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Your Entry to the Fascinating World of Vintage Communications
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From The Editor

This issue contains the debut of a new column, “Radio Reflections,” by Jim Cook. We’ve given him free rein to reminisce about the things and incidents that sparked his interest in old radios and related items. Paraphrasing Jim’s own words, radio collectors are not only attracted by the appeal of the old radios themselves, but also by their history and evolution. In this issue, Jim’s reflections were triggered by memories of the big Zenith console that was his dad’s prized possession and the PiloTuner FM converter that, for a time, sat on top of it.

The son of a radio technician, Jim became a licensed amateur radio operator at age 15 and obtained commercial radiotelephone licenses before he was 20.
While he was an electrical engineering student at the University of Kansas in the 1960s, he worked as a transmitter operator for two radio stations. After graduation, he became an electronic circuit designer for Texas Instruments, but later redirected his career into electrical power engineering. He recently retired after a 34-year career in the facilities engineering group for Hallmark Cards.

In addition to being a member of the AWA, Jim is a member of ARRL and the Tube Collectors Association. He is also a senior member of the IEEE. Jim and his wife Eva live in Shawnee, Kansas, at the west edge of the Kansas City metropolitan area. They have three adult children, one daughter and two sons.

—Marc Ellis, N9EWJ

From The Deputy Director

Hi Everyone. This has been a landmark year for the AWA. On August 20, 2013, the AWA held the Grand Opening of its new, world-class AWA Museum in Bloomfield, New York. With over 250 visitors, a string quartet, and many local and state dignitaries in attendance it was quite the event.

If you have not seen the new Museum, plan a visit soon. It is open Tuesdays from 10 a.m. to 3 p.m. and Saturdays and Sundays from 2 to 5 p.m. For more information about the museum, including a virtual tour of the new facility, visit the AWA web site at www.antiquewireless.org. You’ll also find a collection of museum pictures at “Mini Tour of the New Museum” in this issue of The AWA Gateway.

The new Museum includes a Museum Store offering AWA logo clothing, vintage test equipment and radio receivers excess to the AWA collection, new and used books and souvenirs. The Museum Store also offers collections of past issues of The AWA Journal and The AWA Review in CD form as well as a selection of individual printed back issues. Reading these amazing issues is an excellent way to further your radio collecting knowledge. To order individual issues or CDs from the Museum Store by mail, see www.antiquewireless.org/museumstore.

If you live in the Rochester/Bloomfield/Western New York area and would like to become a docent or guide at the Antique Wireless Museum, please contact me at N2EVR@ARRL.com. It is an absolutely great way to learn more about the history of the technology of communications and entertainment and you will also meet some very interesting visitors as well as some very knowledgeable fellow Museum staff members. We would love to have you join us.

—Bob Hobday, Deputy Director
The AWA Museum

Book Reviews

Volumes of Special Interest to New Radio Collectors and Restorers

By Eric P. Wenaas, eric@chezwenaas.com


Vintage Radio, first published in 1981 with an orange cover, is a revised, edited and expanded version of the classic A Pictorial Album of Wireless and Radio (1905-1928) by Harold S. Greenwood. The latter was published by Floyd Clymer Publications in 1961 with a blue cover. The original book covered the period from 1905 to 1928 with 224 pages, while this book covers the period from 1887 to 1929 with an additional 39 pages. Both books consist primarily of photographs of the classic hardware used in radiotelegraphy, radiotelephony and broadcast radio during the formative years. The photographs are supplemented by explanatory text and a number of advertisements that provide an appropriate context for the equipment.

Vintage Radio is another “must have” for the collector or aficionado who wishes to become familiar with the classic hardware of the wireless era. It is something like the ubiquitous Scott stamp album; it contains pictures of collectable items, both common and rare, to be traded or purchased at swap meets and auctions, to be viewed close up at museum exhibits or in private collections, or at the very least, to be recognized for the icons they are when seen in wireless magazines or other publications. There is an undeniable rush at seeing a very rare piece of equipment “close up” for the first time.

This book contains images of more than a thousand pieces of equipment, most of which were taken from the
private collections of Harold Greenwood, Morgan McMahon, Earl England, Vance Phillips, Ed Raser, and other well-known collectors. Several publishers and manufacturers also consented to having illustrations and images of their apparatus reproduced in the book. The photographs are of good quality, although they are relatively small and in black and white. The small size is dictated by the small page format and the decision to include a very large quantity of photographs. In this case, the choice of picture quantity over image size was the correct decision.

The book begins with several short introductory chapters describing wireless in the early days, and then moves quickly to photographs of the hardware. These are divided into three lengthy chapters: transmitters, receivers, and receiver components. The chapter on transmitters is the shortest of the three, which is not surprising because transmitters tended to be large and heavy, and not particularly easy to transport or display; thus, relatively few transmitters have survived intact. Nevertheless, photographs of the very rare transmitters appearing in the book have an elegance of their own and are appreciated by many collectors.

Fortunately, many transmitter components and pieces of ancillary apparatus have survived. A number of these are pictured in the following categories: spark gaps, spark and induction coils, transformers, variable condensers and inductors, code keys, microphones and transmitting vacuum tubes. In addition to the original apparatus manufactured by wireless companies for their own use, transmitter components manufactured for use by the amateur and electrical experimenter were sold by electrical supply companies such as Electro Importing Co. (E. I. Co.) and Manhattan Electrical Supply Co. (MESCO). These items, examples of which are shown in the book, are also highly prized by wireless collectors.

The next chapter on receivers begins with early apparatus used primarily for reception of Morse code from spark discharge transmitters. This group of photographs, dominated by Marconi and Wireless Specialty Apparatus Co. sets, contains many of the iconic receivers that represent the Holy Grail for wireless enthusiasts. Next come the ever-popular crystal sets that were manufactured for the public in the 1920s, primarily as an inexpensive alternative to vacuum tube sets for broadcast radio. One of the more rare crystal sets appearing in the book is one made by the Victor Talking Machine Company in the early 1920’s. This set was developed to determine if a crystal set could drive a horn speaker in a phonograph without additional amplification. Apparently it could not, because it was never integrated into Victor phonographs.

Anyone interested in collecting broadcast radio receivers will be delighted with the next thirteen sections containing scores of photographs of the classic sets by well known manufacturers of early receivers such as RCA, Grebe, de Forest, Kennedy, Atwater Kent, Freed-Eisemann, Federal and so on. While most of these sets are indeed broadcast receivers, the author did sneak in a few early wireless sets, designed for spark reception, that are as scarce as hen’s teeth. They include, for example, a de Forest Responder and a Three-Coil Synotonizer. If you find one of these, you will make your mark as a premier collector.

However, do not despair if you cannot find one. A large number of the other classic sets shown in these sections are readily available at flea markets and auctions at reasonable prices. For example, there were over a half million iconic Radiola III, IIIA and balanced amplifier sets made by RCA between 1924 and 1926, and these are often available at prices of less than $100. If you do not find the manufacturer of your choice in this group, there are receivers made by a potpourri of additional manufacturers in the section that follows.

The third category of photographs consists of components that were adjuncts to the receivers and often sold separately. Photos of these components are organized by wireless tuning inductances, variable tuning condensers, wireless detectors, vacuum tubes, headsets, loud speakers, amplifiers, batteries and battery eliminators, and servicing equipment. There are a number of subcategories in each of these groups, and many collectors focus on just one. For example, detectors can be further subcategorized as coherers, crystal detectors (cats whiskers or fixed), crystalline materials, electrolytic, magnetic, and vacuum tube. There is such a plethora of components that a collector specializing in one group or subgroup could fill a large display cabinet, if not a whole room, with different types and manufacturers.

McMahon ends the book with a few valuable collecting tips and a list of recommended introductory books on the radio industry and its people such as Radio Collectors Guide 1887-1932, A Flick of the Switch, and A Tower in Babel. He also suggests joining one of the following radio clubs, which he describes as being both “active” and “enthusiastic.” AWA, ARCA (now part of AWA), CHRS, IHRS, NWWRS, SCARS, and VPRS. A current list of radio clubs can be found at http://www.antiqueradio.com/clublist.html.

One popular area of wireless collecting not covered in McMahon’s book is that of paper and literature. The more popular categories include books, radio magazines, equipment catalogs, equipment instructions, advertisements, postcards, and QSL cards (exchanged to confirm radio communications). These have a great appeal because much of the material is generally available and often not expensive.

For example, color ads for radio receivers from the 1920s are readily available on Internet auction sites for $10-$20 or less. Truly stunning color ads were placed by RCA, Atwater Kent, Stewart-Warner and many other manufacturers in large-format magazines such as The Saturday Evening Post and Ladies Home Journal. Grouped correctly, the ads not only show well when displayed properly in albums, but also document a slice of the history of broadcast radio. Whatever your interests are, whether it be antique wireless artifacts or literature, this is the book for you. It is available on the secondary market from websites such as AbeBooks.com for $10 to $20.
Mini Tour of the New AWA Museum
Bruce Roloson photos except as noted.

Staff gathers in front of museum in preparation for the grand opening. Richard Neidich Photo.

Museum gift shop is located just inside the front entrance.

History wall documents radio giants and their achievements.

Artifacts and benches for resting line main corridor. Front doors are in the background.

Showcase at front of museum holds artifacts tracing the origins of radio communication.

The 1920s radio store exhibit.
Mini Tour of the New AWA Museum

The Heathkit collection is virtually complete.

Part of the Marconi ship’s wireless station.

Early phonographs make an interesting grouping.

A corner of the television exhibit.

Equipment from all eras on display at the amateur radio exhibit.

Wireless gear from the era of spark.
Clubs That Will Welcome You

• The Antique Radio Club of Illinois (ARC I) — Meets bi-monthly. Meets generally held at the American Legion Hall, Carol Stream IL but meets in June in conjunction with the 6-Meter Club of Illinois at the DuPage County Fairgrounds and once per year for Radiofest at the Willowbrook Illinois Holiday Inn. Check website for schedules, details and maps.) Contacts: President, Olin Schulter oshuler@comcast.net; Club Public Contact, Art Bilski, 630-739-1060, clubinfo@antique-radios.org. Website www. antique-radios.org.

• Antique Radio Collectors of Ohio —meets first Tuesday of each month at 2929 Hazelwood Ave., Dayton, OH (4 blocks east of Shroyer Rd. off Dorothy Lane) at 7 p.m. Also annual swap meet and show. Membership: $10.00 per year. For more info, contact Karl Koogle: mail to above address; phone (937) 294-8960; e-mail KARLKRAD@ GEMAIR.COM.

• California Historical Radio Society—For info on current meetings, call the CHRS hotline: (415) 821-9800.

• CARS, the Cincinnati Antique Radio Society — Meets on the third Wednesday of each month at Gray’s History of Wireless Museum, which is part of the National Voice of America Museum of Broadcasting, Inc., located in a building that is now on the National Historic Register at 8070 Tylersville Road, Westchester, Ohio. 45069. For more information contact Bob Sands at (513) 858-1755.

• Carolinas Chapter of the AWA — Hosts four “mini-swap-meets” each year (in January, May, July and October) plus an annual conference, “Antique Radio Charlotte,” on the 4th weekend in March. Executive committee meets approximately quarterly. For more info, visit the website at CC-AWA.ORG or contact Ron Lawrence, W4RON, Chapter President, P.O. Box 3015, Matthews, NC 28106-3015; phone (704) 289-1166; e-mail W4RON@carolina.rr.com.

• Central Ohio Antique Radio Assn. —Meets at 7:30 p.m., third Wednesday of each month at Devry Institute of Technology, 1350 Alum Creek Rd., Columbus. (1-70 Exit 103B.) Contact: Barry Gould (614) 777-8534.

• Delaware Valley Historic Radio Club — Meeting and auction begins 7:30 p.m. on the second Tuesday of each month. Location: Telford Community Center on Hamlin Ave. in Telford, PA. Annual dues: $15.00, which includes a subscription to the club’s monthly newsletter The Oscillator. For more info contact Delaware Valley Historic Radio Club, P.O. Box 5053, New Britain, PA 18901. Phone (215) 345-4248.

• Houston Vintage Radio Association (HVRA) meets the fourth Saturday (January thru October) at Bayland Park 6400 Bissonnet, 9 a.m. in SW Houston. Each meeting includes an auction and program. Annual two-day convention held in February includes three auctions, old equipment contest, technical talks, swap meet, and awards banquet. One day MEGA auctions held in the spring and fall. A newsletter, The Grid Leak, is published bi-monthly. Event postings, announcements, photos and other features are available on HVRA website: www.hvra.org. Membership is $20/yr. Address: HVRA, P.O. Box 31276, Houston TX 77231-1276 or call Bill Werzner, 713-721-2242; email: werz1943@gmail.com.

• Hudson Valley Antique Radio and Phono Society [HARPS] meets the 3rd Friday of the month at 7:30PM at the Episcopal Church of Suffern Annex, 65 Washington Ave., Suffern N.Y. 10901 for info contact Rev. Dale Cranston at (845) 357-1615 or dale.cranston@gmail.com.

• Indiana Historical Radio Society — Active since 1971. Meets in Feb. (Lawrence), May (2-days, Kokomo) and Oct. (Greenfield). Flea market, old equipment contest, and auction at all events. Meet details and club info at website www.indianahistoricradio.org. $15.00 annual dues includes the IHRS Bulletin published quarterly. Contact Herman Gross, W9ITT, 1705 Gordon Dr., Kokomo, IN 46902, 765-459-8308, email w9itt@comcast.net.

• London Vintage Radio Club — This Ontario, Canada club meets in London on the first Saturday of January, March, May, and November. Annual fleamarket held in Guelph, Ontario in June. Contact: Dave Noon, VAD3N, 19 Honeysuckle Cr., London, ON N5Y 4P3, Canada. Email: va3dnn@execulink.co. Website: http://lvrc.homestead.com/index.html.

• Mid-Atlantic Antique Radio Club (MAARC)—Meets monthly, usually on the third Sunday of the month at the Davidsonville Family Recreation Center in Davidsonville, MD. (But meets once or twice a year in Northern Virginia—check website for schedules, details and maps.) Contacts: President, Steve Hansman, 855 Arundel Drive, Arnold, MD 21012, (410) 974-0561, email: shans01a@comcast.net; Membership Chair, Geoff Shearer, (703) 818-2686, email: gshearer2@verizon.net. Website www.maarc.org.

• The New Jersey Antique Radio Club Meets the 2nd Friday of the month 7:30 pm at either Info Age 2201 Marconi Rd. Wall Township N.J. 07719 or Bowen Hall, Princeton University. We hold three annual swap meets and four seasonal repair clinics. Visit the club’s website for details www.njarc.org or contact NJARC President Richard Lee (914) 589-3751 or president@njarc.org.

• Northland Antique Radio Club (Minneapolis/St. Paul)—hosts four events with swap meets each year (in February, May, September and November) including an annual conference, “Radio Daze,” for two days in...
mid-May. Annual dues are $12.00, which includes a subscription to the club’s quarterly newsletter. For more info, visit our website at www.northlandantiqueradioclub.com.

• Northwest Vintage Radio Society — Meets the second Saturday of each month at Abernethy Grange Hall, 15745 S. Harley Ave. Oregon City, OR. Meeting starts at 10:00 a.m. Membership $25.00 per year. Guests welcome at all meetings and functions except board meetings. Spring show, the second Saturday in May. For more information, contact Mike McCrow 503-730-4639; e-mail: tranny53@comcast.net.

• Oklahoma Vintage Radio Collectors—Meets second Saturday of each month, (except for April, October, and December), at Hometown Buffet, 3900 NW 63rd St., Oklahoma City, OK. Visitors welcome. Dinner/Socializing, 6 p.m., meeting, 7 p.m. Swap meets on second Saturday in April and October at 8 a.m., Midwest City Community Center, 100 N. Midwest Blvd., Midwest City, OK. Membership $15/year including monthly Broadcast News. Info: contact Jim Collings at (405) 755-4139 or jrcradio@cox.net. Website: www.okvrc.org.


• The Pittsburgh Antique Radio Society welcomes visitors to our Saturday flea markets, contests and clinics held at least four times yearly. A fall auction is included in September and our annual luncheon program is on the first Saturday in December. An annual Tri-State Radio Fest is held in April. Our journal, The Pittsburgh Oscillator, is mailed quarterly. For more information visit us at http://www.pittantiqueradios.org, email President Chris Wells at radioactive55man@comcast.net, or phone Treasurer Tom Dixon at 412-343-5326.

• Society for Preservation of Antique Radio Knowledge (SPARK) — Meets monthly at Donato’s Pizzeria, 7912 Paragon Rd., Centerville, OH. Annual swap meet. Membership, $18/year. Write SPARK Inc., P.O. Box 292111, Kettering, OH 45429; e-mail sparkinc@juno.com or call John Pansing at (937) 299-9570.

• Texas Antique Radio Club — Meets alternate months in Kyle and Shertz, TX. Contact: Doug Wright, 625 Rolling Hills Dr., Canyon Lake, TX 78133. Email: dwjw@gvtc.com; website www.gvtc.com/~edengel/TARC.htm.

• Vintage Radio and Phonograph Society (VRPS) meets monthly on the third Saturday. Located in the Dallas, Fort Worth Metroplex, our current activities are annual convention, auctions, swap meets, repair training sessions and monthly programs. For details visit our website www.vrps.org, or by contacting VRPS President Jim Sargent at (817) 573-3546 or bsargent@swbell.net.

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**READER INTERNET SITES**

In the April issue of *The AWA Journal*, we mentioned an idea proposed by reader Steven Johannessen. He felt that *Gateway* readers might find it interesting and stimulating to look at collections our readers might have posted online. We agreed and solicited URLs. We received and included three of them last time. Here they are again along with some additions received since then. Four readers have responded so far. Additions to the list are always welcome!

Allie Lingo (radiodoc@windstream.net) sent two:

Mike Adams (mike.adams@sjsu.edu) has recently redesigned his Lee de Forest website. Look it over at [www.leedeforest.org](http://www.leedeforest.org).

Ron Lawrence sent several URLs featuring his collections and interests:
Radio Heaven Page
[http://radioheaven.homestead.com/menu.htm](http://radioheaven.homestead.com/menu.htm)

Clough-Brengle test equipment page
Civilian Conservation Corp. page
Ron’s YouTube channel—with video tours of his collections
[http://www.youtube.com/user/w4ron](http://www.youtube.com/user/w4ron)
The Tube Collector’s Association Tube Photo Gallery

Don Ignatius Collection
[www.radionutzantiqueradios.com](http://www.radionutzantiqueradios.com)
At the close of the last installment in this series, we mentioned that the Depression of the 1930s provided great opportunities for the broadcasting industry. Kept at home by their lean pocketbooks, families gathered around the living-room radio to enjoy the free entertainment. Some of the most-loved and best-remembered radio shows of all time were created during this period.

The market for radio receivers was brisk — provided that they could be sold cheaply. And the time was ripe to fill that need. Because radio technology was maturing, designers found it easier to do more with less. Moreover, because radio stations were becoming more powerful and numerous, they could be received on less sensitive equipment.

In their quest to produce less expensive radio sets, the manufacturers concentrated on eliminating expensive components and reducing physical size. Soon, a new generation of modestly-priced table models emerged, running perhaps one third the size of the original tomstones and cathedrals. The downsized sets were enormously successful, and hundreds of thousands of them were sold.

**ATTACKING THE POWER SUPPLY**

As a first step in cost cutting, the manufacturers concentrated on eliminating two bulky and expensive power supply components: the power transformer and the filter choke. In sets made prior to downsizing, the power transformer changed the 110-volt alternating current available at the wall outlets of most homes into both lower and higher voltages. The lower voltages (6.3 volts or less) were needed to light the tubes; the higher voltage (usually in the 250 or 350-volt range), after conversion to the required direct current, provided the necessary plate and grid voltages.

The job of rectification (changing alternating current to direct) was done by a vacuum tube. But the direct current produced by a rectifier is pulsating; that is, it changes rapidly and regularly in value. Without further processing, such current would create a loud and annoying buzz in the loudspeaker. A filter circuit following the rectifier tube was needed to smooth out the pulses, producing direct current of a constant value. The filter choke served as part of this filter circuit which combined the properties of inductance (provided by one or two chokes) and capacitance (provided by two or more capacitors) to accomplish the necessary smoothing. However, thanks to a couple of technological innova-

Here's a typical "downsized" power-supply circuit. R12 is a ballast; pilot lights are powered from a separate tapped resistor (R13-14) Note that the AC/DC line is grounded to the chassis.
tions that had been recently made, separate filter chokes would no longer be needed.

One was the development (discussed in the previous column) of the dynamic (DC-powered) loudspeaker. The speaker’s electromagnetic field coil, electrically identical to a choke, could be substituted for the choke in the filter circuit. And as it worked in the filter, the field coil would also be receiving the DC voltage necessary to energize it for operation in the loudspeaker.

The other innovation was the development of practical electrolytic capacitors — which could be made in much higher values than the non-electrolytic versions. The electrolytics were inexpensive and compact. And they could be made in high enough capacitances to allow the set designers to reduce the amount of inductance used in the filter circuit — paving the way for the speaker field filter choke substitution just discussed.

SERIES STRING HEATERS

Dealing with the choke was easy, but getting rid of the power transformer would be a little more difficult. For one thing it involved devising a new way to light the tube heaters. In traditional radios, as we’ve said, the power transformer converted the 115-volt line voltage into the much lower voltages (generally 6.3 or less) needed to operate the heaters. Now these heaters would have to be operated directly from the a.c. wall plug. That was accomplished by wiring the heaters in series, much like the lamps on an old-fashioned Christmas tree set.

By wiring several tubes in series, the required operating voltage became the sum of the individual heater voltages. But even that sum didn’t come close to 110, the approximate figure required if the series string was to be connected across the line without blowing any tubes. So the string also had to contain a series resistor to drop the voltage still further.

The resistor sometimes took the form of an asbestos-covered third wire included in the radio’s line cord; it was also sometimes installed as a ballast, which consisted of the appropriate resistance housed in a metal enclosure that plugged into the chassis like a tube.

Special tubes with higher-voltage heaters (like the 25-volt types 2SZ5 and 25L6) were developed for transformerless service during this era, but you’ll also run into 6-volt types such as the 43, 6A7, 6D6, 6Q7, etc.

Besides lighting the tubes, as you’ll remember, the power transformer also provided 250-350 volts of alternating current that was rectified and filtered to provide operating voltages for the tubes’ plate and grid circuits. Without the transformer, only the 110 volts provided at the wall plug was available for this purpose, so receiver circuitry had to be redesigned to work on the lower voltages. However, for reasons already discussed, the resulting performance was more than adequate for most listening situations.

The little depression radios were also known as AC-DC sets because, thanks to the lack of a power transformer, they would operate on either type of line voltage. Back in the 1930s (and even later), the downtown areas of many cities were powered by direct current. AC-only sets required costly power inverters to operate in these areas, so the power versatility of the AC-DC sets was an additional selling point.

These radios are fun to collect because their (generally wood) cabinets were produced in a variety of fanciful styles, and their small size makes them easy to display and store. Treat the sets with extreme caution when you plug them in, however. Because the operating voltages are derived directly from the AC line, you can receive a nasty shock by touching the chassis, control knob shafts, or any other metal parts.

Next time, we’ll follow the evolution of the AC-DC set into the 1940s and study the further electrical and physical transformations that took place in this very popular and long-lived receiver design.
The operation of the superheterodyne (superhet) receiver is based on the fact that two frequencies mixed together in a non-linear circuit produce two new frequencies equal to the sum and difference between the original frequencies. The new frequencies are called heterodynes or beat frequencies. Superhet receivers use the difference frequency, called the intermediate frequency (IF).

Prior to World War I, R.A. Fessenden used this principle to make continuous wave signals audible and coined the word “heterodyne” to describe the process. During World War I, E.H. Armstrong developed the principle into the superheterodyne receiving system and sold his patents to Westinghouse.

When Westinghouse joined RCA, it contributed the Armstrong regeneration and superhet patents. The first superhet sold was the RCA Model AR-812 in 1924. RCA used the superhet circuit only for their top-of-the-line models. They vigorously prosecuted others who tried to market superhets and refused to license anyone until forced to by the antitrust settlement of 1930. Beginning in 1931, the superhet quickly displaced all other circuits because its sensitivity and selectivity far exceeded that of the best TRF or Neutrodyne.

THE OSCILLATOR STAGE

The superheterodyne contains an oscillator as part of the receiver. Tuning of the incoming station and oscillator signals is synchronized to maintain a constant frequency difference between them. These two signals are mixed together and the difference, or intermediate, frequency is fed to an amplifier tuned to the that frequency. Since the intermediate frequency amplifier works at only one frequency, it can be very selective and have extremely high gain.

We can generate the IF by operating the oscillator either above or below the station frequency. Designers preferred to operate above the station frequency. Thus, to receive WLW at 700 kHz with an IF of 455 kHz, the oscillator operates at 1155 kHz. There is also a 455 kHz difference with a station at 1610 kHz, but even one stage of RF tuning easily separates 700 from 1610 kHz. This spurious response at twice the IF is called an image.

THE MIXER STAGE

A “bare-bones” diagram of an early oscillator-mixer circuit is shown in Figure 1. Only the essentials are shown, so don’t try to use this diagram for servicing; there are too many variations. V1 is a typical screen-grid RF amplifier operating on the non-linear portion of the plate curve. V2 is a standard “tickler coil” oscillator resembling a regenerative detector.

The RF transformer, RFT, has a third winding, L3, which couples the oscillator signal into the grid circuit of V1 where it mixes with the incoming station frequency. Four frequencies appear at the plate of V1: those of the station, the oscillator, the sum and the difference (IF). The IF transformer, IFT, is tuned to the IF with trimmers CT, and rejects the other frequencies. Variable capacitors CV1 and CV2 tune the incoming station. They are ganged together on a common shaft and trimmed so as to maintain a constant frequency difference. Old texts refer to V1 used this way as the “first detector.”

THE PENTAGRID CONVERTER

In 1934 the oscillator and mixer were combined into

Fig. 1. “Bare bones” schematic of early oscillator and mixer stages.
a single tube called a pentagrid converter. Examples are the 6A7 (7-pin base) and the 6A7 (8-pin [octal] base). A typical circuit is shown in Figure 2. The circuit is still a “tickler coil” oscillator. Counting from the cathode, grid 1 is the oscillator grid. Grid 2 acts as the oscillator plate while allowing the electron stream to pass through.

Grids 3 and 5 are connected together internally to form the screen grid, which is always bypassed to ground for RF. Between them is grid 4, the control or signal grid.

This configuration shields the control grid to prevent interaction between the signal and oscillator sections. Mixing occurs in the electron stream as it is modulated both by the oscillator and the signal. To avoid loading the oscillator grid, it is coupled to the tuned circuit through C (about 50 pF) and returned to ground through R (about 22 kΩ). Everything else works like Figure 1.

The 6A7 and the metal octal 6A8 had 8 active connections including their grid caps. But the single-ended metal octal tubes of 1939 (example: 6SA7), which lack a grid cap, provided only 7 usable connections because one pin is used to ground the shell. The screen grid wasn’t available as the oscillator plate in a tickler circuit because it has to be grounded for RF, so the circuit of Figure 3 was developed.

A tube oscillates when there is positive feedback from output to input and the gain is greater than unity. Instead of feedback from the plate, this circuit gets it from the cathode by connecting it to a tap on the grid coil. The bypassed screen grid can serve as the oscillator plate because it is not part of the feedback circuit. Mixing occurs in the electron stream and all other parts function as in Figures 1 and 2.

Separate oscillator and mixer tubes (Figure 1) continued in use for expensive multiband sets long after the introduction of the pentagrid converter because of better stability and high frequency performance. Next time: the IF amplifiers, diode detector and AVC.
Past articles in this series have featured information on the long wave, medium wave, and short wave bands. The last piece began with some FM development history, FM being the most familiar use of spectrum above 30 MHz. After discussing FM programming, this article will touch on some other aspects of the higher frequency spectrum.

**FM PROGRAMMING EVOLUTION**

FM programming started out slowly. Few citizens had FM receivers in the early days, so interest in FM broadcasting was low. AM programming met most of the known needs and desires of radio listeners. The emergence of TV entertainment at about the same time that FM was getting started also created significant competition for the introduction of FM as a popular entertainment and information medium.

Also a problem in this case was a situation that occurs with the evolution of many new communications technologies, especially in broadcasting; people didn’t buy receivers readily when there was not much to listen to, and broadcasters did not invest heavily in new programming product when the number of listeners and receivers was low.

In the forties and fifties, much FM broadcasting was done by electronics manufacturing companies, such as Zenith, General Electric, and RCA. Their motivation was partly to experiment with, and refine, both the programming and the technical aspects of broadcasting.

As with television, FM broadcasting was first centered in major cities. Broadcasting hours were sometimes unscheduled, erratic, or quite short because of limited programming materials available, little or no sponsorship, and continuing experimentation relative to electronic and audience factors.

During the fifties, FM broadcasting hours and locations increased to the point that major and mid-size cities had full-time listening opportunities, especially from mid-mornings until midnight. New York, Chicago, Los Angeles and other large cities each had a dozen or more stations by the end of the decade.

Programming included some educational and informational formats — classroom lectures, talks and discussions. But the majority was music of basically two types — light or traditional classical, and easy listening which consisted of instrumentals and pre-rock vocalizations. The latter was sometimes described as elevator music, or as Muzak, the trademark name of a product that delivered easy listening music as background sound for retail establishments and the hallways and elevators of office buildings.

However, with improvements in the sciences of high fidelity and recording, the amount of quality music more appropriate for the richer sound provided by FM dramatically increased and with it the amount of programming available for a medium devoted primarily to music.

FM growth was still limited during the sixties as AM delivered what most young users wanted — Top 40, or Hit Parade, pop favorites which increasingly were rock-and-roll dominated, with some genre sidetracks along the way like calypso and folk music. Then the youth culture phenomena hit in the last half of the decade, influencing music, and therefore radio, with harder rock and with longer music segments. Free form rock formatting, with music tracks much longer than the former norm of 3 or 4 minutes, lent itself very well to FM since FM produced better music fidelity, did not have rigidly controlled time parameters for programming, and was either devoting less time to commercials or programming the commercials in blocks allowing for much longer uninterrupted music sets.

Another huge boost to FM broadcasting was an FCC regulation requiring radios produced for sale in the United States to have an FM band. AM only radios were no longer legal to manufacture per the regulation issued in the late sixties. Vehicle radios were exempted from the regulation. The impact was huge as the number of FM sets increased geometrically, and broadcasters had new opportunities to capitalize.

A similar government-influenced market impact occurred about the same time, when VHF-only TV sets were rendered obsolete by a regulation requiring all new TVs to have UHF capability as well. This tremendously boosted the number of UHF tuner production lines at the RCA factory where I was employed at the time.

The difference meant that sets no longer received just channels 1 or 2 through 14, but could also receive channels 15 to about 80, naturally increasing the number of stations. This change was significant then, but not so much now in light of our current cable, satellite, internet, and digital alternatives. Having only 14 channels seems unbelievable, doesn’t it?

The FM band now is loaded from 88 to 108 MHz in highly populated areas. Although predominately music-formatted, the number of sports, talk, and news stations is increasing. The lower part of the range is reserved for...
high school, university, non-commercial, and religious organizations. Translators use some frequencies, re-broadcasting local AM or distant FM transmissions.

Incidentally, you might well run across an antique FM receiver for the original 42-50 MHz band. This was changed to the current 88-108 MHz band soon after the close of World War II.

Many lower-power AM stations use FM translators to reach locations in their listening area that their AM signal does not cover, and also to create more night reception when their AM night power is required to be extremely low. Station managers prefer to broadcast a low power nighttime AM signal, supplemented with an FM signal, rather than to completely shut down the AM station each night and repower each morning. Of course, back when our antiques were originally being used, most stations shut down completely every night, at sunset or late in the evening.

**SIMULCASTING**

The FCC has been ambivalent about AM-FM simulcasting over the years, or at least they have had some changes in position. Early in the FM broadcasting era, simulcasting was either not allowed full-time or was strongly discouraged since original FM programming was being encouraged. Now there are not only no limitations on the amount of simulcast time allowed, but simulcasting is even encouraged to some degree. Allowing FM simulcasting in some areas allows a community to be served more successfully by AM stations with less power, thus preventing the additional AM band signal competition that results with higher powered stations.

In some cases, major AM stations with good area coverage have simulcast in order to reach listeners not normally tuned to AM. And now it is common for an FM station to simulcast on a co-owned AM station. This sometimes results in some station slogans, such as “Hot 95” for example, to be heard, oddly, not only, say, on 95.1 FM but also on a local AM station. The latter might not be acknowledged in the slogan; its city of license and call letters being mentioned only on the legally required hour and half hour.

**WHAT ELSE IS ABOVE 30 MHZ?**

Actually there are a huge number of signals above 30 MHz, but not many with a connection to antique radio other than on the FM band. Radios that receive at frequencies above the FM band are obtainable, either new or as surplus, from various sources. For instance, many scanners are available that cover 30 to 800 MHz although most do not offer continuous coverage of the entire range.

The aircraft band follows the FM band at 108 to 137 MHz. These channels are used by aircraft flying near airports and control towers. They are not used so much for intercity, inter-country, or trans-ocean communications. At my location 10 miles south of the Los Angeles airport, I can pick up pilot-to-tower messages constantly.

Other occupants of the upper spectrum include hams, the military, police, ambulance, railroads, weather, TV broadcasting, and businesses. An interesting example is the listening opportunity available to spectators at NASCAR race tracks. They can rent scanners to let them hear communications between drivers and pit crews throughout the races.

Some portions of the spectrum (near 800 MHz) are blocked out on scanners sold in the United States because they could interfere with the privacy of the public using wireless phones, cell phones or portable landline sets used at home. Though more recent wireless transmission technology does not involve that band portion as much as it did, the ban continues as of this writing.

Some vacuum tube era general-coverage short-wave radios could receive a.m. or code signals up to 60 MHz, although I have no idea what signals above 30 MHz could be heard back then. If a reader can enlighten me on that subject, please do so and I will pass the info along.

If you have no questions or comments, this column is done with spectrum considerations for now. Next quarter? Check it out.
This is the first in a series of articles that I plan to write about why my friends and I collect old radios and related items. Some people collect coins or stamps. Some people collect autographs or first edition books by famous authors. In each case, the items collected have special meaning to the person collecting them. Radio collectors are not only linked to the appeal of the old radios themselves, but also to their history and the development of electronics technology.

I have been interested in old radios since I was a young boy. My father was a radio technician who worked for a department store in Topeka, Kansas before I was born. He admired the Zenith radios sold in the store and, in the early 1940s, purchased one of the best models. This large console radio/phonograph combination became one of his prized possessions. It featured a “shutter dial” mechanism that changed the positions of arrows on the dial to indicate which frequency band had been selected.

The set also had pushbuttons, patterned after the “stops” on a pipe organ, for adjusting the audio frequency response. A built-in loop antenna called a “Wave Magnet,” housed in a cardboard box, was installed in the radio cabinet. It could be swiveled to optimize reception. That was a major innovation because most earlier radios required external antennas, especially for short wave reception.

On winter evenings, Dad would sometimes sit in front of this radio and slowly tune across the broadcast dial listening to distant stations. During the day, reception was limited to regional stations. But signals from distant stations would skip off the ionosphere at night and sometimes provide interesting listening opportunities.

We could listen to the “clear channel” stations and other powerful broadcasters, including WWL in New Orleans and WOAI in San Antonio. And we always heard the “border blaster” stations broadcasting from northern Mexico. Many of these powerful stations in Mexico were funded by companies in the United States. Broadcasting from Mexico allowed them to use transmitter power that exceeded the FCC limit of 50,000 watts for stations operating in the United States, and these stations could promote questionable products such as patent medicines that could not be legally advertised in this country.

Sometimes my father would switch to the short wave bands and we would listen to stations in other parts of the world. I remember being fascinated by the information that it was a different day in Australia because that country is on the other side of the International Dateline. And there was the ongoing mystery about how invisible radio waves from a transmitter in a different part of the world could reach the “Wave Magnet” antenna box in the back of the Zenith radio.

There was another small radio box sitting on top of this Zenith radio, an FM converter that received the frequency modulated radio stations that were just beginning to appear in the late 1940s. The tuner, manufactured by the Pilot Electric Manufacturing Company, was known as the “PiloTuner.” It was an FM radio without an audio output stage and speaker. The low-level audio output was connected to the audio input jack on the Zenith radio normally used for the phonograph.

FM radio had been invented by Edwin Howard Armstrong in the 1930s. He demonstrated this new technology with broadcasts from the Empire State Building in New York City. The original transmitter that Armstrong used for these broadcasts is now on display at the new AWA Museum that recently opened in Bloomfield, NY.

But the development of FM broadcasting was opposed by David Sarnoff of RCA, who blocked Armstrong’s progress, requiring him to create an FM broadcasting network in New England with his own money. To compound Armstrong’s problems, the frequency band for FM broadcasting was reassigned, in the 1940s, from 42-50 MHz to the current 88-108 MHz, making all existing FM transmitters and receivers obsolete.

FM broadcasting revived on the new frequency band in the late 1940s, especially in major metropolitan areas.
areas. But FM radio stations in smaller markets were struggling at that time because few households were equipped with FM receivers. With few listeners, advertisers were reluctant to support FM stations. The only station we could receive in Topeka, Kansas, went off the air, making the FM converter useless. FM Broadcasting in middle America didn’t begin to thrive until stereo broadcasting began in the 1960s.

I remember how our family relied on that Zenith radio to keep them informed about flooding that occurred in Topeka during the summer of 1951. Although our house never flooded, water had risen into our yard as the rains continued and the Kansas River and its tributaries continued to rise. We listened to news reports on radio station WREN, which later became a victim of the flood itself when its transmitter site became a soggy island in the swollen Kansas River.

Later, I worked for that station as a transmitter operator and heard stories about the efforts to keep WREN on the air during that critical time. When power lines washed away, employees used rowboats to take gasoline to the transmitter building for fueling the emergency generator. But as the river continued to rise, the building was structurally damaged and operation of the station became impossible.

My father’s Zenith also gave me the opportunity to enjoy radio programs that were produced for children in the early 1950s. I remember sitting on the floor in front of that radio listening to one of my favorites, “Big Jon and Sparkie,” in which Jon Arthur told stories through a number of fictional characters that appealed to children. Sparkie was an elf who wanted to be a real boy. This afternoon program was on the ABC radio network from 5:00 to 5:15 on weekdays.

On Saturday mornings, Jon Arthur produced a two-hour program called “No School Today.” The theme song was “The Teddy Bears’ Picnic.” That longer program allowed time for story lines to be more fully developed. Jon Arthur was skilled at painting vivid pictures with words, as when he described a cold morning in the railroad yard when the rails glistened with frost and the steam from locomotives hung in the air even after they passed.

Our family depended on that Zenith radio again in the mid-1950s when Topeka experienced a major disruption of natural gas service that lasted for nearly one week during cold winter weather. We had a wood-burning stove that kept the kitchen warm and allowed us to cook food, but the rest of the house was unheated. Every day we would leave the warm kitchen and go into the cold living room to listen to the local news, hoping to learn when natural gas service would be restored.

Although that Zenith radio served us reliably for many years, it fell into disuse by the late 1950s. We turned to television for news and entertainment and began using convenient portable transistor radios when we wanted to listen to radio programs. Many radio programs had disappeared or moved to television. Among those were “The Jack Benny Program,” “The Lone Ranger,” and “Gunsmoke.”

I wish I could tell you that after I inherited that Zenith radio from my father I restored it to original condition and still had it in my collection. But that did not happen. Restoring this radio would have been possible, but it would have been challenging. The original record changer had been discarded and replaced with a threespeed unit when 78 RPM records became obsolete. Besides, large console radios require more space for storage than I had available at that time. I gave the radio to a friend who wanted to restore it, and I hope he followed through with his plans.

That Zenith radio created many good childhood memories and ignited my desire to learn more about radio. I had opportunities to work with many other radios and received my amateur radio license when I was 15 years old. These interests led me to choose a career as an electrical engineer.

In future articles, I plan to share more information about interesting radios that appeal to collectors. I also plan to explore the role that old radios played in historic events during the first half of the 20th century.
Born in 1886, Powel Crosley was the son of a prominent Cincinnati attorney. He was fascinated by automobiles from an early age, and also had a strong entrepreneurial streak. By 1913 he had started up, and failed in, three different automotive manufacturing ventures—most of which were undercapitalized with borrowed money.

That same year, regrouping with a less grandiose plan, he started a mail-order automobile accessories business with a $500.00 investment of his own money. This proved successful, and he was soon able to buy out the company whose products he was selling. He also purchased a printing company so that he could produce his own advertising materials and diversified by acquiring a phonograph cabinet manufacturing plant.

In 1921, Crosley became aware of the radio market through shopping for a receiver for his son. He was shocked by the high prices and he and his son eventually built their own set.

Crosley had been bitten by the radio bug and was also quick to see the potential in low-priced radio apparatus. He designed a few basic radio parts, which he sold along with the products of his phonograph cabinet plant. By now, the latter was also making cabinets for radio manufacturers, including Grebe.

Desiring to manufacture complete, simple sets for the low priced market, Crosley required an Armstrong regenerative license. His first “Harko” brand sets were manufactured by Treco (Tri-City), a licensee firm. But the entrepreneur soon (early in 1923) purchased Cincinnati-based Precision Equipment Company, which also possessed an Armstrong license.

Because of licensing technicalities Crosley had to maintain the Precision radio trade name (“Ace”) in addition to his own. However, by 1924, the Crosley and Precision firms were merged and Crosley was able to drop the “Ace” trademark.

Merger accomplished, the new firm soon branched out of the one-tube niche with the Crosley 51—which boasted a stage of audio amplification in addition to the regenerative detector. This was probably developed to compete with the similarly configured RCA Radiola 111, which was just coming out.

Because of the popularity of the 51, other sets were added to the line—including the one-tube Crosley 50 and the 3-tube 52. There were also add-on amplifiers for making a 50 or 51 into the equivalent of the 52. Also in the new line was the Trirdyn, a 3-tube receiver which used reflexed circuitry to approximate the performance of a 5-tube set.

1924 was a peak sales year for Crosley, enabling the firm to purchase a large interest in DeForest/Canada. And late the following year, Crosley bought the assets of the distressed Amrad Company, including the trademark, manufacturing plant and Neutrodyne license.

1926 saw the first model of what was to become a successful line of refrigerators. In 1927, the firm began an association with De Forest Radio which—though financially troubled—had a substantial portfolio of patents and a profitable tube manufacturing business. Crosley’s interest in this firm was apparently in giving him the leverage needed to secure the favorable patent license agreement with RCA signed the same year.

In 1928, the firm enjoyed record sales and profits with a line of single-dial metal-cabinet table models patterned after Atwater Kent’s. Like the AK firm, Crosley then geared up for high-priced console production just in time for the Crash. Though ringing up four years of deficits, the firm did survive the Depression and was sold to Avco in 1945. The appliance, radio and TV lines were discontinued in 1956.
The Antique Wireless Association is an organization of about 2000 international members linked by a common interest in the history of electrical and electronic communications. AWA members come from all walks of life and our ranks include teenagers, octogenarians, and beyond in both directions. At one of our meets, you might find yourself shaking hands with a retired broadcast executive or military electronics specialist, an engineer in a high-tech electronics firm, or an eager young person looking for advice on restoring his or her first radio.

The organization was started in 1952 by Bruce Kelley, George Batterson, and Linc Cundall—amateur radio operators and radio collectors from upstate New York. Their initial goal was to establish a museum where they could collect and preserve early wireless and radio equipment and historical information before it was lost to future generations. Decades later, their legacy continues to motivate our members.

Some of us are most interested in the technical background behind the epoch-making discoveries that now make it as easy to communicate across the globe as around the corner. Others enjoy the romance surrounding the men and institutions that put these discoveries to work: the maritime radio operators who averted disasters with their alert ears and quick thinking; the short-wave stations that radiated glimpses of exotic cultures and mindsets; the giant radio networks that delivered unparalleled entertainment and timely news to our homes while hawking toothpaste, cigarettes and soap flakes.

Though AWA members share this common interest, which many can trace back to early childhood, they express it in different ways. Some of us collect radio-related literature and manuals. Others collect and restore hardware: Morse keys and sounders, battery radios of the 1920s, telephones, advertising signs, cathedral and console radios—you name it! Collections can become very specialized, restricted to such things as radio components crafted of shiny Bakelite and gleaming brass or perhaps the fragile and intricate vacuum tubes that made the communications miracles possible.

Among our members are meticulous craftsmen who enjoy replicating vintage receivers and/or transmitters. Those who are licensed amateurs frequently operate such equipment in special communications events sponsored by the AWA.

In addition to the commitment to the preservation of historical artifacts and background materials at the Museum, AWA also publishes The AWA Journal and The AWA Review. The Journal is a quarterly publication that gives our multi-talented members an outlet to share their historical research, equipment restorations, troubleshooting and servicing tips and other information of common interest. The AWA Review, which also publishes member contributions, contains more extensive and scholarly papers. It is published once a year.

The AWA Gateway is the latest addition to the AWA family of publications. It’s delivered electronically and free of charge—downloadable from our web site www.antiquewireless.org.

Our content is targeted at those who may not be familiar with the AWA and who perhaps are just becoming interested in the history, collecting or restoration of vintage communications gear. For that reason, our technical articles are more basic than those in our other publications and our articles about AWA generally do not assume knowledge that that only those familiar with our organization might have.

The AWA also sponsors a four day annual convention in August featuring technical presentations and forums, a large auction, an awards banquet, an equipment and artifact competition, a book sale, and an active flea market. The convention affords attendees plenty of time to renew and make friendships, time to engage in long conversations on collection, preservation and all other aspects of the hobby.

The AWA is chartered as a non-profit organization in New York State, an IRS 501(c)(3) tax-exempt corporation, and is a member of the American Association of Museums. To learn more about AWA or to join our organization, visit the AWA website at www.antiquewireless.org.

DONATING ARTIFACTS TO THE AWA

You may have artifacts that you are interested in donating to the AWA. We would be pleased to discuss any possible donation. Please call us at (585) 257-5119.