out; tangles of coax were sorted out, resulting in things not working again for several hours; lab benches were purged of solder splashes, resistor lead cutoffs, blown-up electrolytics, and a residue of filth that constantly descended over the entire city of Camden; 'scopes were scrubbed clean of Coke and coffee splashes and greasy fingerprint smudges; elaborate exhibits were set up to demonstrate whatever phenomenal developments were in progress; and finally, everything that could be lifted was placed on top of lab benches so cleaning crews could come in overnight to scrub and wax the floors. The only problem was, now that everything was spic and span, no work could be carried out for fear of messing-up the place before the Grande Visit!

Labs and offices were not alone in receiving special treatment in anticipation of the General's visit; the building was meticulously inspected and brought up to first class condition wherever (but only where) it was thought Sarnoff might pass. The silly limits to which Building Maintenance fulfilled their obligation caused me considerable amusement one morning. I worked in 10 Building, which began its days in the early 'twenties as a pressing plant for the Victor Talking Machine Company. In fact, fire alarm boxes still had "VTMC" cast in their covers, and offices were more-or-less air conditioned by the cold water circulating system originally employed to rapidly cool record press platens after a record had been stamped from a molten doughnut of shellac and carbon compound.

To get back to my story, on the day before the General's scheduled visit, I entered 10 Building on the way to my office. The entrance consisted of a small lobby with a security guard on the right, a hallway straight ahead to elevators, and at the left, a fire escape stairway leading to upper floors. The stairway consisted a dozen or so steps leading to an intermediate landing where it reversed direction for another dozen steps to the second floor, and so on to the eighth floor. As I entered the lobby, a painter was standing at the bottom step, looking up the staircase and calling out instructions to his buddy, who was out of sight on the first landing: "A little farther, Pat." "Another foot, Pat." Back this way two inches." "OK, that's it!" He was telling his pal where to begin painting downward on the stairs to make it appear to anyone in the lobby that the entire stairwell was freshly painted, but by no means going beyond a critical sight line where there was still old paint that couldn't be seen from the General's path. Absolutely amazing, and it could only have happened at RCA! This vignette lends credence to the tale that Sarnoff once said to a aid while touring an RCA facility, "Why is it I smell fresh paint everywhere I go?"

When Sarnoff arrived in Camden, the first stop was 2 Building, Corporate Headquarters, where God only knows what went on. Then they all piled into limousines for the one-block ride to 10 Building. By now, all elevators had been out of service for an hour, as security guards stood by to whisk the General and his party to the technology delights above. As we waited in anticipation in our lab at the far end of the building, word would flash back that, "He's getting the color camera demo." Then, "They're showing film on the fast-pull-down projector." And, "The Master Monitor blew up in the middle of the film demo, so get ready, you're next." However, by then it was time for the rush back to New York, so he never did get to our lab, but at least we had the whole place cleaned-up.

In retrospect, maybe that's what it was all about.

SHALLCROSS REMEMBERED

Bob Thomas, W3QZO

While attending Drexel Institute of Technology (now Drexel University) I participated in the Cooperative Education Program, whereby terms of classroom instruction are alternated with similar periods of temporary work in industry. As a result of this program, I had nine memorable months of instructive, personally rewarding experiences at the Shallcross Manufacturing Company in my Junior and Senior years during the late 'forties. This article is a reminiscence of my experiences, representing my best recollection of events, but with the caveat that it is subject to lapses and distortions that cloud one's memory with the passage of fifty years. Perhaps the few vignettes related here will provide some insight on industrial life in America before the invention of "personal cubicles," "work stations," and E-Mail.

John Shallcross founded his company in a former bakery in Collingdale, Pennsylvania, a southwestern suburb of Philadelphia, around the mid-'twenties. The first advertisement I have seen for Shallcross Akra-Ohm presision wirewound resistors - the principal product of the company - was in September 1929 QST. From a modest beginning employing a few local women to wind resistors on ceramic forms, the company rapidly outgrew its modest quarters, and moved to a grouping of modern one- and two-storey buildings on Pusey Street in Collingdale.

The plant consisted of a large manufacturing building where about 160 women operated resistor-winding machines, a well equipped machine shop, business offices, and an engineering lab where I worked with two draftsmen, two very competitent technicians capable of handling most technical projects, and one engineer responsible for the basic product line. In addition there were areas for assembling and testing a variety of Wheatstone and Kelvin bridges, decade resistance boxes, telephone test equipment, and fixed and variable audio attenuators. All instrument switches and their component parts were built entirely in-house, as were the attenuators. The company suffered the stigma of running second best to Leeds and Northrup in the instrument field and to Daven in the attenuator line, an image unfortunately reinforced by Shallcross's propensity to copy innovations of those industry leaders.

By the time I joined them for my first co-op assignment, the company was well established under the general management of Mr. Shallcross (popularly known as "Pappy") and his three sons. John Jr. had the most responsible position, under the dominance of his father, in his responsibility for Sales and Marketing; "Spike" was Production Manager, a job that seemed to suit him well, given the large number of females in his domain; and Dewees, a slow, feckless fellow in charge of the Engineering Lab. Thus, the comany was very much under family control, a point not missed by the older employees, all of whom seemed to accept the minimal liklihood of their ever rising very far in company management. It was also a paternal organization with a company subsidized "Sunshine Club" in lieu of a union, but it was generally acknowledged that "Pappy" took care of his faithful employees who might have personal health or financial problems. Even as a temporary employee, I was well treated, once being taken with the long-time "regulars" to the IRE Show in New York, that now-lamented extravaganza of electronics wares displayed by virtually every manufacturer in the business. What an enriching experience - and on top of it all, they gave me $5.00 (about a half-day's pay then) for spending money!

On my first day at work, I was introduced to an officious fellow who pointed to an old fashioned environmental chamber, perhaps four feet on each side and eight feet high, which was used for temperature-testing resistors. "Get it going," he said. This chamber did not employ mechanical refrigeration, but relied instead upon circulation of alcohol cooled by dry ice in a reservoir on the top of the box. Following instructions, I chopped-up about twenty pounds of dry ice from a large block that had just been delivered, climbed up a ladder, and dropped the lumps into the alcohol reservoir. By the time I climbed down, alcohol foam was gushing from the reservoir and streaming down the sides of the chamber onto the floor. By then my "advisor" returned saying, "Oh yeah, I meant to tell you, put the dry ice in a little at time or the alcohol will bubble violently." Although I retained the task of occasionally stoking the chamber with dry ice, it soon became routine and allowed considerable time to get on with more interesting work and friendlier people!

A development program for precision high resistance power resistors necessitated operating them at full load for several hours to stabilize their resistance. I had the enviable task of designing and constructing two power supplies, each with a rating of 2,000 volts at 750 ma. This was a luscious project for a kid yet to graduate. Each supply used two 872 rectifiers, a simple LC filter and output voltage control by a Variac in the transformer primary. They were built in commercial roll-around dollies and each one had a beautiful polished black bakelite panel for controls and meters.

Before the power supplies left the lab for the Resistor Test Department, it was proposed by one of the more mischevious techs that we charge an 8 microfarad oil-filled condenser to 2000 volts and leave it on Dewees' desk. There were visions of the unspecting victim spying a capacitor where there had been none before, speculating on why it had been left there, then picking up only to get zapped by accidentally touching the terminals. But then reality set in, when we realized this drama would be witnessed through a window that separated Dewees' office from the lab. The prospect of Dewees heaving the condenser through the window was rather sobering, so the practical joke was reluctantly abandoned.

My next assignment was to design and build an attenuator test set for a new product that could not be accommodated by existing production test equipment. My new test set consisted of a VU meter, four 600 ohm fixed attenuators, a precision variable attenuator, and several nifty telephone-type key switches to enable substitution of the calibrated attenuators for the unit under test. This project gave me an appreciation for the importance of low impedance grounds when dealing with 100 dB attenuation. It also gave me an appreciation for difficulties encountered when dealing with people. The former problem was easily solved with a heavy ground strip; the solution to the latter was more complicated.

Because the new attenuator test set was to replace one in regular production, the change-over had to be made on a weekend when the plant was closed. I went in on a Sunday afternoon, replaced the old test set with my new one, checked-out the new unit, and left a revised Test Procedure for use with the new fixture. When I arrived Monday morning, I was immediately escorted to the attenuator test room where the production foreman was angrily flipping switches, twisting knobs and yanking patch cords in a blind rage, cursing the #@** junior engineer who wrecked his test facility. At that moment, in walked none other than "Pappy" Shallcross! He got an earful from the foreman then asked me what was wrong with my new fixture. For one thing, the foreman had made several wiring changes in an attempt to get it working the way he thought it should, then finally admitted he had not bothered to read the new operating instructions. Sanity eventually prevailed and the new fixture performed properly when my original circuit was restored and the new Test Procedure followed. Later that day "Pappy" stopped by where I was working, slapped me on the back, and said, "Things got pretty hot this morning, didn't they? You did good." He made my day!

One afternoon toward the end of my co-op tour at Shallcross, two gents arrived in a car and dragged a large square box into the Chief Engineer's office. A few minutes later, we were summoned to the office where, resting on an odd looking tubular cart, was a strange looking instrument. It appeared vaguely like an oscilloscope, but not like any we had seen before. This one was BIG, with the CRT located off-center, on the left side of the panel. Very strange. Further examination revealed that it did not have sweep frequency or sync controls, although it did sport some unfamiliar ones designated Sweep Speed and Trigger. It was manufactured by a new company called Tektronix. The representatives said it had a vertical deflection bandwidth of 10 Megacycles - more than one hundred times better than any scope we had previously encountered. Unfortunately, it didn't fit the requirements of a d-c instrument and audio attenuator manufacturer so, the representatives left with their Model 511. Little did I realize as they departed that I would eventually spend the better part of a forty year career peering into a Tektronix 511 oscilloscope and its many successors.

There are occasionally times in the operation of a business when everything seems to go wrong at once. Today, a culmination of negative circumstances would result in a flurry of memos and perhaps some late evening meetings. But not at Shallcross! When that situation arose at Shallcross it unleashed a furious rampage by "Pappy," which was usually preceeded by someone running into the lab with the warning, "He's headed this way." With that, muffled shouting and counter-shouting could be heard from the Production Room, fully two hundred feet and two closed doors away, as Spike was confronted by his father's wrath. Then, the loud slam of a door, and "Pappy" could be heard venting his anger upon the defensive machine shop foreman. Thunderous footsteps, another door-slam, and a freight train of anger blustered from the shop through the lab and into the Chief Engineer's office, followed by a final door-slam, and more shouting. When it was all over, "Pappy" returned quietly to his office, peace reined, and there were solutions to every problem, all without one memo or an after-hours meeting!

Although tough with management, "Pappy" never harangued, pressured or demeaned the ordinary workers. He was very accessible and quite popular with the average worker. In fact, he seemed to exercise a moderating influence between workers and his lower management, who dared not be unfair, upon risk of being "reported to the boss," emphasizing the paternalistic character of the company. This seemingly close relationship was bolstered with perodic company dances, picnics, and a big Christmas party. The contrast between today's stifling climate of political correctness and carefree life of yesteryear was never more apparent than when Christmas bonouses were distributed at Shallcross. "Pappy" personally walked through the entire plant, handing out the checks. When the recipient happened to be a comely young lady, he might extract a little "bonus" in return, always in the fun of the moment and to the delight of all.

By January 1950 it was time to return to Drexel for the final phase of my formal education. Shallcross offered me a permanent position but I was dissuaded from accepting by my desire to pursue a broader spectrum of technical challenges than existed there. A few months after my departure, events at the company brought my optimistic assessment of employee satisfaction into question, as a favorable vote for establishment of union representation tore down, in a stroke, the years of good will that had existed between the workers and the company. The strong willed Shallcross family would (or could) not tolerate interference with the management of their company. They closed down the Collingdale plant and moved their entire operation to a more favorable labor climate in the southland. The company was eventually absorbed by a conglomerate and gradually lost its identity, bringing to a close another notable chapter in American free enterprise.

Sic transit gloria.

Chickens and Eggs

Early Television in Philadelphia

Bob Thomas, W3QZO

The hackneyed question, "Which came first, the chicken or the egg?" is often applied to analysis of market conditions that seem to accompany the success or failure of a new product or service. In effect, the question asks whether manufacturers must have guaranteed assurance of consumer demand before they begin development a of new technology or, conversely, must a new product or service be firmly established on the market at a reasonable price before consumers will consider its purchase? As in all questions of its kind, there is no definite answer; it all depends!

Perhaps the most important factor in the success of any new technology is the incremental improvement it offers over the current one. For example, radio was an instant success simply because nothing like it had previously existed – there truly was nothing like it! Industry's investment in new radio apparatus and program development grew hand-in-hand with sponsor support and consumer demand, resulting in fantastic growth. In contrast, following an optimistic introduction, color television languished in sales limbo for years, under-financed by industry and rejected by viewers who were justifiably critical of early color quality and unable to perceive sufficient production value in color-enhanced programs to justify the considerable expense of a new color set. Those negative factors were eventually overcome by skillful marketing, such as the "Color Specials" on NBC, by engineering effort to reduce technical defects and, not insignificantly, by an aging population of post-war monochrome receivers which had become ripe for replacement. As an aside, it's worth noting that before the culmination of those developments, David Sarnoff was on the brink of losing the confidence of his Board of Directors as they began to question the wisdom of throwing yet another twenty million dollars at a new business that had already failed to respond to RCA's initial forty-million investment. Fortunately, the General prevailed, but the color TV scenario demonstrated dramatically the crucial balance of industrial and consumer market forces necessary for the successful launch of a new technology.

The ending of WW-II left an American electronics industry with a tremendous reservoir of diverse engineering talent and gigantic manufacturing capacity that lent itself to rapid conversion to mass production of new civilian products. Those circumstances were fortunate, for when commercial television was emerging in the months immediately following the war, there were no receivers available at affordable prices and even if there had been, there would have been few customers for them because there were no regular programs to watch. Compounding the problem, potential sponsors were not interested in funding shows that had no viewers. This was indeed the classic "chicken and egg" effect, so just how (to unashamedly cling to the chicken metaphor) did the fledgling television industry get off the ground?

Industry confidence forced the issue. The impetus to design economical television receivers, assemble an entirely new broadcasting infrastructure, and develop innovative programming, came from CBS, DuMont, GE, Hazeltine, Philco, RCA, Western Electric and common carriers, Zenith, and other far-sighted companies, who made massive commitments to the ultimate success of the emerging television industry. As dedicated as those industrial giants were, however, it was impossible for them to complete their massive tasks overnight, so the chicken-and egg standoff previously mentioned continued through 1945-46. It is ironic that during this brief period of stagnation, some of the most interesting, albeit low-key, events in the history of U.S. television occurred. I was fortunate not only to have witnessed them, but to have been a minor participant.

Television was first enjoyed, one might even say "popularized," by that small group of technically-oriented individuals who just *have* to be personally involved in the forefront of every new development. These "Tekkies" (as we now know them) were the type who later had their own Magnecord tape recorders before the public ever heard of high fidelity, and who built MITS computer kits before the "PC" was invented. In the early days of television in Philadelphia, Tekkies cobbled together their television receivers in a variety of ways. The simplest was a single-channel TRF tuned to the one and only station in the area – Philco's W3XE, located in Wyndmoor, just above the northern edge of the city. More adventurous builders constructed superhets from scratch or by rebuilding an old pre-war set. The most deluxe receivers used the latest model tuners and IF strips "liberated" from one of the local manufacturers. Due to their experimental nature, those receivers were almost never enclosed in a cabinet; they were generally an assemblage of individual chassis, haywire everywhere, with the Kinescope (picture tube to non-RCA folk) lashed with string to a wood support or cardboard box. The Kinescopes used then were a motley lot, usually only 5" in diameter, sometimes 3", and seldom larger than 7". Phosphors were typically P1 (green) or P4 (white), with an occasional P7 surplus radar tube, which had a blue short persistence and orange long persistence, the latter filtered out with a blue filter to give a barely acceptable television display. Except within the laboratories of the great receiver manufacturers, not much was known about sync separation or noise immunity, so the early amateur sets suffered from frequent picture rolling and complete loss of horizontal sync for no apparent reason.

The first television picture I remember seeing, except for the RCA display at the 1939 New York World's Fair, was in, of all places, a Texaco gas station on Lancaster Avenue in Wayne or Haverford. One of my high school pals had use of the family car, and we would drive to the gas station to watch what little television was broadcast in late 1945. The owner didn't seem to mind that we would watch his set by the hour, and we would often be joined by customers who would come and go while the owner was outside pumping gas. This gentleman had an enthusiastic, if not completely accurate, view of television's future, which he thought would enable him to attract travelers by providing a lounge with comfortable chairs and a *television* receiver ("TV" was not yet in common use) to entertain customers while their autos were being serviced.

The very first show we saw at the gas station was a cowboy movie from W3XE. In the middle of the film the projector stopped, a callsign ID slide came up, and the station went off the air for the night. That's the way it was in those times, but the thrill of watching *anything* on television more than compensated for the total absence of "production value;" after all, I remember the details after these many years, so it must have been impressive! Friday night was a good time to go to the service station because there was no school the next day and W3XE (later to become WPTZ, WRCV and finally KYW) broadcast boxing matches from New York. At that time even live cameras used Iconoscope tubes, known for low sensitivity and a tendency for the edges of the picture to become washed-out due to leakage of stored the stored charge from the photosensitive surface. Poor camera sensitivity necessitated intense lighting on the boxing ring. Nothing was visible outside the ring, but we didn't care – this was live television! One Friday night though, we were astonished when we saw spectators beyond the fifth row, and realized we were watching one of the first broadcasts using the new Image Orthicon, destined to be the pickup tube of choice for live programs for the next twenty years.

I don't remember how we learned about television at the gas station, but there was a network of Tekky wannabees (well versed in the science but lacking the wherewithal to acquire a receiver) that passed around word of where operating television sets could be seen. In suburban Philadelphia at least, people who owned receivers didn't seem to mind if a stranger knocked on the door and asked permission to watch. It was not uncommon during a viewing evening for visitors to come in, watch for a while, thank the host, and quietly depart. If you stayed until the station went off the air, you very often got to see the workings of the set accompanied by an enthusiastic explanation of the tribulations encountered in getting it working.

Eventually commercial receivers from several manufacturers began to appear, notably the now-classic RCA 630-TS (194**6**, **30** tubes, **T**able model). This set sported a 10-inch kinescope, a 4-MHz video bandwidth, and weighed in at an impressive 85 pounds. Several companies were licensed to manufacture the chassis of this receiver, either from production drawings or with various levels of kits of parts supplied by RCA. [A very good example of a surviving '630 equipped with a thirteen channel tuner (with subsequently re-allocated Channel-1) was offered for sale at the AWA Conference this fall for $350.] Chicken-and-egg distinctions became blurred as, television networks were formed, programs got better, and receivers rolled off the production lines as fast as they could be stamped out. In Philadelphia, WCAU and WFIL joined WPTZ on the air with regularly scheduled evening programs. Audiences swelled, and the quality of programs – which originated on film or went live to air – rose to tremendous heights as quality production personnel and seasoned stage and screen talent, joined by a new generation of exceptional young actors, flocked to the new medium. What followed for the next few years was, an extraordinary era in show business and most certainly the heyday of television. But that's another story.

The Bruneval Raid ... and the rest of the story
by Bob Thomas, W3NE

Reginald V. Jones was a brilliant British scientist and wartime strategist, whose insightful analyses and clever application of information from decoded German Enigma messages utterly neutralized the Luftwaffe's elaborate system of radio beams that had guided Nazi bombers with deadly accuracy in early years of WW-II. Following that success, Jones turned his attention to dramatic advancements in German radar. French and Belgian Resistance operatives had reported construction of large rotatable parabolic reflectors and, at great risk, provided British intelligence with sketches and even photographs of the installations. This evidence contradicted a naive RAF supposition that those structures were gigantic search lights. In fact, they were steerable UHF antennas, subsequently identified as such in aerial photographs taken in RAF reconnaissance flights by skilled Spitfire pilots diving at 300 mph through intense low level antiaircraft fire to an altitude of only fifty feet for oblique photography.

Recognizing that the antennas were frequently located in pairs near German airfields, Jones correctly deduced that they worked together in a radar system, one precisely locating the position of incoming British bombers, the other tracking Luftwaffe interceptors who were guided to the engage bombers by ground-based operators using voice transmission. That degree of accuracy demanded superb aiming precision, as even minute errors of azimuth or elevation in either half of the system would result in misdirection of the interceptor. The German code name for the system was *Wurzburg.* Monitoring stations in England determined the wavelength of transmissions to be 55 cm (imagine stable 545 MHz transmitters and receivers in 1941!). In contrast, the RAF used a single transmitter and receiver in a PPM (Pulse Position Modulation) system which displayed the target and interceptor as pips on a circular CRT display. Thus, instabilities and orientation errors affected both targets equally, and "all" that was necessary was for the pilot of the interceptor to close the gap between the pip representing his position with that of the bomber. KISS was alive and well sixty years ago!

A Wurzburg installation of particular interest was identified in one an aerial photos at the top a 100-foot chalk cliff in southern France, near the village of Bruneval. High Command planned a daring raid on the Bruneval installation to seize the radar system and deliver it to England for analysis. An attack force of 120 was assembled, consisting of the King's Own Scottish Borderers and the Black Watch – both highly disciplined, rugged Scotts paratroopers; a Navy security officer; and Flight Sergeant C.W.H. Cox, an RAF radar specialist who volunteered for the mission. To minimize risk of "forceful interrogation" should any of them be captured and identified as a specialist with knowledge of strategic information, all personnel were given temporary false Army serial numbers and Army uniforms. All, that is, except Sgt. Cox whose intractable RAF brass would not permit him to wear a non-RAF uniform despite possible tragic consequences from being singled out as a unique expert. No amount of logic could convince the RAF that Cox's distinctive identity would tag him as a person of special interest, placing him in grave jeopardy if caught by the Nazis during the raid. Cox was, quite literally, "a marked man."

In the afternoon of February 27, 1942, Navy evacuation ships embarked for the French coast near Bruneval. Later, on a frosty moonlit night early the next morning, ten airplanes carried the paratroopers and Cox to their drop into enemy territory. They immediately divided into three groups: one attacked the German garrison stationed nearby for defense of the Wurzburg installation; another engaged a small contingent at the radar site while Cox dismantled the equipment; and the third began a sweep to clear the beach where rescue ships, then waiting offshore, would land. With bullets whizzing around them, Cox and the naval officer hurridly disconnected cables from the radar equipment mounted ~~on~~ directly the back of the parabola, unbolted critical equipment boxes from the antenna, then trundled their prizes down a steep slope through a foot of snow to the beach, which now had been secured by the third arm of the force. At the last minute, Commandos who had been engaging the main German garrison in a vicious battle, initiated "a tactical advance toward the rear," joining the others in the boats, just landed at the beach, for return to England, reluctantly leaving behind two men killed and six missing.

Although it had been planned to study the equipment in the presence a radar operator captured and brought back from Bruneval, it was soon learned he was a former jail bird who had been conscripted into the German army and little knowledge of the equipment itself. That was a common situation throughout German technical operations, where lack of operator expertise was compensated by sophisticated (read complicated) equipment with few operational adjustments. Interestingly in that regard, when the top Nazi technical officer was debriefed by Allied intelligence officers after the war, he opined that German equipment *had* to minimize reliance on operator skill because Hitler's ban on amateur radio in years prior to the war had so withered the reservoir of technically-inclined young men, that equipment had to be "fool proof". In any case, examination of the captured radar yielded a mine of crucial information for countermeasures and, quite likely, some "reverse engineering" that benefited British radar. An additional benefit was that it gave Jones the stature among the RAF establishment to insist on using *window* (*chaff,* in U.S. terminology). By either term, the principle was to drop millions of fine aluminum threads, each a half-wavelength long, from an airplane to create a decoy that appeared on radar as an armada of bombers, causing a diversion of fighter planes from real bombing missions.

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> "And now…," as ABC Radio personality Paul Harvey was fond of saying, "…for the rest of the story."

The survivors of the Bruneval raid got together for a reunion in 1947 to celebrate the twenty-fifth anniversary of their heroic operation. During the reception, Sgt. Cox chatted with one of the Scottish paratroopers. He mentioned how apprehensive he had been because of his vulnerability for being singled-out if captured in his RAF uniform while everyone else in was in Army dress. The ruddy Scott replied coldly, "That needn't have troubled ye Laddie. If it appeared ye were about to be captured, we all had orders to shoot you!" And *that* is the rest of the story!

[Summarized from Jones' account in his book, *Most Secret War*.]

BOOK REVIEW

HEATHKIT - A Guide to the Amateur Radio Products[1]
By Chuck Penson, WA7ZZE
Reviewed by Bob Thomas, W3QZO

Arriving home from another day at work, you immediately spot the carton on the kitchen table. Your new Heathkit arrived! Shucking your jacket, you are overcome by a rush of anticipation as you deftly slit the carton open. Lifting the yellow Heath Assembly Manual from the uppermost tier of your new treasure trove, the exotic aroma of phenolic and vinyl insulation, still-curing paint, transformer varnish, and all those resistors and condensers, wafts upward, all the more to heighten anticipation of things to come.

You notice small brown bags, each stuffed with a different kind of component, but it is a rotary switch that grabs your attention. Fondling the switch and marvelling at its complex rotor contacts, you can already begin to hear snappy DX replies to your CQs. And the meter, whether Readrite or Weston (with genuine d'Arsonval movement) stirs visions of dipping a final or peaking a received station as controls are expertly manipulated on the completed kit. **POP** A dinner call breaks your trance, but not for long; your kit will soon be assembled and operating. Happiness is a Heatkit!

Fortunate is the person who has experienced building a Heathkit. Fortunate too, is anyone who has a copy of "Heathkit - A guide to the Amateur Radio Products." In an article in ELECTRIC RADIO Magazine[2], author Chuck Penson describes how his book originated from a desire to simply learn more about the equipment he had collected, which amounts to about 120 of the 160 ham radio kits issued by Heath. Ever-branching avenues of research led Penson from a search through back issues of QST to interviews with present and former Heath employees, access to company files, records from a defunct Heath store, and purchase of hundreds of Heathkit manuals from a hamfest vendor. The basis for a book materialized, and Chuck wrote a detailed description of each model and personally photographed every available unit in the Heath amateur line. Barry Wiseman, Editor and Publisher of ELECTRIC RADIO, joined Chuck at that point to publish the book reviewed here.

The 248 pages of this new 8-1/2" x 11" soft cover book are divided into three sections: a brief history of the Heath Company; an illustrated review of all 160 products related to ham radio, accounting for the major part of the book; and a comprehensive list of over 1000 references to reviews and modifications of Heath gear in QST and CQ magazines. The thirty or so pages devoted to a history of the Heath Company tell of an organization that began not unlike a large family where, through phenomenal success of pioneering products such as the AT-1 and DX-100 transmitters, the financial and technical foundations of the company were firmly established. Success in the amateur market with an unrelenting torrent of new products from late 'fifties to early 'seventies gradually forced a shift away from the friendly family atmosphere to a more formal corporate structure. Eventually, rapid advances in technology caused unacceptable delays in product development and unmanageable complexity in kit construction just when off-shore competition was heating up. Acquisition of the company by Zenith, who acquired Heath for its computer expertise, with no interest whatever in the Amateur Division, finally spelled the death of Heathkits as we knew them. Chuck Penson has woven these exciting times of personalities, products, corporate wars, and intimate inside stories into a colorful, fascinating tapestry. But that is only the beginning; the best is yet to come!

Product reviews are, of course, the raison d'etre for this book. In a word, they are fantastic! All Heath amateur products are arranged, generally one per page, in alpha-numeric order from AC-1 Antenna Coupler to VX-1 Voice Control (VOX). Model numbers are printed at the top of each page to facilitate rapid searching. The upper half of most pages is devoted to a photograph of the equipment taken from an angle that best depicts control layout, cabinet construction and other features of interest. These are no ordinary snapshots, mind you, but sharp, virtually shadowless photographs selected from numerous exposures made by the author. They clearly convey small mechanical detail, the lettering on panels, meter scales and tuning dials, and finish texture. The only exceptions are where equipment in good physical condition was unavailable for photography, in which case a reproduction of a catalog illustration is incorporated with appropriate caption notation. Products that were upgraded by Heath with revised circuits or restyled cabinets (the DX-60, -60A and -60B, for example) are illustrated with adjacent photographs of each model to enable the reader to quickly identify their subtle differences. Another example of product comparison is inclusion of all three versions of the GD-1 Grid Dip meters together in a single photo.

Below each photograph a large-type title gives the name of the equipment, and below that, manufacturing dates and price. Captions at the end of each product review provide dimensions and weight and a very useful list of related products, i.e., various versions of the same product and compatible accessory equipment.

Chuck Penson's descriptive text for each kit is where the greatest value of this book resides. When it comes to Heathkits, Chuck has been there, done that, seen that, knows that, and he generously shares his vast store of knowledge with us. His comments begin with a brief background on how and why each kit was developed and how it faired in sales. This is followed by concise descriptions of circuits, frequency ranges, mechanical features, and a summary of product strengths and weaknesses. Where appropriate, comparisons of circuit details are made with predecessor and successor products of similar types. Finally, tips are given on how to discriminate minor differences that often set one product apart from a nearly identical second version. Information of this type is especially useful when related to internal changes which might not be visible in a flea market inspection. For example, if you would like to acquire a Heath 5-band SSB/CW transceiver (Heath issued seven models!) but don't know which model best meets your requirements, an excellent analysis of similarities and differences can be found by referring to the ten pages of comments and photos for the HW-100, -101, -104, SB-100, -101, -104, and 104A. Make a few notes, take them along to future hamfests or have them handy when scanning For Sale ads, and you will be equipped to make an intelligent decision when one or more transceivers become available.

Hams wouldn't be hams if they didn't modify their gear. Kit-built equipment is probably more susceptible to modifications than factory products simply because the builder has some familiarity with the inner workings. It is not surprising, then, that back issues of amateur radio journals are replete with suggestions for modifications to Heathkits, some of which, according to the author, were incorporated by Heath engineers in subsequent product designs. To assist owners of Heathkits, Penson included a chart at the end of his book listing Heath model number, QST and CQ issue dates and pages, and a brief description of the reason for the modification. This list is followed by a clever chart illustrating the production life span of most amateur-related products manufactured by Heathkit.

As might be expected of any first printing, a few minor gaffs appear in the book. The most obvious, if only because of its prominence, is use of "Forward" for the heading of the preface, rather than the correct term, "Foreword." Page 144 of my copy is completely blank where one would expect the HW-101 description to appear between the HW-100 and HW-104. It is illogical that the most popular transceiver of all time would be intentionally omitted from this book, leading to a suspicion that maybe a publishing glitch worked its way in here. Finally, it's ironic that, with his superb photography throughout the book, the author's own picture accompanying his biography on the back cover is a soft, muddy, out-of-focus snapshot that does not do justice to the very one who gave so much of himself to make the book possible.

So much for nit-picking. A genuine fear stemming from Chuck's book is that it will so heighten respect and interest in Heathkits that we will see their value soar in classified columns and hamfest circuits. If that happens, so be it; they might well be worth more than their presently depressed prices indicate. "Heathkit - A Guide to the Amateur Radio Products" will stand as THE definitive work on its topic for years to come. Obviously born of a labor of love, it is destined to endure as an indispensable dog-eared reference in home libraries and hamfest backpacks.

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1 - Electric Radio Press, Inc.
Box 57, Hesperus, CO 81326
$24.95 + $3.00 Shipping

2 - Chuck Penson, "Writing the Book," ELECTRIC RADIO, No.77 (Sept 1995), 29-31. Electric Radio, Box 57, Hesperus CO 81326

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BOOK REVIEW

SHORTWAVE RECEIVERS
PAST AND PRESENT
By Fred Osterman

Reviewed by Bob Thomas, W3NE

I encountered the new Second Edition of *Shortwave Receivers* for sale on the Registration Table at the renowned DVHRC Havertown Auction. A brief perusal convinced me to hand-over the modest price to Alice for a publication destined for classic status among references within its scope, that is, commercial tabletop and rack-mount shortwave receivers marketed from 1945 to the present. The book is a delight to read, or to just idly page-through. The author is Fred Osterman, President of Universal Radio Research, Inc, a major supplier of amateur and SWL communications equipment. He has compiled comprehensive descriptions of communications-type receivers from seventy-eight manufacturers, each covered in a separate chapter comprised of sharp photographs and extensive specifications of every model produced by the company. Chapters begin with an informative short history of the manufacturer and perhaps some interesting, sidelights, e.g, RACAL is a contraction of the names of its two founders, RAYmond and CALdwell. The historian will appreciate illustrations of trademarks employed throughout the existence of each company. The company logo extant when each model was manufactured is printed adjacent to the receiver's photograph. The rich variety of industrial art conveyed by trademarks is, in itself, an absorbing aspect of this book, particularly the contrast between early visually appealing classic designs, of Eddystone for instance, and the modern fascination with sterile symbols of "corporate identity."

A half-page is devoted to each receiver, allowing plenty of space for a photograph and specifications. The latter are elaborate listings of salient features; frequency coverage; performance data when available; a brief circuit description, often including tube types; available accessories; and comments on similar models and production variations. A separate box lists country of origin, line voltage range, size and weight, current status of manufacturer and model, degree of rarity, and production dates. Clever icons clearly indicate the type of frequency display used by each receiver and show if the display is an analog dial or a mechanical or electronic digital display and the resolution of the display. Estimates of used-price ranges are given and, although influenced by the usual variables, Osterman's estimates are realistic, at least in the case of several models with which I have had personal experience. Receiver overall performance is indicated by a "star" rating system, from one-to five-stars. Finally, if a review article has been published for a receiver, the source and date are listed -- a very handy reference for the prospective buyer.

Chapters describing receivers are preceded by a detailed Table of Contents listing every model covered and a 34-page section containing a wealth of information on the following: Definitions of receiver terminology; an explanation of every control to be found on a receiver; explanations of all items in subsequent receiver descriptions; advice for novices on what to look for when buying a used receiver; a comprehensive list of books, periodicals, clubs and journals, sources of suppliers, and internet sites where more information can be found. An additional chapter is devoted to forty-eight receivers that didn't rate inclusion in the main body of the book, such as several of the ubiquitous German AM/FM/SW table models, the East German HRO knock-off, and other models of passing interest. There are photos and brief descriptions of "Receivers that Never Were," stillborn models that didn't make it to market or were flops that were immediately withdrawn.

Fred Osterman has produced a book that is as near perfect within its scope as one is likely to find these days. Plowing-through page after page of costly commercial receivers can become tedious for the hobbyist but there is no question that they should be included in the name of completeness. One unfortunate error is a listing of the 6BJ6 and 6U8A in the tube complement of the RME-69, which went out of production more than ten years before those tubes were designed. Inclusion of the Sony ICF-6700/6800 is inexplicable. These nearly identical radios in a *faux-military* motif both have handles and that would seem to classify them as "portables," types that are not treated in this book. On the other hand, the Sony 2010 was omitted despite its overwhelming acceptance as THE small receiver of choice among SWLs for a multiband receiver in the same category as the 6700/6800.

This book, with its solid editorial content presented in superb typography and excellent photographs on 351 pages of high-quality slick paper, all at a reasonable sale price, raises an interesting question: Why can't other authors achieve the same results? In recent months we have seen several entries in the same vein and price range as Osterman's book, yet they failed miserably in their physical realization. Without attempting to fathom why this is so, we can only hope that authors of the future will discover Mr. Osterman's secret for producing a book of such quality that, beside its editorial content, possesses all of the qualities to make it a coveted addition to our libraries.

Shortwave Receivers Past and Present
Second Edition, 1997
Fred Osterman
Universal Radio Research
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<u>BOOK REVIEW</u>

TRANSMITTERS

Exciters & Power Amplifiers

Raymond S. Moore, Author and Publisher

Reviewed by Bob Thomas, W3QZO

Most communications equipment collectors are familiar with Ray Moore's *Communications Receivers,* now in its third edition. The book reviewed here is the complement of that earlier work, covering many amateur HF transmitters manufactured in the U.S. between 1930 and 1980. Each transmitter listed is accompanied with an illustration, incidental historic information, and technical data, including a brief circuit description with tube line-up, and input/output power ratings. Material is based on advertisements from contemporary publications and brochures, covering manufacturers ranging from such well known giants as Collins and Johnson to some (but by no means all) esoteric brands of yesteryear.

Ray Moore has compiled a valuable reference for denizens of auctions and hamfests in search of antique rigs worthy of restoration as well as for oldtimers who like to simply re-visit the past from their armchairs. The former group will especially benefit from the book's comprehensive listings of tube-types; a bargain antique transmitter that uses 841 or 860 tubes, or a vintage linear amplifier that employs several $30 sweep tubes, might not be much of a "bargain" after all! A further benefit will be realized from Moore's descriptions of minor, though important, differences between various versions of the same basic model as, for example, the Harvey-Wells TBS-50, -A, -B, -C, -D series.

Many aspects of *Transmitters* are commendable, but a book is more than raw content; presentation of that content must be accomplished with pleasing typography and clear illustrations. Moore's book is disappointing on both counts. Text is printed in an ungraceful, pedestrian typeface with clumsy letterspacing, all quite unnecessary in this era of inexpensive word processors and variety of type fonts. It is in the illustrations, however, that a lax publisher's attitude is most evident. Allowances must surely be made for the quality of reproductions of illustrations that were deficient when originally published sixty years ago, but that does not excuse the graininess, terrible gray scale rendition and halftone moire' on the numerous photos derived from manufacturers' literature or high quality magazine ads, e.g., the Johnson *Thunderbolt,* with panel detail submerged in murky blackness. Other lapses too profuse to enumerate contribute to an overall shabbiness in graphics that we can only hope will be corrected in future editions. Finally, Mr. Moore, among many technical writers and publishers, habitually uses mHz (*milli*hertz) rather than the correct abbreviation, MHz, when referring to frequency in Megahertz.

Looking beyond the aesthetics of publishing quality, Moore's latest book will be a valuable addition to the collector's library, and will be profoundly useful to those who carry it along as they tramp through field and parking lot looking for another "must have" restoration challenge.

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BOOK REVIEW

TUBE TYPE TRANSMITTER GUIDE[1]

BY EUGENE RIPPEN

Reviewed by Bob Thomas, W3QZO

Shortly after publication of my review of Ray Moore's new book, *Transmitters, Exciters and Power Amplifers* (DVHRC *Oscillator*, September 1996), I acquired another book covering nearly the same topics by Eugene Rippen. A review of the that book and a comparison of the two publications are presented here.

There are more similarities than differences between the Moore and Rippen books. Moore restricted his coverage to HF transmitters-manufactured in the U.S. between 1930 and 1980, whereas, Rippen's work includes VHF as well as HF rigs and accessories of both domestic and (some) foreign manufacture in the somewhat more interesting period of 1922 to 1970. Both books have essentially identical formats, which consist of a photograph and a fairly complete description of each model, and both are reasonably comprehensive within the their respective boundaries of coverage. However, Rippen does a vastly better job from the viewpoint of the vintage transmitter enthusiast simply because he begins at the very dawn of tube-type transmitters and cuts-off at 1970, which defines the end of the "vintage" era. Furthermore, Rippen's inclusion of VHF equipment makes for more complete coverage of several manufacturers' product lines, Gonset, Johnson, and WRL in particular.

Anyone desiring to build a transmitter representative of a period covered by Rippen will find numerous examples to emulate, from a cute 1929 Leeds 7¼-Watt Hartley, through beautiful meter-laden rack-and-panel rigs of the 'thirties by Collins or Gross, and into the post-war era when tubes still survived and slick packaging reined supreme. The book also has an undeniable value as a swap meet companion. Armchair enthusiasts will experience warm satisfaction from leafing through pages rich in memories for oldtimers and perhaps, for newcomers to the hobby, a bittersweet regret for having missed something good, reactions sure to be enhanced by old advertisements that have been interspersed throughout the book. Three cross-referenced indices should assist in quickly locating any specific rig on the basis of manufacturer, model number, or final amplifier tube type.

Mr. Rippen's book exhibits some publication gaffs, not the least of which is the horrible reproduction of photographs. Every photo illustration in the book is a 40-line halftone (comparable to the lowest quality newspaper picture) which appears to have been made with a nylon stocking, producing a mottled pictures devoid of detail. However, at least the photos are uniformly bad which might be preferable to the wild quality swings in Moore's book .Typos are one thing, but when an author lists contributors to his book he should at least ensure their names are spelled correctly! The author has a compulsion to list the manufacturer's address for every entry, but we didn't really have to be told 28 times that Collins Radio Company is located in Cedar Rapids, Iowa! There are a few technical errors; a McMurdo Silver Model 701 transmitter is erroneously listed as a B&W 701, and there is a listing for a Heatkit Q-Multiplier which has nothing to do with transmitters. Those things do happen, but they are certainly not reasons to reject a book that rises above its production glitches with the comprehensive, thoughtful coverage of Mr. Rippen's labor of love. It is a valuable reference for all who share his interest in vintage amateur transmitters.

How does one narrow a purchase decision when, on balance, the books are so similar? It has been suggested by some reviewers that the answer is to buy both. I don't necessarily agree with that. If the choice had to be limited to either Moore's or Rippen's, book, I would choose the latter on the basis of its more meaningful period of coverage, greater scope of equipment covered, and twenty percent lower cost. Of course if you're a nut like me, you *will* buy both!

[1] Published by Sound Values, P.O. Box 9, Auburn, CA 95604. 146pp., Soft Covers. $17.95

OLDE AUDIO

Bob Thomas, W3NE

DISCLAIMER: The following article has been written from memories of events of fifty years ago and might, therefore, contain some unintentional errors. Furthermore, there almost certainly are a few *intentional* exaggerations here and there, arising from the author's passion for the times and his attempt to convey the unbridled enthusiasm everyone felt while being swept along in the early development of "high fidelity" audio.

My first brush with high quality audio was in 1943 during high school days while working part time at Herbach and Rademan's Manufacturing Division on the third floor above the H&R store at 522 Market Street. One of the technicians, Marty Gold, sold me a push-pull 2A3 amplifier he had built. It was in the impeccable style of equipment constructed at H&R in that filament and power supply wiring was squared-off in neatly laced cables, and all components were similarly parallel to chassis sides between terminal strips and tube sockets. I paid Marty $10 for that amplifier and it became the object of my affection for several years. Later I purchased a public address amplifier with P-P 6L6s from H&R, which they sold at a distress price because it had been built at the store by a former counterman who was summarily discharged after being caught with his hand in the till. I used that amplifier in a small-time business with a friend, playing records at dances.

In 1944 I bought a copy of Hugo Gernsbach's *Radio-Electronic Reference Annual*. An article that immediately attracted my attention described construction of a "Frequency Modulated Pickup" that operated in the old FM band. We had a pre-war Zenith console FM receiver, so I decided to build the pickup. It was constructed in a U-shaped sheet metal channel open at the top with a 6C5 oscillator at one end and a modified crystal pickup at the other. The arm was pivoted just ahead of the oscillator, helping to balance the arm. The builder was instructed to take the pickup apart, saving everything except the crystal element. A short extension rod was soldered to the crystal actuating arm, and a brass ring ½" in diameter was soldered to the far end of the extension. The cartridge was then re-assembled (minus the crystal element) so the actuating arm extension with ring attached protruded out the back of the housing. This assembly was mounted on the channel with the ring in close proximity to a small coil connected to the oscillator tank circuit. The needle transferred record groove undulations to the shorted-turn ring, changing the oscillator coil inductance to modulate the frequency in accordance with needle movements. The oscillator was picked-up by the FM receiver to reproduce recorded material with pretty good fidelity, everything considered. Great fun for a kid!

A confluence of events following WW-II set the stage for rapid development of high fidelity audio reproduction in the late 'forties, specifically:

- The LP record, invented by Peter Goldmark, and subsequent development of mass production methods by CBS and allied companies were on the threshold of maturity;
- "Tape recording" had reached U.S. labs from Germany, and was beginning to appear in consumer and broadcast products, instantaneously raising expectations for audio quality;
- New materials and components, and other strategic developments of the war suddenly became available for civilian applications;
- Manufacturing facilities, engineers and a vast production labor force, only recently dedicated exclusively to wartime production, suddenly became available (and desperately needed) new products to sustain commercial manufacturing;
- FM broadcasting was rapidly expanding and economical high quality receivers were available;
- And, a pent-up thirst for improved audio quality – by technically-inclined individuals, if not the general public – was poised, ready to explode.

It was around 1946, while attending Drexel and penniless, that I became really immersed in the exotic world of High Fidelity Audio – a term we always used, never resorting to the consumer vernacular, "HiFi." THE magazine of the day (actually the only magazine) was *High Fidelity,* which was published at the seat of audio perfection, Boston. The editor was C.G. McProud, and he published a fine monthly magazine and an *Audio Annual,* all files of which I foolishly threw away when my fickle interests drifted to other areas. Integrated receivers, with everything in one box, were unthinkable at that time, – a view that seems to have come full circle – so there were design and construction articles on tuners, pickups, turntables, preamps, power amplifiers, tone controls, and equalizers. There were frequent articles on broadcast equipment and acoustics by professionals in those fields, technical articles from leading manufacturers the likes of Klipsch, Tannoy, Hartley and Jim Lansing on speakers and enclosures (at one time the Englishman Hartley advocated making speaker enclosures of brick and mortar!); McIntosh or Henry Hosmer Scott on amplifiers; and engineers from RCA and Western Electric on disc recording techniques. McIntosh had been a broadcast consultant in a partnership with Andy Inglis, later to become manager of the RCA Broadcast Systems Division. Most articles in *Audio Engineering* were in the context of the magazine's title: they were high level technical manuscripts that included mathematics when required but definitely none of the dumbing-down so prevalent today, even in so-called "esoteric" magazines that thrive on pompous rehashing of well established vacuum tube fundamentals.

The most notable article ever to appear in *High Fidelity* would have to be the one that introduced the Williamson amplifier to the U.S. The domestic version used a 6SN7 phase inverter driving triode-connected 807 push-pull output tubes coupled to the speaker through an imported Partridge output transformer. The secret of this exceptional transformer was high quality core material for low hysteresis loss, and interleaved sectionalized windings to minimize leakage reactance to extend high frequency cutoff and eliminate instability in negative feedback circuits. The basis for the amplifier and transformer requirements were propounded by D.T.N Williamson, who had written a series of articles in *Wireless World* during 1947, and still available in a reprinted booklet, a testimony to the sound (no pun intended) principles established so long ago by Williamson.

For many years reproduction of LP records was complicated by utter lack of an industry standard for playback equalization. Every record manufacturer had their own pet equalization so, to properly reproduce records from all sources, phono preamps had to provide six or more different response curves selected by a switch on the preamp. It was years before the RIAA accumulated enough clout to specify a single standard curve, probably the only altruistic contribution to society this outfit ever made. Furthermore, note my earlier comment that LP development was at the "threshold" of maturity. In fact, by 1950 LPs still suffered horrendous tracing distortion, warping, and surface noise, all studiously ignored, to varying degrees, by record manufacturers' "quality control" departments, even to the end of LPs – a fact conveniently overlooked by the anti-digital cult.

A favorite receiver of the day for high quality AM reception was the TRF (Tuned Radio Frequency), basically a high gain bandpass amplifier on the station carrier frequency, eliminating the oscillator, mixer, and narrowband IF amplifier of a superhet. A TRF typically used using five Miller coils in shield cans about 2½" in diameter, and a 3-gang variable condenser. One of the coils was used in a high-Q 10kc. notch filter to attenuate the audio beat between adjacent stations with AM carriers on 10kc. channel spacing. A TRF sounded pretty good and I would build another one today if there was anything worth listening to on AM, but when FM became prevalent in Philadelphia, after the war, I scrapped mine and bought a Pilotuner for $19.50. The Pilotuner was housed in a squarish wood box with a large dial, going unnoticed today at swap meets. It did not have AFC so it tended to drift and would occasionally jump from one station to another, but in its day, it was quite prolific and highly prized. Meissner also made a tuner in kit form or factory-built, the Model 8C/8CK, but it never had the following of the cute Pilot even though the Meissner circuit was more refined.

So much for FM reception at home, but suppose you wanted to listen to FM in your car. You were pretty limited there. Tube-type FM receivers for automobiles were made by the German company Becker and sold in Philadelphia at an exorbitant Full List Price only by Cherry's, which was located around 18th and Spruce. The mechanical pushbutton tuning mechanism employed linkages made of a special plastic that spontaneously turned to powder after three years. I bought a second receiver after my first three-year melt-down, foolishly thinking they surely would have solved the appalling plastic problem, but they hadn't. Welcome to 1955! At that time no one had thought of circular polarization for FM transmission as commonly implemented today, so mobile reception suffered from cross-polarization losses of the horizontally-polarized signal and vertical mobile antenna. AM was rapidly becoming like it is today, so the short comings of mobile FM were gladly tolerated.

The most memorable events in the early days olde audio were the annual Audio Fairs sponsored by the Audio Engineering Society and *High Fidelity* with support from all major manufacturers. The Fairs were held in ordinary guest rooms in (I think) the New Yorker hotel. Each company had a room or suite, so one can easily imagine the din created by an industry based on making loud sounds, each trying to rise above their neighbors! But attendees loved it as they shuffled through jammed hallways from one exhibit room to another, usually just browsing, but sometimes searching-out a new technology or a product rumored to be shown here for the first time. And so it was that Magnecord made a big splash every year with their latest tape recording wizardry. Four elements characterized Magnecord machines: 1) "sortof" broadcast performance; 2) a price within reach of well-off enthusiasts; 3) heads with lossy solid metal cores that rapidly acquired a groove where the tape eroded the soft core, and; 4) hiss, Lots and LOTS of tape hiss that did not seem to bother too many listeners for, after all, we were experiencing response out to 15kc. (at 15 i.p.s)! Not only that, Magnecord seemed to have a new hook every year. Their first showing was the new and revolutionary – for its time – Model PT-6, what would be considered a less-than-basic recorder today. This was followed the next year with the PT-66, now with three heads so you could monitor a new recording directly from tape. The next year they introduced binaural sound by recording *two* tracks on quarter-inch tape. WOW! The recordings were made with two signals picked-up by an artificial head with an Altec miniature condenser mike in each ear canal. There is no mixing of right and left channels in a binaural system, so the reproduced audio retains nearly human phase and amplitude relationships by virtue of the life-like head dimensions, making binaural sound as near as one can come to actually sitting in the audience. When you put on the earphones and heard a playback of a live concert it was very impressive, but when you heard applause coming from all around – wonder of wonders – that was nirvana, and an experience I will never forget! From then on, Magnecord trotted out various tricks like a sliding second playback head for variable delay effects and four-track recordings, but they never seemed to make much progress with hiss reduction and they eventually succumbed to competition from Ampex and European products. Still, Magnecord made an indelible impression on the audio industry.

Other manufacturers showing products at Audio Fares were Altec Lansing and their gigantic "Voice of the Theater," folded exponential horn speaker system originally designed for behind-the-screen motion picture sound driven with a W.E. 300B tube power amplifier. Gold plated 0000-AWG Monstrous Cable was *not* used for connections in that setup; audio enthusiasts of that era were not easily fooled. Altec Lansing also manufactured Model 604B 15" coaxial monitor speaker, and numerous British manufacturers attended with speakers and amplifiers using strange sounding tube types, like KT-something or other; we tended to ignore them(!). After graduation and in a new job, my first priority was to run down to Radio Electric at 7th and Arch to buy an Altec 604C, all forty pounds of which had to be lugged home on the subway. My new 604C supplanted a 12" Jensen with a four pound Alnico-1 magnet, probably a pre-war leftover, purchased for $12.50 in 1944 and still going strong in its original boomy bass reflex cabinet.

Pickup manufacturers included GE with the first low cost variable-reluctance pickup, Shure, Pickering and Paul Weathers, whose New Jersey firm led the way in low stylus force and low arm inertia from its balsa wood arm and a near-zero tracking force FM-based pickup, not unlike the one in Gernsbach's book! The manufactured by Pickering was in static balance, enabling playback with the platter vertical. On the disc recording side there was of course the Scully Lathe, the defacto mastering machine (don't ask how much it cost, you couldn't afford one) and some lesser machines from Rangertone and Presto. I saw a complete Presto professional portable disc recorder at a recent MARC Radiofest on sale for $8.00 with no takers; made me want to cry.

An entrepreneur named Emory Cook introduced an innovative approach to binaural discs. These discs were recorded with one band for the right channel, and a second band for left. They were played with a special arm manufactured by Pickering that carried two-pickups spaced by precisely the right radial distance so that when lowered onto the disc, each stylus dropped in corresponding right/left tracks for synchronized playback. It was a Rube Goldberg scheme, but by this time I had become a real audio nut and since I could not afford a binaural Magnecord tape machine, I invested in the special arm, two pickups and a bunch of Cook records to listen to the binaural organ music. As in the Magnecord binaural system, right and left channels were completely isolated so, on reproduction through earphones, the sensation was equivalent to being present at the original concert. My experience with binaural sound in those days spoiled me by the time stereo was eventually introduced with mike placement according to the moon's phase, cross-channel mixing by some technician who may or may not get it right, and further unwanted mixing of opposite channels due to questionable speaker positioning. I have never experienced better sonic realism than that created by headphones and true binaural recordings, surround sound notwithstanding.

However, for better or worse, and for undeniable reasons, stereo was destined to emerge as the system of choice. While various approaches were being made to stereo recordings, it fell to Westrex to invent and commercially develop orthogonal two channel disc recording. An era had ended and publications changed in lock step, first with the popular commercialization of high fidelity audio, and then into stereo. As *Audio Engineering* passed into to oblivion, engineering issues became the exclusive purview of the *Journal* of the Audio Engineering Society, leaving *Audio Review* and their ilk to publish soft ball technical "overviews," doo-wop record reviews, and useless equipment reviews biased by the magazine's mission to protect its advertisers.

The resulting vacuum in honest performance reviews was filled by "The Audio League," founded by Julian Hirsch and his buddy Houck. Their publication, funded by subscription-only (no advertising) and consisting of ten or twelve pages of poorly reproduced offset printing, was packed with meaty test data, graphs, and thoughtful comment on all classes of audio products. Hirsch and Houck were not daunted by lack of laboratory facilities; for example, loudspeaker response measurements were made outside in the back yard of one of the partners – you can't get much more anechoic than that – and while most of their instruments were Heathkit quality, they turned out good, repeatable test results. Their basic approach to speaker testing was to compare each speaker to every other speaker in the test group until they were able to select the best of the lot, which then become their "Reference" in subsequent evaluations. It came to pass that the Acoustic Research AR-1 consistently emerged as the Reference, a situation that subjected their methods to criticism, but they never wavered from their methodology or their conclusions. They proved that the "Music Power" parameter favored by the EIA was virtually useless as an indicator of power amplifier performance, and constant hammering by Hirsch-Houck Laboratories eventually forced acceptance of more meaningful RMS specifications, at least as an alternative to misleading Music Power, for consumer product specs. Another finding of H-H Labs was that the main contributor of failure of many amplifiers of that era to meet their maximum output power specification was not the amplifier itself, but its power supply, which frequently lacked sufficient regulation to support full-power output. The Audio League eventually closed up shop, but not before exploding many audio myths. Julian Hirsch then joined Stereo Review where he was able to maintain his journalistic integrity – if you understood his code words and knew how to read between his lines!

By the 'sixties the audio field had split into sharply-defined professional and consumer categories. More recently, New Age audio snobs have emerged, convinced they hear nuances indiscernable to lesser mortals. These dilettantes obsess over anything non-digital and non-solidstate no matter how flawed, for example, single-ended tube-amplifiers without inverse feedback. On one hand they wallow in 1930s tube theory, and on the other they crave the latest *hype de jour* quack product, like wire claimed to be "Harmonically Accurate; Tonally Correct" (I kid you not). Such a pity that this self-centered mystique has usurped the innocence and awe we once felt for genuine milestone inventions and rational product development. The Olde Days of audio are gone for ever, but they were exciting and fun while they lasted!

REPLACEMENT INSTRUCTION MANUALS

Bob Thomas, W3NE (EX–W3QZO)

Restorers of broadcast radios are well aware that Rider, Sams and various specialist publications usually can usually fulfill their need for schematics, parts lists, alignment data, and perhaps dial cord stringing. However, achieving satisfactory results with restoration and subsequent operation of vintage amateur equipment demands more information than BC radios. The manufacturer's operation/maintenance manual, while not absolutely essential, certainly facilitates troubleshooting and adjustment of ham gear for optimum performance, and could possibly avoid an FCC citation or inadvertent destruction of an expensive transmitting tube.

Used amateur gear is very often not accompanied by a manual, so we are fortunate that there are convenient sources for manufacturer's original documentation. But where does one go for this vital data? Several individuals have accumulated large numbers of manuals that they utilize as masters for copies offered for sale. It's, however, that in these days of nondescript "boat anchors" for sale at distress prices, one often belatedly finds that a replacement manual costs more than the equipment itself! However, the benefits of a manual usually make it a worthwhile investment almost regardless of cost. It should be added that some of the same suppliers of instruction books also purvey a wide range of Rider, Sams, and manufacturer's radio service data as well as a variety of technical literature.

I recently identified several pieces of ham equipment that I had been putting off restoring for lack of manuals. They ranged in complexity from an Astatic D-104 amplified microphone to a Johnson *Ranger* transmitter, and included such rarities as a McMurdo Silver *Vomax* VTVM, and an E.H. Scott Model SLR-H low-radiation shipboard receiver. Catalogs were ordered from five "mainstream" suppliers, specifically, Hi-Manuals, "Manual Man" Pete Markavage, Puett Electronics, A.G. Tannenbaum, and W7FG., all of whom regularly advertise in amateur and vintage radio magazines. My personal experiences and pertinent commentary on each supplier are listed below.

Hi-Manuals is operated by Al McMillan, W0JJK, who was employed by World Radio Labs for over twenty years. He acquired the WRL stock of manuals upon the demise of the company, thus explaining his comprehensive coverage of Globe/WRL products. His catalog costs $2.00, and you must order from the current edition. Most manuals are ham-related and include exotica from Howard, Micamold, TMC, and esoteric "garage" outfits whose appealing gear is still floating around. Coverage of Hallicrafters receivers and transmitters is excellent – best of any supplier. Manuals were delivered in two weeks by First Class mail. Quality is fair: lightweight covers and stapled pages replete with all of the original owner's scribbles, murky photographs and rampant Xerox "noise." Schematics are squeezed onto one page. Prices are highest of suppliers reviewed, but this may be the only place that has that rare manual you must have!

Manual Man, a.k.a. Pete Markavage, is an affable, knowledgeable participant at major local hamfests.. His 39-page catalog with about 2400 listings is available for two stamps. Pete has a good assortment of manuals for vintage ham gear, test equipment, and some consumer products. He is excellent for Eico, Hickok, and most front line amateur equipment manufacturers of past and present fame. Heatkit manuals are strangely absent because of claimed "space restraints" but you are advised to inquire in the event Heath (copyright holder) is unable to supply your needs; Pete stocks manuals for over 975 Heathkit models, so don't be put off by their absence from the catalog. Manuals I ordered arrived in two weeks by Priority mail, an interval that would have been shorter had not Pete made a special effort to telephone me to clarify a question I had about a transceiver production variation. Two copies of the schematic are supplied, one reduced to a single page and another, full-size, on a fold-out. Pete cleans-up and often redraws parts of masters, resulting in spotless pages that are bound with a plastic multi-ring binder between heavy covers tastefully printed with original graphics, when available. Pete also sells reprints of old-time technical articles and catalogs. In a word (actually, two), Manual Man products are First Class.

Puett Electronics is, literally, a "mom and pop" operation, where shipments are liable to be delayed while a visit is made to see Cousin Jesse in Idaho. Their $5.00 catalog lists thousands of items in *random* order! Just try to find out if they have a book for an Eico 145 Signal Tracer (they do, it's on page 30, between a Conn Electronic Organ and Sprague Capacitor Checker). Puett products are oriented more toward broadcast radios than amateur apparatus. Besides conventional owner's manuals, Puett lists interesting booklets and catalog reprints covering components, test techniques, broadcast equipment and consumer items. Their specialty is E.H. Scott and McMurdo Silver literature – a cornucopia of advertisements, business correspondence, company newsletters, patents, and marketing-oriented technical tutorials. Finally, there is the "Puett Antique Radio Club." For $15.00 a year you get 25 perks, including discounts, radio schematics, "search" schematics (you tell them about your unidentifiable radio and they come up with a schematic), O.T. radio program cassettes, and "much, much more." Quality of Puett manuals is only fair. Covers over-emphasize Puett company information at the expense of clear identification of the equipment manufacturer and model. They have the effrontery to print schematics with one half on one side of a page and the other half on the opposite side! That happened in two manuals I purchased; imagine tracing the circuit of an SX-28 front end with a schematic divided through the band switch! Some reproductions are not so great either, a fault they attribute to an outside duplication service. Puett is a good source for unusual items unobtainable anywhere else. With more attention to quality , they could be a great source.

A.G. Tannenbaum is the creation of none other than our own Alice (A.G.) and Mike Tannenbaum. They moved from Long Island to their new home Dresher about two years ago. The 60,000 pounds of manuals and service literature they brought with them now reside at their business location, an attractive building in a residential section of Ambler, convenient to the Ft. Washington interchange of the PA Turnpike and Route 309. Their 80-page Issue-3 Catalog lists over 4500 manuals, and is available free by mail or direct from Mike's hand at any DVHRC event. A.G.T. has, by far, more manuals than any other supplier. In addition to extensive listings of amateur manuals, the catalog covers test equipment, computers. military gear, and high fidelity equipment. The latter category includes manuals for amplifiers, receivers, tape recorders, CD players, turntables, and equalizers produced by most major manufacturers, particularly Kenwood, for which there are over 350 listings. And that's not all; you can obtain copies of any Rider service notes and original issues of Sams Photofacts as well as miscellaneous service-related literature. Manuals are furnished in heavy covers with plastic multi-ring binders and large fold-out schematics, but with residual markings from previous owners. There is a $2.00 shipping charge unless they are hand-delivered, which is often possible. Vintage radio books, magazines and catalogs come and go at A.G.T., so it's worthwhile inquiring what's available if you are looking for material for your technical library. Although unrelated to our topic of manuals, it's worth noting the catalog lists a few of the many circuit components carried. There are no listings for numerous radios and communications equipment that continually pass through the premises, but latest inventory is available on their web page. Finally, customers are invited to visit the Ambler office to browse specific files for items of interest that might not be formally cataloged.

W7FG Vintage Manuals was mentioned recently in the *Oscillator*. His catalog listing about 2000 manuals costs $.50. While vintage equipment from major manufacturers is well represented, there is nothing exotic by "fringe" manufacturers of yore. However, the catalog has excellent coverage of early Hallicrafters and Hammarlund products, and about 500 Heathkits. It also extends practically into the present with many rice boxes, VHF power amplifiers, antennas, and auxiliary equipment. Military gear is also well represented. W7FG's prices are generally lower than other suppliers reviewed here, but there is no sacrifice in quality or service. My manuals arrived in ten days by Priority mail. They are of excellent quality, with heavy covers and multi-ring plastic binders (even for a one-page instruction sheet!) and included a single-page reduced schematic and *two* large fold-out schematics – this is a guy who appreciates the value of a fresh schematic to save and another for soldering iron burns. All pages of my manuals had been meticulously cleaned of original owner's doodles. W7FG is the only supplier with an 800 telephone order number. By the way, be sure to take note of that WATS number in the supplier list that follows.

SUPPLIERS of REPLACEMENT INSTRUCTION MANUALS

Hi-Manuals
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W7FG Vintage Manuals
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WAVES, ENIGMA, AND THE COVENTRY MYTH

BRITISH INTELLIGENCE IN WW-II

Bob Thomas, W3NE

Throughout the second World War, German strategic messages were encrypted prior to transmission by an ingenious machine so effective that absolute secrecy was literally guaranteed. The device, dubbed "Enigma", was an electro-mechanical machine, somewhat like a typewriter in appearance, with a keyboard for entering messages and illuminated letters for displaying output text. In the encode mode, plain language messages were typed on the keyboard and coded ciphers appeared on the lights. The machine was so diabolical because every time a letter was entered on the keyboard, the encryption code changed. For example, when the "E" key was pressed, the lights might issue a "J", but when "E" was pressed a second time, the output would be a different letter, "W" for example. Similarly, decryption of an encoded message entered as a code cipher at the keyboard in the form "FFFH," might be decoded as "GUNS." Very clever, but what the Germans didn't know was that the British were able to assemble a close approximation of a genuine Enigma machine using code wheels stolen by Polish patriots from their Nazi occupiers. The quasi-Enigma machine was not perfect, requiring anywhere from a few hours to several days to decode a message, but it enabled British intelligence to read German wartime messages intercepted by radio or smuggled to England from agents on the continent. Furthermore, and most importantly, the Germans were oblivious *for the entire duration of the war* that the British were routinely reading their most confidential correspondence!

Intelligence information related to air defense, particularly from decoded Enigma messages, was routinely forwarded to Reginald V. Jones, a brilliant physicist who was Scientific Officer to the Military Intelligence Service. One such fragment of information came shortly after the start of the war from a conversation overheard between two captured German prisoners of war, in which the term *X-Gerät* (Translation: *X-Apparatus*) was mentioned. Interrogation of the prisoners along lines suggested by Jones revealed only that X-Gerät was a system of bombing apparatus employing radio pulses. Jones deduced that the "X" implied crossed beams, but he recognized that locating a target with the precision being achieved by Luftwaffe bombers would require exceedingly narrow beam widths which were beyond comprehension at that time. While Jones was ruminating over this puzzle, several new clues surfaced, all centered around the German word *Knickebein* (literal translation: *Croocked Leg*). First, a Luftwaffe pilot's notes found in his downed aircraft listed beam headings and included a reference to "Radio Beacon Knickebein;" messages from the French and Belgian underground mentioned construction of Knickebein installations and included sketches of large antenna structures; further interrogation of prisoners established a vague association between X-Gerät and Knickbein; and finally, deciphered Enigma messages increasingly carried references to "Knickebeins" with data for beam headings to strategic English cities from locations in France and the recently overrun Low Countries and Norway. Jones coalesced all these clues into a simple explanation of what the Germans were up to. Specifically, he determined that X-Gerät was a system of narrow radio beams emanating from Knickebein transmission sites on the continent. These beams intersected over English target cities and conveyed information to the bomber navigators which enabled them to fly along the beam and when to commence bombing. Beyond that basic framework, however, no one knew how the system really worked. For his effort, Jones was derided and personally humiliated by many top members of the British military and scientific establishment who refused to acknowledge existence of long range navigational radio beams as postulated by this young upstart. After all, the RAF didn't need "beams" to locate their targets; they relied on good old dead reckoning and celestial navigation! (In truth, the RAF had a controversial record of bombing accuracy at that stage of the war.). Meanwhile, thousands of British lives were being lost every day from the fearsome accuracy of the Third Reich's blistering air attacks

The answer to the remaining questions were eventually revealed by examination of a receiver found in a Heinkel 111 that had been shot down over Scotland. The receiver's Type Plate identified it as a "Blind Landing Receiver," equipment routinely found on aircraft around the world for aid in landing in bad weather using the well known Lorenz two-beam system. Lufthansa had used a nearly identical design on its commercial airliners in 1934! Nothing seemed out of the ordinary about the receiver, until Jones received an intelligence report of a secretly monitored conversation between German prisoners who were mocking their captors for overlooking the secret to X-Gerät when it was right under their noses. This prompted Jones to personally ask the engineer who had performed lab tests on the captured receiver if there was anything unusual about it. The reply was, "No, although it is much more sensitive than needed for blind landing." There it was – the Germans had disguised the secret beam receiver with a bogus Type Plate. Jones had successfully unlocked the mystery of Nazi beams! The maelstrom of controversy that surrounded Jones and his beam theory did not subside, however, until Winston Churchill settled the matter with finality in a crucial meeting during which Jones' persuasive argument so impressed Churchill that he prevailed over his stubborn opposition.

Final details of X-Gerät were quickly discovered. Frequency range, determined from the captured receiver's tuning range, was found to be 30 to 33.5 MHz. Monitoring by British aircraft within that range revealed exact operating frequencies, modulation characteristics, and approximate location of Knickebein stations. Precise locations of the stations and further details of antenna construction were obtained by aerial photography from risk-laden reconnaissance sorties flying through enemy flack directly over the stations. Knickebein antennas radiated two narrow Lorenz beams from a dipole radiator with a reflector spaced one-quarter wavelength away on each side. Each reflector was broken at its center, with relay contacts. By sequentially energizing one relay then the other, the narrow transmitted beam would shift very slightly to one side or the other, resulting in a radiation a pattern shaped like two overlapping petals of a flower. One petal was modulated with a 2-kHz dash signal, and the other modulated with 2-kHz dots. When an airplane flew exactly between the two beams, on the central overlapping section, dots filled-in spaces between the dashes, creating a continuous tone. If the plane deviated off-center in one direction dashes were heard, and in the opposite direction, dots were heard. The central beam, where the steady signal existed, was only 0.6 degrees wide, providing a path only 400 yards wide over a typical English target city. Each Knickebein antenna assembly consisted of a large array of radiators and reflectors mounted on a turntable so it could be pointed with precision to the selected target, precision so great that compensation was required to correct for the minute error introduced by the slight flattening of the earth's surface at the poles.

A basic X-Gerät system employed one Knickebein to transmit a Director Beam along which a bomber flew, while a second Knickebein, located several hundred miles away, transmitted a Cross Beam that intersected the Director Beam over the target. In actual practice, the system was much more sophisticated than that. A second "Reserve Director" was transmitted in case the main beam failed; and as many as three Cross Beams intersected the Director to accurately define the approach to the target. Additionally, bombers did not ride the Director Beam the entire distance from their home field to the target; they initially followed a Secondary Director until they had nearly arrived at the target, then suddenly changed course to get on the main beam in a "crooked leg" path, a maneuver from which the term *Knickebein* was derived.

Now that the principle of the beam system was thoroughly understood and accepted, the British began to jam X-Gerät beams with noise generated by commandeered medical diathermy machines. They later transmitted false dot and dash tone signals from ground stations, disorienting German bomber navigators and throwing the Luftwaffe into confusion. If all that were not enough, the RAF was now able ride along a Director beam right to a Knickebein transmitter site with obvious results. Of course, the Germans quickly realized that X-Gerät was no longer viable, and so they initiated a new round of Teutonic ingenuity.

Evidence of a new technology was beginning to appear in the sudden rise of Enigma traffic bearing references to *Wotan*. What could it mean? Jones puzzled over this new terminology, but it was not until he consulted a former university colleague, an outstanding German scholar, that its significance became clear. According to German mythology, Wotan was leader of all the gods, and he had only one eye. That was it: one eye – *one beam!* Support for the single-beam theory came from another decoded Enigma message in which an attack ordered against a British military installation assigned only a single station to transmit a guidance beam. During the raid, German bombers were not very accurate in azimuth, but their range accuracy was quite good. British listening stations began to monitor transmissions from 40- to 50 MHz, where they discovered Lorenz right/left beams similar to those of X-Gerät but, in addition to dot–dash modulation, the single Director Beam was modulated by a pulse. Subsequent examination of a captured airborne system and pilot's log revealed that the plane detected the pulse, then re-transmitted it back to the ground station on a different carrier frequency. The round-trip pulse delay was converted to a distance at the ground station and then relayed by voice to the bomber's navigator. This system also had a refinement using a second set of frequencies that enabled the plane to return to base by a route different from its outbound flight.

One of the countermeasures used against Wotan in the London area was to tune-in the bomber's re-transmission of the pulse on a ground-based receiver, then re-radiate it back to the plane on the German ground station carrier frequency. This process introduced additional delay (from the bomber to the British receiver and back to the plane) that caused an error in the distance calculation, throwing the bomber off-range. Brute force jamming was also employed, but a more sophisticated tactic was to transmit false range information to the bomber by overriding the German communications channel with a local ground-based transmitter. The pilot never knew for sure if he was getting genuine range instructions from his base or bogus ones from the British, with the effect that he could believe neither! Wotan was effectively neutralized by these ploys, and was finally abandoned, but it didn't matter much because by then the Soviet Union had entered the war and German offensive resources were transferred to the Eastern Front. The tide had turned in the Battle of Britain, and Germany concentrated technical development on radar defenses, upon which Jones continued to direct his skills and ingenuity with the same zeal as he had against the beams.

One of the most poignant stories to emerge from World War-II tells of a deciphered Enigma message revealing Luftwaffe plans for a massive air attack on the city of Coventry on the night of November 14, 1940. According to the story, this information was forwarded to Churchill who had to decide either to evacuate Coventry, in which case the Germans would immediately realize the British had broken the Enigma code, or to do nothing and sacrifice the lives of hundreds of innocent Coventry civilians to preserve a crucial strategic secret. The story relates that Winston's anguished decision was to preserve Britain's secret knowledge of Enigma; Coventry was brutally attacked, nearly destroyed with over 1400 casualties. It's a gripping story, but Churchill's dramatic role is a myth with no substance whatever. What follows is the chain of events as they actually occurred.

The German bomber command typically transmitted Enigma messages each afternoon with a coded list of target cities and Kneickbein frequencies to be used for raids that night. These messages were ordinarily decoded within a few hours by British Intelligence and forwarded to R.V. Jones, who had developed a keen sense for determining actual target city code identities. Thus, target 51 might be Derby, home of Rolls Royce, major producer of aircraft engines, target 52 the industrial center of Birmingham, and so forth. He generally was able to alert the Fighter Command as to probable targets for that night, as well as the time of the attack within ten minutes, bomber speed and line of approach, altitude, and the anticipated Knickebein beam frequencies so defense forces could be prepared and jammers preset to the beam frequencies.

A number of tragic lapses occurred on November 14 that doomed Coventry. On the afternoon of that day, cryptographers were unable to decode Enigma traffic in time to provide Jones hard data he needed to make informed predictions for that night's raid. Later, when the Knickebein beams were turned on in preparation for the raid, British monitoring aircraft made frequency measurements as they flew along the beams, but not with sufficient accuracy for Jones to do any more than make an educated guess as to which were the Director and Cross beams. In any case, his best estimate was forwarded to Fighter Command who set the jammers in accordance with Jones' recommendations. That night a massive Luftwaffe armada flew right through confused British air defenses to wreak havoc on Coventry. Decoded Enigma data finally became available the next day, and it supported the guess Jones had made the night before! If that were true, and jammers set accordingly, how could Coventry have sustained so much damage? An investigation disclosed that, while the carrier frequencies had been set correctly as advised by Jones, the dot–dash tone modulation frequency of the jamming signal had been set to 1.5-kHz, NOT to the 2-kHz employed by the Knickebein beams! The error had arisen by a series of misadventures too convoluted to relate here, but in any case, they led to the destruction of Coventry despite the accuracy of Jones' predictions.

With regard to Churchill's knowledge of an impending attack on Coventry, he certainly could have had no inkling that city was a target since the related Enigma message was not decrypted until the day after the attack. Furthermore, Winston had departed from London on a trip to a country retreat on the afternoon of November 14. As he read his file of Enigma reports during the course of his trip, he came upon a message indicating London was to be subjected to air attack that night, whereupon he reversed his journey and returned immediately to London, as it was his policy to never leave the City and its people when an air raid was expected. So much for the Coventry Myth.

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Born in Steam

Bob Thomas, Blue Bell, PA

One of my earliest recollections as a child is handling the throttle of a 2.5" gauge live steam Pacific. Actually, it was not running on steam, but on air supplied from a trailing hose connected to a compressor. I was two years old in 1929, the year my father completed his B&O P-7 Pacific built from a kit of castings designed and sold by H.J. Coventry in eighteen sections at $5.00 per section or $85 if bought all at once. Without facilities for running it outdoors at first, it was operated up-and-down on a short track consisting of brass rail screwed directly down on 3-foot lengths of 1" x 4" pine board painted gray with sloping sides to simulate ballast, and ties represented simply by black painted stripes. There were twelve sections, held tightly together by screen door hooks and eyes at their ends. This was about as elementary as a home railway could be, but it was my introduction into a life long hobby.

Although the locomotive was operated under steam on a test stand in our basement, it was not until 1937 that it was given a chance to strut its stuff hauling a train on an outdoor track. That year my father bought some 5/8"-high steel rail from the Buddy-L Company in Texas. We only had a tiny suburban backyard which limited the size of the track to a 32-foot diameter circle with one switch to a long straight siding on our driveway. The circle was made in twelve sections with rail rolled to correct radius and connection between sections with 1/8"x3/8" "flat-wire" fishplates and four 6-32 screws and nuts. "Flat-wire" is made by hot-rolling round wire to new crossection with flat sides and edges retaining a slight curvature from the original wire. They were just the right height and shape to jam between the foot and head of the rails at joints, resulting in a stiff, self-supporting joint in all directions. Rails were fastened to 1"x3" maple ties (offcuts from a bakery woodshop that still made horse-drawn bread wagons!) by round-head wood screws with washers under their heads.

The track was heavy enough that it could be laid directly on the backyard lawn without any restraints to hold it in position and a few shims to compensate for hollow spots. However, the lawn had a 2% slope, necessitating closing the throttle just before the train's descent, and opening it at again at the bottom, carried out, respectively, by my father and me for every circuit of the train. This was fine for the novelty of a first year's operation, but before the following summer, the lawn was surveyed to determine what was required to produce a level track. Realistic trestle bents were made from rough sawn 1" x ¼" wood strips, called "lath" that was used in those days to anchor plaster to walls (plasterboard hasn't been around for ever!). There were three bents per track section and each bent was custom-cut to height and numbered for its specific location on the lawn; transverse tilt was incorporated for superelevation. The track was upgraded at that time with additional ties in spaces between the original ones, and longitudinal stiffening strips were nailed on each side of the track sections to act as guard rails, since the track would now be 18" above the ground at the bottom of the slope. Finally, everything was given a heavy coat of creosote preservative. Eventually a tunnel was broken through the stone foundation of our house into an unexcavated crawl space where my father installed a manually-operated turntable.

It was now 1938, and the fun *really* began with continuous high speed operation with the P-7 at the head of a thirteen freight car consist. Rolling stock was comprised of exact scale cars and rugged "standoff-scale" cars originally made for handling in my toddler years. A headend car disguised as a Weight Test Car was built with an automobile speedometer driven with a spring belt from the axles to indicate speed, frequently observed in the region of 120 scale m.p.h. What fun! We ran the train at every opportunity, including nighttime when, in our tight-knit suburban community, crowds of curious neighbors quickly gathered to find out what all the clatter, hissing and whistling was about. At times they were three deep alongside the elevated part of the track for a summer evening of cheap depression-era entertainment. It was during one of our night runs that disaster struck, when someone in the crowd threw the switch against the mainline, causing the speeding locomotive, propelled by the momentum of its 13-car train, to dive from the highest elevation of the track onto the concrete driveway. How it survived the impact was nothing short of a miracle, but the locomotive and tender escaped with minor scratches as did the leading cars, which were fortunately the rugged semi-scale ones. After that, signal lights and a *lock* protected the switch!

Operating a train was great, but nowhere near the fun as when I would lie down on our riding car behind the P-7 and rocket around the track, hand on throttle, reverser linked up, and an incomparable eye-level view of flashing rods, rocking deck, and ties merging to a blur – a sensation unmatched even by the "real thing!" In the fall when I was back in school and the track was still up, I would come home in the afternoon, get out the riding car, and pull myself around until dinner time, switching the freight cars or imagining I was making up time on the point of the *Capitol Limited*..

All of the above is what a small scale home railway means to a boy. This boy never grew up: I now operate my 2.5" gauge engine (a B&O B-18 ten-wheeler I completed in 1979) from my lie-down riding car on the PLS track. The only difference is the creaking of arthritic joints as I get up and down from the car, but the joy is still there!

April 19,2007

THE WORLD BEFORE WUSL

Bob Thomas, W3QZO

In the July *Oscillator*, our Editor reported on presentation of the prestigious Mercury Gold Award to Mike Koste in recognition of the outstanding Public Service Announcement he produced as Production Director at FM Station WUSL. That item prompted some reminiscences of WPBS, which was the predecessor, in frequency and physical property, to WUSL.

It all began in the late 1950s when the Bulletin Company, owner of WCAU and publisher of the *Evening and Sunday Bulletin* newspapers, sold the entire WCAU-AM, -FM and -TV broadcast properties to CBS. Not included in that sale was the Muzak franchise for Philadelphia, which was retained by the *Bulletin*. Muzak background music programming, sometimes irreverently referred to as "Wall-to-Wall" or "Elevator" music, was a highly profitable operation which the *Bulletin* had been broadcasting on a subcarrier of WCAU-FM. Because the Muzak transmission channel had been lost with the sale of WCAU, and desiring to maintain their broadcast presence in the Philadelphia area, the paper established a new FM outlet, WPBS. CBS was instrumental in obtaining a frequency allocation for the new station, which was constructed on land adjacent to WCAU property at the Roxborough transmitter and antenna complex on Domino Lane.

The Bulletin also retained two of its WCAU managers to run their new operation; Donald Thornburgh, who had been the highly respected General Manager of WCAU, became Vice President for the *Bulletin's* new broadcast interests, and Ed Meehan, formerly in charge of Muzak and other activities at WCAU, became General Manager of WPBS. Ed had had a colorful career in sales at RCA's Broadcast Division, rising to Transmitter Sales Manager prior to joining WCAU. He hired Jim Quinn from the RCA Service Company to be Chief Engineer of the new station, and together they designed and managed construction of new WPBS facilities. Russ Spencer was brought in to separately manage Muzak sales, billing, and extensive installation and service operations.

The WPBS building was rather large for an FM station because it accommodated the entire Muzak operation in addition to the usual broadcast requirements for sales, traffic, production, library and transmitter. The source for Muzak programs was ¼" audio tape on 18-inch reels, each supplying eight hours of music from unattended playback machines. Reproducing equipment was built especially for Muzak; it was owned by them and physically located in a room entirely separate from normal broadcasting. Tapes were "bicycled" from one station to another to maintain variety in music sequences. Muzak was very aggressive in maintaining their trademark. Inspectors roamed the city listening for "bootlegged" Muzak in restaurants and other commercial establishments while ASCAP inspectors were similarly on the lookout for unlicensed use of their music properties that might have been received from conventional broadcasts and distributed on a private PA system.

There was a convivial atmosphere at WPBS and Muzak, a reflection of Ed Meehan's gregarious nature. Birthdays and special events were celebrated with office parties or in-house lunches; ladies from various departments frequently went out together for lunch at a restaurant or at one of their homes; outdoor picnics were held in a grove behind the station where the company had provided tables and benches; and the company sponsored a Christmas party every year for employees and their spouses. It might not have been a happy family 100-percent of the time, if such a thing is possible, but it *was* a family – a nice place to work.

In those times the Chief Engineer of a radio station was a full-time resident employee responsible for installation and maintenance of all technical equipment in conformance with strict, if not intrusive, FCC regulations. Additionally, in a station the size of WPBS, building services also fell within the purview of the Chief ("Jim, the faucet in the lady's room is leaking."). One of the most stressful events for a Chief (although not as bad as being shut down by lightning or ice falling from the tower and smashing the antenna transmission line below) was the unannounced arrival of an FCC Radio Inspector (RI). Everything was fair game for the RI. He would issue a citation for a burned-out pilot lamp, frayed insulation on a mike cable, or fewer spare tubes than specified by FCC regulations. Without debating the economics, it has become a sad fact that the romance of broadcast engineering in small stations has been drained by today's automated solid-state

SIDEBAR

Early Philadelphia FM Stations Of Note

WDVR, Later changed to **WEAZ** (Philadelphia) – Background
"Easy 101"

WFLN (Philadelphia) – Long Form Classical

WJBR (Wilmington) – Light classics; Shows/Films/Soundtracks
First station in the region to broadcast stereo, employing the Crosby system

WPBS (Philadelphia) – Background; Big Band; Classical

WSNJ (Bridgeton) – Light classics, Jazz, Shows/Films

WTOA (Trenton) – Classical; Light Concert; Shows
"Voice of the Trenton *Times,* From the Capitol to the Cape;"

WUHY (PBS, Philadelphia) – Classical, Jazz, Public Affairs

WHEN RAILS MET RADIO

Robert G. Thomas, W3QZO
216 Sunrise Ln., Philadelphia, PA 19118

The December 1993 issue of *Trains* magazine carried an illustrated article (Jerry Fox, "The Grand Ole Pan-American," Vol. 53, No. 12, p. 72, Kalmbach Publishing Co., 21207 Crossroads Cir., Waukesha, MN 53187) describing daily live broadcasts of a passing railroad train on WSM, Nashville. Beginning in 1933, under sponsorship of the Louisville and Nashville Railroad, WSM picked-up the sound of L&N's crack *Pan-American* passenger train as it thundered past the station's transmitter site every day at 5:08 PM.

In those simpler times, the broadcast achieved instant popularity among a huge Depression-era audience. The station was deluged with fan mail for the train crews, who became known by name to listeners, and were the subject of cab-side interviews. When the pickup point was moved to a railroad junction requiring sounding of the whistle, locomotive engineers reacted to their celebrity status by becoming "artists" with the whistle cord! Widespread publicity was heaped upon the L&N for the punctuality of the train. According to the article, "Many listeners checked the time of day by the *Pan* broadcast. If the train happened to be a few minutes late, it became a topic of conversation that evening."

The advent of glamorless diesel locomotives in 1942 and a shift in audience preferences to more "sophisticated" programming gradually eroded listenership. This was compounded by increasing production costs and network schedule conflicts, eventually prompting WSM to resort to use of a recording of the train's passage until the program was finally discontinued in 1945. For several golden years, however, that unique combination of an audience with simple tastes and a craving for diversion from problems of the times, innovative programming and engineering at WSM, and an enlightened railroad with superb on-time performance, coexisted to produce a notable page in the annals of live radio broadcasting.

As an aside, it would be interesting to have an account of the reminiscences of some *OTB* readers who were within the range of WSM and were fortunate enough to have heard the live L&N programs. Finally, those wishing to read the complete article may obtain back issue of *Trains* from the publisher, or possibly from a large model shop or tourist railroad gift shop.

CONGRATULATIONS!

To Frank and Bobbie Hagenbuch, DVHRC's representatives in Williamsport, for the birth in November of daughter Sarah.

READERS' COMMENTS

William R. Jones

I stopped in at the Fall Swapmeet on Nov. 18 at Souderton. My time was short, so I could stay only a minute. However, I did pick up a copy of the *Oscillator* that I read over with interest. Congratulations for a fine job . . .

The article, "Shallcross Remembered," by Bob Thomas, W3QZO, I found very interesting. I have lived in roughly the same time frame, although Bob is maybe a few years older - my guess. I too worked for a company similar in management philosophy to Shallcross, as many of us did in the '50s and '60s. From the article, one can see the seeds of many beginning problems for the company, and then the final absorption. Actually, the article could be used as a classic "what not to do" for a business-management classs. Some of the old ways were simpler, direct, but not necessarily correct! . . .

I will tell you that in the '50s there were mountains of what we now call "classic" radios thrown on the scrap heap, many in excellent condition. (I know you oldtimers all know this!) I can also recall my father buying at auction the battery radios of the '20s for 50¢ each; then we would take them apart and salvage the screws, nuts, and bolts and trash the rest.

What an interesting time we have lived through!

BOOK REVIEW

HEATHKIT - A GUIDE TO THE AMATEUR RADIO PRODUCTS[1]

By Chuck Penson, WA7ZZE

Reviewed by Bob Thomas, W3QZO

Arriving home from another day at work, you immediately spot the carton on the kitchen table. Your new Heathkit has arrived! Shucking your jacket, you are overcome by a rush of anticipation as you deftly slit the carton open. Lifting the yellow Heath Assembly Manual from the uppermost tier of your new treasure-trove, the exotic aroma of phenolic and vinyl insulation, still-curing paint, transformer varnish, and all those resistors and condensers, wafts upward - all to heighten anticipation of things to come.

*You notice small brown bags, each stuffed with a different kind of component, but it is a rotary switch that grabs your attention. Fondling the switch and marveling at its complex rotor contacts, you can already begin to hear snappy DX replies to your CQs. And the meter, whether Readrite or Weston (with genuine d'Arsonval movement) stirs visions of dipping a final or peaking a received station as controls are expertly manipulated on the completed kit. **POP!** A dinner call breaks your trance, but not for long; your kit will soon be assembled and operating. Happiness is a Heathkit!*

Fortunate is the person who has experienced building a Heathkit. Fortunate too, is anyone who has a copy of Heathkit - A Guide to the Amateur Radio Products. In an article in *Electric Radio* magazine[2], author Chuck Penson describes how his book originated from a desire to simply learn more about the equipment he had collected, which amounts to about 120 of the 160 ham-radio kits issued by Heath. Ever-branching avenues of research led Penson from a search through back issues of *QST* to interviews with present and former Heath employees, access to company files, records from a defunct Heath store, and purchase of hundreds of Heathkit manuals from a hamfest vendor. The basis for a book materialized, and Chuck wrote a detailed description of each model and personally photographed every available unit in the Heath amateur line. Barry Wiseman, editor and publisher of *Electric Radio*, joined Chuck at that point to publish the book reviewed here.

The 248 pages of this new 8-½" x 11" soft-cover book are divided into three sections: a brief history of the Heath Company; an illustrated review of all 160 products related to ham radio, accounting for the major part of the book; and a comprehensive list of over 1000 references to reviews and modifications of Heath gear in *QST* and *CQ* magazines. The 30 or so pages devoted to a history of the Heath Company tell of an organization that began not unlike a large family where, through the phenomenal success of pioneering products like the AT-1 and DX-100 transmitters, the financial and technical foundations of the company were firmly established. Success in the amateur market with a torrent of new products from late '50s to early '70s gradually forced a shift away from the friendly family atmosphere to a more formal corporate structure. Eventually, rapid advances in technology caused unacceptable delays in product development and unmanageable complexity in kit construction, just when offshore competition was heating up. Acquisition of the company by Zenith, which bought Heath for its computer expertise, with no interest whatever in the Amateur Division, finally spelled the death of Heathkits as we knew them. Chuck Penson has woven these exciting times of personalities, products, corporate wars, and intimate inside stories into a colorful, fascinating tapestry. But that is only the beginning; the best is yet to come!

Product reviews are, of course, the *raison d'être* for this book. In a word, they are fantastic! All Heath amateur products are arranged, generally one per page, in alpha-numeric order from AC-1 Antenna Coupler to VX-1 Voice Control (VOX). Model numbers are printed at the top of each page to facilitate rapid searching. The upper half of most pages is devoted to a photograph of the equipment taken from an angle that best depicts control layout, cabinet construction and other features of interest. These are no ordinary snapshots, mind you, but sharp, virtually shadowless photographs selected from numerous exposures made by the author. They clearly convey small mechanical detail, the lettering on panels, meter scales and tuning dials, and finish texture. The only exceptions are where equipment in good physical condition was unavailable for photography, in which case a reproduction of a catalog illustration is incorporated with appropriate caption notation. Products that were upgraded by Heath with revised circuits or restyled cabinets (the DX-60, -60A and -60B, for example) are illustrated with adjacent photographs of each model to enable the reader to quickly identify their subtle differences. Another example of product comparison is inclusion of all three versions of the GD-1 Grid Dip Meter in a single photo.

Below each photograph a large-type title gives the name of the equipment, and below that, manufacturing dates and price. Captions at the end of each product review provide dimensions and weight and a very useful list of related products, i. e., various versions of the same product and compatible accessory equipment.

Penson's descriptive text for each kit is where the greatest value of this book resides. When it comes to Heathkits, Chuck has been there, done that, seen that, knows that, and generously shares his store of knowledge with us. His comments begin with a brief background on how and why each kit was developed and how it fared in sales. This is followed by concise descriptions of circuits, frequency ranges, mechanical features, and a summary of product strengths and weaknesses. Where appropriate, comparisons of circuit details are made with predecessor and successor products of similar types. Finally, tips are given on how to discriminate between minor differences that often set one product apart from a nearly identical second version. Information of this type is especially useful when related to internal changes which might not be visible in a flea-market inspection. For example, if you would like to acquire a Heath 5-band SSB/CW transceiver (Heath issued seven models!) but don't know which model best meets your requirements, an excellent analysis of similarities and differences can be found by referring to the ten pages of comments and photos for the HW-100, -101, -104, SB-100, -101, -104, and 104A. Make a few notes, take them along to future hamfests or have them handy when scanning "For Sale" ads, and you will be equipped to make an intelligent decision when one or more transceivers become available.

Hams wouldn't be hams if they didn't modify their gear. Kit-built equipment is probably more susceptible to modifications than factory products simply because the builder has some familiarity with the inner workings. It is not surprising, then, that back issues of amateur-radio journals are replete with suggestions for modifications to Heathkits, some of which, according to the author, were incorporated by Heath engineers in subsequent product designs. To assist owners of Heathkits, Penson included a chart at the end of his book listing Heath model number, *QST* and *CQ* issue dates and pages, and a brief description of the reason for the modification. This list is followed by a clever chart illustrating the production life spans of most amateur-related products manufactured by Heathkit.

As might be expected of any first printing, a few minor gaffes appear in the book. The most obvious, if only because of its prominence, is use of "Forward" for the heading of the preface, rather than the correct "Foreword." Page 144 of my copy is completely blank where one would expect the HW-101 description to appear between the HW-100 and HW-104 - a printing glitch that is being corrected with a paste-in page for present holders od the book and for future buyers. Finally, it's ironic that, with his superb photography throughout the book, the author's own picture accompanying his biography on the rear cover is a soft, muddy, out-of-focus snapshot that does not do justice to the very one who gave so much of himself to make the book possible.

So much for nit-picking. A genuine fear stemming from Chuck's book is that it will so heighten respect for and interest in Heathkits that we will see their values soar in classified columns and the hamfest circuit. If that happens, so be it; they might well be worth more than their presently depressed prices indicate. Heathkit - A Guide to the Amateur Radio Products will stand as *the* definitive work on its topic for years to come. Obviously born of a labor of love, it is destined to endure as an indispensable dog-eared reference in home libraries and hamfest backpacks.

MADE IN PHILADELPHIA:

HERBACH AND RADEMAN COMPANY

Robert G. Thomas, W3QZO

Almost anyone having technical interests will be familiar with the name Herbach and Rademan (H&R) through that company's periodic publication *This Month*, an absorbing catalog of new and surplus equipment useful to experimenters, radio amateurs, and schools. Some old-timers may have even visited the original Market Street store in person. Few, however, are aware that H&R had a thriving Manufacturing Division that made a material contribution to the national effort during WW II.

The H&R store was founded in 1934 by Maury Rademan and Mr. Herbach, whose first name I cannot remember, for he was universally referred to as "Mr. Herbach."* The contrast between these two men was profound: Maury, with sleeves rolled-up and darting about like a chickadee, was a "Counterman's Counterman" of boundless energy and encyclopedic knowledge of his stock. Mr. Herbach was a soft-spoken elderly gentleman of the old school, always impeccably dressed, not too involved with details, but possessing a keen sense for business opportunities and customer satisfaction. In common with many large radio stores of the time, H&R catered primarily to radio servicemen, commercial sound contractors, schools, and amateurs; but also carried extensive lines of sporting equipment, scientific apparatus, and model supplies. What set H&R apart from the others was a comprehensive manufacturing capability. All engineering and manufacturing facilities were located on a single floor above the H&R retail store in an ancient long, narrow building at 522 Market Street, Philadelphia.

The H&R Manufacturing Division was established in the '30s to design and produce public-address amplifiers, process timers, electronic counters, and various other products for sale in the retail store. In addition, a standard line of portable and laboratory Geiger counters was manufactured for the emerging field of radiation research; a laboratory notebook shown to me, which had belonged to a scientist employed by H&R in the late '30s, indicated that significant in-house research was conducted as the basis for product design in this field. Custom design and construction services were offered to industrial and government customers for a wide range of special products. With the onset of WW II, production of radiation-measuring equipment for oil exploration and atomic research increased, and resources were expanded for manufacture of numerous strategic products for the war effort.

Mr. Herbach was in charge of the Manufacturing Division, assisted in day-to-day operations by Maury's brother Norman, who was foreman and timekeeper. The Chief Engineer was Jack Wagenseller, W3GS, former ARRL Section Communications Manager for Eastern Pennsylvania. Altogether a grand fellow, Jack displayed great depth in all technical matters, possessed a temperament that was even to a fault, and had a disarming sense of humor. He insisted upon and received the absolute highest quality of workmanship in everything made by H&R. In my subsequent 40-plus years in the industry, except for Tektronix, I never encountered construction quality even approaching that which was routine at H&R.

At the peak of the war effort, the Manufacturing Division employed three highly qualified technicians, two mid-level techs, a machinist, 15 to 20 female assemblers, and two or three general assistants who picked up the slack wherever needed.

Some of the products manufactured by H&R in the late war years were as follows:

- High-volume production test systems for IRC carbon resistors.
- Compact HF transceiver "Spy Set" concealed in a suitcase.
- Plug-in one-tube BFO assembly.
- TRF (non-radiating) broadcast receivers for merchant-ship crew morale.
- Inexpensive portable Geiger counter.
- Laboratory radiation measurement equipment.
- Rack-mounted Up/Down event counters.
- Specialized equipment for the U.S. Navy.

I was employed by H&R full-time during summer vacations and part-time on afternoons and Saturdays in 1944-45, during my last two years of high school. At 35¢ an hour, it was no way to become rich, but I was more than compensated by learning "how things are done," rare practical training that was an asset throughout a later career in engineering. My job began as dogsbody and gradually advanced to spot welding, coil winding, spraying moisture/fungus-proofing (MFP) varnish in isolation on the dreaded unheated third floor, cable assembly, equipment final assembly, trouble-shooting, and receiver test.

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* Herbach must have been a true old-timer: the McGraw-Hill Radio Trade Directory for Aug. 1925 lists Moskowitz & Herbach, a seller of radio kits at 512 Market St. - Ed.

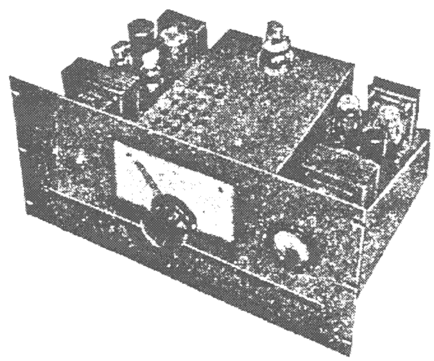
My departure from the company occurred suddenly and unexpectedly - as it did for many of the other employees. One morning in August, I took time off to visit the Navy recruiting office in hopes of taking the Eddy Test, which was used to screen candidates for electronics training. Failure of a preliminary vision test disqualified me from further consideration, so I returned to H&R, where I was astonished to see all work in-progress covered with brown wrapping paper, and everyone standing around chatting. I was told a new kind of bomb had been dropped on Japan, and the war was over! Company management tried to assure everybody that existing work would be completed, but that afternoon telegrams started rolling in, cancelling all Government contracts. So ended a memorable phase of my life.

NEW!

35-WATT SINGLE DIAL TUNED BAND SWITCHING EXCITER UNIT

ECO-1 Exciter Unit, 35 watts, output R.F. on 10, 15, 20, 40, and 80. Gang tuned, Band switching, Single dial control. Type 807 power output tube is straight R.F. amplifier on all bands. Oscillator keying for break-in operation. Stabilized oscillator circuit, clean chirpless keying. Regulated power supplies. Phone-CW switch. Remote control connections. Tubes (3) 6AG7 (1) 807, (2) 816, (1) 5T4, (1) VR150, (1) VR105.

Price $160.00 for rack mounting
Table mounting cabinet **$7.50** extra



DESIGNED BY HAMS—FOR HAMS

BY THE MANUFACTURING DIVISION OF

THE HAM CENTER

HERBACH & RADEMAN, DEPT. Q-1
522 MARKET ST. · PHILA. 6, PA.

The war's end did not terminate the Manufacturing Division, however. Commercial equipment continued to be built and, in a bold attempt to move toward civilian products, Jack and his remaining staff introduced the ECO-1, a single-control 35-watt amateur radio exciter, and the AMM-1 Modulation Monitor, advertised in 10/46 and 12/46 *QST* respectively. Further advertisements of the ECO clearly reveal the continuing saga of the Manufacturing Division. While early ads referred to the old Market Street address, in March 1948 the Liberty Lincoln Building at Broad and Chestnut Streets was listed as the address - clearly a mail drop, for that was about when redevelopment of Market Street began in preparation for the new Independence Mall, forcing H&R to re-locate the store to Arch Street without a manufacturing facility.

Finally, in April 1948, the ECO-1 was advertised under the banner of El-Tronics, 2647 N. Howard Street, heralding the sale of the manufacturing operation to a Mr. Ellis, who already had an established business in automatic garage door openers. Jack and some of the original H&R people also made the transition. Manufacturing continued much as it had at H&R with such products as a frequency meter for the CAA's new Distance Measuring Equipment (DME) navigation system, a projectile-velocity measurement device for Aberdeen Proving Ground, a medium-cost triggered oscilloscope, and subcontracted construction of RCA service test equipment. Unfortunately, for want of sound financial management the company failed in 1952, sending my old pals off to new endeavors.

As for H&R, the Arch Street store was sold to new owners who moved first to Erie Avenue, then to Bristol, Pennsylvania, where it is presently located, continuing to offer an Aladdin's Cave of interesting products, which are still advertised in *This Month*. Several of the former principals retired in Florida, but sadly, Maury suffered a sad death from cancer shortly after the war.

EPILOGUE

The scene now moves to Fifth Street just north of Chestnut Street, where a crowd of several hundred has gathered in a driving rain storm on New Year's Eve 1976. Slowly, out of the shadows, the Liberty Bell begins a short trip on a temporary railroad track from its traditional home in Independence Hall to a new pavilion just off Market Street. When it has completed its historic journey, I am struck by the realization that it now reposes almost precisely where the H&R counter once stood. Thus, in addition to its traditional significance, the bell has become an uncelebrated monument to American free enterprise and industrial excellence.

The Club puts out a newsletter and welcomes comments and information on what people are doing now. If interested, the secretary is Frank Maul, 39-63 Bernice Rd., Seaford, NY 11783, or vice president John Eisele, 233 Columbus Pkwy., Mineola, NY 11501.

READER COMMENTS

Ross Smith of the Indiana Historical Radio Society, on reading the list of production figures for Signal Corps radio gear in the July *Oscillator*, was reminded that his employer, CTS Corporation, had turned out a couple of hundred thousand RM-29 remote-control sets during WW II. The RM-29 was an adapter, placed at a radio transmitter-receiver, which allowed an ordinary field telephone (EE-8) to remote-control the radio over a couple of miles of field wire. It worked with such famous radios as the SCR-178, -284, -608, -609, -610, and -628; hence the large production. The RM-29 was basically a steel-cased magneto (hand-cranked) telephone set with control features added, so it was appropriate for CTS to make them: the company had gotten its start much earlier, making magneto farm phones as Chicago Telephone Supply.

TENUOUS CONNECTIONS

Bob Thomas, W3QZO

A pioneer amateur who actually lived the times we savor passes his artifacts to a museum for preservation. A collector/historian informs us of a unique and somewhat mysterious artifact he has acquired from that earlier era. A messenger, fortunate to know both individuals and to be in the right place at the right time, notices the confluence of these two circumstances, forging one more "tenuous connection" in the ever-expanding web of antique radio.

The title of this piece does not refer to broken wires or cold solder joints. Rather, it is about events and people who came together in a singular example of the way in which the innumerable, seemingly haphazard branches of our hobby crisscross one another to create that complex lacework we fondly refer to as "Antique Radio Collecting."

The "tenuous connection" about to be described began in June, during a visit to Jack Williamson, W3GC. Jack, co-founder of Barker and Williamson, had recently moved to a retirement community, and had several items he wanted to donate to the Antique Wireless Association Museum in Rochester. I offered to spare him the trouble of packing the material by personally delivering it to the Museum when I go to Rochester in September to attend the AWA Annual Conference. Among the paper items Jack was donating to the AWA were several 1925 issues of a rare magazine called *Amateur Radio*. Naturally, since they would be in my possession for several months, I took the opportunity to read all the magazines, which were quite absorbing, and then set them aside in readiness for the trip north.

Amateur Radio began publication in January 1921 as *The Modulator*, with articles on contemporary technical developments and on current events and personalities of the Second District amateur-radio community. At some point the magazine absorbed another fledgling ham publication called *Radio Relays*, resulting in the addition of reports on traffic handling and DX. The modest $2.00 per year subscription cost was supplemented by revenue from numerous advertisements by leading manufacturers of the day. One of the Associate Editors was William J. Halligan, who went on to found Hallicrafters. Regular writers included the prolific E. M. Glaser, 2BRB; Fred Parsons, 2ABM; and the Editor, Lloyd Jacquet. The publication was produced under the auspices of the Executive Council, Second District, Inc., which represented technical and political interests of eleven radio clubs in the vicinity of New York City and Northern New Jersey. Another activity sponsored by the Executive Council was organization of the ARRL Hudson Division Radio Show and Convention, held annually at the Hotel Pennsylvania in Manhattan. Jack Williamson recalls attending one of the Conventions. This is one-half of a "tenuous connection."

Now for the other half: The August DVHRC *Oscillator* presented "Collecting Radio Lapel Buttons," wherein Ludwell Sibley described the satisfaction derived from augmenting normal antique-radio interests with subsidiary items, such as lapel buttons that were distributed to publicize various activities in the Radio Days. One of the buttons illustrated in Lud's article was issued by - guess who? The Executive Council Convention, New York, 1921. Connection completed!

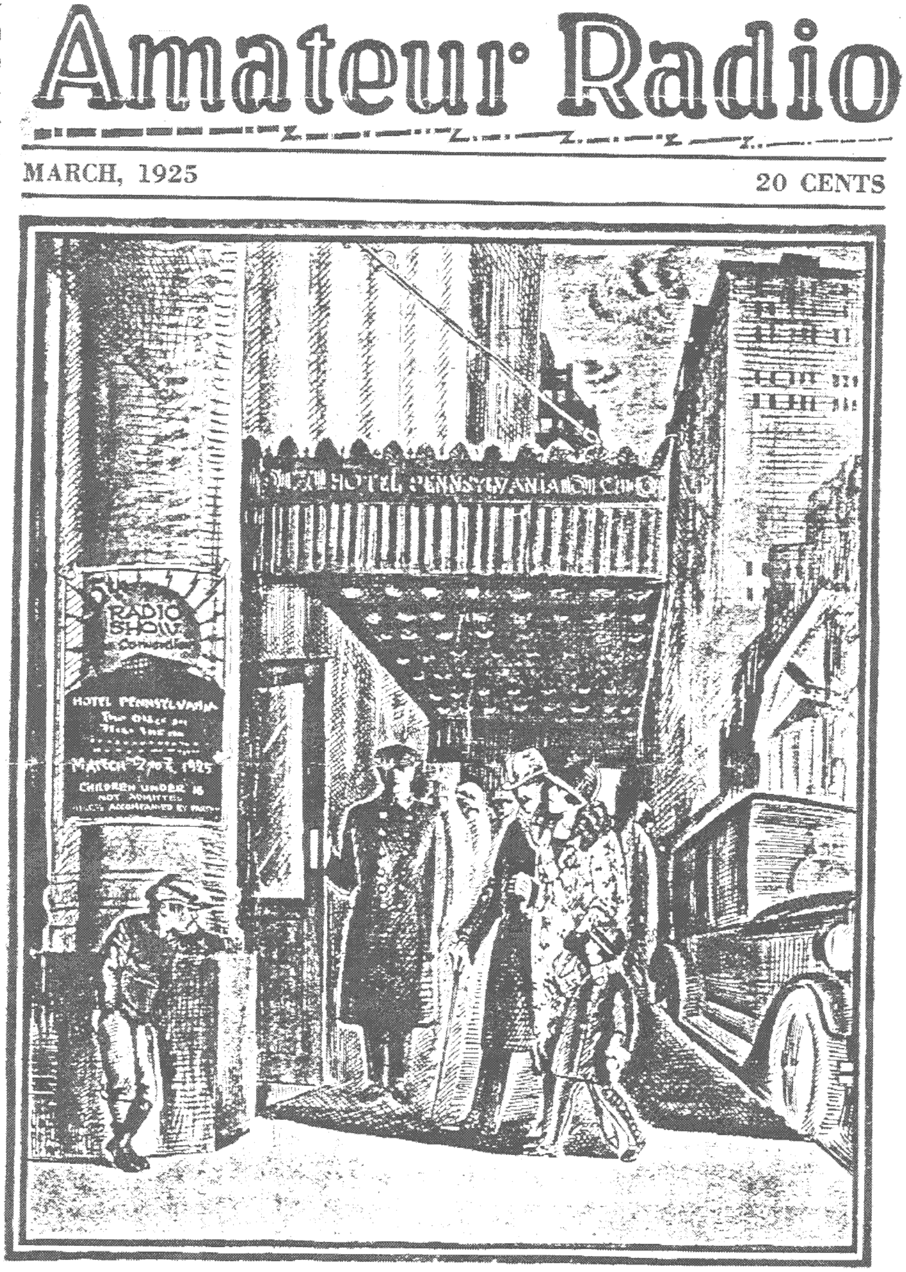
Another look at the above:

THE HUDSON DIVISION CONVENTION OF 1925

Bob Thomas, W3QZO

The March 1925 issue of *Amateur Radio* announced the 5th Annual Radio Show and Convention, to be held in New York City on March 2-7. The cover of that issue carried a heart-rending scene in which a lad wearing a peaked cap and knickers with a hole in one knee - obviously a young radio enthusiast - stands forlornly by the entrance to the Hotel Pennsylvania, observing a grand couple and a smartly-dressed little girl emerge from a big limousine and enter through a door attended by a uniformed doorman. A sign above the boy announces the radio show, with "Children under 16 not admitted unless accompanied by parent." Makes you want to cry!

An article the following month described the convention. What a grand affair it must have been! Exhibitors included RCA, which displayed a three-foot model of a UV-199 Radiotron; General Radio; Adams-Morgan, with broadcast sets; Dubilier; Pyrex; Cardwell; REL; Brightson Laboratories, with their "True Blue" tubes; and the U. S. Signal Corps, showing its new SCR-157 500-watt transmitter on 900-1600 meters. Other exhibitors were Howard B. Jones of connector fame, Amber Mfg. Co. with its "MarvODyne, featuring the Filameter," and Resas, showing the Tone-A-Dyne set ("heard 70 stations between 8 and 11 PM"). Local clubs went all-out with displays. The Bronx Radio Club had a diorama of the dirigible Shenandoah passing over a house with a fully detailed interior, including a ham shack with transmitter. The Long Island club displayed 2GL's transmitter. "A spark set whooped things up . . . [and you could] hear the rip and crash of 'Old Betsy'."



The banquet was like nothing you'll see today. No sweatshirts or jeans at this affair! This was a grand event and all the participants extracted the utmost pleasure from it by dressing accordingly. A photograph shows throngs of men, and some YLs, in attendance. Captain Droste, 2IN, was Toastmaster and ARRL founder Hiram Percy Maxim was principal speaker. Maxim asked all the hams who had communicated with England to stand, and so many rose, "It really [did] not seem possible that so many stations operated by amateurs could be so successful . . ." Those were the days!

4/15

RESTRICTED-SPACE ANTENNAS

When all else fails – *Punt!*

Bob Thomas, W3NE

This is the tale of two years with successive bouts of rejection, struggle, disappointment and expenditure of cash on a variety of antennas before finally achieving a victory (of sorts). It began with a request to management of the retirement facility at the W3NE QTH for permission to run a single wire to a tree 170 feet from our third-floor balcony. The terse answer was no. Absolutely NOT! There went any chance for a multi-band long wire in the open and clear of the noise that roars through the apartments 24/7. As related in a previous article the first reaction was to erect a rotatable magnetic loop for reception-only. It receives pretty well but local noise level is S9+ on 75 meters and S6 on 40M, although it's very low on 20M and above.

The first transmitting antenna tried was a pair of Hamsticks in a dipole arrangement, located three feet beyond the balcony railing. That configuration was balanced so there was no stray RF in the shack. However, the tuned nature of Hamsticks gave the dipole a useable bandwidth of only 40 kHz in the 80-meter band. It didn't take long to become disenchanted with having to go outside, especially in hostile weather, to adjust the length of Hamsticks' whips every time it was desirable to QSY very far. And of course band changes necessitated changing the Hamsticks themselves, which was also annoying even though they were fitted with bayonet quick-change disconnects. Finally, Hamsticks are not very efficient so they seldom produced rave signal strength reports. A short wire dipole was tried next but it had wild feed point impedance swings and was so close to our brick building most of the RF heated bricks and never got radiated.

OK, time for something radically new. A screwdriver (S.D.) antenna would solve the QSY issue but there are no grounded pipes anywhere near shack for the good RF ground required by an unbalanced antenna. Furthermore an inside trailing counterpoise wire hot with RF is a non-starter for safety reasons. Nevertheless, it was thought the amount of ironwork in the balcony might provide an adequate ground reference for a single S.D. antenna mounted on the railing.

Two leading manufacturers of S.D. antennas, Hi-Q and Tarheel, were contacted to learn if either had customers who had success with their product as a balcony-mounted antenna. The proprietor of Hi-Q had not sold any of his antennas for that application but he volunteered the opinion that mounting one at a 45° angle to horizontal *might* work. Tarheel was called next, where "Robert," the go-to guy for advice on their products, said he had a few customers with an S.D. antenna mounted at 45° on a balcony but results varied. The best he would say was, "It might work or it might not." A local ham of fifty years' experience with most types of HF antennas thought, "It might work on some bands but not others." With those uninspiring opinions for success, the dice were rolled and an order placed for a Tarheel 100A screwdriver antenna and an Ameritron SDC-102 remote controller.

A rugged mount was fabricated from several feet of 1¼"x ¼" architectural-grade aluminum angle obtained from On-Line Metals.[1] The angle stock was cut to length, milled to 45° angles as needed, and bolted together with ¼-20 stainless steel hardware The lower end of the antenna tube was gripped between two DX Engineering resin split-insulators bolted to cross members on the mount. Brackets and special threaded clamps held the mount assembly to the balcony railing. The whole contraption looked like a rocket launcher! (Fig.1)

Performance forecasts proved to be lamentably accurate: there were a few frequencies where SWR was barely acceptable, but it was unusable on most frequencies from 3.5 to 29 MHz. Gripping the balcony railing at various places caused a slight shift in tuning. Bonding parts of the railing and the balcony's steel support structure made little improvement in its flaky SWR. Different loading coils at the base of the antenna did not make any improvement, nor did addition of a line isolator in the coax feed line. After thinking about the dismal situation, and reading many internet tutorials on mobile antennas, the realization struck that a balcony railing, regardless of the amount of ironwork in its construction, is not the same as a car. It's not the bulk of a car that provides a good ground plane for a vertical HF whip or S.D. antenna to work against; it is the *capacitance between the car and ground* which transfers the actual earth ground reference to the car itself. An unbalanced antenna on a car works against that "coupled ground" in the typical HF mobile situation.

What to do? Thoughts returned to some kind of balanced antenna which would eliminate stray RF and squirrely performance associated with unbalanced antennas in all-band operation. Since there was already one Tarheel S.D. antenna on hand, it was decided to jump in with both feet and buy another 100A and Ameritron controller to make an S.D. dipole. A twin-S.D. dipole should radiate an RF field much stronger than those weeny Hamsticks and, of equal importance, it would support frequency agility controlled from the comfort of the station operating position.

More aluminum angle was ordered along with a 6 ft. length of 2"x4"x 1/8" rectangular aluminum tube for a new support strut to hold the heavy dipole out from the balcony. A 4 ft. length of 3"x1"x1/4" UHMW (high-density polyethylene) channel from McMaster Carr[2] is bolted to the end of the strut to support the S.D. antennas without affecting their RF radiation. (Fig. 2) A Comtek[3] 1:1 current balun couples the balanced impedance of the dipole to unbalanced coax transmission line to the shack. The balun has little effect on the minor impedance mismatch between the 75-ohm dipole and 50-ohm coax. However, it is essential to convert the balanced dipole feed point to the unbalanced coax to prevent RF on the coax shield. A snap-on ferrite bead was added around the coax right at the balun to ensure complete RF suppression. Several smaller ferrite beads on each S.D. control cable isolate them from high level RF at S.D. antenna feed points. Figure 3 shows the completed antenna.

In the shack, two Ameritron controllers, for independent adjustment of each half of the dipole, are partially recessed through the top of a 5"x9"x3" chassis. Control cables to each half of the dipole plug in to the back of the chassis through Cinch-Jones connectors chassis. Each controller has LED readouts of antenna position and ten memories that store S.D. tuning addresses. A TenTec graphic-display SWR analyzer, described last month, facilitates rapid adjustment of both sides of the dipole for a desired frequency. The two addresses are stored in memory, then all that's necessary later to rapidly QSY to that preset frequency is to recall appropriate memories, causing each S.D antenna to retune to the new frequency.

There hasn't been enough on-air experience with the S.D. dipole for a thorough evaluation but so far it has performed reasonably well on 40- and 20-Meter SSB. Operation on 75M SSB is still limited by high level local noise on the receive side although 80 CW has been rewarding with the receiver adjusted for narrow bandwidth and optimal DSP noise reduction. Everything considered, the screwdriver dipole is fulfilling most expectations for a restricted-space antenna that can be tuned on any band right from the operating position with no spurious RF floating around. It wasn't easy getting here, but the effort is finally paying off.

REFERENCES

[1] On-Line Metals: http://www.onlinemetals.com/ Good source for cut-to-size metals and plastics in sheets and most shapes. Reasonable prices.

[2] McMaster-Carr: http://www.mcmaster.com/# Supplier of stainless steel hardware, U-bolts and all-thread rod, plastics in sheet and many shapes, Neoprene rubber, cabinet hardware, lubricants, tools and general hardware. Economical, fast (usually overnight) UPS delivery on most orders.

[3] Comtec: http://www.dxengineering.com/search/product-line/comtek-jerry-sevick-w2fmi-series-current-baluns High performance current baluns with a variety of terminal locations in NEMA waterproof housings (Not plastic pipe!).

THE LAST MISSION

Destinies in war

Bob Thomas

This is a story of special significance as we observe Veterans Day on November 11th. It tells about the crew of a B-24 on the last strategic bombing mission in the European theatre during WW-II, and especially about the radio operator on that fateful flight. But first there are some introductory matters to cover.

Design of the B-24 Heavy Bomber began in late 1938 at Consolidated Aircraft Corp. as an result of a request for a second source for the Boeing B-17. Consolidated was almost ready to fly its Model 31 flying boat incorporating a new, highly efficient wing designed by Consolidated engineer David R. Davis. The long and slender Davis wing exhibited 20 percent lower drag than a conventional wing, enabling higher maximum speed and longer range. A preliminary design for a new long range heavy bomber based on Model 31 was approved by General H.H. "Hap" Arnold as an alternative to perpetuating the relatively old B-17 of 1935. Final design of the new aircraft was completed in the spring of 1939 and the first prototype XB-24 was flown in December of that year.

The B-24 (named *Liberator* by the British) served as the Allies' Heavy Bomber on every front of the war. It was used by Winston Churchill as his personal airplane and became the subject of a commemorative stamp in the series, "American Advances in Aviation" issued July 29, 2005. A few Liberators continued in service after the war in air rescue and weather reconnaissance missions for the Coast Guard, but most were scrapped, some flown directly from the factory to a scrap yard!

Extended range contributed by the Davis wing, enabled non-stop transatlantic flights and sufficient range to conduct air attacks on U-boats in regions of the Atlantic where the subs had been free to maraud Allied convoys at will. Daylight high altitude precision bombing raids on strategic targets like defense plants and railroad yards deep within Germany were made possible by the B-24's advanced capabilities. Over 18,000 of the planes were manufactured; 7000 were made in Henry Ford's Willow Run Plant, where one B-24 was turned out every hour! Air crews were housed on-site so that ground-tested B-24s could be flown right off the adjacent airfield.

For all its advantages, the B-24 was not without drawbacks. Its flying boat heritage endowed it with a deep fuselage prone to breaking up in hard landings or ditching at sea. If the fuselage did survive at sea, the shoulder wing did not offer crewmen the temporary survival platform of the low-wing B-17. It had marginal capability for taking off fully loaded, and once airborne it generally could not land with a full bomb load. The unheated, unpressurized fuselage was inhospitable to crews at high altitudes, where temperature could be 50 degrees below zero. The most serious fault of the B-24 lay in the difficulty of flying it, especially in tight formations – exactly the tactic for which it was intended! That problem was vividly illustrated by a comment from a veteran crewman that, "You don't know what shit hittin' the fan means 'till you've seen a Liberator flip over on its side in the middle of a forty-plane formation." Once in trouble, recovery was difficult and if control couldn't be regained, escape from a B-24 could be difficult. Those issues and loss from enemy action meant the chance of survival by B-24 crewmen was only 37% after three missions in early years of deployment, and a mere 50 percent in later years. Men who flew in the B-24 were the personification of The Greatest Generation!

U.S. Army Air Force officers and enlisted men received specialized training at facilities across the country to prepare them for final assignment. Men who qualified to join heavy bomber crews after 1937 were sent to Westover Air Base in Massachusetts, for B-24 training flights and specific intensive training for their jobs. Lieutenant Richard Farrington, a tall 20 year-old athletic man who had enlisted two years earlier and was trained as a B-24 pilot, took command of a crew assembled at Westover. His copilot, another 20-year-old and similarly well built, was Jack Regan. Other officers in Farrington's crew were Christ Manners, bombardier; and Mel Rossman, navigator. Enlisted men assigned to Farrington were Harry Gregorian, nose gunner; Jerry Barrett flight engineer (and top gunner in combat); Howard Goodner, radio operator; Jack Brennan, waist gunner, Al Seraydarian, tail gunner and armorer; and Bob Peterson, gunner in the ball turret that extended down from the fuselage. At 28 he was the oldest and only married man in the crew.

Boarding a B-24 was not an easy or simple task: Gregorian was the first to pull himself up inside the front wheel well into the nose gunner's cramped bubble; he was followed by bombardier Manners to his spot at the bombsight; and then navigator Rossman to his cramped quarters with a small table and charts. The rest of the crew pulled themselves up through the bomb bay and on to a 23"-wide girder above the bombs. Farrington, Regan, and Barrett went forward to the flight deck, Goodner to his radios, and gunners back to their stations. B-24 crews went on long day and night cross-country flights simulating combat simulations for their first twelve weeks at Westover. When not flying, the pilot and copilot sharpened their flying and navigating abilities in Link Trainers while the rest of the crew continued studying for long hours and received intensive practical training from seasoned veterans for the special requirements of their jobs. At the end of August 1944 the thoroughly trained Farrington crew received ten-day passes. When they returned they shipped out to England.

Farrington and his crew were assigned to the 784th Squadron, 466th Bomb Group, 96th Combat Wing of the 8th Air Force, based at AAF Station 120, near Attlebridge on the East Coast of England. Following a final week of ground training they began their first practice bombing missions where each man honed the skills he would need in actual combat. Then it was on to the Real Thing with the 466th to attack a hardened fortress occupied by Germans at Metz, France. Dense cloud cover over Metz caused that phase of the mission to be scrubbed so they continued on to a secondary target at Karlsthrue. [The Luftwaffe's declining effectiveness near the end of the war resulted in a shift of German defenses from fighter aircraft to massive concentrations of antiaircraft batteries surrounding cities and strategic targets.] As the formation approached Karlsthrue they entered a cloud of shrapnel that pelted the planes, but did not inflict serious damage – this time! They continued flying through the flak for a hairy but successful bomb run before returning safely to Attlebridge. With their first mission behind them, Farrington's crew took part in several more raids on synthetic oil plants, aircraft factories, supply depots and railroad yards, each one adding to the excellent reputation the crew was accumulating.

By Christmas the excellent performance of the entire crew had been noticed and they were promoted to "lead crew" status, by which they would have expanded responsibilities in navigating to, and precise acquisition of the target. That came with plusses and minuses: They would have to participate in thirty missions instead of the regular 35 to qualify for completion of a tour, and they could expect to fly less often. On the negative side, they would have more training and more responsibilities on missions. It necessitated addition of Radar operator (a.k.a. "mickey man") John Murphy and visual navigator George Noe, the two men who would accurately acquire targets on which following planes in the group would toggle their bombs. In a change unrelated to promotion to lead, was Jack Perella, replacing Mel Rossman as regular navigator. Radio operator Howard Goodner would now be busier receiving coded instructions for the formation from HQ and transmitting periodic mission reports.

Farrington's crew acquired an excellent reputation with completion of each mission. After Christmas they were rewarded by promotion to "lead crew" by which they would have expanded roles in navigating to, and precisely acquiring the target. It necessitated more training, addition of radar operator John Murphy and visual navigator George Noe to the crew. Jack Perella came on as navigator in the regular crew. Goodner would receive coded messages from HQ on his BC-348 and send mission status on the Collins ART-13 Autotune transmitter. They were relieved of combat flying in January and February 1945 to practice new skills required of lead crews.

They returned to combat on February 15, leading the Third Squadron on the first of several of successful raids Germany. With each mission the boys became sharper in acquiring their target and leading the squadron to achieve improved bombing accuracy. Their luck changed on April 4 on their way back from a raid on a fighter base in northern Germany. No. 2 engine was hit by flak. Farrington feathered the prop but they were losing altitude and falling behind the squadron. He realized they could not make it back to England so, with a new heading from Perella, he changed course to a U.S.-held field near Brussels. They had a pleasant evening touring Brussels and the following day they were ferried back to Attlebridge in a C-47.

It had been standard procedure that a certain B-24 would not be permanently assigned to any one crew. That policy changed, however, and the Farrington crew was permanently assigned the *Black Cat,* Ford B-24J1-FO, Serial No. 42-95592. They flew a number of missions in Black Cat beginning April 13, to ferry fighter personnel to Belgium. Then on the 16th as lead on a long, difficult mission to strike railroad yards north of Munich, and on another long mission on the 18th to railroad yards at Passau, where they their bombing achieved the highest accuracy in the Second Air Division. Physically and emotionally drained, the men were looking forward to 48-hour passes promised for the next day, thankful they would not have to participate in another raid scheduled for April 21 to bomb a railroad bridge at Salzburg. Their euphoria changed to frustration when a lead crew scheduled for that raid contracted measles and Farrington's crew was re-assigned at the last minute to take its place. They would not be flying lead in the mission, but would lead a nine-plane group in the middle of the formation.

The Command Pilot for the mission, who would be flying in the co-pilot seat with Farrington, was Lt. Col. Louis Wieser, a West Point graduate who had flown a full combat tour with distinction. The morning of April 21 dawned with driving rain and zero visibility. Farrington's men dragged themselves aboard *Black Cat,* everyone expecting the mission to be cancelled because of atrocious weather. That didn't happen, and at 0631 the first B-24 trundled down the runway. Farrington followed a few minutes later behind a plane he couldn't see to begin his twenty-third mission. Weather conditions had not improved as they approached their Salzburg target. Command pilot Weiser gave the order to abandon the attack, turn right and return to base. As Farrington banked the plane for the turn, Jack Perella shouted in disbelief, "Navigator to pilot: We can't make a right turn here; a right turn will take us over Regensburg!"

Everyone knew Regensburg was heavily protected by fearsome antiaircraft batteries. Perella's warning was echoed on the command frequency by other navigators and radar operators until Wieser barked, *"I'm in command of this mission. We stay on this heading!"* And so the formation turned right. In a few minutes four puffs of flak appeared in the distance ahead. Then four more puffs, much closer. Next a thunderous concussion rumbled through *Black Cat,* physically tossing crewmen around in the plane. A sheet of flame erupted between engines 1 and 2, and an instant later the left wing folded between the engines and broke off, sending *Black Cat* into a flat spin. While Farrington fought sluggish controls, trying to stabilize the ship, Al Seraydarian wriggled out of the tail bubble, and grabbed his parachute, fighting centrifugal force created by the spin. That force pinned Christ Manners to the floor as he grabbed his chute and just made it out through the wheel well. As *Black Cat* spun downward toward earth, crews in other planes reported seeing two or three chutes open before it crashed in a plume of flame.

The country was overjoyed as victory in Europe approached. That made it all the worse when, on May 7th, the day before VE Day, families of the *Black Cat* crew began receiving terse war department telegrams informing them of their loved ones' death or MIA status. Al Seraydarian and Christ Manners had escaped before the plane crashed and were held as POWs until liberated by American troops. They visited families of the lost crewmen but were unable to offer much information about the mysterious "third chute" that had buoyed families' hopes their son or husband was on that chute and would return home someday. Those hopes gradually faded, leaving families of lost crewmen only memories and cherished letters from better days.

Thomas Childers is Professor of History at the University of Pennsylvania. As he was preparing his late mother's house for sale in 1995, he came upon all 300 letters his uncle, radio operator Howard Goodner, had sent home. Reading them sparked an urge in Childers to learn the facts surrounding fates of all the *Black Cat* crew. He corresponded or personally met with families of the lost crew, who were universally frustrated by the War Department's disinterest in furnishing information about their lost loved ones, Childers then began to personally search official records related to that last flight. He examined the archives of 466th Bomb Group at Maxwell Field, Alabama where written reports of the fatal mission revealed the mission should have been cancelled because of poor weather. Childers later learned survivor Christ Manners had died but he was able to locate Al Seraydarian, who had suffered from tortured memories of the event every day since it had occurred. Seraydarian had been in the tail section when it broke off, and managed to escape by opening his chute, which dragged him out when it opened. Records from forensic examination of the crash site disclosed that the bodies of Jack Brennan (waist gunner) and Howard Goodner were lying clear of the wreckage, intact but with numerous fractures of the skull and limbs; the impact of their bodies caused depressions several inches deep in the earth, leading to the supposition they had been thrown clear of the plummeting airplane without parachutes.

With some questions answered but many still shrouded in mystery Childers decided only a trip to the crash site in Germany and interviews with eyewitnesses would yield answers to satisfy his quest for closure. Among numerous eye witness accounts given to Childers by residents of Scharmassing, the rural village where the plane went down, the most revealing was from a woman who was nineteen at the time of the crash. She vividly recalled going to the site shortly after the crash and seeing two bodies on the ground. She remembered that one was so strikingly handsome she could never forget his face. When Childers showed her a picture of the entire *Black Cat* crew without commenting, she pointed to Howard Goodner without hesitation, and murmured, "There he is."

With Howard now positively identified and most other questions answered to his satisfaction, Professor Childers returned to his home near Philadelphia. *Wings of Morning* is the product of his dedicated research. It brings all these events to life, memorializing the men who flew those hazardous daylight missions. As November 11 arrives again, this time seventy years after that last mission, take a moment and think about the short lives of those gallant flyers.

Author's Note:

The entire section of my manuscript related to B-24 crews and their experiences is based upon information obtained from *Wings of Morning*. The introductory description of the B-24 and all illustrations are based on several associated internet sites; specific URLs available upon request.

***Black Cat* Lead Crew**

Standing: Murphy (Radar), Perella (Navigator), Regan (Co-Pilot), Farrington (Pilot), Noe (Visual Navigator), Manners (Bombardier)
Kneeling: Peterson (Gunner), Brennan (Gunner), Barrett (Flt. Eng.), Goodner (Radio), Seraydarian (Tail Gunner)

Commemorative postage stamp. Issued July 29, 2005.

Plaque erected near the crash site by German townspeople in honor of the *Black Cat* crew who died there.

An Apartment Workshop

Bob Thomas
Blue Bell, PA
Rev. 1

At the end of her article "A New Roof," in the July SMEE *Journal,* tracing the history of the Hatherill's workshop shed, Ann Hatherill asked if any other members have workshop stories to tell. In view of increasing commentary on the aging of the model engineer community, perhaps my personal experience will assist others facing the traumatic prospect of losing their shop due to moving from their traditional home to smaller quarters.

In 1999 my wife and I reached the stage in our lives when we had to consider how and where we would spend our remaining years. Some readers of this journal might be having similar thoughts, lamenting the prospect of giving up their beloved workshop. We eventually decided to move from our house (and workshop!) of forty years into one of the retirement complexes that have proliferated in the U.S. in the past two decades. Such a fate might conjure images of life at "Bayview Manor" in the BBC programme, *Waiting for God.* However, that would be a false assessment of actual possibilities, and should not be allowed to strike fear in the heart of a somewhat aged, but still active, model engineer. Quite the contrary; given appropriate circumstances it is entirely possible to pursue one's model engineering pastime in an apartment environment, albeit with accommodation to some reasonable constraints, as I hope this article will demonstrate.

Only my treasured file of *The Model Engineer,* a few models, books, small tools, a modest stock of material, and a some storage cabinets were saved for a new life in their future apartment home. The one we chose has a living room (lounge), small kitchen, and three bedrooms, one of which my wife graciously dedicated to my exclusive use for a combination workshop, drawing office, and library. How is that for generosity!

Management of our facility allows entering residents considerable latitude for making custom renovations to their apartment before occupancy The most useful renovation was adaptation of a clothes closet five feet wide by two feet deep to accommodate a metal-topped bench on which an Asian Minilathe and Minimill would be placed after we moved in. Recessed incandescent lights were installed in the closet ceiling, and electrical outlets for the machines were put in one wall. Two Bi-fold doors completely cover the closet to conceal its contents when closed, but when opened, Figure 1, each pair of two hinged doors folds together, making nearly the entire width of the closet fully accessible.

Scale drawings of the room were made to determine best layout for convenient accessibility of everything with passage ways wide enough for the future when I will no doubt be navigating with a Zimmer Frame or wheelchair. The 10'x9' room was then fitted with fluorescent ceiling fixtures above proposed locations of a desk and workbench. The floor covering selected is durable vinyl tile with a dark variegated pattern to obscure the rigours of hard use, although it does little to help finding the inevitable dropped 14 BA screw as would a light uniform coloured floor.

Effort devoted to planning room layout was well spent, and I have not regretted any early decisions after seven years of use. Figure 2 shows the loose issue portion of my file of *The Model Engineer.* It was accumulated from my first subscription in 1962 as well as earlier years given to me by friends. In the mid-sixties the Kent and East Sussex Railway sold donated back issues to raise funds for preservation expenses, enabling several additional years to be obtained. Missing volumes to 1924 were later purchased from TEE. Shelves behind the loose issues contain bound volumes of *M.E.,* prototype publications, and works of well known British model engineers, all of which have provided valued guidance and now serve for "recreational" reading.

The central feature of the workshop is a substantial 30"x60" workbench, Figure 3. The top is made of 1.25" chipboard with a hard composition top that has proved to be been quite durable, only now beginning to show signs of use. The ½" capacity drilling machine in the photograph was of Asian origin and subsequently found to be unsuitable for my needs; it has since been replaced by a precision ¼" machine with a digital depth readout on the spindle. Large holes are drilled with the Minimill which, while somewhat inconvenient, is more accurate and much safer than a lightweight pillar drilling machine. A compact air compressor is located at the back of the knee hole in the bench. A warning here: some modern motor/compressors systems operate at very high speed, generating appalling noise and vibration. I had to make a layered support base with two stages of compliant vibration isolation to attenuate transmission of noise to the apartment below – in a building with floors of 5"-thick concrete!

Recently I designed and built a 1"-scale free-lance box cab electric locomotive entirely in the apartment workshop. Having no sheet metal equipment, large plates were purchased cut-to-size from an internet vendor. Truck (bogey) castings and rugged buffer beams were machined on the Minimill and all other fabrication was completed in the shop. With an overall length only one foot shorter than the bench, handling the new locomotive in later stages of construction was cumbersome at times, but not impossible. A Gauge 1 Camelback locomotive is currently being built, a project more in keeping with the capacity of the workshop facilities.

Ancillary room furnishings include two filing cabinets for drawings, catalogues and other printed matter. Two utility cabinets store large tools, photography equipment and material for my amateur radio station. A small cabinet with 33 drawers is the repository of small tools and pieces of stock. Long lengths of stock are hidden behind the door to the room. Taps, dies, small reamers and hardware are immediately accessible in the plastic drawers of small cabinets at the rear of the bench.

This description of how one model engineer of a certain age relocated his workshop will hopefully enable the reader to see that it is quite practicable to continue one's life-long hobby even in the confines of an apartment. Forethought and moderate compromises are necessary but, as has so wisely been said, "It's better than the alternative"!

THE RCA FACTORY

It wasn't pretty!

Bob Thomas, W3NE

The factory where RCA manufactured and tested television studio equipment evolved from 1930-era mass production of home radio sets. Unfortunately, most of the primitive methods and attitudes of those ancient days were inherited along with the factory floor space. Production and test facilities for broadcast equipment were adjacent to each other on 17-2, RCA jargon for second floor of Building 17. That venerable building, with a tall tower topped by an illuminated stained glass tableau of *Nipper* in the iconic "His Master's Voice," is one of the few RCA buildings still standing in Camden. It was converted several years ago to residential lofts by developer Carl Dranoff.

Most television studio equipment was constructed on steel "bathtub" chassis like the one in the illustration. They were horizontal frames in the shape of a shallow **U**, with tubes plugged into the open front of the **U**, and circuit components on the back. Chassis were 19" wide and made in multiples of $1^3/_4$" high, with slots for mounting screws to match tapped holes in racks regardless of where the chassis was positioned. A rack full of chassis had a well-ventilated neat appearance in the front, where tubes, controls and test points were accessible. Components and terminal boards were exposed for service at the rear.

Production started by mounting all mechanical parts on the front of the chassis and terminal boards and connectors on the rear. This work was divided into small stages, each described in detailed assembly instructions that specified type of hardware and orientation of every component. Women completed an individual assembly stage then passed the chassis to the next operator. Each small assembly stage took about the same time to accomplish to maintain a smooth flow. Chassis with completed mechanical assemblies were transferred to another area for wiring with pre-cut and stripped wires or cables, and addition of small components. This was also divided into small stages with explicit instructions for each.

The RCA wiring production line was an appalling eye-opener for anyone with "normal" experience building electronic equipment. All soldering was done with 100-Watt American Beauty irons operating on 220 Volts! The high line voltage was necessary because of the load from so many soldering irons in one place, but maybe it wasn't exciting when there was a short in an iron or its cord! Even more stunning to the uninitiated was the way the ladies had been trained to hold their soldering iron: with the hand and fingers wrapped around the handle and forearm raised as if intending to stab someone in the back! How they were able to obtain precise control of the iron's tip with that illogical grip was beyond me, but they all did it and their work was not too bad in spite of the awkward appearance.

Completed chassis were sent to Quality Control for mechanical inspection prior to electrical test. An inspector examined each soldered joint individually, and if it was sound, a dab of red paint was applied to verify the joint was made correctly. Well and good, but boredom apparently took its toll so it was embarrassing, to say the least, to receive a phone call from an irate Chief Engineer complaining that his brand new RCA product was inoperative because of an intermittent joint with no solder, but held together with red inspection paint. All you could do in those situations was take a deep breath, swallow and punt.

Chassis that passed mechanical inspection were sent to another area for electrical performance testing. Each test position was equipped with a custom fixture to hold the product, and all the test equipment needed to verify its operation in conformance with a step-by-step test procedure. That document, prepared in consultation with the design engineer, ranged in length from two to a hundred pages, depending on the product's complexity. Each test in the procedure had space for recording actual measurement results for the unit under evaluation; nevertheless, customers received units that obviously had not passed certain tests. As with assembly slipups, stifling work rules and indifferent attitudes of factory management made it impossible to eliminate those self-destructive lapses in quality.

Tom McIntyre was supervisor of the electrical test department. He worked under the Camden Plant Production Manager A. L. Malcarney who, to be charitable, had difficulty with anger management. A Management-by-Fear philosophy pervaded the entire factory so each supervisor acted, not in the best interest interests of the Corporation, but to protect his job, which could be terminated in an instant by the volatile Production Manager. Today we call it *PYA*. To survive in that that atmosphere, Tom prioritized everything that went on in the Test Department on the basis of two numbers: his mandated monthly production quota and the date of last day in the month. As his production goals converged with that fateful last day, relations became very tense on the test floor; it was not a good time for an engineer to be in the area investigating performance problems. Even at other times, presence of an engineer spelled *interruption* to Tom, We were barely tolerated when a performance issue required our help, but we were never accepted gladly, especially in the dreaded last week of the month.

That all changed for me by a peculiar circumstance. One afternoon while going over some results with a Test Technician, Tom took me aside to say he needed a favor. It seems he was unable to meet his production quota the previous month for an audio/video switcher I had designed. To avoid the wrath of the tyrannical Malcarney Tom had resorted to a desperate ruse. He delivered the correct number of shipping cartons to Inventory to satisfy his production quota, but some were empty because their "phantom" switchers had not yet passed through final test. The paperwork looked good, but now he had to retrieve the cartons from Inventory so the empty ones could be properly filled with switchers that had, by then, been completed. Tom asked me to write a change order that would require returning the entire production run from Inventory for installation of "official" revisions. He was basically a good guy so I went along with him, and wrote an Engineering Change Notice to unnecessarily increase the power rating of one resistor from ½-watt to 1-watt. That was risky for me because costs to move, unpack, revise, and re-pack all the switchers would be charged to Engineering. Fortunately nobody noticed, Tom was off the hook, and I had a new friend in the factory! After that episode my projects always got the best test technicians and work rules that might have caused friction with the union mysteriously vanished.

RCA was selling our new solid state video tape recorder in large numbers during the '60s. One afternoon I made a routine visit to the Test Room when, to my surprise, I spotted fellow Phil-Monter Roland Madera, W3PWG, wearing his trademark wide suspenders. Rollie had just been hired to take up slack in final testing of the machines. He had only recently joined Phil-Mont so I didn't know him very well at first but over the next several weeks we always took a few moments to chat whenever I was in the area. A month or so later Rollie was nowhere to be seen. There had been a layoff that affected Rollie because of his low seniority. He was back again several months later when he told me finding a job in the interim had been difficult because prospective employers were reluctant to hire victims of RCA layoffs who usually would return to higher wages at RCA when hiring picked up again. He was laid off a second time, opted for longevity and stability in his new job, and never returned to RCA.

Old bad habits and intractable management, – in Engineering and Marketing as well as Production – eventually took their toll. The Broadcast Division could no longer compete against the superior quality and advanced design of products from forward-looking domestic companies and Japan. A last gasp effort to move from Camden to a new facility in Deptford extended the life of the division for a few months but it was too late. Within several months the end of a long contribution to broadcast technology came to a sudden end when RCA was purchased by General Electric and the French firm Thomson CSF. Stanford University temporarily acquired the Princeton Laboratories. RCA ceased to exists except as a Trademark.

CRITERIA FOR TELEVISION PROJECTORS IN LIFE CARE FACILITIES

by Robert G. Thomas

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PROLOGUE

The social, educational, and entertainment value of television programs projected on the big screen of the auditorium at Normandy Farms Estates are enthusiastically embraced by a vast majority of residents. Large audiences are drawn to the auditorium several times every month by videotaped motion picture feature films, religious productions, and timely live television broadcasts. When this vital amenity was installed by ACTS several years ago along with the installation of projectors in auditoriums at other ACTS facilities in the region, projector technology was in its infancy and, furthermore, the specific model selected had marginal capabilities then that have since declined even further due to aging effects. Now, with the availability of later generations of new projectors having vastly improved performance, it is appropriate to re-assess the quality of pictures projected on the auditorium screen and evaluate the potential to achieve improvements with new products, in relation to their price and performance, for fulfilling the special needs of the NFE audience. Finally, although comments here are sometimes related specifically to circumstances at Normandy Farms, they are applicable, in general, to all Life Care facilities.

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NFE RESIDENTS' SPECIAL NEEDS

It would be a rare NFE resident indeed who does not have some degree of vision impairment. The most fortunate among us might simply have a manageable overall decline of visual acuity or diminished ability to see in low light conditions. For many, cataracts might have been a problem in the past and hopefully successfully treated, but for those with untreated cataracts or retina impairments associated with aging, seeing clearly in dim light is an ongoing challenge. Approximately ten percent of NFE residents are afflicted with age-related macular degeneration – loss of vision in the central region of the visual field – but despite that limitation, some still attend auditorium screen presentations. While we cannot overcome many of the natural effects of aging, it is often possible to compensate for them, and every reasonable effort should be vigorously pursued to do just that in a community where advanced age is the norm and where auditorium presentations are a significant element in leisure activity.

With regard to the topic at hand, auditorium screenings should be exhibited with as bright a picture as possible, not so much to enhance visibility of highlights (brightest parts of the picture), but rather to increase the brightness and color rendition of the dark portions to enable detail in shadows to be discerned by viewers, especially those with low vision; otherwise, crucial nuances in shadows, which are essential for portraying texture and creating realism, will be buried in muddy darkness. This is not a severe problem with most live TV programs because broadcasters modify the picture brightness range to cope with certain technical limitations of the medium. However, feature films released on videotape by movie producers generally reproduce lighting effects exactly as the director intended, in some cases relying upon shadows with an abundance of detail that is crucial to the plot or mood of the story.

At home we can often modify low key (dark) scenes to partially compensate for our individual vision impairments by simply turning-up the brightness and contrast controls of our TV receiver, but that is not possible with an auditorium projector which is already working all-out. The dark, murky pictures presently shown in our auditorium are the antithesis of what the NFE audience, with its unique limitations (and even viewers with normal vision, for that matter), requires for unfettered enjoyment of screen programs. Something should be done to correct this situation. It might be asked, "If pictures from the existing projector are so bad, why don't residents complain about it?" The likely reason there has not been a demand for improvement to date is that no one realizes just how bad the situation truly is – it has *always* been that way! Think of the reaction patients have the day after successful cataract surgery, which is typically, "I didn't know how much I was missing!" The same reaction can be expected from the residents by a major upgrade of the auditorium projector!

FUNDAMENTALS OF THEATRICAL FILM AND TELEVISION EXHIBITION

Before proceeding, it will be necessary to become acquainted with some basic terminology that will be used through the remainder of the paper. The first term to learn is the unit of measurement for brightness: it is the *lumen.* Lumen is a quite common unit, in fact it is printed in large letters on the side of most light bulb boxes to inform consumers how bright the bulb will be. An ordinary 60 watt light bulb has a brightness (or luminosity, to get technical) of about

830 lumens, so that gives some idea of the magnitude of brightness we are talking about. Sad to say, the projector in the NFE auditorium once had a brightness of only 700 lumens – less than a 60 watt bulb – when it was brand new, and it has since fallen substantially below that as a result of aging effects, so that gives some indication of what we are up against.

The lumen defines the brightness of the projector, but what we are most interested in is the unit of measurement for light reflected by a screen (a.k.a. "luminance"), and that is the *footlambert.* To find out the amount of light reflected by a perfect screen (in footlamberts), we have only divide projector brightness (lumens) by the square foot area of the screen. Thus, in the case of the 10 x 12 foot screen in the auditorium (120 square feet), the NFE projector with 700 lumen brightness will produce a screen luminance of 5.8 footlamberts under ideal conditions. Let's see how that stacks up with commercial movie theatres.

The film industry has established technical standards for exhibition of motion picture films in theatres to ensure utmost enjoyment by an *average* audience. Of particular interest is the industry specification for screen luminance, which must be maintained in the range of 12 to 22 lumens. Uh-oh! Compare the *lowest* recommended luminance of 12 footlamberts with the 5.8 footlamberts barely squeezed from the NFE screen – not at all good! Furthermore, theatres intentionally limit screen brightness for projection of motion pictures to avoid disturbing shutter flicker effects with films that do not encumber televised pictures in our auditorium so, in general, theatre specifications are on the *low* side of what is really appropriate for their audiences, and thus vastly lower than urgently needed at NFE.

The following factors must be taken into account above and beyond the standards for first-run theatre luminance when considering a brightness specification for a new projector: 1) the substantial above-average screen luminance needed to fulfill the unique needs of NFE residents; 2) loss of luminance because the screen is not 100 percent efficient and therefore does not reflect all of the light from the projector; 3) still less light reflected to viewers sitting at the sides of the auditorium; and 4) projector brightness is rated on "as-new" condition, and will decline with time. Taking all those effects into account, a realistic initial screen luminance from our120 square foot screen would be at least 34 footlamberts (twice the industry average) so, ***a new projector should provide <u>at least</u> 4100 lumens.*** This figure will appear in a later section as a guide for recommendation of a suitable product.

A discussion of projectors would not be complete without considering *resolution, aspect ratio,* and *contrast ratio.* Projector resolution is the degree to which the detail in the picture is portrayed on the screen; it is expressed as the number of picture elements (pixels) displayed on the screen. Today's color television pictures are composed of 768 pixels in the horizontal direction and 480 pixels vertically – a total of about 370,000 pixels. However, computer graphics and DVD recordings possess more detail than standard TV pictures and, in the future when high definition television programming becomes readily available, substantially higher resolution will be required to reproduce the fine detail those pictures contain. To avoid premature obsolescence, a new projector should have a resolution of at least 1024 pixels horizontally and 768 vertically, although higher resolution, or the capability to interpolate to higher resolution would be preferable.

Aspect Ratio refers to the proportion of a picture's width to its height. The aspect ratio of a normal television picture is 4:3, which simply means the picture is four units wide and three units high. When a film begins with an announcement that, "This film has been modified to conform to your television set," it means the original film was shot in a wide-screen format like Cinemascope (10:4 aspect ratio) and the sides picture have been intentionally chopped off to make it fit in the narrow confines of your 4:3 TV display. A different approach to accommodate wide-screen films on normal TVs has become common recently. The entire picture is reduced in size until its full width fits on the screen, but that reduces its height as well, resulting in blank spaces above and below the picture on your screen, for what is sometimes called a "letterbox" display. That technique preserves all of the original picture content, and will become more prevalent as programs are simulcast in high definition which uses a 16:9 aspect ratio.

Contrast ratio is a measure of the brightest part of the picture relative to the darkest part. If the contrast ratio of a picture is 700, it means that highlights in the picture are 700 times as bright as the darkest shadow. A low contrast ratio causes pictures to look "washed out," whereas, higher ratios produce a "snappy" picture with rich tonal gradations. Contrast ratio is a property of the projector, and the higher the better. However, if incidental light in the auditorium spills onto the screen, shadows are obliterated by the stray light and contrast is ruined. As an aside, light in the auditorium, essential for safety considerations, should be confined to the back of the room to minimized its detrimental effect on picture contrast ratio.

VIDEO PROJECTOR TECHNOLOGY

Projectors using a Liquid Crystal Display (LCD) are the most appropriate type for our auditorium. A liquid crystal is a microscopic cell containing colored polymers that vary light transmission in accordance with an electrical signal. Over 170,000 LCD cells are arranged on a clear wafer in such a way that they produce a miniature TV picture in their characteristic color when a video signal is applied. LCD projectors simply pass light from a brilliant lamp through separate red, green and blue liquid crystal wafers. Colored light corresponding to the three pictures is then combined and passed through a projection lens to the screen. These projectors are simple, rugged devices that utilize well known design and production techniques. They are available in a wide variety of capabilities and prices from numerous manufacturers and dealers, resulting in competitive pricing. The projector in the NFE auditorium at present is an LCD type but, as previously noted, its capabilities fall well below the special needs of our audience.

The light transmission efficiency of LCDs is inherently low, so lamps used for the light source have to operate at relatively high power, causing a decline of brightness with lamp age, which is typically 1000 to 3000 hours to failure. Lamps are usually supplied as part of a plug-in module that is costly (about $450), but not unreasonable when amortized over its lifetime. More advanced LCD projectors employ two lamps to satisfy the need for bright pictures, bringing with it both advantages and disadvantages. On the negative side, initial cost is necessarily higher than with single-lamp models because of the more elaborate optical and cooling systems and the higher initial cost of the lamps themselves, as well as recurring lamp replacement costs. There are compensating advantages, however: our target level of screen luminance almost demands a two-lamp projector; two lamps provide an element of protection in event of a catastrophic lamp failure, inasmuch as the second, surviving, lamp enables continuation of the show, albeit with reduced luminance, that would otherwise have to be suddenly cancelled; and, projector brightness can be tailored to suit program material and audiences to conserve lamp life by using a single lamp for computer graphic presentations and programs viewed by audiences with normal vision.

LCD PROJECTOR PRICE/PERFORMANCE CONSIDERATIONS

The plethora of LCD projector models numbers, features, quality levels, and prices can be overwhelming unless they are arranged in groups for analysis according to application and price/performance. Three categories, defined below, suffice for products in this analysis.

Light Portable. Projectors in this category cost about $900 to $1800. These are low cost, lightweight entry-level portable projectors for use in schoolrooms, startup home theatres, and marketing promotions where brightness and resolution are not paramount. They weigh in the neighborhood of three pounds and have light output of 700 to 1500 lumens.

Portable. With a step up in price range of $1800 to $3500, projectors at this level have more operational features, greater flexibility in application, higher quality construction, and improved performance compared to the lowest ranked products. These projectors are intended for mid-level applications in conference rooms, deluxe home theatres, quality field applications, and modest auditoriums. They weigh from 6 to 18 pounds and have light output in the range of 1500 to 3000 lumens.

Fixed Venue. This price/performance category is comprised of high grade projectors costing $4000 to $8000 with 3000 to 5200 lumens brightness. Some models are classified as "portable," but they are primarily intended for fixed installation for demanding service in corporate board rooms and auditoriums of moderate audience capacity. They have excellent resolution and easily adapt to a wide variety of video formats. Latest models employ "micro-lenses" on the LCD arrays to improve contrast ratio. Professional features and rugged construction promote reliability and stability of setup adjustments. They weigh about 18 pounds for quasi-portables, to over 40 pounds for models intended for permanent installment in medium-size auditoriums such as ours.

The chart on the next page is a tabulation of LCD projector features that has been included to facilitate comparisons between the three categories. Values listed for each item are typical for the products within a category, but may be higher or lower for specific models within that grade classification. Deep discounting is rampant in the industry and must be considered when comparing prices shown in the tabulation with those that might be obtained elsewhere. The net, or "street" prices listed here are about 40-percent of "list" or "MSRP" prices.

LCD Projector Characteristics			
Item	Light Portable	Portable	Fixed Venue
Principle Application	Entry level portable, schoolroom & field sales	Conf rooms, home theatre and small auditoriums	Board rooms & moderate capacity auditoriums
Initial Rated Brightness, lumens	700 - 1500	1500 - 3000	3000 - 5200
120 sq. ft. Screen Luminance, fl	5.8 - 12.5	12.5 - 25	25 - 42
LCD Chip Dimensions, inches	0.55 – 0.7	0.7	1.4
Resolution, H Pixels	800	1024	1024/1360
Format (HDTV, etc.) Adaptability	4:3, 16:9	4:3, 5:4, 16:9	All
Projector Net Cost w./Lens	$900 - $1800	$1800-$3500	$4000-$8000
Lamp Cost	$350	$450	$475-$775
Approximate Operating Cost,$/Hour	0.20	0.25	0.25 - 0.50
Weight, pounds	3 - 10	6 - 18	18 - 50

[*Specifications subject to change*]

RECOMMENDATION FOR PROJECTOR SELECTION

Only projectors in the highest of the three categories (Fixed Venue) possess potential for fulfilling the demanding needs at NFE. That said, the lower-rated projectors within that category, while suitable for young and middle-age audiences of a general population, are capable of providing only marginal improvement in satisfaction for our residents, and cannot be considered candidates for purchase. Only a few projectors in the Fixed Venue category possess all the qualities required, however, because new products are introduced quite frequently, it would be unwise to make a specific purchase recommendation at this time. If it is decided in the future to proceed with acquisition of a new projector, the most appropriate model can be selected and evaluated in-house before a final purchase decision is made, in which case the cost can be expected to be in the upper range of Fixed Venue products.

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EPILOGUE

It is unfortunate that legions of residents attending televised film exhibitions in the auditorium do not benefit from advancements in projector technology that have become available in recent years. It is a situation that can and should be remedied by replacing the present outmoded projector with new, state-of-the-art equipment. Compromise is possible, but that is a questionable policy when considering acquisition of costly apparatus whose performance will impact residents for years to come. A possible reason for compromise in the minds of some might be related to the expense of purchasing the appropriate projector. On the other hand, individuals seldom make financial compromises in the care of their eyes or correcting vision impairments, so it would be ironic if the fervor to achieve the very best sight possible were thwarted by settling for an auditorium with less than the best possible television pictures. In short, if a projector with necessary capabilities cannot be afforded now, it would be preferable to wait until funds became available to purchase it, rather than to buy a less than adequate compromise product at this time.