

Collecting Radio Peripherals Part 6 - Parts and Test Instruments

This is the last installment of a six-part series in which we've tried to give you an (admittedly brief) orientation to the many kinds of radio-related items that can add color and interest to your collection of radio receiving sets. The first five installments covered Service Literature (two parts), Books and Periodicals, and Vacuum Tubes and Accessories. Now we'll wrap up the series with some coverage of radio parts and radio test equipment.

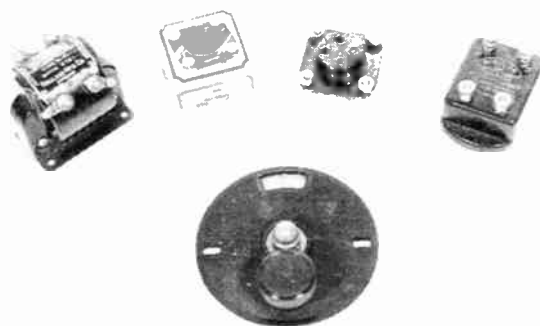
Parts of the Battery Era

Radio collectors and restorers accumulate vintage parts for two distinct reasons: (1) to use for repairing vintage receivers in their collections or (2) to collect for their intrinsic historical and/or visual interest. As a special case of (2), some folks like to use their vintage parts to build faithful replicas of vintage radios.

As luck would have it, a collector can accumulate parts for both reasons without too often being forced to agonize about whether a choice displayable part should be "wasted" on a radio repair. Generally speaking, the parts one might want to display are not often needed to make repairs. Here's why.

Collectible parts are generally associated with the battery sets of the 1920's. Back then, the parts count in most sets was relatively small and (with some notable exceptions) the parts themselves tended to be both simple in construction and very well built. Failures (with the exception of audio transformer burn-out) are rare.

Considering how quickly receivers became obsolete during this era of



Grouping of 1920's parts. Top: audio and r.f. transformers (at l. and r.), tube socket with box. Bottom: vernier dial.

explosive technological development (the radio market then must have been similar to the computer market of the mid 1980's thru mid 1990's) it's ironic just how well-made some of these parts were. The radio sets of the era were built more like pieces of laboratory equipment than consumer appliances.

In addition to the large market for complete receivers, there was a very big demand for parts with which to construct or improve home-built radios. The result: radio parts were attractively packaged and designed as well as actively marketed. As a fair analogy, think about how high-performance automotive parts are marketed today.

Because they are so well-made and attractive, and also so large by later standards, the parts of this era make great display items. Among the pieces you may find of interest are knobs, dials, tuning capacitors, audio- and radio-frequency transformers, tube sockets, rheostats, resistors, and plugs and jacks. Done in gleaming bakelite

and polished metal; wound with silk- or cotton-covered wire; beautifully finished with enamel or crackle paint; these components can be a joy to behold!

Besides the parts used for basic receiver construction, those sold to improve performance or enhance operating convenience are worthy of special mention. They include vernier drives, "high fidelity" audio transformers, antenna substitutes, variable grid leaks, self-adjusting filament rheostats and multiple-headphone adapters.

Parts Become Deglamourized

During the 1930's, as radio circuitry became more sophisticated, radio components also began to change. The new circuits required more parts, manufactured to higher electrical standards. Yet if the improved radios were to be marketable--particularly during those depression years--prices had to be kept down.

Engineers found ways to downsize resistors, capacitors, transformers and coils while actually improving their performance. But the fancy housings and paint jobs went out the window. It made no sense to spend money on the appearance of a part that would be hidden under a chassis.

In any case, the public at large was losing its fascination with the mechanics of radio reception. Though radio was becoming an essential part of American life, the set itself was being taken for granted much like any other electrical appliance. The "nuts and bolts" were kept discreetly concealed within a stylish cabinet. (over)

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Though there were still plenty of amateur set builders, their numbers had declined. Radios had not only become more complicated; they had been engineered to the point where it was cheaper to buy a good-performing set than to build one. Radio parts and equipment stores now were catering more to service technicians and hard-core hobbyists than to the general public.



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20's transformer ad suggests that buying parts during this era could be an ego trip.

So the parts of this era tended to be generic, marketed in a low-key manner and purchased dispassionately to do a job. Most of the glamour had gone out of such items, and though collectors accumulate them today, it is with the intent of using the parts to make repairs—which, of course, are required much more frequently in a.c. receivers with their more complicated circuitry and higher operating voltages.

Test Equipment

If there ever was a category of collectibles requiring the collector to keep his head on straight, it's test equipment. Vintage test equipment of the twenties and thirties frequently shows up in radio swap meets, sometimes at attractive prices. A lot of it is quite charming and/or intriguing to look at: the twenties gear has that lab equipment look; the thirties equipment is a little more "designy" and radiates a strong feeling of nostalgia all its own.

If you are buying test equipment for display purposes only, that's fine. Buy on the basis of your personal taste and the physical condition of the instruments. Not everybody is into this area, so there are some good deals to be had.

But most test equipment cries out to be used, and if you are thinking of purchasing an instrument because you think it might be neat to give it some space on your

repair bench, watch out! Before you become seduced with the idea of twiddling all those interesting dials, know that—no matter how good it looks—the unit might not be reliable.

Its design might be primitive and flawed and, even if not, fifty to seventy years of aging (under conditions that might have been less than ideal) can play hob with calibration. Be sure you have some way to check your prized old instrument before relying it for serious repair work. Compare it with a modern equivalent of known accuracy (borrowed, if necessary). If the unit doesn't check out, recalibrate if you know how (it helps if you have the original manual) or relegate it to the display shelf.

Generally speaking, the technicians of the twenties, thirties and forties used the same types of test equipment, though the instrument designs changed and improved over the years. You'll run into multimeters, tube testers, and audio and r.f. test oscillators from all these eras. Beginning with the late 1930's, you'll also find oscilloscopes designed for the radio service trade.

One type of instrument that is unique to its era is the set tester, which saw wide use during the 1930's, give or take a few years. The set tester provided the means to check the operating voltages on vacuum tubes without removing the chassis from the cabinet.

The instrument was equipped with a multi-lead test cable terminating in a special plug. This plug was inserted into the correct adapter to fit the tube socket in question; the tube was removed; the adapter was plugged into the vacated tube socket and the tube was plugged into a special socket that was either built into the adapter or located on the instrument's front panel.

Now the operating voltages could be read from the instrument's built-in metering system. In most cases, the set tester could also be used as a conventional multimeter by plugging test prods into jacks provided for that purpose.

The special advantage of this instrument was that it could be used to acquire a lot of diagnostic information without removing the chassis from the cabinet. This was a boon to technicians making house calls on the massive consoles of the 1930's and early 1940's.

One instance in which it might be helpful to use an old instrument (if you can trust it) is in the comparison of measured set voltages to the "correct" figures given in service literature voltage charts. The reason: older instruments tended to have less sensitivity (a lower "ohms-per-volt" rating) and thus tended to load down the

(continued on p. 9)

COMMENTS FROM THE EDITOR

Readers. . . your many letters and contributions have once again made it possible to publish a chock-full 10-page issue. Thanks—and keep writing! MFE

PLAY IT AGAIN!

A No-Nonsense Course in Radio History, Evolution and Repair

REGENERATION AND AUDIO AMPLIFICATION

Until 1920, radio, like the telephone and telegraph, was used for transmitting messages point-to-point. The idea of putting out a signal for anyone who might be listening (broadcasting) was ridiculous except to a few experimenters who broadcast voice and music to ships. No one seriously thought that such activity would have any commercial value.

One broadcasting experimenter was Frank Conrad, a Westinghouse engineer in Pittsburgh who built a station (8XK) at his home and sent out programs several times a week. He developed a growing circle of fans who listened on homemade receivers. One Pittsburgh department store even advertised receiving sets for listening to Conrad's station.

The Broadcasting Craze

The Westinghouse management took note and asked Conrad to build a station at the Pittsburgh plant. Licensed as KDKA, operation began on November 2, 1920. Conrad also had designed a receiver which was put into production a few weeks later and offered for public sale as the Westinghouse RC.

A wave of excitement swept the nation in 1921-22 when the public realized there was entertainment in the air. Stations began to appear all over the country, and people stayed up all night to listen. The demand for radios was incredible; dealers could not keep sets and parts in stock. Sales of factory-built receivers went from 100,000 in 1922 to 1.5 million in 1924.

At first, all stations transmitted entertainment on 833 kHz and weather and market reports on 619 kHz. In 1922, a third frequency of 750 kHz was also permitted. With only 3 frequencies to tune, a crystal set was quite satisfactory for local reception. The most popular tube set for distant stations was the regenerative receiver.

The Regenerative Circuit

The regenerative detector was invented by E. H. Armstrong in 1912. He licensed 20 small companies to use the circuit before selling the rights to Westinghouse in 1920. Then rights then became part of the RCA patent pool. The Westinghouse RC mentioned above was regenerative. All the early Crosley sets, now so popular with collectors were also regenerative. RCA used the circuit on its low and moderate priced radios until about 1927, but most makers abandoned it around 1924 because improperly adjusted

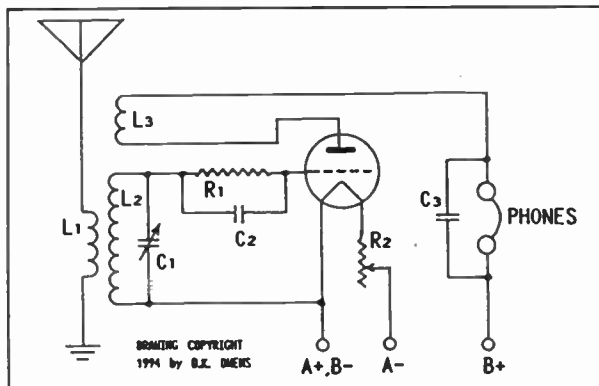


Fig. 1 Regenerative detector circuit

regenerative sets radiated interference to other sets nearby.

Figure 1 shows a regenerative detector. It is a grid leak detector (see last month's column) with one additional element - L3. L3 (called a "tickler" coil) feeds some of the radio frequency in the plate circuit of the tube back into the grid via coil L2. The connections are such that the feedback is in phase, which would normally result in oscillation. By making the coupling ("electrical distance") between the coils adjustable, the energy fed back can be kept just below the point of uncontrolled oscillation. The signal goes "round and round" many times, being amplified with each pass.

Passing through same the tuned grid circuit many times is the same as going through many tuned circuits. The result is a sharply selective set with great sensitivity. The regenerative circuit was popular in home made shortwave receivers of the 1930's because it got so much performance from one tube.

Coupling between coils was usually

controlled mechanically by changing the spacing or orientation of the coils with respect to each other. High-quality sets varied the inductance of the tickler coil with switch-selected taps. Regeneration control could be smooth and precise on expensive sets like the Westinghouse RC or tricky on the cheap Crosley sets with their sloppy mechanical arrangement.

Audio Amplification

Although the regenerative detector was used as a stand-alone receiver, it was most often followed by 1 or 2 stages of transformer-coupled audio amplification using the circuit of Fig. 2. The amplifiers were usually part of the receiver, but some manufacturers offered them as separate options.

The primary of T1 in Fig. 2 is connected in place of the phones in Fig. 1. Most audio-frequency transformers had a turns ratio of 1:3 (the secondary had three times as many turns as the primary). This made the voltage across the secondary three times the voltage across the primary.

The popular 201A tube had a voltage gain of 8. Total voltage gain is the product of the individual gains. From the input of T1 to the plate of V2 (assuming 201A's at V1 and V2), the total voltage gain is $3 \times 8 \times 3 \times 8 = 576$. A phone jack at the plate of the detector tube (in this case, the regenerative tube of Fig. 1) and at the plate of each amplifier tube (V1 and V2) was usually provided.

The headphones were plugged into whichever jack gave lowest satisfactory volume, and the following tubes were turned off to conserve the batteries. The signal at V2's jack was usually strong enough to drive a horn speaker—at least on the stronger stations.

Note that the grids of the amplifier tubes are returned to A- to give them a negative bias and the detector grid is returned to A+ to give it a positive bias.

Next time we will discuss radio frequency amplifiers.

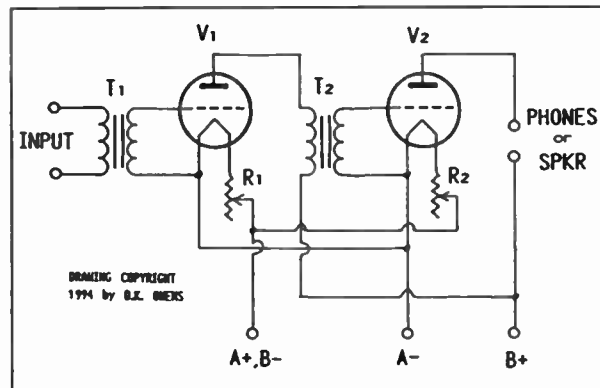


Fig. 2 Two stages of audio amplification

Conducted by Ken Owens
478 Sycamore Dr.
Circleville, OH 45113

Ken will be happy to correspond directly with readers who have questions about radio theory or repair. Please include a long SASE with your query. This correspondence will also be printed in R.C.'s "Information Exchange" column so that all readers can benefit from it.

COLLECTING POST-WAR TUBE SETS

Old timers may scoff, but this baby boomer finds plenty to enjoy about broadcast sets from the 1945-1960 period!

By Terry Schwartz

My first old radio was a post-war Zenith. I got it from an older co-worker who found it in the basement of some rental property he owned. Left there long ago by a forgotten tenant, it sat for years collecting dust and tarnish on its brass trim. When it came to me, the line cord was brittle and cracked, but still in one piece. Inside, it smelled musty and dank, with that familiar electrolyte odor you find in every old piece of tube gear. Through the dust and grime, I could see the underlying beauty of its wood cabinet and its black quarter-moon dial. This simple set was the one that started my love affair with old radios.

The Lure of Postwar Sets

Now I may take some heat from you purists out there, but I've never been obsessed with finding radios from the "golden age" (that is, the pre WWII era). My collection is all over the map from the 20's through the 60's. But by far the largest share of it is post-war (many from 1946). I suspect that there was a large pent-up demand then, due to war-time shortages, and a resulting production boom, mostly consisting of variations on the venerable "all American Five."

I'm not ashamed in the least of collecting these later sets. Don't get me wrong. I treasure my assortment of cathedrals, tombstones and TRF's. It's just that there is a special place in my heart (and therefore in my collection) for post-war "baby-boom" era radios. And let's admit it, these are a lot easier to find, collect, display and fix.

What is it, you may ask, about these units that fascinates me? Well, it's not really any one thing. I am intrigued by the subtle variations in circuit design, and the evolution over the years in the tube complement. The reduction in size of the i.f. cans, the mass-production oriented construction techniques. But perhaps most of all, what I find interesting is the wide range of cabinet designs.

Styling to Match the Times

Some manufacturers must have employed creative, inspired designers, while others stuck to functional, utilitarian construction. Many sets reflect the style and spirit of the times. The fierce patriotism of the late forties shows through in the square-shouldered cabinets of the table radios. The highly-styled



Sextet of Terry's postwar charmers includes sets by (top row, from left) Ward's, G.E. and Zenith; (bottom row, from left) RCA Victor, G.E. and Coronado.

examples of the early to mid fifties, with their big chrome grills and knobs, splashy colors and sculpted contour lines, often echo the automotive designs of that era.

This time period also saw the popularization of the clock radio, giving designers the clock face to balance against the radio dial. From the middle to late fifties up to the early 1960's, cabinet designs reflected the technological revolution then taking place, featuring squarer, sleeker cleaner lines. Inside the sets, one can see innovations such as printed circuit construction.

The Nostalgia Factor

Technical and styling issues aside, there is another reason I like these post-war radios. Being in my mid-thirties, I'm among the last of the baby-boomers. These

Terry Schwartz has been interested in electricity and electronics for as long as he can remember. As a boy, he repaired everything from toasters to TV sets for friends and neighbors. Later, while attending electronics school and working part-time in a TV repair shop, he began acquiring old radios. The collection now numbers about 45 sets.

Terry is a senior engineering technician with a Minneapolis-based fortune 500 company, and is involved in designing embedded controllers and sensor systems for robots. He enjoys the contrast between his high-tech job and the simpler technology of radio repair. "When I get home, I like to downshift a couple of notches and work on something a little less complicated than my normal work."

While he takes an occasional college course with the goal of obtaining an engineering degree, Terry would really rather own an electronic repair shop. "If it would only pay as well!"

are the radios I remember from my earliest years--the ones my parents couldn't wait to get rid of when the transistorized versions came along. Many were placed in the basement or attic when a tube or capacitor failed.

They simply weren't worth fixing then. Tubes were already becoming obsolete, and for a few dollars more then the cost of a repair you could buy a new radio. No tubes. No hassle. More reliable. All good things right?

All I can say is thank goodness a few of the old sets survived on their attic or basement storage shelves. These sets are artifacts from times most Americans remember fondly. I find the pre-war radios fascinating as well, but they don't cast the same spell for me. Though I have some trouble relating to the earlier era, I can and do appreciate the styling

and technology of those days. My father, on the other hand, strongly identifies with my pre-war radios (he is older than all of them), and can't even fathom my interest in the post-war units. Classic example of generation gap, I suppose.

Starting a Collection

So just what do you need to know about collecting post-war radios? What follows is what I have learned. I'm no expert, but I have seen more than a few of these sets!

1. Get the books. *Radios of the Baby Boom Era* is a fairly comprehensive set, comprising six books and published by Howard Sams Corp., publishers of Sams Photofacts. Included are photos, tube complements, the Photofact number and a brief description of most radios covered by a Photofact in the 1946-1960 period. While not all of the radios you will find will be listed, each volume has a cross reference that may help you find a similar set that is covered. No information on current pricing is given, but just paging through these volumes is fascinating. For pricing information, use the Collector's Guide to Antique Radios, 3rd Edition, by Marty and Sue Bunis. These volumes are priced at \$16.95 per volume for the Sams set (\$91.80 total) and \$18.95 for the Bunis book. (Price Source: Antique Electronic Supply, 6221 S, Maple Ave., Tempe, AZ 85283; possibly also available from local bookstores in your area.)

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INFORMATION EXCHANGE

This is an open forum for interaction among our readers. Here you can ask questions about some aspect of our hobby, answer a question that's been posed or pass along other information of general interest. Send your questions, answers and information to The Radio Collector, P.O. Box 1306, Evanston, IL 60204-1306. Submissions may be edited or paraphrased.

QUESTIONS TO BE ANSWERED

Sensitivity Query

Why do some of my old a.m. radios seem to lose volume and sensitivity at the higher end of the standard a.m. band?--Bill Miedema, Tower lakes, IL

ANSWERS TO QUESTIONS

Better Wrinkle Paint Effects

In answer to Marvin Stacy's question in last month's column, the wrinkle effect can often be enhanced by applying heat during the drying period. A heat lamp or high wattage light bulb works fine. If the painted piece is put into a box along with the heat source--so that the heat is more evenly distributed around the object--results will be better. This technique worked fine with the wrinkle paints of a few years ago; I'm not sure about the more modern versions. Be careful if you use the box idea. There's danger of fire.--Paul Bourbin, San Francisco, CA.

I have found two reasons for failure of paint to wrinkle. One is not applying a heavy enough coat; the other is too low a temperature. I get the best effect by painting outdoors in summertime when the temperature is around 90 degrees. I get more uniform results by painting in two coats applied about 15 minutes apart.--Ken Owens, Circleville, OH

Regarding the question on wrinkle paint: most likely the paint wasn't thick enough. It's difficult to spray enough on without developing runs and snags. As the thickness decreases, the wrinkles get finer and finer until the surface doesn't wrinkle at all. The paint may also have been allowed to dry too slowly.--Alan S. Douglas, Pocasset, MA.

Chartless Tube Checker

Responding to S. Weller's question concerning the feasibility of using tube checkers with missing charts, I wrote an article in *Antique Radio Classified* a few years ago on how to do just that. A note to ARC should get the correct back issue. Also an ad in ARC might yield copies of the charts for your model. Some of the test equipment companies, if still in business, will send the information for a reasonable charge. Hickock is one of them.--Paul Bourbin, San Francisco, CA.

Write ARC (Antique Radio Classified) at P.O. Box 2, Carlisle, MA 01741. You might also try advertising in the admirable publication you are now reading! However it would be prudent not to buy a tube tester until you find one that comes

with a complete set of documentation. There are usually several units to choose from at most any radio flea market.--Ed.

GENERAL

That Bakelite Issue

My remark about using household cleaners on Bakelite was misunderstood. What I said was that Bakelite is affected by alkaline substances. While some household cleaners are pH-balanced, others (like Windex with ammonia and, I believe, the Fantastik/Formula 409 types) are not. Why take the chance? When in doubt, check the cleaner with litmus paper or other test, or one can call the manufacturer's consumer information number and ask (often the number is on the product label). Ed Lyon wrote an excellent series on plastics in the *Mid-Atlantic Antique Radio Society* newsletter. It answers many questions and dispels many of the myths concerning plastics used in radios.--Paul Bourbin, San Francisco, CA

The Mid-Atlantic Antique Radio Club can be contacted at P.O. Box 1362, Washington Grove, MD 20880--Ed.

I covered this subject in my article in the *Old-timer's Bulletin* of May, 1993, which Marc Ellis used as the basis for his *Popular Electronics* column of September, 1993. Having retired from nearly 30 years of working with plastics for DuPont I can assure Paul Bourbin and Dick Mackiewicz that Bakelite is virtually indestructible. Short of boiling it in lye or battery acid, no household cleaner is going to harm it. If the surface is already extensively degraded, cleaning may remove the degraded layer, making it look as if the cleaning compound did the damage.--Ken Owens, Circleville, OH.

I believe that Dick Mackiewicz is correct in stating that washing Bakelite with normal household detergents is not harmful. But that only applies to Bakelite. A plastic item is not made of Bakelite just because it is black. Just to name a few of the other possible compositions: *hard fibre, asphalt composition, celluloid, hard rubber*. Several of these were on the market up to 1930 or later, and most of them had undesirable attributes. The much superior Bakelite was developed (accidentally) around 1910, about the same time Edison formulated Condensite (Blue Amberol) for cylinder phonograph records. Condensite was very similar to Bakelite, and Edison sold his patent to Bakelite to avoid legal entanglement.

All of these plastic products were com-

posed of the "binder" material (of which Bakelite is an example) and a larger volume of "filler." The filler material varied widely from the relatively coarse and hygroscopic wood fiber to non-hygroscopic materials such as mica particles. The less hygroscopic materials made the most stable product.

In order to qualify for the "Genuine Bakelite" label, producers using this filler had to meet standards set by the manufacturer.

Panels made of these plastic materials were finished by a process called *calendar*. That is, they were passed through rollers (generally heated) operating at a different surface speed than the materials themselves were traveling.

The finish on products *molded* from these materials was a result of great pressure, heat and the "release" compounds used. Molds with complicated structures are made by the most unique craftsmen-sculptors in every sense of the word.

I was employed for a time by Molded Insulation company of Philadelphia, now the VIZ Corporation (named in honor of Victor I. Zelloff, the founder).--C. Orval Parker, Pocono Summit, PA.

I guess the bottom line is this: If you're not sure that a plastic item is Bakelite, it would be prudent to clean it only with a pH-balanced formulation--Ed.

Kadette, Jr.

Adding to the comments made last month on the Kadette, Jr., this radio was totally unique, not just cheap. It was built entirely on the speaker frame. The two-section tuning condenser had what is now called the "butterfly" configuration, with solid insulation between the plates; it had only a 90-degree turning range. The volume control was flat/linear and operated by a thumb knob. The filter and bypass capacitors were in two blocks and constitute the major elements of the four different versions. I once had to make three trips to the parts store to get the correct block to repair one of these sets.--C. Orval Parker, Pocono Summit, PA

Oops Department!

In last month's Information Exchange, I garbled Ken Owens ("Servicing tips") information on isolation transformers. It should have read: . . . suitable transformers of 100 VA rating are available from Fair Radio Sales, P.O. Box 1105, Lima, OH 45802 (Cat. No. 97313) or Hosfelt Electronics, 2700 Sunset Blvd., Steubenville, OH 43952 (Cat. No. 56-276 or 56-246) for less than \$15.---Ed.

CORRESPONDENCE FROM OUR READERS

Letters may be paraphrased, shortened, or otherwise edited so that everyone gets a chance at the floor!

Foxhole Feedback

Julian Jablin's foxhole radio article in last month's R.C. really took me back. I think the circuit first appeared in *Popular Science* during World War II. I doubt that the GI's built them, but I did. The secret was the Gillette "Blue Blade." Apparently the blue coating was a semiconductor because nothing else would work. Mine worked well enough, but was not as sensitive as a Galena detector. A piece of blued steel spring like a clock spring might work in place of the extinct "Blue Blade."—Ken Owens, Circleville, OH

The first I heard of foxhole radios was in a book by Jack Gould in the early 50's, titled something like "All About Radio and Television." I can't lay my hands on it just now, but I recall that the sets were said to have originated in Italy after the Allied invasion. Gould was, according to the book jacket, the radio editor of the *New York Times*, so he probably wrote more on the subject in his paper. The term "foxhole radio" may have originated with Gould, not from the GI's themselves.—Alan Douglas, Pocasset, MA.

Here is a bit more on foxhole radios. The army-supplied morale receivers were only useful to the troops when they could remain in one place and gather together. Those who were spread out and consistently on the move could not benefit from them, and so might have been tempted to build the "foxhole" sets.

From the information I have gathered, the coils were usually wound continuously, with no taps, from lengths of field telephone wire. A safety-pin "contact" would be inserted through the insulation at the coil turn that provided the best reception. R-14 military headphones were readily available to most troops and had the requisite 2,000-ohms impedance.

"Blue" blades are the only blades I have ever heard of that worked well. I think these were made from carborundum steel. Carborundum crystals do work well as a detector, especially with a volt or two of bias.

Typically, a permanent contact was made to the center of the blade (blue coating scraped away) and an "adjustable" contact—made with a pencil lead—was located at the junction of the ground edge and the blue coating. The resulting assembly might have functioned as either a normal carborundum detector or as a Perikon detector (principle is based on contact between dissimilar materials).—Dick Mackiewicz, Coventry, CT

Dick is graciously sending Foxhole Radio author Julian Jablin a couple of "N.I.B."

blue blades for experimental purposes. So I expect that Julian will be contacting us soon with a "Son of Foxhole Radio" article.

Our final letter comes from an ex GI who also wrote the two repair articles that appeared in the September and October R.C. At one point during the war, Steve had time and access to parts—but not access to a morale set. The result? Well. . . read on!—Ed.

The Ultimate G.I.-Built Morale Set!

While stationed at Dinjan Airfield in India (1944-1945), my buddies and I needed a "morale set." There were BC348 and SCR274N units on the base, but they were locked in the repair shop along with our carbines. I solved the problem by building a 5-tube superhet.

On furlough in Calcutta, I was able to purchase a schematic for a British "Phillips" broadcast-band radio along with the i.f. transformer, tuning capacitor and coils. Lacking a power transformer, I dismantled and rewound a discarded one from a junk pile. Resistors, capacitors and other small parts came from our shop.

The completed set was installed in a homemade cabinet, and we used it to listen to the nearby Armed forces Radio station.

When transferred to Burma in September, 1945, I left the set with my three tent mates. I don't know what happened to it, but could it be that some young Indian took it home and is still using it?—Steve Kalista, Sr., Jim Thorpe, PA



Detail from Steve's snapshot of his G.I. tent radio. It wasn't fancy, but it sure outperformed a blue blade and pencil lead!

Alan's Fluke

Like Alan Douglas (see last month's "Correspondence"), I also use a Fluke DVM and wouldn't part with it. However, for the beginner who is going to buy one meter, I recommend the analog VTVM for its ability to see peaks when aligning receivers. Peaking is difficult on a DVM.

Alan's Fluke must be tougher than mine. Mine did not survive 600 volts a.c. applied to it while it was in the "ohms" mode. (It happens to the best of us!). The factory put it back in shape for me and calibrated it at half the cost of a new one.—Ken Owens, Circleville, OH

No, Alan is not deserting the antique radio fold but, immersed in high-tech day after day as he is, it is very pardonable that some of it should follow him home. . . .—C. Orval Parker, Pocono Summit, Pa.

Florida "Must-See"

Cypress Gardens in Winter Haven, Florida has a wonderful collection of antique radios and radio memorabilia dating from the 1920's through the 1950's. I spent about three hours just looking at the sets and enjoyed every minute of it!—Marvin Stacy, Deltona, FL.



Permanent radio exhibit at Cypress Gardens displays 75-100 sets, vintage microphones and other radio memorabilia.

The Readers Talk Back

Am writing this on the fly. . . I have been collecting radios for four years and now have over 300. What I need is basic repair information designed for a dummy (me). Every time I read an article, the writer assumes that the reader has as much knowledge as themselves.

Here are some questions of the kind I'd like to see answered:

- How do you tell if a capacitor is bad—can you check with a VTVM?
- Can a 3-wire resistor cord be replaced with a 2-wire cord?
- How do you replace an old-type (dynamic) speaker with a p.m. unit?

I am not really interested in theory, theory and more theory. I do repair most of my radios, but it's all done by the seat of my pants and many shocks to my body.

One special note. Recently I bought a few Catalin radios at fairly decent prices (\$145.00 to \$450.00). I will not buy any

(continued on p. 8)

VINTAGE BOOK REVIEWS

Books from the era when vintage radios were new! Look for them at swap meets, flea markets and used book stores.

MALLORY RADIO SERVICE ENCYCLOPEDIA, Published by P.R. Mallory & Co., Inc., Indianapolis, IN. Sixth Edition, April 1948. 552 pages. Softbound.

This one of the most useful references available to the collector/restorer of a.c.-operated and auto radios. It contains an incredible amount of valuable information in clear, easy-to-use form.

The first section is a brief introduction, followed by an explanation of how to use the book as a service aid. Though intended for the service technicians of the era, it might just as well have been written for the collectors of today.

The bulk of the book consists of a listing of thousands of sets by make and model. Following the listings are columns of information providing data on controls, condensers and vibrators that may be used in the set, as well as miscellaneous data. The "miscellaneous" section is probably the most useful to collectors; it provides the number of tubes, the complete tube complement, the i.f. peak and, if the set is listed in Rider's manual, the volume and page in which it can be found.

The book concludes with three appendices of notes and circuits that are referenced by the various listings in the body of the book.

The restorer will find this volume useful in many ways. It provides part numbers and values that might be obliterated on original components; the reference schematics of capacitor and control circuits can be used to uncover improper modifications; the tube count and tube complement information can be used to identify sets with missing model numbers.

Perhaps best of all, the encyclopedia serves as a handy index to the Rider's manuals. Original Rider's indexes are hard to find and often cover only a few volumes, but this edition of the Mallory book references all Rider's from Volume 1 through Volume 16.

The volume also includes many sets not covered in Rider's, and its clear layout shows at a glance which sets they are -- useful information for the radio researcher. The data that is provided about these radios will keep you from flying completely blind if no other documentation is available.

Not all of the earliest a.c. sets are mentioned and occasionally one can find a later one that has been skipped, but omissions are few. This book contains one of the most comprehensive listings available. The accuracy of the information presented seems quite good. While I have not checked all the listings, I have not found an error in the years I've used this encyclopedia.

When shopping the flea markets for the Mallory Encyclopedia, pay special attention to the editions you may find offered. The later the edition, the more sets will be included--and the earlier editions did not include the Rider's reference. A transformer listing was provided instead. (*Rider's listings first appeared in the Third Edition, published in 1939 -- Ed.*)

It can be difficult to find a copy of this book in good condition. It is softbound and most copies that turn up have seen heavy use. But the *Mallory Radio Service Encyclopedia* is worth searching for. I consider it a "must have" for everyone in the hobby.

Conducted by Paul Joseph Bourbin
Copyright 1994 by Paul Joseph Bourbin

COMPANY CHRONICLES

Brief Biographies of Classic Radio Manufacturers

AMRAD

Amrad's roots go back to before World War I, when the American Radio and Research Corporation was put together by the banking house of J.P. Morgan. The farsighted Morgan, creator of U.S. Steel and General Electric, had obviously divined the money-making possibilities in the fledgling radio industry. However, "J.P." died in 1913, leaving the direction of the empire to his son and namesake "Jack."

Jack, who lacked his father's drive and business acumen, entrusted the direction of Amrad to Harold J. Power, a wireless operator on the Morgan yacht and recent graduate of Tufts College (Medford, MA). Powers' business experience was nil, but he had been a wireless operator and radio amateur for several years.

Not surprisingly, Amrad became a primarily a research company--conducting experiments in areas such as radio broadcasting. However, the arrival of World War I galvanized the firm into action, and it expanded to produce field radios for the Army Signal corps and marine sets for the Navy.

At war's end, the military contracts dried up, but the company kept going making non-radio items and was eventually able to obtain some lucrative peacetime business from the armed services. Amrad management had little interest in private-sector marketing,

turning down--in 1920--an opportunity to purchase a half-interest in Armstrong's regenerative patent for \$500.00!

But that same year, as the public's obsession with radio broadcasting became obvious, Amrad entered the arena. Its first offering to the listening public, a modular radio receiving system originally designed for radio amateur work and requiring the interconnection of six or more units, met with a luke-warm reception. By fall of 1921, Amrad had designed a more user-friendly two-unit (tuner plus detector-amplifier) receiver, but the management-top-heavy firm was slow to get the new set into full production and missed the lucrative Christmas radio marketing opportunities of that year. By 1922, Amrad was in the hole, and executive dismissals began early in the following year.

The firm's continuing marketing attempts followed the previously-established pattern. Its modular set designs did not win radio listeners' hearts and, in any case, always seemed to hit the market a little to late to capitalize on key seasonal selling opportunities.

When Amrad went into receivership in 1925, its assets were purchased by Powel Crosley--who was primarily interested in obtaining the troubled firm's Neutrodyne license. A line of Crosley-produced Amrad Neutrodynes was soon on the market, and the firm probably would have survived had it not been for the stock market crash and Great Depression. As it was, Crosley closed down the Amrad operation in 1930.

The information for this company biography was obtained from Alan Douglas' three-volume encyclopedia "Radio Manufacturers of the 1920's," published by Sonoran Publishing, 116 N. Roosevelt, Suite 121, Chandler, AZ 85226.

CORRESPONDENCE
(continued from p. 6)

more due to the fact that they just ain't worth it. When non-collectors see my display, they like the old cathedrals and tombstones (purchased at prices between twenty and eighty dollars). I think the Catalin market is false, and will some day really bomb out. The old wooden radios are still the most admired by the general public. In the end, that is the group that sets the prices.

Some day, I will write the story of how I got started collecting. It would be interesting to hear from other collectors on the same subject.--David Hofeld, Linwood, NJ.

Although I am not a collector, but a constructor of one- and two-tube regenerative receivers, my problem is similar to Mr. Rocazella's (see last month's "Correspondence" column). I need more basic radio information.

The *Play it Again* article by Ken Owens in last month's issue was helpful, although I am puzzled by the first paragraph under the heading "Grid Bias." There may be others in my category who might become regular subscribers if more basic information appeared in *The Radio Collector*.

Suggestions: (1) Provide a way for readers who have similar interests and live close to each other to get in contact. (2) How about some coverage on grounds and grounding arrangements?--P.V. Petrosino, Oceanside, CA.

Just wanted to let you know that I've enjoyed getting *The Radio Collector* this past year. I think you have a good balance of articles and that your approach is basic enough! It would be wise for anyone starting from scratch in this hobby to get a reference book or two.

I personally favor the construction or repair articles, Information Exchange and reader's correspondence features. Maybe you could expand these occasionally and leave out the book and manufacturer reviews.--Anthony Jacobi, Ralston, NE.

I think you need some basic articles, but for me the way you have it is great. Try adding a little more detail sometimes. Marvin Stacy, Deltona, FL.

Perhaps you could get people to write articles if you provided an incentive--like a 6-month subscription extension, coffee mug or T-shirt for those who submit publishable material.--Stan Lopes, Concord, CA

Thanks much to all the readers who took time to send comments. On the issue of "Is R.C. basic enough?," Ken Owens, author of our Play It Again column offers an excellent perspective. He stresses that a certain amount of theoretical knowledge is very helpful in getting the full benefit from even the most basic discussions of radio principles and restoration techniques. Since

it isn't always practical to present complete background theory along with every article, he suggests keeping a basic electronic text on hand for reference, recommending The Radio Amateur's Handbook, as reviewed by Julian Jablin in our last issue. Tony Jacobi makes the same point in his good letter

Regarding the three good questions proposed by reader Hofeld, each would make the subject of a very useful--as would the topic on grounding suggested by reader Petrosino. Anybody care to step forward with a contribution?

Stan Lopes' point that it might be a good idea to offer incentives for submission of publishable material is well-taken. I'm giving this some serious thought and will probably announce, in the next issue, a deal for full-length articles as well as "personal history" stories of the type proposed by David Hofeld.

Any such incentive will have to be a modest one; right now R.C. is something of a shoestring operation! But it would, at least provide the author with a tangible "thank you" for his efforts. And I do plan to give the "incentive" retroactively to those who have already had articles published in R.C.

The suggestion that we provide a way for readers with similar interests to get in touch with each other is another winner, and I'll soon be making an announcement about that also.--Ed.

Stewart Warner Site Cleared

Your April, 1994 issue carried a photo of the Stewart Warner plant (Chicago, IL) as it appeared under the wrecker's ball in March, 1994. Here's a shot of the site taken in September, 1994. It's one of a group sent to me by Leo Gibbs, W8BHT. The homes in the background are samples for the housing development to come.--Alan S. Douglas, Pocasset, MA.



Once occupied by the giant Stuart-Warner plant, this empty lot will soon be the site of a large condominium development.

Heroic AK "Save"

I recently acquired an Atwater Kent Model 20 that had been the home of a family of mice. The set had also been exposed to water and mud. Even the tuning capacitors were corroded and some of the tube sockets were rotted.

I considered scrapping the set, but

couldn't make myself do it. I ordered parts and, while I was waiting, dismantled all three tuning capacitors so that I could polish and wax the plates. The rotted rivets were replaced with round-head brass screws (heads filed flat). Bypass capacitors and audio transformers checked out ok.

When power-up time came, I couldn't pick up my r.f. generator on the set. The only things left to check were the r.f. coils--which proved to be covered with green copper corrosion under the discolored cotton insulation.

I wasn't able to locate cotton-covered wire in the correct size, so I rewound the coils with enamel wire in the same gauge. On powering up the set again, I was able to hear signals!

The beautiful mahogany case was refinished, and the front panel repainted with brown crackle enamel. Restoration time was three days (intermittent), and the result was well worth the work.--Alton A. DuBois, Jr., Queensbury, NY.

Headphones and Antennas

Your information on headphones in "Collecting Radio Peripherals" (11/94) was spot on! That flashlight cell is also great for checking old speakers and watch-case meters. You mentioned collecting old antenna kits and parts. In addition to headphones and meters, these antenna items are a major collecting interest of mine. I have several hundred insulators, lightning arresters, some N.I.B. kits, etc.

There is a new club called "Old Familiar Strains" (2940 S.E. 118th Ave., Portland, OR 97266-1602) dedicated just to this niche. Dan Howard is the president. Dues are presently set at \$10.00 per year. Send a SASE for info, or some small monetary contribution for the next bulletin.

By the way, add "cans" to the list of synonyms you gave for headphones. Some of the early receivers were actually the size and weight of a can of tuna fish. Maybe heavier!--Dick Mackiewicz, Coventry, CT.

Regarding the article on headphones, I remember writing to Alan Douglas that I had seen an item (from the 1920's) reporting that one model of Baldwin phones had a sensitivity of 1.5×10^{-10} watts. He wrote back that using phones of such sensitivity was the equivalent of adding one more stage of audio to the receiver. It would be nice if someone could devise a way of comparing sensitivities of the common antique headphone models.--Ray Larson, W. Los Angeles, CA.

Maybe Dick Mackiewicz could be persuaded to take on such a project. He already has a large headphone collection, and is accumulating more with the idea of writing a book on the subject. For one thing, it might be instructive to compare original specs, where available, with current specs on a selection of the same models--giving us some idea of how much sensitivity might have been lost with age through loss of magnet strength--Ed.

DICK'S CORNER

Tips and Tidbits from the World of Antique Radio Collecting and Restoring

Radio Mysteries

There were many mysteries in the plots of vintage radio programs such as *The Shadow* and *The Green Hornet*. The story lines of *The Radio Boys* novels also contained radio mysteries. But the mysteries I'd like to discuss here are those strange parts found at the bottom of that box of vintage electronics gear you bought at an auction or rescued from someone's attic.

Here are a couple that had me mystified for a while. The first is a round metal disc about six inches in diameter. It has green felt on the bottom and one Fahnestock clip on the edge of the upper surface. Its label proclaims it a "Remojoy Aerial" made by the Remo Corporation of Meriden, CT. I looked and looked and looked at this item. I knew it had probably been made in the 1920's, since I have a Remo trumpet speaker from that era, but I couldn't figure out how it was supposed to work. Was it a hoax foisted on the public during an age when almost any radio item would sell?

A few days later, that "bulb in the brain" finally flashed. The standard "candlestick" telephone of the time would fit perfectly over the Remojoy. If the antenna terminal of a radio were then connected to the Remojoy's Fahnestock clip, with a short piece of wire, the set's antenna circuit would be capacitively coupled to the phone lines and reception would be much improved.

The second mystery came in a brightly colored box labeled "howl arrestor." I opened it, thinking it might contain a new item for my lightning arrestor collection. But, to my dismay, all it contained was a small part shaped like a miniature skullcap and cast in some rough metal. A few days later, I remembered that one of my early Atwater kent sets had a nickel plated "cap" fitted over the top of one globe tube.

Aha! The "howl arrestor" had to be a similar device. Its weight would, perhaps, prevent a sensitive tube from vibrating and

creating microphonic sounds that might otherwise feed back through the radio's circuitry to cause a howl. The "skullcap" might also act as a radiation shield, preventing stray r.f. from feeding back into earlier stages and causing the same type of annoying noise.

If you've been baffled by one of these mysterious parts, please drop R.C. a note and share your experience with the other readers!

Cord Caution

Many collectors will spend countless hours restoring a set to near perfection, stripping it to the bare chassis so that each small part may be individually cleaned, shined or even replated. The cabinet will be completely and faithfully refinished, all knobs original, etc. But more often than not, the restoration is flawed by the failure of the collector to replace the (inevitably) worn-out line cord and plug with items of the correct vintage. Vinyl-covered cords with molded-on plugs simply don't belong on radios of the 20's, 30's and 40's.

Cloth-covered cord, as well as a.c. plugs in vintage styles, are still available at decorator lamp stores and some hardware establishments. Also, be sure to check the sets in your "junk" collection for salvageable cords and plugs.

And keep your eyes open at rummage or yard sales. You may spot old extension cords, lamps, or small appliances equipped with appropriate cords and plugs and available for a dollar or two. I once bought a box of three-dozen new black and white cloth-covered cord sets, probably intended for electric irons, for \$3.00. These look really good on late 1920's metal-cased table sets.

Don't spoil an otherwise flawless restoration by installing an inappropriate line cord!

Conducted by Dick Mackiewicz

POST-WAR TUBE SETS

(continued from p. 4)

2. **What goes wrong?** For the most part, these radios are rather robust. The quality of paper capacitors (a prime cause of failure in earlier sets) had greatly improved by the time the "baby boomer" receivers were built. However, I still make it a practice to replace, automatically, any such capacitor that looks questionable. The electrolytic filter capacitors, usually multi-section types, are a different story. I usually find them open.

Dial lights and dial cords also frequently need replacing, as do line cords, volume controls and power switches. While you are working on the set, be sure to lube all control shafts. I've only occasionally had to replace a tube—maybe in one out of five that I've serviced—and I've serviced plenty!

If the loop antenna is mounted on the back of the set, make a sketch of the connections between the antenna and the radio as soon as you've removed the back for servicing. These leads tend to break easily, and replacing them can be confusing without a diagram.

If you like the clock radios, try to accumulate a couple of extra Telechron movements. These were the most popular of the movements used in the fifties and, while they seem to run forever, they do get noisy and sometimes fail. Many are interchangeable.

3. **What to look for?** Personal taste plays a large role here. Lately I lean towards colorful plastics, but I also find a lot of brown ones. I used to buy more wooden cabinet radios, but my refinishing backlog is growing too large. I'll still buy a nice clean one, or a really interesting one, but by the 1950's plastics had really come into their own.

Don't be afraid of chipped or cracked cabinets. Auto-body repair techniques and materials work well on them and give you an opportunity to change the color (if you wish) when you repaint. My personal preference is to stick close to the original color, but

I've seen some wild (and nice looking) paint jobs. For plastic cabinets and dial windows that are dull but intact, first clean thoroughly, then try Novus polishes.

So add a few post-war radios to your collection! They don't take up much room, and eventually will have some value, at least to you. I suspect they will grow in monetary value as well, if that is a concern of yours. Realize that in the 1950-'s, no one thought that pre-war radios had much value. If we restore and preserve a little bit of this latter day technology now, we will all be better off thirty or forty years down the road!

PARTS AND TEST INSTRUMENTS

(continued from p. 2)

circuits they were measuring more than modern ones. Thus, the voltage measured could be significantly lower than the actual voltage present.

That's why most voltage charts will indicate the "ohms-per-volt" rating of the instrument used to take the readings. And many of the older charts specified a 1,000 ohm-per-volt meter. Modern meters of any quality at all have ratings of at least 20,000 ohms per volt, and so would tend to read higher at the same circuit points.

It won't replace your modern multimeter, but if you have a vintage meter—of proven accuracy—rated at 1000 ohms-per-volt, it can come in handy for use with voltage charts specifying that value. The most inexpensive multimeter in the Radio Shack catalogue is a \$15.00 instrument rated at 2,000 ohms per volt. This is close enough to provide usable readings, and—being new—could at least be relied upon to have decent calibration.

See you next month, when we'll begin a series on vacuum tubes.

Marc F. Ellis

CLASSIFIED ADVERTISING

Subscribers may place one free classified ad, up to 30 words long, in each issue. Count your name, ham call (if desired), complete address and one phone number as six words. Additional words are 15 cents each per issue. Non-subscribers pay 30 cents each per issue for all words. Free ads will be automatically run in two issues, but expire after their second insertion unless renewed by mail or phone. Those wishing to run the same ad for extended periods of time may want to use a "business card" space (see Display Advertising Dimensions and Prices table elsewhere in this issue). This is a boxed area in which we can print your business card or any advertising message that will reasonably fit (no charge for setting type). We reserve the right to make editorial adjustments in classified ads without advance notification and to refuse advertising at our discretion. We will reprint, without charge, any ad containing typographic errors, but assume no other financial responsibility.

Wanted Schematic, output cable make-up & operating instructions for Heathkit Lab Generator Model IG-42. Gladly pay copy & shipping cost. Bill Halstead, 3194 Sugarplum Rd. NE, Atlanta, GA 30345. (404) 938-8730.

Wanted Knight Kit "Ocean Hopper" radio with coils. Bill Miedma, (312) 526-6131.

Wanted Driver for AK horn Model H, dead or alive. Need threaded base and diaphragm per AK service manual. Alton A. Dubois, Jr., 67 Peggy Ann Rd., Queensbury, NY 12804.

Wanted 20's and 30's Popular Mechanics, Popular Science, Science & Mechanics and Mechanix Illustrated. Will trade vintage auto mags 2-for-1. Rich Volkmer, 530 Mignin, Warrenville, IL 60555. (708) 343-1313

Wanted Majestic 15A, Grundig 1041 and speaker for AR46. Carlos Martinez, #21 Colonel Irizarry St., Cayey PR 00736. (809) 263-2741.

Wanted Schematic for Champion Spark Plug 9vdc radio Model SPR-810 made by RIC (Japan). Terry Schwartz, 340 Oakwood Dr., Shoreview, MN 55126-4821. (612) 483-4173.

Wanted Old radio headphones and headphone plugs. Highest prices paid. Examples: I will pay \$20 for BASCO headphones, \$25 for Long Distance headphones, \$25 for Bronston headphones. Will pay \$10 each for Federal headphone plugs. I will buy bulk assortments of headphones, plugs and parts. Dick Mackiewicz, 1549 N. River Rd., Coventry, CT 06238. (203) 742-8552.

Wanted Andrea table radios. Stan Lopes, KB6LGV, 1201-74 Monument Blvd., Concord, CA 94520. (510) 825-6865.

For Sale Sencore LC53 "Z-Meter" capacitor-inductor analyzer with original manual, exc. condition, \$400 (shipping included, U.S. only). H. Goldman, 3 Amy Lane, Queensbury, NY 12804. (518) 792-1003.

For Sale RCA Radiola 17 wooden coffin-A.C. no knobs; Radiola 33 poor shape, hole in cabinet; Radiola 60 poor wood cabinet; Radiola 33 painted green; Eveready radio chassis 8 tube green. \$25 each or \$100 for all plus UPS. Kevin L. Moe, 616 Lockrem, Ottawa, IL 61350. (815) 433-4598 evenings.

For Sale Radio parts, tubes, test eqpt, service data. 1000's of new and used items for radios. Write wants, LSASE for reply. Krantz, 100 Osage Ave., Somerdale, NJ 08083-1136.

For Sale or Trade A very nice RCA Victor chair with horn and Nipper logo. Great for your office or radio room. \$60.00 plus UPS. Paul Fulton, 711 Jacquelyn Rd., Westwood, NJ 07675. (201) 664-5260.

For Sale Cabinet only for a Franklin cathedral, \$15.00, and for a Lark cathedral, \$10.00. UPS extra. Victor Marett, 3201 NW 18th St., Miami, FL 33125. (305) 634-9569.

For Sale Send for list of inexpensive (spell cheap) radios, parts, tubes, etc. Example: Silver-tone 4506 (GOR 75) restored \$85. Stan Lopes, KB6LGV, 1201-74 Monument Blvd., Concord, CA 94520. (510) 825-6865.

For Sale Superior TV-50 signal generator, \$20.00. Chassis, power supply, speaker for Radiola 66, \$40.00. RCA WR99A marker generator 18-216 mhz, \$20.00. UTC A18 small, \$20.00. Kevin L. Moe, 616 Lockrem, Ottawa, IL 61350. (815) 433-4598.

For Sale Two binders containing original Philco service information, 1946-1950. Covers about 140 radios and record changers, complete with all production changes. One binder containing original 30's service information covering 69 G.E. sets, 21 R.C.A. sets \$45 plus postage for all three. Over 4 inches thick! Dick Mackiewicz, 1549 N. River Rd., Coventry, CT 06238. (203) 742-8552.

For Sale NC-100A, HRO-7, SK-24, NC-2-40-D w/speaker. Call for prices. Jack Iverson, N9KYT, 1110 Old Mill Dr., Palatine, IL. (708) 359-0941.

For Sale Gernsback magazines, Electrical Experimenter (1918), Radio News (1920's), others, plus over 100 books. SASE to Goldman, 3 Amy Lane, Queensbury, NY 12804.

For Sale Parting out Zenith 7S363. Send SASE for list of reel-to-reel audio tape recorders. Claude J. Dellevar, 13009 Maclay St., Sylmar, CA 91342 (818) 365-1629.

For Sale Capacitors, tubes, parts. Thousands in jam-packed illustrated catalog No. 49. Send \$3.00 U.S./Canada (\$5 overseas) for a heavy-paper limited edition copy. Don Diers, 4276 North 50th St., Dept R2, Milwaukee, WI 53216-1313.

For Sale Excellent reproduction of 1920's S.S. Kresge crystal set blueprint \$4.00 including postage. Dick Mackiewicz, 1549 N. River Rd., Coventry, CT 06238. (203) 742-8552.

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MONTHLY MINI QUIZ

Match wits with our quiz editor! See next month's issue for the answer, as well as the names of all readers who responded correctly.

This British woman scientist carried out studies on wave theory that may very well have influenced the work of Hertz.

Answer to last month's quiz: Edwin H. Armstrong

Correct answers from F. Krantz, Paul Bourbin

Conducted by Julian Jablin



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