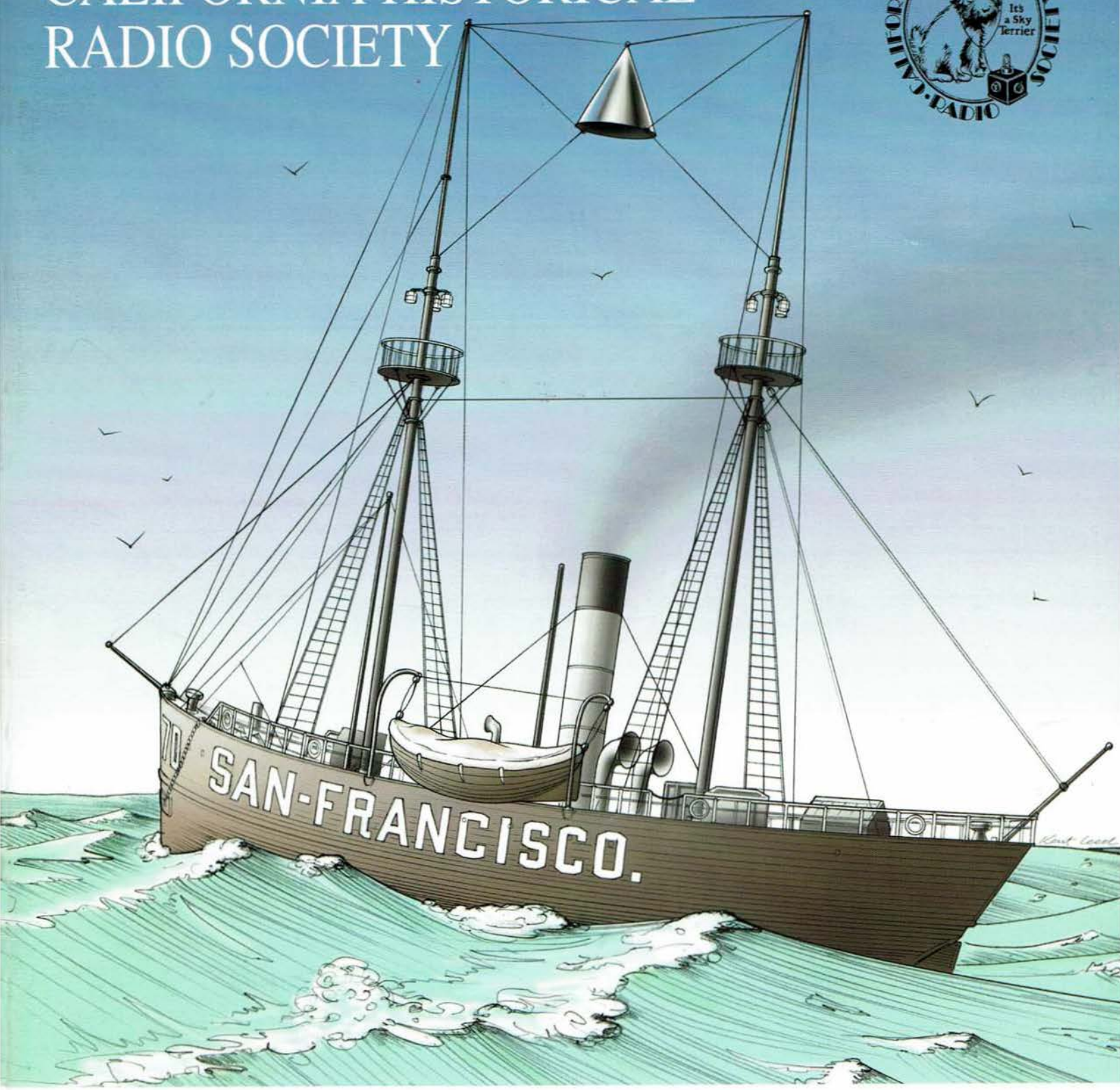
VOLUME 23 NUMBER 1 SPRING/SUMMER 1999

JOURNAL OF THE

CALIFORNIA HISTORICAL RADIO SOCIETY



Miracles in Trust

by the Perham Foundation

FOR THE RESTORATION AND PRESERVATION OF EARLY RADIO

CHRS Officers and Staff

Steve Kushman
4233 25th St.
San Francisco, CA 94114
(415) 821-7671
kushseal@flash.net
PRESIDENT
MAIL PICK-UP/ HOTLINE

Lee Allder
Box 6785
San Rafael, CA 94903
(415) 499-9228
VICE PRESIDENT/
PUBLICITY

Russ Turner
414 Liberty St..
San Francisco, CA 94114
(415) 824-8367
SECRETARY

Will Jensby
645 Giannini Dr.
Santa Clara, CA 95051
(408) 296-6071
TREASURER

Bart Lee
88 Kearney St.. #1310
San Francisco, CA 94108
(415) 956-5959
GENERAL COUNSEL

Don Steger
4821 Rockland Way
Fair Oaks, CA 95628
(916) 967-4630
SACRAMENTO CHAPTER

Paul Bourbin
25 Greenview Ct.
San Francisco, CA 94131
(415) 648-8489
paulbourbin@delphi.com
ON SITE EVENT
CHAIRMAN

Cover Art
by Kent Leech

Dale Sanford
107 St. Thomas Way
Tiburon, CA 94920
(415) 435-6131
Dalevsan@aol.com
CHAIRMAN OF THE BOARD
MAILING CHAIRMAN

Mike Adams
112 Crescent Ct.
Scotts Valley, CA 95066
(408) 439-9544
mhadams@got.net
EMAIL CHAIRMAN

Larry Clark
438 York Dr.
Benicia, CA 94510
(707) 745-9132
TECHNICAL ADVISOR/
LIBRARIAN

Hal Layer
Box 27676
San Francisco, CA 94127
(415) 366-5060 KK6HY
MAILING LABELS

Norm Lehfeldt
757 Guerrero St.
San Francisco, CA 94110
(415) 285-0643
NAME BADGES

Mike Simpson
21818 Via Regina
Saratoga, CA 95070
(408) 867-7315
oldradio@jps.net
MEMBERSHIP CHAIRMAN

Alan Voorhees
10809 McIntyre St.
Oakland, CA 94605
(510) 562-3235
alan@antiqueradios.com
WEBSITE CHAIRMAN

Stephan Ponek
945 Linda Mar Blvd.
Pacifica, CA 94044
(650) 355-1550
BOARD MEMBER

Stephen Sutley
Box 1094
Pacifica, CA 94044
(650) 359-7787
radiome@mindspring.com
BOARD MEMBER

JOURNAL STAFF:
Stephen Sutley

Contributors:
Mike Adams
Paul Bourbin
Charles Kittleson
Steve Kushman
Bart Lee
Don Koijane
Roy and Kathryn Tucker
Alan Voorhees
Hal Layer
Charlene Hunter

The Perham Foundation

101 First Street, Suite 394
Los Altos, CA 94022
(408) 734-4453
(408) 736- 2685 (FAX)
perham@perham.org
www.best.com/~perham/herrold.html

Donald F. Koijane
President
(650) 473-6467 (650) 473-6468 (FAX)

About CHRS

The California Historical Radio Society (CHRS) is a nonprofit corporation chartered in the State of California. CHRS was formed in 1974 to promote the restoration and preservation of early radio and broadcasting. Our goal is to provide the opportunity to exchange ideas and information on the history of radio, particularly in the West, with emphasis in collecting, literature, programs, and the restoration and display of early equipment.

The *Journal* of the Society is published and furnished free of charge to members. Yearly membership dues are $20 (U.S. funds).

Submissions for the *Journal* are always welcome. Typed copy is preferred, submitted on a 3.5 inch IBM or Macintosh diskettes in ASCII or Microsoft Word format. Send all material to Stephen Sutley and include your name, address, and phone number/Email. You write about radio and we'll print it.

CHRS
P.O. Box 31659
San Francisco, CA 94131
415 821-9800

CHRS on the Internet:
http://www.antiqueradios.com/chrs/

1899 Event website:
www.perham.org/1899.html

CHRS Welcomes the **Perham Foundation** in this issue of the journal as we commemorate the centennial anniversary of the first practical wireless transmission in America. Perham's proposal of a Consortium of Bay Area Technical History Museums and their displays of electronics history at Fry's Electronics store moves us closer to fulfilling the dream of a permanent site celebrating the legacy of our technological achievements.

CHRS 1999 Schedule As of 7/31/99.

Steve Kushman

Here is the rest of this year's schedule. You must be a current member to sell at our events. Please, no activity before the start time. Check the **CHRS HOTLINE, 415-821-9800** for the best and latest information.

August 7th, Saturday, 8AM - Los Altos Hills, Foothill College, Lot "D". Take the El Monte Rd. west exit off I280. Right into campus. Right at tee. Seller's fee applies. Meet /Auction.

August 28th, Saturday, 11AM - San Francisco - The Cliff House. Commemoration of the first wireless transmission from the Lightship San Francisco to the Cliff House, August 23rd 1899. In conjunction with The Perham Foundation. See "News and Information" for all the details.

September 4th, Saturday, 9AM - Fairfield. At The Western Railway Museum on State Route 12, between Fairfield and Rio Vista. Swap Meet and Picnic. It's more than a radio swap meet. It's trains. It's antique electric streetcars and interurban trains. Take rides on this historic rolling stock. Bring the whole family. CHRS will provide a barbecue lunch for members and family. It's a great location for a meet, on the lawn beneath cooling shade trees. The kids may enjoy seeing the ducks on the pond. Your battery radios and windup phonographs are welcomed. Vintage entertainment is always appreciated.

There is no seller's fee. *Everyone* must pay a special reduced Museum admission price for CHRS of $5. Children under 12 also have a special reduced price of $2.50. This fee is an all day pass for the grounds and includes the train rides, the car barns, gift shop, and you might get a private tour by one of the Museum volunteers. From the Bay Area, take I80 east, take State Route 12 towards Fairfield. As you see Travis AFB, in the distance, the road veers right. You will then go over three hills and at the bottom of the third hill, look for the Western Railway Museum on your right. Please **RSVP** on the **HOTLINE, 415-821-9800** or Email me, with the number of people who will be attending, so we will know how much lunch we should provide. Thanks to **Paul Bourbin.**
(Watch your speed through town.)

October 2nd, Saturday, 9AM - Pismo Beach - Oceano Airport. 561 Airpark Dr. Joint meet with SCARS. Campgrounds available. Take this opportunity to fly your plane to the event. Working on reduced hotel rates. See ***www.aircamp.com*** (events) for map and details. Our meet will be live on the Web! Open House to follow at Bob's Radio and TV, 238 Ocean View, Pismo Beach. Questions? Call **Dan Steele** at 805-773-8200. Thanks **Dan!** And thanks to **Thurston Armstrong** of SCARS.

November 6th, 8AM - Los Altos Hills, Foothill College, Lot "D". Take the El Monte Rd. west exit off I280. Right into campus. Right at tee. Seller's fee applies. Meet /Auction.

December - Nothing yet. How about a Holiday party and mini-swap? Who will organize it? Please let us know. We ask this question every year. Will this be the year that somebody steps up?

Sacramento Chapter - Meets the 3rd Tuesday of every month, 7pm at the SMUD building, corner of Elkhorn and Don Julio in Sacramento. All members are invited to attend.

Tube Collector Association
PO Box 1181 Medford, OR 97501
(707) 464-6470/ philbert@pacbell.net
New group of collectors and historians dedicated to radio/wireless vacuum tubes and related histories is now into their fourth issue:

To aid interaction between collector-historians
To provide a forum for new discoveries in tube history
To conduct "tube" meetings in conjunction with national radio-collector events

Dues are $20 per year. Please contact the Association for membership information.

COMMEMORATION-
100 YEARS OF RADIO IN SAN FRANCISCO

WHAT-

100th ANNIVERSARY OF RADIO: AUGUST 23, 1899 S.F. WIRELESS SUCCESS WITH A SPARK COIL ON THE LIGHT SHIP *SANFRANCISCO* ANNOUNCING BY WIRELESS THROUGH THE FOG TO THE CLIFF HOUSE THE ARRIVAL OF THE TROOPSHIP *SHERMAN* TO THE WAITING REPORTERS FOR THE *SAN FRANCISCO CALL* NEWSPAPER.

WHERE-

CLIFF HOUSE, SAN FRAN CISCO, POINT LOBOS AT OCEAN BEACH

WHEN-

AUGUST 28, 1999 AT 11 AM, and LUNCH

SPONSORS-

CALIFORNIA HISTORICAL RADIO SOCIETY, PERHAM FOUNDATION, MARITIME MUSEUM, NATIONAL PARK SERVICE AND THE U.S. COAST GUARD

WHO-

YOU! RADIOMEN, COAST GUARD, NPS VOLUNTEERS AND STAFF, HISTORIANS, AND THE PRESS: RADIO NEWSPAPERS, and TELEVI SION

EVENTS-

SPARK RADIO EXHIBITS AND DEMONSTRATIONS, LECTURES, DEDICATION OF SITE, COMMEMORATIVE BROADCASTS AND PUBLICA TIONS, OPERATION OF COM MUNICATIONS CIRCUITS, LUNCH

CONTACTS-

PERHAM FOUNDATION
408 734 4453
CHRS 415 821 9800
MARITIME MUSEUM
415 556 0532.

CHRS News & Information ... from the President

Steve Kushman 3/20/99

About this issue - This special edition of the CHRS Journal is mainly devoted to the commemoration of the first practical use of radio in America- 100 years ago. The date was August 23rd, 1899. and took place in San Francisco. The San Francisco Lightship 70 sent spark signals, through the fog, to the Cliff House from 9 miles offshore. The transmission announced the arrival of the troop ship *Sherman*, bringing back local heroes from the Spanish American War. Soon there after Marconi was using wireless to report on yacht races off the Atlantic. A short ten years later, "Doc" Herrold was broadcasting voice and music from San Jose. The importance of that first transmission, **"Sherman is sighted,"** is sometimes overlooked. Those words represent the first of countless messages broadcast in America over the last hundred years and signaled the beginning of new industries and technologies that would change our lives forever.

Radio on TV - Your President was given the opportunity to produce a short TV feature about the August 23rd, 1899 radio event. Please watch if you can, (or tape it). It will feature such stellar entertainment as our own **Woody Wilson,** re-creating the original transmission using a Ruhmkorff coil that he built from scratch. He taps out the sparks on a key provided by **Frank Camenisch.** Also featured are demonstrations by **Paul Bourbin.** He operates his vintage spark transmitter, puts himself in the aura of his crackling Tesla coil, and provides music of the times by acoustic phonograph disc and cylinder. See **Will Jensby's** coherer. You will also see **Bart Lee,** who tells the story of this historic anniversary. Plus we'll hear from **David Fowler,** Webmaster for the Museum of San Francisco and **Ernest James,** historian with the California Military History Museum. Watch for this feature on the program, **"Sunday on Seven," 11am, August 22nd, on Channel 7, KGO-TV,** San Francisco. Thanks to all for their time and cooperation on this project.

The Commemoration Event - On **Saturday, August 28th,** in a joint effort with the **Perham Foundation, CHRS** will commemorate the 100th anniversary of radio in America. The place is the famous **Cliff House,** at Ocean Beach in San Francisco. The time is **11am.** There will be guest speakers, exhibits, demonstrations of vintage equipment and a re-creation of the original transmission with the help of a **US Coast Guard** cutter. A limited number of spaces will be available on the cutter. If you would like to be on the ship, please let us know. A lunch will be served for the Press. **CHRS** encourages our members and guests to have lunch at the Cliff House or one of the other eateries on Point Lobos. We wish to thank **Don Koijane** and the **Perham Foundation** for their participation in the production of this Journal and the co-sponsorship of the event. Thanks go out also to **Bob Holloway,** park ranger, and **Steve Haller,** Presidio historian, and the **National Park Service.** Thanks to Chief Warrant Officer **John Kedge** and the **US Coast Guard** for their help. Thank you to **Richard Everett** and **Mary Lou Herlihy** of the **S. F. National Park Service Maritime Museum.** Thanks to **Ed Gable,** curator of the **AWA Museum** for loaning the telegraph inker. Also thanks to **Woody Wilson, Frank Camenisch, Will Jensby** and **Paul Bourbin** for loaning vintage equipment. Thank you **Mike Adams, Lee Allder, Stephen Sutley, Bart Lee, Russ Turner** and **Alan Voorhees** for your help on this event. Mark your calendars, bring your families and join us for this historic event at this historic location.

Airport Exhibit - "On the Air," continues to get rave reviews. If you haven't seen it, be sure and get to SFO before it ends. The exhibit features many items provided by **CHRS** members and can be found in the North Terminal Gallery of San Francisco International Airport. This area is located between the moving sidewalks, on the way to the United Airlines gates. The exhibit runs through August. Be sure to check it out.

Want Ads - The ads in the CHRS Classified are the most current we have. They consist of any ads from last year that were requested to be held over and ads submitted with renewals. We will run your ads until you ask us to cancel them.

Technical Re-print Service & Advice-Larry Clark, our technical advisor and librarian is looking for more of the Specialized Series of Sams . He also would like to have the technical articles from old issues of *ARC* and the *AWA Old Timers Bulletin.* Keep your eyes open for them. Remember, Larry offers technical advice, or re-prints from Riders, Sams or anything in the library to our members. Call Larry for advice at 707-745-9132. For reprints send $1 and a S.A.S.E. to :

Larry Clark
438 York Dr.
Benicia, CA 94510

Getting Serious - Once again, unfortunately, we must write about trust. Trust between members of the same Club with the same interests and goals. At our July 4th meet in San Francisco, **Mike Simpson** and **John Eckland** brought a van full of radio and historic material for sale. They spent their time to acquire it, sort it, pack it and drive it to our meet. They could have sold it at a flea market, through ARC or on eBay. But they didn't. They shared their finds with us. And someone, I hope by mistake, removed a valuable item from their area, without paying for it. It was a beautiful program from the 1933 Century of Progress World's Fair in Chicago. If you picked it up by mistake, please return it, no questions asked. If you meant to take it without paying, you have done nothing but hurt your fellow members. The sellers are hurt financially and may think twice about sharing their next truckload with us.

ed.- There's an outside chance it was the public – watch your stuff.

Please let me know if you have any comments, questions or suggestions for the Club. Call me at 415-821-7671 or Email me at kushseal@flash.net . Keep up the good work of preservation and restoration. See you at our next event.

Steve

THANKS FROM CHRS!

We would like to express our gratitude to the members listed below, who sent back contributions along with their renewals. This list covers the period of 1998 through the present. These thoughtful members realize that paying dues is not enough. Operating costs continue to rise, so monetary donations and the money raised at our on sight auctions, really becomes important. Also big thanks to our members too numerous to mention for their contributions of items for auction at our events. An organization is only as strong as the members who support it. CHRS can flourish– only with your help. Once again, thanks to all!

Warren Attebury
Sam Burt
Chester Carter
Jim Chanin
Andy Coleman
Donald Day
Geoffery Day
Raymond Erickson
Jack Farrell
Angelo Giustino
Gilbert Hayse
Nick Itsines
Dennis Lariviere
William McGowan
Les Meszaros
Kelly Scott Molles
Roger Mueller
James Neale
Jake Panzarella
Curt Philips
John Polk
Dan Ramos
Dave Rinehart
Eugene Rippen
Wayne Ross
Ernie & Polly Sagesser
David Salomon
Edwin Senior
Stephen Sparks
Eric Stumpf
Dale Tucker
Steven Webester
Paul Wiegman
Jerry Wiley

"Doc" Herrold award presentation to **Paul Bourbin** (rt to lt), Bart Lee, Steve Kushman

The prestigious Charles D."Doc" Herrold Award recognizes exceptional achievement in the preservation of radio and broadcasting history.

Past recipients:

1998 - **Will Jensby**
1997 - **Paul Bourbin**
1996 - **Henry Engstrom**
1995 - **Hank Olson**
1994 - **John Wentzel**
Also: - **Bruce Kelly**
Norm Berge
D. H. Moore
Mike Adams
Edward A. Sharpe
Paul Giganti
Bart Lee

MUSEUM SITE DONATION NEEDED

Eugene Rippen

This is going to be brief and to the point.

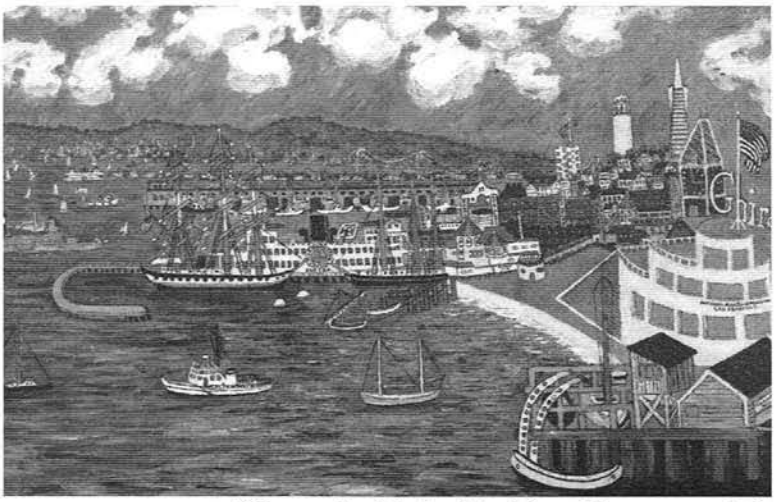
There is a lot of great gear to be displayed, and if there really was a permanent museum site much more would be donated.

Such a site could also be used for sales, service or club activities, to the extent appropriate.

What is wanted is a deductible donation of a properly zoned building. A very long term lease might be considered but transfer of full ownership is preferred.

Please contact: **Eugene Rippen**,
105 Donnington, Auburn, CA 95603,
(530) 888-6020.
rippen@foothill.net.
Or, contact:**Stephen Sutley**
ssutley@mindspring.com

The maritime museum's radio wing will open in November 1999. **Tom Horsfall,** and **Dick Dillman** are restoring a complete Victory ship radio room. The radio wing will cover radio from 1899 to 1999



SF mural with the Maritime Museum on left

"Who are We?"

by Mike Adams
adams@email.sjsu.edu

CHRS – Article on values and purposes of club

There was a very good discussion at the CHRS Board meeting in early July. It started with several members asking an important question, one that speaks to the purpose of the organization: "Why can't we build a CHRS Museum?" I recall the same question being asked fifteen years ago when I was the president of SCARS, the Southern California Antique Radio Society. And while all agreed it was a good idea, after all between the 1000 or so members there was plenty of museum-grade technology to display, the issue was quickly put to rest because of the high price and unavailability of local real estate. The inevitable Where? For the typical radio collector club, we, like similar small organizations that charge $15 dollars a year and spend most of it on a quarterly journal, simply cannot just buy a museum. And if we decided to fund raise what changes would an organization like ours have to make to become a museum owner? This directly speaks to the issue, "Who are we?" Is there an educational foundation lurking under our hobby club exterior? Would we even want to do the sorts of things that would put us in that category? Can we honestly say what our club's "values" are, do we know, dare we find out?

There is plenty of anecdotal evidence that our membership primarily wants to collect old things sold out of car trunks in parking lots. What's wrong with that? It is here that I quote longtime CHRS president and friend Paul Bourbon who lamented many years ago that, "All we are (as a club) is a front for a swap meet." Like many of us at the board meeting in July, Paul early on had wondered if a hobby club as we seem to be really had any interest in anything more than the monthly flea market. I wonder the same thing. Are we really an educational entity as some of us would like to believe? How many in our membership really have thought about educating the public on the same model of a Tech or an Art museum? Think suits and ties, million dollar budgets, education directors, marketing specialists, IMAX theaters, cafes and gift stores. How electronics history, pure history, fits into the Bay Area competitive market for museums and other "attractions" is what a Packard Foundation-funded study is supposed to answer for the Perham Foundation and its technical museum consortium of which CHRS is a part.

Then discussion centered on the idea of a modest "CHRS Clubhouse," probably a better definition of who we are than museum operators. It would be like this: Well meaning volunteers would occupy a small storefront in a heavily trafficked area, the public could walk in and view radio collections, and in an adjoining room a kindly and helpful old gentleman would be repairing radios on a 1930s-equipped repair shop. I did visit a similar place many years ago, an antique Carousel horse museum near Ghiardelli Square, the repair bench in the back with actual artisans doing restoration. A good idea, if it survived. Well-funded and professionally staffed, such a place could exist. But there are pitfalls when you base any operation on volunteers.

Here's a local example of an electronic clubhouse. When under Proposition 13 Foothill College lost funding for the electronics museum's paid staff, volunteers from the Perham Foundation signed up to man the front doors and conduct tours. As a long time member of that august board, I recall how difficult it was to get even the retired board members and friends to fully staff the place, and the hours of operation continued to shrink. And remember, that operation was already built and in place, its bills and insurance paid for by the college. No phone bills to worry about, handicapped facilities already in place, no earthquake problems, no electric bills to pay, no security issues and still there were not enough volunteers in all of the Silicon Valley to keep it operating for more than a few days a week.

Nevertheless, if the membership collectively decides that activities beyond swap meets should be pursued, there may only be two realistic options: Board member Alan Voorhees hit it on the head when he said that our best bet was to, "Take the collections and displays to where the people already go," a mall, an area with established traffic. Foothill proved the wisdom in that, located out in the countryside near nothing, and rarely visited by more than a dozen people on some days. I'll admit I had a mind-changing experience when I visited the excellent radio exhibit at the San Francisco Airport. A very slick, expensively-mounted history of broadcast radios and programming, not the sort of purist AWA minutiae, but material very accessible to the public, an exhibit done by museum pros, educational/historical generalists rather than hobbyist-true believers like us. An expensive model, but it reaches a giant audience without the expense of a building and on-site people.

The other choice is to declare ourselves as an educational group, seek funding for a building, and if successful, stand by and watch our carefully worked out dreams for a pure history museum "place of record" be logically and necessarily taken over by CEO-type board members, professional PR and marketing specialists, black tie fund raisers, and the rest of the cadre of people who make successful museums and happy audiences happen. This is the road that the Perham Foundation is now on, and many of their number do not even realize it, and it has taken that well-funded and long-established group more than a decade.

Whatever we decide, no matter how small an effort, it will still require a commitment of time and energy from leaders and volunteers, and plenty of deep pockets, otherwise it will not be successful. Now who will stand up and volunteer to create such a place? Or should we continue to do what we do best, that parking lot thing?

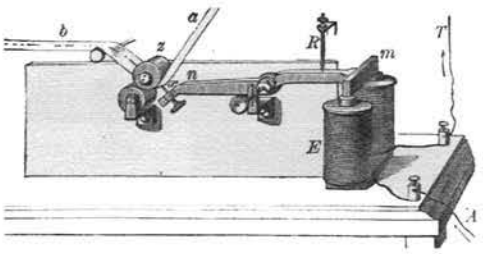
EARLY RADIO AND ITS MARITIME EVOLUTION

Bart Lee, xWPE2DLT 327 Filbert Steps San Francisco, CA 94133 (415) 956 5959

Correspondence is invited.

The opening of the San Francisco Maritime Museum's ***Radio Collections and Displays,*** set for November, 1999, by the National Park Service, provides a good opportunity to review some radio history as it relates to radio's maritime service.

Many systems of modern technology have developed first with some existing mode of accomplishing the task the system aims to do, but then call forth a new technical mode to realize the full potential of the system. In radio, Marconi adapted the experimenters' spark-generated damped electromagnetic wave to a system of communications using 19th century laboratory equipment and modeled on the land line telegraph. His system assumed the name "wireless telegraphy" and it worked. He signaled across the Atlantic Ocean in 1901, a fitting beginning to the technological wonders of the 20th century. As soon as he succeeded, many others sought to do it better. One of the most important of these men is Lee deForest, a science Ph.D. from Yale. He wanted better ways to detect the Hertzian waves that Marconi (and others, notably Nicola Tesla) sought to communicate with. He tried wire in an acid bath, and he tried a candle's flame. On that model, he thought of using a light bulb with a glowing filament. He did not work in intellectual isolation, and indeed many of his inventions were in truth adaptations (as was true with many inventors of the day, and of ours). Ambrose Flemming in England had used a filament, and a metal plate, in an evacuate bulb to gather electrons from it, as early as 1904. Edison had discovered the process some twenty years earlier. Flemming saw that his "valve" could turn an alternating current of electricity into a direct current. The Marconi company quickly put the Flemming valve to work as a detector of electromagnetic waves, turning the alternating currents they created in wire antennas into direct current in receivers, that could operate a telegraph register inker, or what we call headphones that made sounds. This "diode" valve worked better than the earlier laboratory equipment, the tube of iron and silver filings known, from its action, as the "coherer" which had been invented by Edward Branley in about 1892.



The Register.

DeForest came to the problem of detection of radio waves with this background. Based on his work with the candle flame, in December of 1906, he put a wire between the filament and the plate. He shaped the wire in a back-and-forth manner that reminded him of a football field, so he called the wire the "grid." He connected the receiver's tuning circuit to the filament and the grid. He connected his headphones to the filament and the plate. The device "detected" radio waves, in the buzzy form from which they emanated from a spark transmitter. DeForest called his three element, triode valve the "audion." It made radio waves into audio electrical patterns that could be heard with the human ear. The developing technology of wireless telegraphy had given birth to the Vacuum Tube.

Ironically, deForest at first thought that some gas should remain in the valve. Later work, especially that of Irving Langmuir at AT&T, showed better performance with higher vacuum. DeForest first thought the audion would only be good for detection of radio waves. His own later work, at Federal Telegraph in Palo Alto in 1911, showed that the audion could also amplify signals. By 1913, still in Palo Alto, deForest made his audion oscillate, creating the same sorts of alternating electrical patterns that he had invented it to detect. Later work, especially

An early filament light bulb experiment with induction.

that of Edwin Howard Armstrong in 1914, made the audion oscillate at high enough frequencies to permit "feedback" of the original signal into the receiver's tuning circuits, which enabled world-wide wireless communication by 1915. This principle of "regeneration" enabled paralleled audions to create enough radio frequency energy that in 1915, the Navy at its lead station, NAA in Virginia, communicated by voice with Paris, and Mare Island, California, and was heard in Hawaii as well. It would only be a matter of time, and the progress of the First World War, before the vacuum tube systems replaced the earlier sparks and arcs of the first decade of wireless.

The new system of wireless communications had called forth the ideal instrument for its advancement to its full potential. The spark systems wasted enormous amounts of energy and bandwidth in damped oscillations compared to the single frequency continuous wave generated by an arc system. The vacuum tube provided a clean, single frequency at much higher efficiency than the heavy, power-hungry and electromagnetically messy arc systems. The vacuum tube permitted radio reception world-wide, and in many cases, radio transmission world-wide, with a simple tuning apparatus and one of deForest's audions (or their various vacuum tube successors). The technology of creating, processing, detecting, amplifying, and modifying electromagnetic energy, i.e., radio waves and the intelligence that they were made to carry, settled down into better and better "radio tubes" all descended from Lee deForest's audion detector valve.

Every use of wireless became more efficient in power and bandwidth. Smaller radios could cover longer distances, and be heard through challenging natural conditions, and the interference of intense use of the various radio bands. By the 1930s, receivers boasted of single-signal capabilities. Ships at sea and aircraft in flight employed small, high power vacuum tube transmitters and receivers, by the mid 1920s. The lives that wireless had saved at sea multiplied with the new powers that vacuum tubes gave to radio systems. Amateur radio operators, as well as researchers, in the early 1920s used vacuum tube equipment to explore higher and higher frequencies. They discovered the ionospheric propagation of radio waves that enabled world-wide communication reliably day and night. Commercial and maritime operations soon followed these pioneers.

By the 1930s, radio was routine in maritime service, and in international work, competing with cables. Large shore stations kept in touch with vessels and aircraft wherever they were, including the poles. The technology had stabilized into a world wide network of commercial and maritime stations, including those of the navies and governments of the world, as well as dozens of nations broadcasting to each other on the "short waves" that were the high frequencies first explored by amateurs, and many more amateurs experimenting, and communicating world-wide. Yet, one had only to listen to the short wave broadcasters to hear the distant thunder of approaching war.

The peace time maritime fleet prepared for war as early as 1939. The U.S. Government set out to build a fleet of merchantmen, first the Liberty Ships (such as the *S.S. Jeremiah O'Brien*) then the Victory Ships (such as the *S.S. Pope*). Naval construction provided battleships, submarines, and minesweepers, and everything in between. Every ship employed radio for coordination, intelligence, and safety and rescue. Usually, ships communicated using Morse Code, usually encrypted but often in plain language. As early as 1907, Lee deForest and the U.S. Navy used small arc radios to provide voice communications among ships, using amplitude modulation of the carrier signal generated by the arc. It was the vacuum tube that permitted reliable voice "radiophones," as they were called. The vast amount of traffic, however, required Morse Code by interrupted continuous wave modulation, or "CW"

Fishermen and many other maritime users preferred voice communications because they did not have to learn the code that way. In the late 1930s both fishing and pleasure craft used amplitude modulation ("AM") radios to stay in touch with shore and each other. John Steinbeck's *Voyage to the Sea of Cortez* in 1940 relates these uses for weather, fishing information, and morale. Amateur radio operators experimented with radiophone as early as 1919, when experimentation could begin again after World War One. Broadcasting, technologically and as a compelling social phenomenon, took off like a rocket in the early 1920s, using a.m. on medium waves and frequencies, and in the 1930s on short wave. However far out at sea one might be, broadcasts of voice and music could be heard, along with weather and advisories, and perhaps instructions from shore, in Morse Code. In World War Two, the merchant marine equipped each of its ships with low frequency, long wave radio sets and also high frequency, short wave sets (as well as a 1920s style crystal set receiver for emergencies). Each ship also had a short wave receiver for the crew to listen to, the "morale receiver." All equipment was highly shielded so that no stray radio waves disclosed the ship's position to a hungry wolf pack of enemy submarines. Until and into the Vietnam War era, merchant ships and for that matter Navy ships as well, continued to rely on vacuum tube radio equipment whose principles has been worked out in the early 1920s.

Performance improved the effectiveness of a standardized architecture. Modulation of traffic signals of high volume took on various modes, such as Baudot teletype and eventually digital encryption. Voice signals, initially in the Air Force, were found to carry better with the carrier stripped away and all the power put into only one of the two intelligence-carrying sidebands of the AM transmission. This single side band "SSB" mode quickly spread to all radiophone communications except broadcasting, because of its efficiency and penetrating power. By the 1970s it was the dominant mode of military, naval, aviation and maritime communications in voice.

Three developments of the middle century changed both the principles and the architecture of their implementation. During the Second World War, the vacuum tube was pressed into the simple on-off duty of computation, initially for ballistics but soon in cryptanalysis. The computer age began, with thousands of Lee deForest's audions, standardized at high vacuum, cooking away at billions of digits. In 1947, AT&T applied the physics of quantum mechanics to the earlier work of others on crystal detectors, oscillators and amplifiers, inventing the "transistor." In time, through the work of Robert Noice and others, researchers fabricated many transistors onto single chips of semiconductors like silicon, turning sand into computer power. By 1954, the transistor was at work for the telephone company, and by 1956, it worked in radios, and by 1957, in computers. In 1957, the Russians launched the first Earth Satellite, "Sputnik" — the "fellow traveler." Its radio signals beeped down to the whole Earth. The space age had begun. Soon these three developments merged: transistorized computers on chips communicated world-wide via satellites using radio and in every other mode. Wireless evolved into the World Wide Web.

Today's mariner can talk anywhere in the world via satellite, or maritime high frequency SSB radio. He can use a satellite telephone to link to the world's telephone networks. He can enjoy digital e-mail traffic messaging anywhere in the world by satellite or by high frequency digital radio. He can determine his position within yards by satellite Global Positioning System transmissions supplemented by long wave radio beacons supplying digitize local data. He can steer his ship by a star or by a man made GPSS satellite's data. If in distress, he can launch a Emergency Radio Beacon (the EPIRB system) so help can find him. All of these systems use chips and digital technology, yet all of them are the children and grandchildren of Marconi, Tesla, deForest, and a host of others dedicated to improving the radio art.

SCIENTIFIC AMERICAN

January 1897

An invention which promises to be of the greatest practical value in the world of telegraphy has received its first public announcement at the hands of Mr. William H. Preece, the telegraphic expert of the London post office. During a lecture on 'Telegraphy Without Wires' recently delivered in London, Mr. Preece introduced a young Italian, a Mr. Marconi, who, he said, had recently come to him with such a system. Telegraphing without wires was, of course, no new idea. In 1893 telegrams were transmitted a distance of three miles across the Bristol Channel by induction. But young Marconi solved the problem on entirely different principles, and the post office officials had made a successful test on Salisbury Plain at a distance of three-quarters of a mile.

WIRELESS TELEGRAPHY EXCITES MUCH INTEREST

From *S.F. Call* 8/26/1899.

Information Solicited Regarding Method of Procedure.

Associated Press Asks for Full Details ofthe Recent Successful Experiment by The Call --- Description of Apparatus.

The wonderful achievement of The Call in announcing the sighting of the transport Sherman by means of the latest marvel of the nineteenth century -wireless telegraphy- has aroused intense interest throughout the country and has brought forth the following inquiry from the Associated Press.

Chicago, Aug 25

Paul Cowles, Superintendent, Western Division, The Associated Press, San Francisco: Please send in the first mail, as requested yesterday, all the data that you can secure concerning the enterprise of The Call and the experience with wireless telegraphy. We would like to know especially the height of the mast supporting the vertical wire at the sending station, also the height and nature of the support of the vertical wire at the receiving station, which I believe was at the Cliff House. Further, the character of the apparatus at the sending station, whether an induction coil was used or not, and if it was about how many cells and their size were used on these coils.

A.C. Thomas
Superintendent Central Division

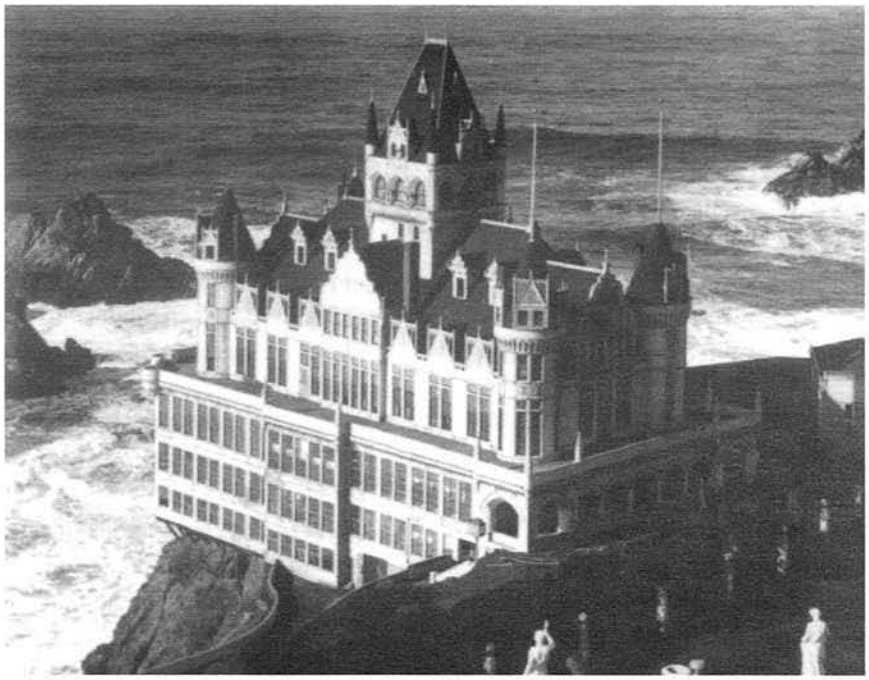
The expert electricians of The Call who have been conducting the successful experiments have been authorized to make the following statement: The San Francisco Call, in order to test the practicability of wireless telegraphy, began experiments about seven weeks ago by installing a transmitter apparatus consisting of a six-inch Tesla oscillator, a coil giving a current of very high frequency, which was placed on the nineteenth floor of the Claus Spreckels building. The height of the transmitting instruments from the street level being about 270 feet, and from the flagstaff on top of the dome a vertical wire of sixty feet was suspended to connect with the coil, the ground connection of the coil being made through the water supply system of the building.

The receiving instruments, consisting of a sensitive tube or radio-conductor, which actuates a suitable Morse relay, which in turn works a decoherer and a recording apparatus, were established on Telegraph Hill at a distance in an air line of about a mile and a half from the sending station and at a height of about 180 feet above sea level. A vertical wire about seventy-five feet in length was used at this station. While occasional signals were transmitted over this distance it was soon ascertained that the influence of the high potential wires, trolley, etc., which form a net work in this vicinity, would militate against the ultimate success of the experiment between these stations. However, sufficient encouragement was given to continue experimenting in a more favorable locality and a site for the sending station was established at Sutro Heights on an elevation of about 130 feet, above which a vertical conductor of seven-nineteen standard cable ninety feet long was suspended from a sprit on top of the flagpole. A receiving station was first established four miles distant along the beach, but with imperfect success. An intermediate receiving station was then installed at a distance of one mile, at which signals were received although shattered.

This latter effect was ascribed to the proximity of a trolley wire, the occasional spark of which during the passing of a car affected the receiving apparatus. The Tesla oscillator used for sending being of a high frequency and giving waves of a short length, it was decided to install a Ruhmkorff coil of twelve-inch spark. The receiving station was then changed to a distance of 200 feet and located in the Cliff House, where with the aid of flag signals the instruments were adjusted until absolute accuracy was attained in the transmission of messages at this distance.

The vertical wire of the sending station was at it's lowest point 100 feet above the receiving station. The apparatus was perfected to such an extent that the aerial wire at the receiving station was entirely dispensed with, and continued accuracy and results were attained. The receiving instrument was then placed on the yacht Lurline and connected with a wire suspended from the masthead, about seventy feet. A start was made from a point a half-mile off shore, the total distance from sending station being about one mile. Messages were received, and by gradually increasing the distance off shore until eight miles were reached the zone within which perfect messages were obtained was passed, and only signals received, Morse characters losing their intelligibility. It was then decided to place the transmitting instruments on Lightship No. 70 anchored on San Francisco bar, about nine miles from the receiving station, which latter was established at the Cliff House. The coil was operated from the dynamos on the lightship, the form of energy being the same as hitherto used and adjusted for an eight-inch spark. Vertical wire on lightship eighty feet, at Cliff House ninety-five feet. A conical capacity was used at both places and found beneficial. Between these stations messages were received, which, although somewhat indistinct, were nevertheless intelligible, the crude apparatus not being quite susceptible to the fine adjustment required for this distance. Improvements in the instruments now being made justify the belief that perfect success will be attained at a much greater distance. During these experiments for the San Francisco Call it has been demonstrated that much erroneous matter has been published on this subject and it has only been by a step by step process that success has been reached. It is proposed to continue the same line of investigation until the various apparatuses used are brought down to the smallest possible compass and highest degree of perfection.

AMERICA'S FIRST RADIO STATIONS, RIGHT HERE IN SAN FRANCISCO

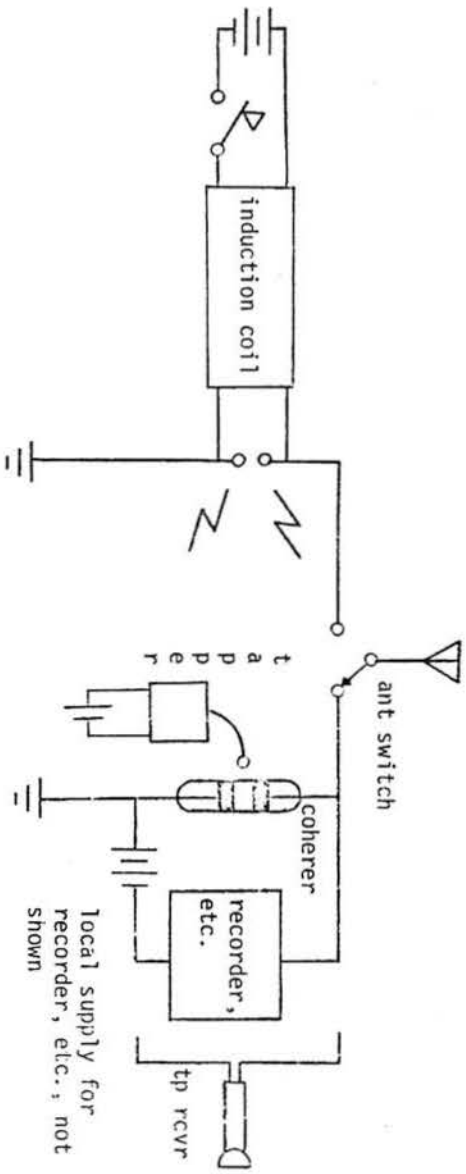


The two accompanying photographs depict two of the world's first radio stations. The San Francisco Call building, still standing (although modernized) at Third and Market Streets, housed on its very top floor the first 1899 Rhumkorff Coil spark transmitter used for the feasibility experiments of April, 1899 between the building and Telegraph Hill. These worked well enough to test out to Ocean Beach, about seven miles. With that distance working, the men using wireless for the *Call* were confident that they could transmit a signal from the *Lightship San Francisco* nine miles to the Cliff House. They did so on August 23, 1899, getting the journalistic scoop. This was the first working use of wireless, of radio, in America; Marconi reported yacht races in New York in October, 1899. The Cliff house, as it looked in 1899, is the second photo. A 1982 CHRS article by **Kathryn and Roy Tucker**, details this San Francisco wireless feat as one of the main radio adventures of 1899.(it is used by their permission) Another paper of theirs, about the Coherer, the detector of radio waves used at the time, also appears nearby.

The cover of this journal shows the *Lightship San Francisco,* number 70, transmitting America's first wireless telegraph message: SHERMAN IS SIGHTED, on August 23,1899 at 5 PM from the bar nine miles off the Golden Gate (after a newspaper-published etching circa 1899). A long wire antenna came up to a "capacity hat" from a large Ruhmkorff coil, powered by the ship's dynamo, the primary of which was keyed with the message, as soon as the troopship *Sherman* loomed in the fog, returning the regiment of the First California Volunteers to San Francisco from the Spanish American War.
Drawing by Kent Leech, CHRS

1899- First Year for Wireless in the United States

Roy and Kathryn Tucker N6TK and AA6K



Trying to ascertain a precise start year or a personality to designate as the innovator for anything in history appears almost impossible. Whatever or whoever is generally agreed upon as the "first" usually will lose out to some earlier claimant. So it is with radio. Partisans frequently tout cases of pre-Marconi or pre-Hertz experimentation in the wireless realm; the names of Loomis, Dolbear, Stubblefield, Edison, and others in the U.S. constantly pop up. Most such claims don't survive if a clear definition of radio is agreed upon: Hertzian/electro-magnetic waves. Still, the "discovery" of yet earlier pioneers and inventions constantly emerges in radio historical literature.

With this warning about the dangers of ever dogmatically proclaiming a precise start for anything, we will try it for the first emitting of wireless signals in the U.S. for communications purposes. It appears clear to us that the year is 1899 and that at least six documented, almost simultaneous, operating activities prove it. A few laboratory experimenters have to be recognized as having been active in the country before that year. Tesla, Pupin, DeForest, Pickard, Marriott, and others got started in the period a little before, all inspired by the same source- the work of Hertz in Germany from 1886 to his death in 1894. This inspiration was certainly reinforced by the immediately following work in Europe of Branly, Lodge, Marconi, Braun, and others, but the claim under study is communications without interconnecting wires, and that means practical work involving true radio signals over a substantial distance. Communications furthermore means the conveying of intelligence not just demonstrating a phenomenon of nature.

If 1899 was the pioneer year for radio in the U.S., it is certainly matched by the monumental events going on Europe that year. Marconi established communication across the English channel to inaugurate international communication without wires. The first maritime distress signals were emitted from a Marconi equipped lightship off the English coast during three incidents. The last one required rescue efforts dispatched from shore. France made its first warship wireless installation; so did Britain. Temporary installations on British war vessels saw a quick proving of their value in naval maneuvers. At the end of the year, the first use of the new communications technique in warfare took place as the Marconi Company dispatched equipment and operators to support British operations in the Boer War which had just broken out in southern Africa. In Germany, the efforts of Slaby, Arco, Braun, and others were being made to parallel those of Marconi; while in Russia, Popoff was continuing his work. Virtually all of these numerous efforts were aimed at the very practical problem of communication with ships at sea- merchant and naval.

The first activity of note in the U.S. in the monumental year 1899 involved the Army's work of Captain George Squier. He transmitted wireless messages 12 miles from Fire Island to the Fire Island Lightship off the coast of Long Island, New York. A popular history of the U.S. Signal Corps in recounting the incident labels this as "the first radio message to spark through the United State's atmosphere." This was accomplished by an 1897 graduate of West Point who eventually became a Ph.D., a two-star general, head of the Signal Corps during the First World War, and was a substantial contributor to the world of radio technology for a number of years. No exact date is listed in the various sources regarding Squier's work, but it would appears to have been around Spring or Summer.

Almost at the same time as the Army's Fire Island demonstration, the U.S. Lighthouse Board began similar work. This organization years later would be absorbed into the Coast Guard but was then an independent entity within the Department of Commerce. In July, W. J. Clarke of Chicago installed equipment at the Tompkinsville, Staten Island, New York lighthouse and communicated with the

lighthouse tender Mistletoe. Clarke's efforts are considered the first in the country of manufacturing wireless communication equipment for commercial markets.

Perhaps because so many authorities on radio history have been easterners, they typically leave out one significant event for the year 1899- the first wireless communication in California other than scientific experimentation. Jane Morgan's work Electronics in the West presents considerable detail on it including a reproduction of the first page of the August 24th edition of The Call of San Francisco which explains it. The entire operation was an improvisation of a group of amateur experimenters enthusiastic about the prospects of giving an early warning of the arrival of an important ship at the Golden Gate.

In August, a regiment of troops, locally recruited for the Spanish-American War, was returning on the vessel Sherman after their service in the Philippines. It was desired to get an early warning of the ship's approach so local citizens could be alerted to cheer on their heroes. George Mitchell, a physics teacher in a local high school, conceived of the idea of communication by wireless from the lightship San Francisco, which was nine miles off shore, to the mainland. The word would immediately be communicated by wireless when the Sherman was sighted. Soon a substantial group of people were involved in the communications project including telegraphic and electrical interests plus the Spreckles Company and The Call. The latter looking of course for a newspaper scoop.

Equipment was handmade and installed on the lightship and at the Cliff House Hotel. Apparently there was only one transmitter and one receiver set because it was several days after the critical communications day before the operator aboard the San Francisco knew whether the operation was a success.

On the 23rd of August, the ship was sighted, the shore notified, cannons were shot off to alert the townspeople, and the next day The Call bannered the arrival plus a reference to the new wireless telegraph. The men who had been so successful in this most daring experiment, with virtually no prior knowledge to fall back on, continued to experiment through the 10th of September.

Placing this first California radio communication alongside the other activities of 1899, it would appear that it came in third in the nation, just behind the Lighthouse Board's work on the East coast. Since the Army, Lighthouse Board, and the San Francisco experimenters all were apparently within two or three months of each other in commencing operation, it would appear that virtually a tie was established in priority of activity. It would be until March 1904 that the Navy would erect its first California shore station- Mare Island. Amateur experimenters had beaten this event by almost five years.

The Weather Bureau also utilized the year 1899 to begin wireless development. This organization, then within the Department of Agriculture, hoped that communication by radio could be utilized to obtain weather information from or provide it to offshore lightships and isolated localities. Late in the year, Professor Reginald Fessenden at the University of Western Pennsylvania (University of Pittsburg) was hired to begin work on the project. This was the start of his extensive contribution to the development of radio. Whether he established any actual installations before the year was out is not clear; it would appear that the following year was the first operating station for the Weather Bureau radio.

Marconi, after a successful reportage of a yacht race in Ireland in 1899, was invited by the New York Herald to provide wireless service for the America Cup Race to be conducted near New York City. In September and October of 1899 this was done. Three Marconi sets were utilized as was a fourth set of American manufacture (W. J. Clarke Company). What was particularly significant about this event, which appears to have actually been the fourth communications utilization of wireless in the country, was the widespread publicity it received. The European work of the previous decade was well publicized, even the word "wireless" was no real novelty, but this was the first use of the new technique in the U.S. that was well known; and this in the vicinity of New York City which had always been a fashion leader in almost any aspect of life. Marconi's heroic stature, already well established from his European endeavors, was further reinforced in the public's mind by the yacht race triumph.

The U.S. Navy was attracted by Marconi's developments in Europe and sent observers to watch the yacht activity at New York. They were highly impressed and made favorable comments, in light of difficulties in naval communications during the recently concluded Spanish-American War. For further evaluation, the Marconi Company made temporary equipment installations on several naval vessels and a shore station, and conducted formal tests in October and November to demonstrate their value in ship-to-shore and ship-to-ship communications. While the Navy was suitably impressed by the performance, it was not convinced that the financial terms offered for procurement by Marconi's company were appropriate and decided on a world-wide search for competitive offers.

The Army sent Captain Samuel Reber as observer of the Marconi tests with the Navy. He also recommended rejection of the procurement of Marconi Company equipment on the terms offered. By this time, the Signal Corps was operating another permanent wireless link in addition to the one at Fire Island. This was in New York harbor between Governor's Island and Fort Hamilton. Apparatus in all their installations had been assembled by the Army.

To further demonstrate that 1899 was "year one" for U.S. radio communication, the corporate scene began to unfold. In addition to W.J. Clarke's manufacturing

efforts, Marconi incorporated a United States affiliate to further his manufacturing and operating activity. This was the Marconi Wireless Telegraph Company of America established in November. Twenty years later this would be the nucleus of the gigantic, and then fully American owned, Radio Corporation of America. Marconi's company was not the first incorporation for this purpose in the country though, for in September, a group individuals headed by G.P. Gehrig in Philadelphia had established the American Wireless Telephone and Telegraph Company. This was a most optimistic title since there was yet no record of anybody, anywhere, having produced a wireless telephone signal- but obviously the hope was there.

What about the amateurs? There was no indication that any true amateur radio operators existed in the world prior to 1899. This assumes that an amateur is one who does something for the pure enjoyment of it rather than for purposes of expanding the frontiers of scientific knowledge or for practical purposes such as commercial or military application. But the year also turned the corner on this situation. In July 1899, the American Electrician carried the first actual article on constructing wireless equipment. Previously published material had all been strictly scientific in appeal. In that year, Ray Stannard Baker in his The Boy's Book of Invention gave a layman's description of the work of Marconi and his predecessors. Obviously, the title of his book suggested the group that the new technology was beginning to fascinate. Within less than a year, accounts began to appear of pure hobbyists, often very young people, who were experimenting with communications without wires. They were using the techniques that just a few years before were pioneered by the scientists and commercial interests such as those described in our presentation.

Just to add one more claim to fame for the year 1899, Lee DeForest received a doctorate from the Sheffield Scientific School of Yale University. His research thesis was on the topic "Reflection of Hertzian Waves from the Ends of Parallel Wires."

The equipment used in these various starts for radio communication in the U.S. was all basically the same and state-of-the-art for the time. A simple radio frequency generating device, a spark gap, and equally simple detecting device, a coherer, comprised the hearts of the apparatus. Tuning circuits were not used; the antenna's length being the closest approximation of a frequency determining device. Power for the spark came from an induction coil fed by storage batteries (or conceivably a transformer and AC supply); the primary [of the coil] being keyed to convey intelligence. The coherer detector typically closed a relay that was a portion of a moving-tape ink recorder- thus a written record was produced of the telegraphic dots and dashes. This could have been replaced by a telephone receiver for audio reception. Grounded antennas, with both vertical and horizontal components utilized for transmission and reception, were used. Sometimes these were temporary installations using kites or balloons for elevation. Wavelength would typically be in the present day AM broadcast band of 200 to 550 meters or longer. Lack of tuning and the breadth of the spark signal precluded more than one station within range operating simultaneously. Sometimes this led to skullduggery between rivals in operation.

In summary, when 1899 began all practical demonstration of radio communication had occurred only in Europe. Knowledge of this was widely disseminated around the world, but only a bare minimum of scientific laboratory work of this nature had occurred in the U.S. By the end of the year, the Army Signal Corps had two working communication links installed using equipment it had fabricated, the Lighthouse Board had demonstrated to themselves the potential value of the new technique and did it with equipment furnished by the first the American wireless equipment manufacturer, and the Weather Bureau indicated interest in creating a network of stations for their work. Furthermore, a group of amateurs in San Francisco hastily improvised a working installation in that area to give advance warning on an important news event. All this in addition to the arrival of Marconi in the U.S. to show how his equipment could cover news of an important yacht race. After his success with the yacht racing, temporary installations were made on Navy facilities to show what they could do in the vital area of naval communications. Amateur enthusiasts began to emerge when aroused through popular literature aimed at the non-professional public, and several wireless corporations were formed. All of these activities eventually became known to the average American through coverage by the popular press and found great acclaim from people more and more eager to exploit the potential of the new communications medium.

The best accounts for the activities of 1899 in the U.S. are found in the Navy's *History of Communications- Electronics in the United States Navy* published in Washington DC, 1963.

The Squier story is in *A History of the U.S. Signal Corps* , by the editors of Army Times, NYC, 1961.

The amateur story is found in the *American Radio Relay League's Two Hundred Meters and Down, The Story of Amateur Radio* by Clinton B. DeSoto, West Hartford, CT, 1936.

The California story is in *Electronics in the West, The First Fifty Years* by Jane Morgan, Palo Alto, CA, 1967.

Two good biographies: *Marconi, The Man and His Wireless* by Orrin Dunlap, NYC, 1937

Marconi, Pioneer of Radio by Douglas Coe, NYC, 1943

Coherer Explanation

Bart Lee

Not too much contemporary literature exists that describes the equipment of 1899, much of which was proprietary or governmental. The amateur radio literature that began to appear around 1908 often described simple homemade equipment that was almost identical with that used by the pioneer experimenters of ten years before. Especially good are the books by Victor Laughter and Alfred Morgan and the magazines of Hugo Gernsback.

The French scientist Edouard Branly (1844-1940) invented the coherer as a device for electrical experiments in the 1880s. The device holds filings of one or more metals such as silver and nickel between the faces of two cylindrical rods, in an evacuated chamber, usually glass. It is thus the earliest vacuum device after the light bulb and the Edison-effect device of a light bulb and a plate inside of it. It predates the vacuum tube diode "valve" of Dr. Ambrose Flemming by about 15 years and the vacuum tube triode "Audion" of Dr. Lee deForest by a couple more years.

The principle of operation of the coherer is not electrons in a vacuum and it is not semi-conductance as we know it in silicon transistors and chips. When radio-frequency alternating voltage appears across the two cylinder faces between which rest the filings, a direct current can begin to flow between the two cylinders. The radio-frequency voltage seems to drop the surface resistance among the filings, in the same way a detergent or surfactant such as soap decreases the surface tension of water molecules. The particles seem to cohere together, and thus conduct electricity better. When the resistance among the filings goes down, the direct current can flow through them. The resistance among the filings remains low after this change, whether or not the radio-frequency current continues, and irrespective of how long the direct current flows. The coherer is thus a one-shot, on-only detector of radio waves, and the first detector of radio waves after Dr. Heinrich Hertz's loop with a spark gap.

The coherer was adapted to signaling service by application of feedback. The direct current that flowed through the coherer was routed through not only a recording device (such as a telegraph inker with continuously running paper tape) but also through an electrical bell mechanism. That current caused the tapper arm of the bell to move, as it would to ring the bell. That tapper arm was positioned to tap the coherer, gently, which tap de-cohered the filings. These filings then resumed their natural relatively high resistance to electrical current. It is the need to tap the coherer after each pulse that implies that the device continued to conduct direct current whether or not the radio frequency voltage ended.

If and when another pulse of radio-frequency energy came along, the filings once again cohered together, the current once again flowed to the recording device and the tapper, and the coherer thus prepared itself for yet another pulse of radio energy. Inasmuch as the tap happened as soon as the pulse went through the filings, the beginning of each signal restored the coherer. Using the Morse code, the signals pulsed out in radio energy provided different patterns in time, with greater or lesser delay between a pulse and the next pulse, depending on whether the pulse was a long one, a "dash," or a short one, a "dot." The dash and dot appearance of telegraph signals came from the ink recorders in use on land-lines and marine cables, in which the length of the pulse determined the length of the inked line.

This information suggests that the coherer would thus present an "S" (•••) as three closely spaced direct current pulses followed by an absence of a next pulse, something like •••_, where the glyph "_" is merely a place-holder for a dot-length of time with no signal in it, analogous to the glyph zero ("0") as a place holder in calculation. Thus the letter "O" (— — —) as three widely spaced, i.e., longer-in-time direct current pulses would look something like: •___•___•____. Other letters had various unique patterns of close and wide spaced pulses. The rhythm of telegraphy was steady enough, as if sender and receiver were operating at the same "clock-speed," so that different letters could be distinguished from this data. In this aspect, looking only at the beginning of each pulse, however long, Morse code is an entirely binary code of on and off at a given rate of time.

Soon after the coherer came into use, wireless operators found that they could copy the messages without an inker from the sequence and timing of the sounds of the tapper. The tapper's sounds resembled that of a land-line telegraph "sounder," although that latter device made one sound at the beginning of the pulse, and then a different sound at the end of each pulse. The coherer's tapper made its tap at the beginning of each pulse whatever its length.

Soon telephone receiver earpieces were employed to hear the combination of the direct current flowing through the coherer and the radio-frequency's audio "hash" modulation. Originally, Branly had used a galvanometer and battery circuit to detect the change in the coherer's resistance, and hence the radio-frequency pulse. Some experimenters used telephone transmitter carbon granule microphones as radio-frequency detectors. Others used carbon battery rods on knife edges. By 1907, "crystal" detectors of carborundum and silicon, providing audio to a telephone earpiece, had replaced the coherer and the devices that followed it, such as the Flemming valve and Gugliermo Marconi's magnetic detector. With the invention of radio-frequency regeneration by Edwin Howard Armstrong in about 1914, the deForest Audion became the commercial detector of choice. In 1909, Branly shared the Nobel prize with Marconi. As late as the 1950s, a Japanese radio control toy used a coherer circuit.

(415) 956 5959
Correspondence is invited.

ARCTURUS RADIO TUBE COMPANY

NEWARK, NEW JERSEY

ARCTURUS

The Coherer- Early Detector with Lots of Inventors

Roy and Kathryn Tucker

The first practical detector of radio waves was the coherer. This statement of course ignores Hertz's sparking ring that responded at a maximum of a few feet from his RF generator. Oddly enough, the coherer was reasonably well developed before any practical application was found for it in communication. Further, at least nine individuals contributed to its development before it became the detector in a working wireless communications system-that of Marconi.

The coherer detector operated on the principle of the coherence (tight adherence) of certain powdered metal in the presence of radio energy. This lowered resistance in a locally powered DC circuit which could actuate a responding instrument such as a sounder, tape register, telephone receiver or any other device that gave an audio or visual indication of current flow. Sometimes they were even used to start motors running or shoot off cannons!

As far back as 1835, an individual named Munk observed that a mixture of tin filings, carbon and other matter in a loose condition would be non-conductive normally, but would become conductive when a discharge from a Leyden jar condenser was passed through it. Pierre Guitard in France made a significant discovery in 1850 when he observed that dust particles tended to cohere into little clusters or strings when dusty air was electrified. Guitard neither understood the origins of the strange behavior or found any use for it, but he was on the path of the electrical dust-particle precipitator without knowing it.

The first practical step in the invention of the coherer was made in 1866 by S.A. Varley working in England. His goal was to perfect a lightning arrestor for telegraph lines that would send a lightning strike to ground while not grounding out the lines during normal use. He found loosely packed carbon and tin filings would stick together in the presence of lightning and pass electric current. His lightning arrestor used this principle to ground telegraph wires only when a lightning strike occurred. Soon after the strike, the filings would loosen up and disconnect the grounding circuit. While Varley did not understand what caused his arrestor to conduct, or even that the giant lightning spark was producing electro-magnetic waves, the existence of his device became widely known. It was remembered after Hertz's achievements were announced and better detectors were sought.

David Hughes in England in 1878 produced a "pre-Hertzian" demonstration of electro-magnetic wave generation and detection. If he had better understood what he was doing, and had more widely disseminated his findings, he might have taken on the credit bestowed on Hertz a decade later. His RF energy was generated by the discharge of a Leyden jar and it was detected by the cohering of loose zinc and silver filings. Strangely, there was no general disclosure of his experimentation until other investigators had made wireless information known. Hughes was much better known for his work in perfecting the carbon microphone. From the same nation as Hughes, and just a year later, Lord Rayleigh found some related phenomena as had the earlier investigators; this time it concerned meteorological considerations. This involved certain patterns of snowflake formation under the influence of atmospheric electricity.

In Italy, Calzecchi-Onesti in the year 1884 published an article explaining the cohering of copper filings when subjected to a high-voltage discharge of electricity. Soon all of the knowledge of these earlier workers would itself begin to adhere in the mind of the one individual generally credited as the coherer's inventor, Edouard Branly of France. When Branly by 1891 had completed his version of the coherer, he knew of Hertz's demonstration of electro-magnetic waves. He was so close on the heels of Hertz in experimenting it sometimes has been stated that he was the second individual to demonstrate Hertzian

waves and was sufficiently more advanced from Hertz that he was entitled to the designation as the first true wireless communicator. Branly always denied this and stated that Marconi's work a few years later was the first truly practical wireless communicator demonstration.

Branly, while primarily a physicist, practiced medicine on the side and explained that his knowledge of the workings of the human nervous system gave him his inspiration for the coherer. The comparison was with the neurons of the nerves which rather than continuous fibers were actually massed closely but not necessarily in contact, and they transmitted "messages" back and forth to the brain. Branly's coherer resembled the later ones used in practical work by others except it lacked certain refinements. It consisted of metal filings placed between metal plugs in a glass tube. A series circuit powered by batteries connected to the two plugs. A sensitive meter inserted in the circuit indicated current flow in the presence of Hertzian waves. A tapping on the tube was found necessary to break up the conductance before the next RF signal could be detected.

A few months before Marconi began serious experimentation, Sir Oliver Lodge in Britain began to improve Branly's device. His work in 1894 in generating and detecting Hertzian waves has also led to the same claim as some of the partisans of Branly, that he (Lodge) was the true "second place" developer of radio knowledge after Hertz. Lodge fitted his tube of filings with a clockwise mechanism which tapped the tube continuously to jar the filings loose between reception of spark signals. This was called decohering and also restoring. While all these discoveries and inventions from Munk onward could be referred to as coherence or coherers, the formal name by which these go down in history was not used until Lodge conferred the name coherer on his version. A public demonstration of his full transmitting and reception system was made in 1894.

The final pre-Marconi development of the coherer, and an important one, occurred in Russia. Again, a possible "number two" to Hertz in wireless research presents itself in the work of Alexander Popoff, also in the year 1894. He was attempting to develop apparatus to detect distant thunder storms. He found that a coherer detector could ring a bell as a result of lightning strikes at a distance, somewhat akin to Varley's finding for direct lightning strikes. Popoff's coherer was rigged in such a fashion that the responding bell clapper not only rang the bell, it tapped the coherer tube to knock the filings loose. Most future coherers of whosever design would utilize such a decohering device although not always doing double duty as an audio responder. Although not appreciably improving on it, Captain Henry Jackson of the British Royal Navy was using a Lodge coherer in the mid-1890s in his attempts to develop wireless signaling for naval communications.

Marconi's work began in 1894 after reading an obituary of Hertz. Deciding to couple Hertz's transmitter with a better receptor than Hertz's resonating ring, Marconi chose the coherer of Branly. He knew of its advantages since it had been able to respond as far as 200 feet compared with only a few feet for the ring of Hertz. The first efforts of Marconi, with strictly home-made components, produced transmissions which could ring a coherer's bell at 30 feet. A redesign of the coherer produced substantially improved results. The best filings were found to be 95% nickel and 5% silver ground as fine as dust. The gap between the contact plugs was narrowed to the thickness of a piece of paper. He found that one refinement of his own invention made a tremendous improvement: this was to exhaust the air from the tube. Among other things, this tended to retard any oxidation tendencies. It was also found desirable in all designs to insure against moisture.

With the improved coherer, Marconi began to get ranges in the hundreds of feet. He also replaced his original switches and bells with telegraphic keys and sounders, thus beginning true communication of intelligence (by way of Morse code). The vacuum coherer design of Marconi more or less ended development work on the detector. He was able to reach ranges up to almost two miles while still experimenting in Italy. In 1896, he moved his base of operations to Britain and soon obtained a patent on his complete communicating system, including the use of the coherer as detector. A range of 150 miles had been reached in 1900 while still using relatively low-power transmitting stations. Much of his extending of the communication range had been done by improved antennas rather than by any improvement in the receiving device.

Most experimental work of all the wireless pioneers until the early 1900s used the coherer or related devices. It was used in the famous trans-Atlantic sending of the letter "S" Marconi accomplished in late 1901. All of the initial radio communicating in the U.S., starting in 1899, used coherers. Despite development of other detectors from about 1902 onward, it had some serious use in communication until about 1910. A few amateurs used it even longer.

There was one post-Marconi development in the coherer, a sort of finale to improvements in a device that clearly had a ceiling on refinement. This involved the work of two inventors in Italy, Castelli and Solari, working to improve the apparatus in use by the Italian Navy. Their version consisted of a drop of mercury in a tube between two steel plugs. This provided for self-restoring and eliminated the constant problems associated with decohering.

Mercury was also the conducting medium in The Lodge-Muirhead coherer developed in the early 1900s in Britain, but this device was so much removed in make-up from that of Branly/Lodge/Marconi as to be considered virtually of a different type.

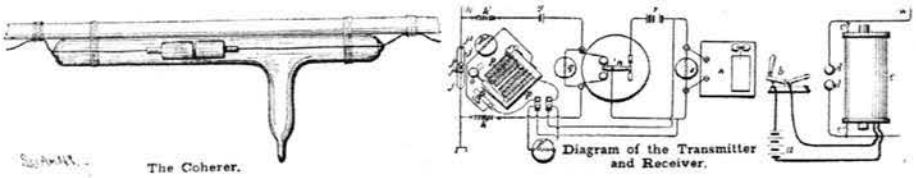
A book published in 1909 by Victor Laughter states that while the coherer had been superseded by other detectors of an improved nature:

> the only system at the present employing it [coherer] for com mercial use is the Slaby-Arco. As the Slaby-Arco coherer is of the most improved type it can be taken as the standard...

The Slaby-Arco Company had merged with several other German electrical interests a few years earlier to create the still existing giant Telefunken Corporation. In 1903, Slaby-Arco won out over all other competitors in bidding to supply the initial wireless equipment for the U.S. Navy. Range and reliability were the chief factors in granting the bid. Apparently their coherer was the superior one as this form of detection bowed out. The description given by Laughter does not suggest, however, any dramatic change from that developed by Marconi a number of years before. He does mention that the German detector had sloping contact plugs in the tube so that they would allow different adjustments to be made for the filings by revolving the tube. Platinum wires were soldered to the plugs which made contact with the filings of oxidized nickel silver alloy. Laughter stated that a principal advantage of the Slaby-Arco was its ability to work with a Morse register, but actually this ability had been demonstrated by others as much as ten years before.

The big drawback of the detector brought forward by Branly and improved by others was its low sensitivity, lower than any other device except the Hertz resonator. The requirement of mechanical decohering was a constant burden. Nearby electrical disturbances (atmospherics) or mechanical shock triggered unwanted response. Of course this was exactly what Popoff had in mind when it came to his storm detector. The coherer was also only an on-off device that could respond solely to telegraphically interrupted radio signals, not ones of varying strength such as radiotelephony modulation. Even copying radiotelegraphic signals left a lot to be desired since the coherer would not return to its reception mode very rapidly and only fairly low speed Morse could be copied.

The diagram below shows the coherer as first used by Marconi and others, an untuned input circuit, and various possible indicator devices. Chokes were often inserted in the two lines feeding the responding devices to separate radio energy from the DC supply. As demonstrated by Popoff, it was possible to couple the decohering tapper with an audio indicator such as a bell or buzzer. The most sensitive operation was when a telephone receiver was listened to for clicks rather than having a register produce a printed record on tape. The telephone receiver method was utilized by Marconi and his two assistants in receiving the 1901 trans-Atlantic signals. because no permanent record was produced, some persons later would question whether the signals had truly crossed or perhaps only imagined reception took place. On the other hand, when interference was received, the garble of signals simply would produce one continuous dash, but conceivably audio reception might distinguish one signal from another.



The Coherer.

Diagram of the Transmitter and Receiver.

In the course of the 1890s and early 1900s, diligent efforts were made to produce a "syntony" system (tuning) to avoid reception of unwanted wavelengths. The earliest of these were used in conjunction with coherer detection. Lodge's earliest tuner involved the type of device eventually designated a loose coupler. Marconi's tuner placed a variable condenser in the circuit along with the inductance. The later diagrams show such tuning arrangements.

Today, a coherer on the antique collector market will bring a fabulous price. Its simplicity, coupled with numerous "do-it-yourself" articles published for amateurs from about 1899 to 1912, will make it a reasonably easy task to produce a working replica for those not able to acquire an original. It would not be an anachronism to include a resonant tuning circuit to feed a coherer detector today since these were in the process of becoming popular at the end of the coherer age; this thanks to the "syntony" discoveries of a plethora of investigators including Lodge, Tesla, Braun, Pupin, Marconi, DeForest, Stone, and others. Almost immediately following the 1901 trans-Atlantic "spectacular" of Marconi, he and others brought forward improved detectors which quickly terminated use of the coherer for those who wished state-of-the-art detecting devices. The magnetic, electrolytic, and mineral detectors, plus still others, came in short order as the first decade of the century wore on. As late as the 1920s, though, school scientific supply houses were selling coherer receivers to demonstrate to students how it all began for radio back in the 1890s.

As a sort of the "last of the Mohicans" version of the coherer, there was a limited use in the 1920s and slightly before of something called the filings detector. This appeared to be the classical coherer of twenty years before, minus any need for decohering, but the appearance was deceiving. It really was a rectifying, rather than a conducting, device. Elmer Bucher of RCA described it in one of his numerous books of the era. He stated it had some use among amateurs.

The filings detector consisted of a tube with brass electrodes that was connected in a receiving circuit in a somewhat different place than the original was placed, but there was one significant difference in the device. The filings which filled the approximately 1/4" space between the plugs was filled with scrapings from any of the well known crystal detecting minerals such as galena or silicon. To find a sensitive point, equivalent of adjusting a cat's whisker, the tube was rotated until the tumbling filings indicated high sensitivity. Even a few brass and nickel filings were added to the mineral scrapings. Some of these detectors were used in conjunction with a local battery similar to the type of circuit often used in normal mineral detectors, especially the carborundum detector that always required a local EMF source. Although primarily functioning in the same fashion as the more conventional mineral detector, it would appear that both cohering of the filings as well as semiconducting characteristics of the crystal material account for the detecting action. Unlike the earlier coherer, this one could detect radiotelephony signals. Without decohering facilities and a local DC circuit, it would appear to not be able to detect continuous wave signals.

Contemporary or near contemporary accounts of the coherer can be found in the following:

Laughter, Victor. *Operator's Wireless Telegraph and Telephone Handbook*, Chicago, 1909.

Erskine-Murray, James. *A Handbook of Wireless Telegraphy*, New York, 1907.

Stone, Ellery. Elements of Radiotelegraphy, New York, 1919.

Loomis, Mary. *Radio Theory and Operating*, Washington D.C., 1925.

Detailed historical accounts including pictures and diagrams of equipment as follows:

Howeth, L.S. (ed.). *History of Communication-Electronics in the nited States*, Washington D.C., 1963.

Constable, Anthony. Early Wireless, England, 1980.

Accounts of radio personalities as follows:

Dunlap, Orrin. *Radio's 100 Men of Science*, New York, 1944.

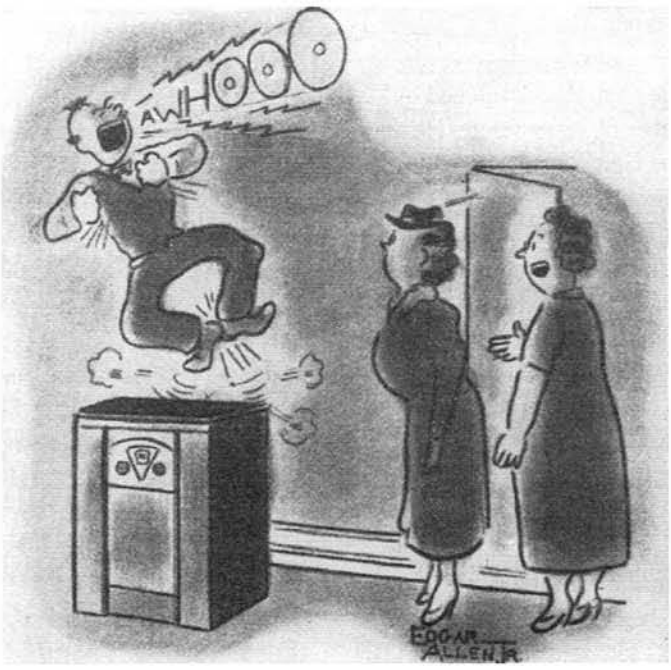
Coe, Douglas. *Marconi, Pioneer of Radio*, New York, 1943.

The filings detector and various construction details as follows:

Bucher, Elmer. *The Wireless Experimenter's Manual*, New York, 1920.

Morgan, Alfred. Publications prior to World War I.

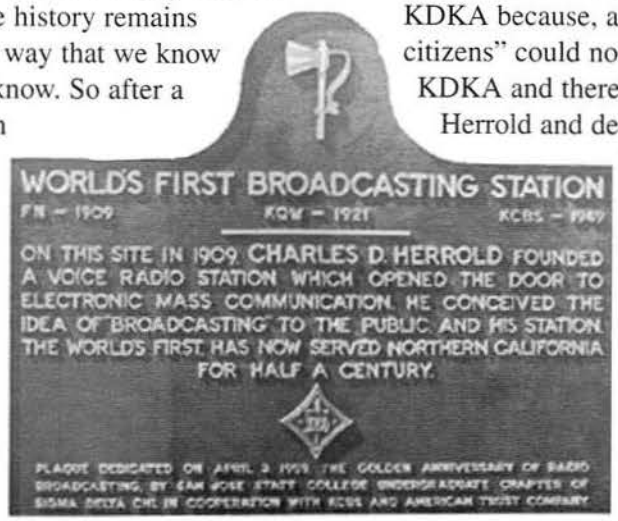
Reprinted with the kind permission of Kathryn K. Tucker AA6TK and Roy T. Tucker N6TK.



"Still No Respect"

by Mike Adams
adams@email.sjsu.edu

Charles Herrold is not a household word. I'll bet my State pension that most CHRS members still believe that broadcast radio suddenly began, fully formed, in 1920 on KDKA. My grown kids still think George Washington chopped down the cherry tree, so sound bite history remains the major way that we know what we know. So after a half dozen articles in radio history journals (CHRS, SCARS, AWA, ARC), a PBS documentary, a Charles Herrold Day declared by the Mayor of San Jose, a web site and a book, you still don't know the real story. I have tried hard, following in the footsteps of retired San Jose State University professor Gordon Greb, trying to get the guy known by at least some of you.



It gets worse. I shouldn't be too surprised, but after spending years researching Herrold and other pre-licensed broadcasters in the 1900-1920 era, I receive for my work in a special ceremony in a parking lot at Ampex the coveted "CHRS Herrold Award," but on the plaque the word Herrold is misspelled as "Harold." At the AWA Conference I get the very prestigious Houck Award for Historical Documentation, for my work on Charles "Herold," another spelling gaffe. Still, I thank the historical community and I proudly display these awards, spelling notwithstanding.

Some of the misunderstanding surrounding the "who was first" broadcasting claims can be traced to historians who should know better: In 1921 George Clark, the RCA in-house historian, dismissed the claims of all before KDKA because, as he wrote, "ordinary citizens" could not buy radios until KDKA and therefore men like Herrold and de Forest were not really broadcasters because their audiences were technical, ham types, not "citizens." (the reality from my research is that for the first 3 or 4 years after KDKA, most listeners were still using and building home-brew sets) And between 1958 and the 1980s, Herrold proponents at CBS and civic boosters in San Jose were stubbornly trying to convince the world that Herrold was the first broadcaster or the first to play music on the air or even the first to get a license after WWI. None of those claims are true. By the way, and you heard it first here: the two warring stations over who was first, Westinghouse and KDKA and CBS and KCBS are now owned by the same company. Ha! Let's see them fight over that one.

So I have been asked by your editor to re-introduce Charles Herrold, to point you toward the Website, and to shamelessly beg you to buy the completed-but-not-yet-published Herrold book, co-written with the aforementioned professor Greb. Some of the text and accompanying photos that follow can be found on the Web:

http://www.ksjs.org/herrold

Charles David Herrold was born in 1875 in Illinois. His family moved to San Jose, where his father became a successful apricot farmer. They lived in a Victorian-style house downtown on Fifth near Washington, three blocks from my San Jose State office, a house that remains unchanged today. Charles attended San Jose High School, then located on the SJSU campus, then known as the State Normal School. It was there that he began to be recognized by his teachers for his superior grasp of mechanical and scientific subjects. He constructed telescopes and microscopes and excelled in photography. And, typical of a young man at the turn of the century, he learned about the early wireless successes of Marconi and others. He hung out at nearby Lick Observatory and planned a career in astronomy.

Could I have the first slide? (1) This a high-school aged Charles with a telescope of his own construction. After high school he attended Stanford but was forced to give up astronomy when its only professor quit. He switched to physics, wireless and radio. After three years he dropped out for health reasons, moved to San Francisco and began to invent and manufacture electrical and mechanical devices for dentistry and surgery, deep sea salvage and pipe organs. When the 1906 earthquake destroyed his home, he left San Francisco for Stockton where he became a teacher at Heald's College of Mining and Engineering. There he began to experiment with radio-telephony. He also began to think about how he could use the wireless to send entertainment into homes.

In 1909 Herrold opened a vocational school in what is now the heart of Silicon Valley, downtown San Jose. The Herrold College of Wireless and Engineering was immediately popular with the young men who were excited about the new wireless hobby. Boys who nicknamed him "doc" (he did not complete a degree) or "prof" knew that training at the Herrold College could lead to a well paying job as a wireless operator. Herrold used the money earned from training students to pay for his true passion of inventing, specifically trying to give a voice to the wireless telegraph. Beginning in 1909 with a crude spark gap transmitter, Herrold began to experiment with daily transmissions of music and talk. In 1910 Herrold submitted a notarized statement to an electrical publication saying, "We have given wireless phone concerts to amateur wireless men throughout the Santa Clara Valley." That published statement, by the way, is just about the only early reference I've found to what is generally accepted today to be broadcasting for an audience on a scheduled and regular basis.

(3) Herrold married a young woman named Sybil in 1912 and she created a weekly show using the latest version of the Herrold transmitter, now with Poulsen-like DC arc technology. By 1913, Charles was employed as Chief Engineer at the National Wireless and Telephone Company of San Francisco, his job to create and patent a wireless telephone system for two-way use. The famous Herrold photo of that time, (4) shows he and his students "on the air," a crank up phonograph "acoustically coupled" to the patented Herrold microphone. This photo was the basis for the reconstruction of the Herrold station displayed (5) at the Foothill College Electronics Museum, and for years wrongly labeled as KQW. Some of the important pieces are original, collected by Douglas Perham in the 1930s/40s. The coils are fake, the arcs do not exist except in photos (6). The water-cooled microphone is real, one of several in the Perham collection. I took one apart and photographed the insides, in (7) the six carbon button elements in series, and in (8) the two protruding connections are for the circulation of water used to cool the mic during its use in a high current DC arc circuit. I can add here that the Herrold Web site has a page of detailed mic photos and the book has everything there is about the Herrold devices and their patents, a half dozen in all. A great book, "I couldn't put it down."

From 1912 through the start of World War I in 1917, Charles Herrold and his students continued to have fun with the radio station, presenting daily "wireless concerts" for listeners in Santa Clara Valley, taking requests and dedications for records, entertaining their friends, parents and a small audience of hobbyists and set builders. Except for the set building, that is exactly what my students do every day over the SJSU station I supervise, KSJS, 90.5 FM. There can be no argument that Charles Herrold was the first college broadcaster, supervised the first college radio station. I can identify.

This is what you should know:

The significance of Herrold is that he was the first to use radio to broadcast entertainment programs to an audience on a regular and pre-announced basis. He started the first radio station. He was not the first to broadcast pre-announced to an audience, that was Fessenden in 1906; he was not the first to broadcast election returns, that was de Forest in 1916; he was not the first to get a US broadcast license, that was Conrad and KDKA. Herrold's claim was that he continued on a regular schedule until the War forced him and all others off the air. After the War, the arc method of transmitting music and voice was replaced by the vacuum tube, and by 1921 Herrold was licensed as KQW, San Jose, now KCBS. Herrold ran the station until 1925, free-lanced at Bay Area stations until the mid-30s. During WWII the aging Herrold worked as a janitor at the Oakland shipyards, and he died in a rest home in Hayward in 1948, age 73.

But sad as the story is, and you will cry during part of it, Herrold did seem to have the last laugh as an inventor. In this photo (9) is a Herrold-invented device which is probably some sort of antenna coupler, also shown on page 39 of Greenwood's 1961 book, "A Pictorial Album of Wireless and Radio, 1905-1928. Little did the innocent and long suffering Charles Herrold realize that he had in 1920 invented the prototype for today's Compact Disc case! Thank you Charles, Now can we give the guy some respect?

Fig.1

Fig.2

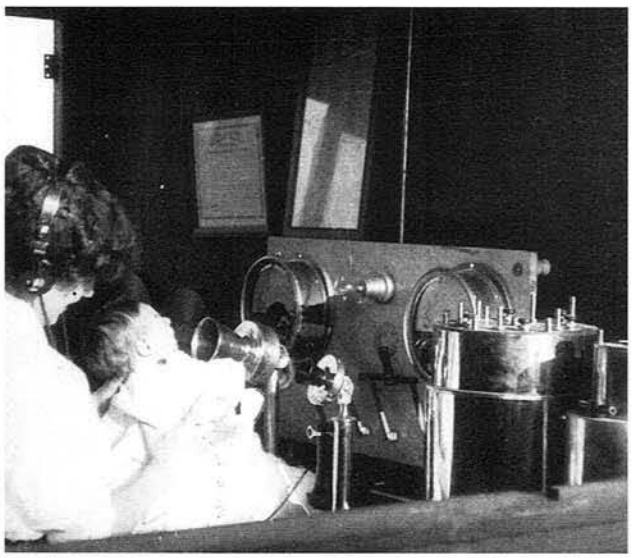


Fig.3

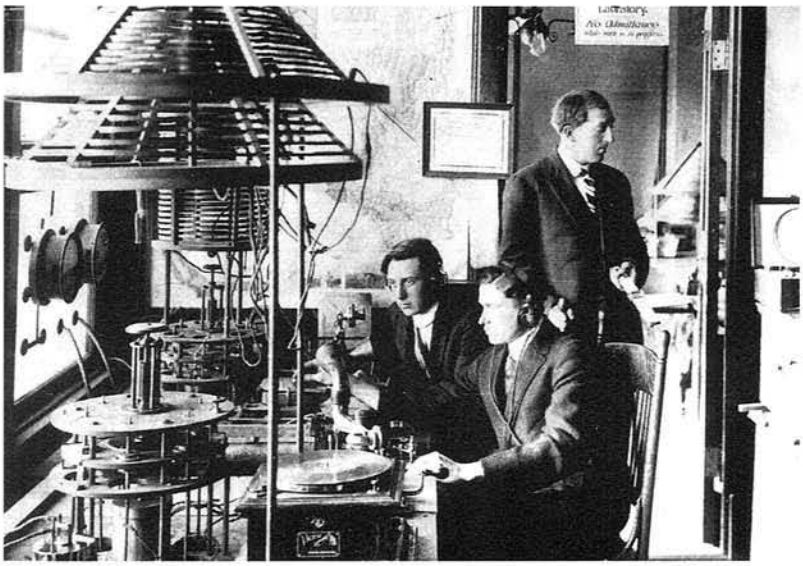


Fig.4

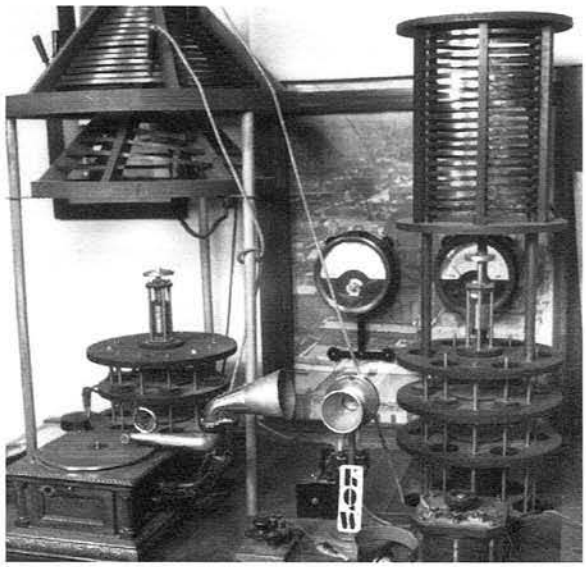


Fig.5

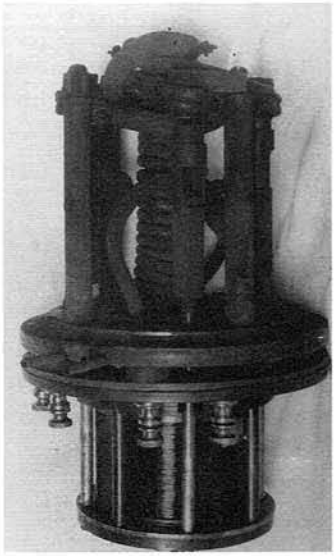


Fig.6

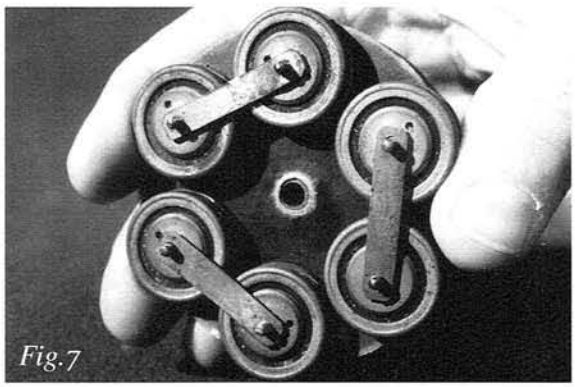


Fig.7

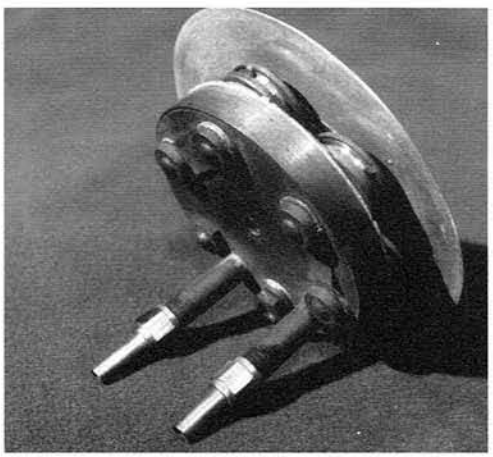


Fig.8

Fig.9

RCA Tube Production Harrison, New Jersey 1930-1976

by Charles Kittleson - Editor/Publisher, Vacuum Tube Valley Magazine

At one time, Radio Corporation of America (RCA) was the largest and most powerful electronics company in the world. They were involved in many of the early developments in radio, broadcasting, movie theaters, sound reproduction, television and countless other electronic innovations. This article covers vacuum tube manufacturing at their Harrison, New Jersey facility and is only a small part of the vast history of this technological giant.

The Forming of RCA

Radio technology played a major role in the Allies winning World War I. Radio was also instrumental in ship navigation and communication. The government had taken over all of American Marconi's coastal and inland stations for wartime use but did not want a foreign company to manufacture all the wireless equipment. In 1919, Radio Corporation of America (RCA) was formed and it took over the assets of the American Marconi Company. Patents relating to vacuum tubes, transmitter design and receivers were held by AT &T, GE and RCA . In July 1920, an agreement was reached between the three companies to permit RCA to use the radio patents of all three companies. The first popular tube developed and marketed by this group was the UV-201 triode. GE originally developed the UV-201 and RCA began marketing it in December 1920. It was distributed under the Radiotron name in the east and under the Cunningham label in the west. In 1921, Westinghouse, which held some of the Armstrong and Pupin patents, joined the RCA group as a cross-licensee.

In the early days of radio after World War I, RCA acted as a research and development and selling agency for radio related products and vacuum tubes. Before 1930, RCA was merely a vendor. The actual manufacturing was done entirely by other electrical manufacturing companies. General Electric of Schenectady, New York and Westinghouse of East Pittsburgh, Pennsylvania manufactured RCA radio receivers and receiving tubes. RCA-branded tubes were also manufactured by General Electric at the old Thomas Edison lamp works in Harrison, New Jersey. Some of the first receiving tubes marketed by RCA were the types UV-200 and the UV-201. Later RCA-branded types included: WD-11, UX-201, UX-120, UV-199, etc.

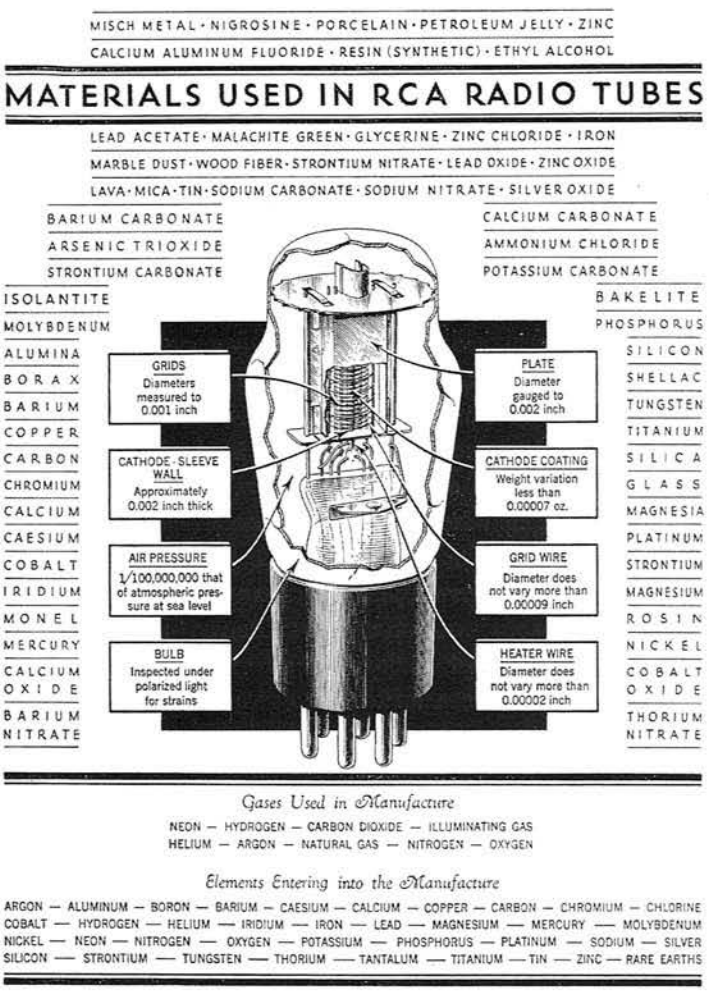
AT&T, RCA, GE and Westinghouse (the Big Four) had a monopoly on the electronics and tube business in the USA. They were the holders of most of the important patents, and other companies were promptly sued and put out of business if they tried to put up a challenge. RCA had hundreds of industry "watchdogs" and spies who reported patent violators to their army of corporate attorneys.

In the late 1920s, the "Big Four" agreed to consolidate their efforts to reduce duplication of R & D and manufacturing efforts. RCA concentrated on radios and receiving tubes, GE and Westinghouse concentrated on transmitters, industrial and transmitting tubes.

This arrangement lasted until May 1930, when the government sued RCA claiming their arrangement was a "restraint of trade." The litigation lasted until November 1932 when the consent decree was issued by the courts. The judgment permitted the companies in concern to engage in open competition after May 1935.

RCA At Harrison

On January 1, 1930, RCA completed the consolidation of RCA Victor (Camden, NJ) and Radiotron (Harrison, NJ). RCA then began to manufacture tubes under the Radiotron brand at Harrison.



Elmer T. Cunningham was the RCA representative on the West Coast from the very beginning. Cunningham had a great reputation for his tube products and in 1931, the Cunningham Company of San Francisco, California was taken over by RCA and consolidated into the RCA Radiotron Company. In 1933, Cunningham became president of the RCA Radiotron Company. Because of Cunningham's great reputation, he was able to convince RCA to have their tubes branded with his name to be sold on the West Coast until the late 1930s. In 1934, RCA purchased the then defunct De Forest Radio Company. This gave them an avenue to begin the manufacture of transmitting tubes in Harrison and other locations.

An Inside Look at Tube Manufacturing

From the beginning, RCA's goal was to dominate the tube market. This driving force allowed them to be successful in the tube business for 46 years. Let's look at what went into the manufacturing of RCA Tubes.

Raw materials obtained for manufacturing tubes were of high purity. There were sixty-five various types of metal, chemical compounds and gases used to manufacture tubes. This is in addition to up to forty separate and distinct parts, which were assembled with the utmost care and precision.

Samples of raw materials were pre-tested for purity by the Inspection Service Department. Materials that passed the inspection were then processed, built into parts and assembled into sample tubes. The sample tubes were then tested and retested to reduce potential for failure in the field.

Spot checks were made on each individual operation and part. In the Quality Control Laboratory, a double check was made on all spot checks to insure only the best tubes were sold to customers. Tubes were then placed in life test racks and operated for a period of 500 hours under extreme conditions. These tubes were then checked for changes and a detailed report was compiled.

When finished tubes passed the rigid inspections of the QC department, they were packed in sealed cartons. Before actual shipment, they were checked again to prevent tubes damaged in storage from being shipped out.

In the development laboratory, engineers were busy improving existing designs and researching new types. In Harrison, the research and development department occupied the largest section of the entire Radiotron Laboratory. According to company literature, only the most skilled and talented engineers were employed in the lab.

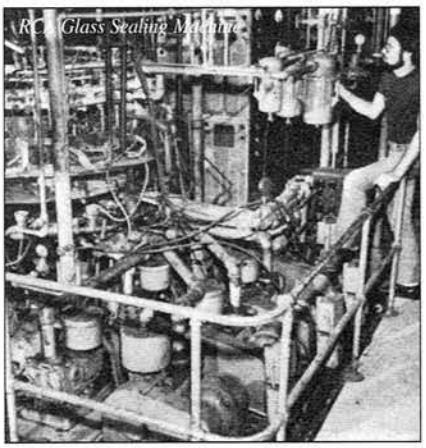

Tube Girls Burning in receiving tubes at Harrison in 1932

Tube Types Developed by RCA

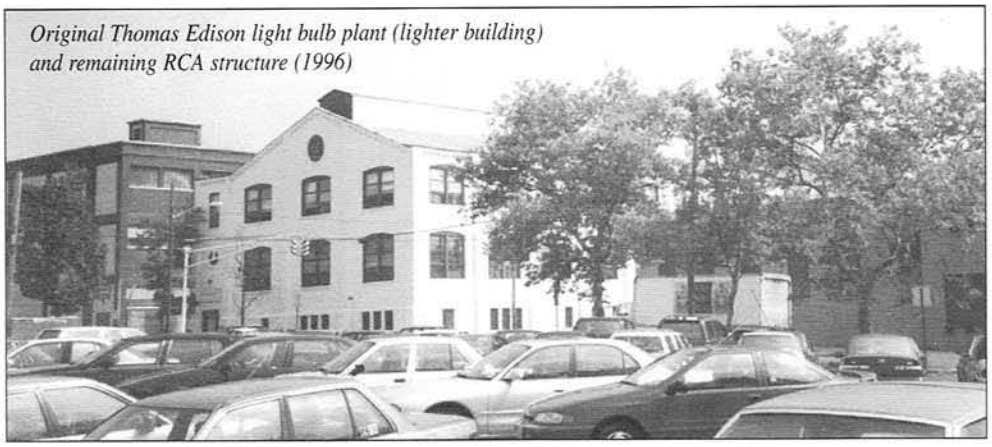
Even in the early days, many tube companies legitimately rebranded other manufacturer's tubes to sell under their name. RCA was no exception; they bought and rebranded tubes from GE, Westinghouse, Sylvania and Tung-Sol. However, RCA was responsible for introducing several popular audio tubes. By RCA's request, GE designed the 210 transmitting tube in 1922, which was put into production in 1925. The 210 was also used as an audio output tube in some radio receivers in the late 1920s.

Also, at RCA's request, Westinghouse developed the type 250 triode in 1928 for use as a high power audio section in expensive radios. Westinghouse introduced the type 245 triode in 1929 as a low cost, low power alternative to the 50. Although Westinghouse developed these tubes, literally all of them were branded RCA before 1930. The first RCA tubes made at the Harrison facility were the 2 volt filament types: RCA-230, RCA-231 and RCA-232.

In 1933, RCA in Harrison introduced the 2A3 triode power amplifier in single-plate version. Later it was manufactured in the more common double plate version. In 1935, RCA introduced the first successful metal tubes, initially developed by GE. Also in 1935, the first US" eye tube," 6E5, was introduced by RCA. In 1936, they introduced the famous 6L6 (metal version) and in 1937, the 6L6G glass version.



RCA Glass Sealing Machine



Original Thomas Edison light bulb plant (lighter building) and remaining RCA structure (1996)

RCA also came out with the 6V6 (metal) in 1937 and the 6V6G glass version in 1938.

In the mid-thirties, after De Forest was out of the tube business, RCA went into the transmitting business in a big way. Some of the more famous developments in this period were: RCA types - 805, 807, 810, 811, 813, 833 and countless others. These types were used in radio transmitters during the war and in civilian use afterwards in civilian applications.

During World War II, RCA was on the forefront of tube development for communications, radar, sonar and related defense electronics. Several additions were added to the six square block facility in Harrison. To supply the tube needs for the ever-demanding war effort, RCA ran production shifts around the clock, seven days a week. At one point, they employed 20,000 workers at the Harrison facility and were churning out tubes by the millions. This facility was, without a doubt, the most prolific producer of vacuum tubes in the United States.

After the war in 1948, RCA introduced versions of the 12AX7, 12AU7 and 12AT7 series of miniature dual triodes. In 1950, they introduced the 6146, a powerful and compact beam tetrode for amateur radio transmitters. Black and white and color television picture tubes were in constant development after the war. In 1950, RCA developed the very first color television picture tube in Harrison. Through the 1950s, hi fi was all the rage and RCA again got into the fray. The 6L6GC, a higher power version of the 6L6GB, was introduced by GE in the late 1950s. RCA introduced their famous "black plate" version of this tube shortly thereafter. Westinghouse introduced the 7591, a popular integrated amp and receiver tube in 1961. RCA sold their rebranded version of this tube and later made their own version. RCA never made an EL34 or 6CA7; they either rebranded European Philips EL34s or GE 6CA7s. RCA never made a 6550 type. Their 6550s were rebranded Tung-Sols or GE 6550As. Other hi-fi types introduced by RCA included: 6973, 7025 7199 and 7027A.

Television was in a major growth mode in the 1960s. RCA developed hundreds of television receiving tubes, Novar types and countless others. The Nuvistor, a small metal-ceramic tube resembling a transistor, was introduced by RCA in 1960.

RCA Tube Burn-in and Test Racks

The Giant Begins to Die

Throughout the 1960s, RCA continued to be a major player in electronics. However, things started to slow down in the early 1970s. In mid-1974, RCA announced that its newly introduced line of radios, phonographs and tape players would be its last. At that point, audio products had declined to less than 5% of RCA's consumer electronics business. This business sector was becoming crowded and there was continual downward pressure on prices.

In 1975, RCA dissolved its Electronics Component Division at Harrison and created two new divisions: Picture Tubes and Distributor and Special Products (D & SPD). D&SPD were responsible for worldwide distribution of replacement parts and tubes. Due to an industry shift to solid-state for nearly everything electronic and the steady decline in its receiving tube business, RCA closed its receiving tube plant in April 1976.

In November of 1976, the David Weisz Auctioneer Company held a 12-day public auction to liquidate all of the machinery, equipment, instruments and supplies at Harrison. This included all of the tube manufacturing equipment such as grid winders, cathode sprayers, test consoles, glass sealing machines spot welders, tube aging racks, etc. Also up for grabs were 650,000 square feet of buildings in one complex and 147,000 square feet at another site.

In August of 1996, John Atwood and I visited the Harrison site and observed only two buildings that remained from the original complex. The original Thomas Edison Lamp Works building still stands at South 5th and Bergen Streets, occupied by a clothing manufacturer. Another large building right next to it is occupied by Vo Toys, an importer of toys. The rest of the buildings were razed and an auto repair facility and a strip mall occupied their land.

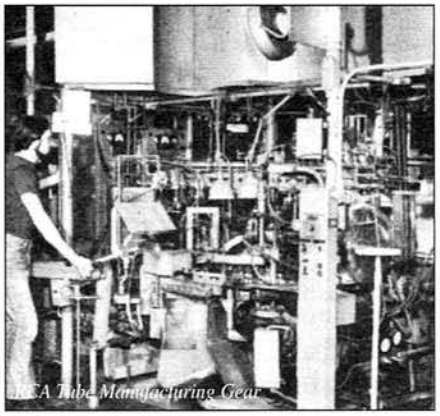
Bibliography:

1. John Stokes, 70 Years of Radio Tubes and Valves

2. Gerald F. J. Tyne, Saga of the Vacuum Tube

3. Bro. Patrick Dowd, History and Development of the All-Metal Radio Tube, AWA Old Timer Bulletin, June 1992

4. RCA Promotional materials from the 1930s through 1960s



RCA Tube Manufacturing Gear

RCA Single Plate 2A3

Bay Area Technical History Consortium

by Don Koijane President, The Perham Foundation

The Perham Foundation has taken the lead in creating a Bay Area Technical History Museum Consortium. Funded by the Packard Foundation, a two-year feasibility study is currently being conducted by a team of consultants that will lead to a full-fledged business plan.

CONSORTIUM MEMBERS:

California Historical Radio Society
Computer History Association of California
History Museums of San Jose
The Palo Alto Historical Association
The Sunnyvale Historical Association
The Computer Museum History Center
Museum of American Heritage
The Perham Foundation
The Tech Museum of Innovation
Hewlett Packard Archives
Intel Corp. Museum
Stanford University History of Science and Technology Collection

For more information please contact **Don Koijane** at (408) 734- 4453

Fry's Electronics History Exhibit

The Perham Foundation was asked by the management of Fry's Electronics to help with the theme for their new flagship store in Sunnyvale. The theme for the new store is Silicon Valley History- the first 100 years.

The Perham Foundation chose six local stories and collected the appropriate artifacts and photographs to create six separate exhibits. The exhibits are located in the book section of the Fry's flagship store at 10077 East Arques Avenue in Sunnyvale.

In addition to the six exhibits we selected 33 historical photos that were blown up to 8 ft. by 8 ft. and mounted around the periphery of the store. The six stories and accompanying exhibits are listed below in chronological order. Eighteen more exhibits are planned for the Arques Avenue store.

1909 The first electronics company in the West coast was the Poulsen Wireless Telephone and Telegraph Co. in Palo Alto. The name was later changed to the Federal Telegraph Co. Cyril Elwell, the founder and a Stanford graduate, started the company by obtaining the U.S. manufacturing rights to a Danish invention, the Poulsen arc. Their first product was a radio transmitter using the arc technology. The first Poulsen arc brought to this country by Elwell from Denmark is on display.

1911-1913 The first three-element vacuum tube, or triode, that could be used for audio amplification was developed by Dr. Lee DeForest at Federal Telegraph Co. Dr. DeForest called the tube the Audion. An early Audion, in a radio receiver configuration, is on display.

1927 Philo T. Farnsworth invented the first all electronic television system on September 7, 1927 in his laboratory on Green Street in San Francisco. One of the key inventions in that system was the television camera tube, or what Farnsworth called an "Image Dissector." An early example of an Image Dissector from 1940 is on display.

1937 Russell and Sigurd Varian, along with Bill Hansen, invented the Klystron vacuum tube at Stanford University in 1937. The invention was made possible because of a $100 grant they received from Stanford. The Klystron was used as a local oscillator in airborne radar systems in World War II. Early examples of Klystron oscillators and amplifiers are on display.

On December 11, 1998, we installed our largest artifact, a Varian Klystron, the VA-842 at Fry's Electronics Sunnyvale store. The Klystron is 10 feet tall and weighs 900 pounds. The tube was used in the Ballistic Missile Early Warning System (BMEWS), a radar system designed to detect invading Russian missiles and aircraft.

1971 Marcian "Ted" Hoff, at the Intel Corporation, along with Stan Mazor and Frederico Faggin, shipped the world's first microprocessor - computer on a chip - in 1971. Samples of the Intel 4004 microprocessor along with more modern Intel microprocessors are on display.

1976 Steve Jobs and Steve Wozniak designed and built Apple's first computer. They called it appropriately, the Apple I and offered it as a kit rather than a completely assembled unit. The bag of parts and a bare printed circuit board cost $666.66. Only 200 units were manufactured. A rare Apple I is on display.

For more information contact **Don Koijane** at (408) 734-4453.

Intel's 4004 had 2,300 transistors vs. this year's Pentium III with 9.5 million

Officers, Directors, Advisors, and Administrator of the Perham Foundation

President
Donald F. Koijane
(650) 473-6467 (home)
(650) 473-6468 (FAX)

Vice President
Will Jensby
(408) 296-6071 (home)

Secretary
Edwin Vivian El-Kareh
(408) 774-9300 (H/W)
(408) 774-0525 (FAX)

Treasurer
Gerald H. Tucker
(650) 326-4908 (home)
(650) 961-3266 (office)

Directors
Daniel Ramsey
(510) 757-8148 (home)

Robert Underwood
(408) 255-1997 (home)
(408) 737-7600 (office)

Advisory Council
Mike Adams
George Durfey
Jim Maxwell
Walter Serniuk

Office Administrator
Rachel Wagner
(408) 734-4453 (office)
(408) 736-2685 (FAX)

Want Ads

CHRS Classified

For Sale - Tubes, over 4000 in stock, N.O.S. and tested used. Kelly Molles 209-955-6719. molles@ jps.net www.angelfire.com/ca2/tube-sanradios

Wanted - RCA 9T, 10T, Radiola 26 grille, Philco 70 cathedral cabinet, RCA 186K, Zenith 9S-262, 9S-365. Bob Eslinger 860-928-2628. radiodoc@neca.com

For sale - Novelty radios, original "Blabbermouth" by Nasta and cathedral reproduction (mint in box), both for $45 OBO. Curt Brohard 510-521-4299.

Wanted - Still need antenna for Radiola Super VIII console, or details to construct one...pictures, dimensions, etc. Mark S. Rauber 775-782-3596.

Wanted - Parts for a Philco Beam of Light record changer, model year 1941-42. I own one model each #42-1009, plays 78's & 33's, T41-609, plays 78's only. Bob Meko, 440-355-5785.

For Sale - Philco 38-2670. Works OK. Bob Moore 408-252-5471. mustang@best.com

For Sale - Vintage Hi Fi. Restored Dyna. Eico, Scott, Fisher and more. Plus all kinds of audio tubes and hi voltage caps. Charlie Kittleson 650-631-6550

For Sale - My 6 page list is full of radios and "Stan's Stuff". Just ask for it. Will send by Email if desired. Always free advice! Send a SASE to Stan Lopes, 1201-74 Monument Blvd., Concord, CA 94520 or Email for the list to splopes@aol.com.

Wanted- Blue, etched, side mirror for Sparton 558 (4 knob). Chassis for Stewart Warner R469. Abbottwares "Hula Girl" Radio. But wait, there's more...Make any project requiring voice over come alive with professional voice over service available from the Kushman Voice Co., where, "The Written Word Becomes the Spoken Idea". Steve Kushman 415-821-7671. email kush-seal@flash.net

For Sale - Over 500 Edison Diamond discs and William and Mary player. $1200 for all of it, or discs at $3 each, player $500. Nice original condition. Steve Bohte 707-585-6808.

For Sale - Atwater Kent breadboard radios and parts. Send for my list. Paul Thompson, 315 Larkspur Dr., Santa Maria, CA 93455. 805-934-2778

Wanted - 1940 Zenith 1207 chassis and escutcheon, Sparton 109, 110, 111 chassis, Philco Predicta antenna, AK 84 cathedral cabinet, Eico HF 89 schematic, information on electro magnetic Lumiere pleated diaphragm speaker and ex-Graybar employee / radio collector named Orville Johnson, who lived in San Francisco. Chris Galantine 530-244-2337.

Wanted - WW II military Television. US Army/ Navy glide bomber cameras, receivers, monitors, transmitters, dynamotors, manuals. #s SCR, ATJ, ATK, ARJ, AXT, CRV, CEK. Phone or fax Maurice Schechter 516-294-4416.

Wanted - Novelty vacuum tube sets and catalin radios, basket case cathedrals or other unusual wood table models. Jack Gray, 707-226-2550 or at trustmej@aol.com

Wanted - Wings radio and Sparton dial glass #C3011, for Triolean mod. 1867. Frank Moore 406-259-7250.

Wanted - 1930's to 1940's radios to buy and restore for my personal collection. Un- restored radios only. Call Andy 916-645-7001.

For Sale - Heathkit VF1 VFD, $20 H. Meyer 650-349-2071.

Wanted - Any information about radio operations at the Presidio, 1901-1991. Bart Lee 415- 956-5959 x103.

For Sale - Tube Lore, 186 page reference book gives an insightful scoop on about every North American tube. Reviewed by Eric Barbour in Vacuum Tube Valley as "an instant classic". Ludwell Sibley, 102 McDonogh Road, Gold Hill, OR 19725-9626 for $19.95 postpaid in the US and Canada. $24.95 for air overseas.

For Sale - Ham Station. Drake R4A receiver, MS4 speaker, T4X transmitter. Heath SB200 linear amp, SB610 spectrum analyzer. Shure #444 mic. $250 all. Collins R-390 VRR receiver $75. Arthur Adams 650-321-4886.

Wanted - Zenith printed material prior to 1940: advertisements, brochures, matchbooks, etc. T.S. Melvin 610-494-8000 x200.

Wanted - Junction box for RU-16/GF-11 early W.W.II command set. Black tag preferred, blue tag OK. John (Jay) Coward 831-336-3414

For Sale - Edison console radio, unrestored $1,000. Swiss made wind up phonograph in camera case, $1,500. Many old tubes, radios, 3" Pilot TV with magnifier, $450. Looking for kit assembly instructions for Globe "Chief" transmitter. Guiseppe Bennett 510-534-9576.

Wanted - Predicta TVs and unusual portables, plastic JVC Videospheres and Pyramids. Sheldon 415-454-8851.

Wanted - Early or unusual telegraph keys, sounders, relays, etc. Larry Nutting 707-539-1883. larryn@sonic.net

Wanted - Hallicrafters HT30. Looks more important than operational. John Gibson 510-849-1051. gibson@smoot 1.lbl.gov

For Sale - NRI Model 70 professional tube tester in oak cabinet VG $40. B&K color bar generator with manual $25. Ken Miller 412-242-4701.

Wanted - C-1218/GR control box for AN/GRC-38 radio set (BC-610). Any information on the history, use and manufacture of the Hallicrafters HT-4 and BC-610 transmitter. Mikhael Brown 408-578-1076. mikhael_brown@hp.com

Wanted - Back cover, chassis shielding (2 pieces), and special power cord plug (chassis), for Edison C-2 radio phono. Schematic for Tanberg cassette deck model TCD-330 . Also want a Brush Soundmirror tape recorder, model BK-401, which used paper tape. Fred Deal, 916-428-4842.

For Sale - 3 boxes of Sams. Approx. 150 folders $30 for all. Will Mathis 408-226-0181. will4bird@aol.com

Wanted - The complete horn speaker for a Radiola "Grand". Everything including the driver out to the grill or parts. Darrell Combs 916-969-0635.

Wanted - Radiola 62 console, complete. Philco 42-360 chassis. Philco model 18, 10" speaker. RCA 27K chassis. Richard Lane 209-634-2442.

Wanted - Old electrical meters before 1900, as is, your price. Leonard Cartwright 408-739-6025.

Wanted - Transistor radios and pocket reel to reel recorders. Guy Doss 408-241-2437.

For Sale - Scott SLR-H entertainment receiver of W.W.II, (typically used aboard ship). Covers 0.53 to 1.60 and 5.55 to 15.6 MC, in three bands. 12 tubes, push-pull 6V6 audio. Exc. cond. with cabinet & manual. $175. Henry Engstrom 707-544-5179. email pacifica@sonic.net

For sale - Beautiful 1939 Stromberg-Carlson console radio. Mint condition. $650. Also, Philco 90 chassis, completely restored, works fine, needs cabinet. $150. Herb Brams 650-328-1139.

Wanted - Obsessed collector seeks the following items in effort to satiate habit... Radios with chrome grilles or trim, any set with extreme art deco styling, (wood, catalin, plaskon, mirrored). Radio store advertising signs and displays. I also buy & repair old clocks. Please call, I'm desperate for a "fix". Adam Schoolsky 603-883-7931. email radios@artdeco.com

Join the World's Biggest Radio Swapmeet

Alan Voorhees

Radio collecting is social activity. It's fun to meet with other collectors and swap stories along with swapping radios. It may be frustrating to see someone else get a great deal that you just missed, but that's part of the fun as well. Swap meets across the country, both smaller local meets as well as the large national meets fit into the collecting scene by bringing collectors together.

They're especially great if you just collect radios, that is you look for sets you like and buy them. However, if you're a more "serious" or specialized collector, all you come away from most swap meets are some stories. It's hard to find that certain radio that's needed to fill out a gap in a collection. This is one place where the Internet excels. At any given moment there are hundreds of radios available, from common 60s and 70s clock radios to rare and exotic sets.

As an example, I collect Kadette radios. Many of them are scarce and seldom show up at meets. There were seven different color combinations of the plastic Kadette Classic made. I have five of them, all found and purchased on the Internet. I've only seen one at a meet, and it was priced several hundred dollars more than any of the ones I own.

Of course not everything is cheaper on the Net. At Extravaganza 98 in Lansing there was a radio with a damaged cabinet available for $200. I didn't buy it (nor did anyone else). The seller auctioned it off on the Internet and the winning bid was more than twice that amount.

So how, you ask, do you get in on the Internet action if you don't have a computer? There are several options. The first is to try your local library. Most libraries across the country now offer Internet access. They'll help orient you to the way the Internet works and off you go. It's free, but the disadvantage is, of course, that you're limited to the amount of time you can spend at the computer at any one time (there are others waiting) and you'll have to leave your house to get there. It's a good place to start so that you'll know you're interested in joining the rest of us on the web. Other options might be at work or with the help of a "connected" friend to guide you (ask around at your next radio swap meet, you'll probably find several folks willing to help).

Once you're hooked you'll want to get Internet access at home. The cheapest way is probably WebTV, with equipment costs starting around $100 (there are monthly Internet access charges as well). You can get a demonstration at most television/video stores. A better, although more expensive way, is to get a computer. Many used computers a few years old are cheap and more than good enough for Internet use. If you're both a computer novice and an Internet novice and have a few extra dollars in your pocket, the Apple iMac (less than $900) is an excellent computer that's ready to connect to the Internet simply by plugging it in and connecting it to your telephone line. It'll look good sitting next to that Philco as well.

One other thing you'll need is an access provider, the company that hooks up your computer to the Internet through your phone line. Access charges range from around $7 for a few hours of connection time each month to around $20 for unlimited access time. WebTv is their own provider, for a first-time computer user you might want to try America Online, which offers often excellent user support. Ask around for other recommendations in your area.

Now you'll just need some places to go. These are web addresses (URL's in Internet lingo) and are those www-dot-somethings you hear bantered about everywhere. Here's a great place to start:

http://www.antiqueradios.com/chrs/
It's the CHRS site on the web.

Here you'll find information about the club and events, as well as links to the largest (and most accurate) listing of antique radio sites on the Internet (http://www.antiqueradios.com/links/) in the Antique Radio Resources database.

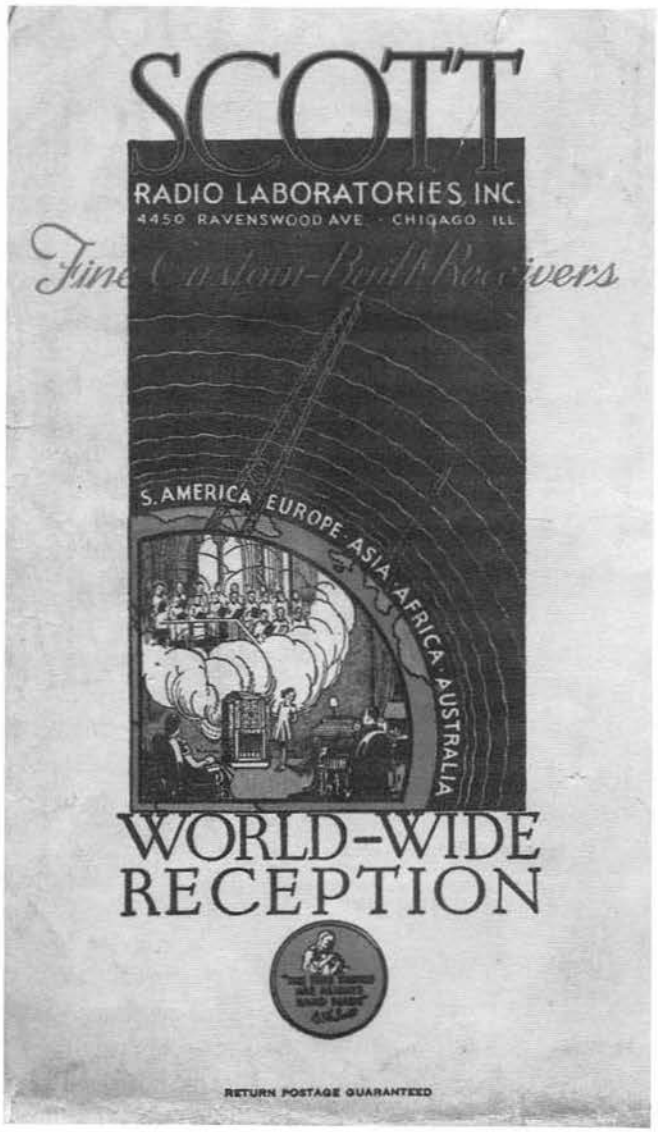
You'll find the category "Radios For Sale" in the list, and here are two of the best places to buy (and sell) radios:

Radio Classified has hundreds of classified ads available for free viewing and posting (http://www.radioclassified.com). They're keep current and are computer searchable (you can look for just the "For Sale" ads with "Zenith" in them, for instance). Another top site is eBay Auction (http://www.eBay.com). Go to "Collectibles: Radio" to find several hundred sets listed. Both Radio Classified and eBay have new items posted every day ... sort of like a never ending swap meet.

Then once you've perused the listings and made offers on what you're interested in, it's time to get some more individual involvement. The Internet isn't the impersonal spot that many anti-Internet guys claim it is. In fact, I've become friends with more radio collectors on the Internet than I've met at local meets. Here's where you might go: Wednesday evenings at 10 (Eastern time) is the weekly Radio Chat session (http://www.antiqueradios.com/chat.html) where collectors across the country (and sometimes around the world) meet and discuss old radios and collecting. Another place is the Antique Radio Forums (http://www.antiqueradios.com/forum/) where you can ask questions about a mystery radio you found, a set you need help repairing, or you can help others with similar requests. The folks that visit the forums are really good at answering most requests for help, even some pretty obscure ones.

Spend some more time back at the Antique Radio Resource database looking at web sites others have made available. You'll find numerous collections pictured, links to free schematics, part and tube suppliers, radio history sites and places to listen to vintage radio programs and much more (there are well over 400 sites now listed). Then you can start thinking about creating your own radio web site.

ed.- By the way, eBay is not a "personal trading site" as they would have you believe- it is a full-blown auction. I suggest that internet prices are generally higher for the real good stuff because of the nature of "auction" sites: all you need are two collectors butting heads to achieve big prices. And other dealers may base their prices on these results. We may need deeper pockets or stronger will power.



A Vintage Book Review

by Paul Joseph Bourbin

Elements of Radio Servicing, by William Marcus and Alex Levy 1955
Published by McGraw-Hill,
566 pages, hardbound.

Elements of Radio Servicing is another book in the "Marcus" series of textbooks designed for the high-school and vocational school training of radio servicemen. While published in the same year as *Practical Radio Servicing* by the same authoring team and publisher, it is not the same book. While *Elements of Radio Servicing* is a more advanced book, covering a broader range of consumer electronic items, it is not required that one study *Practical Radio Servicing* first. *Elements* stands just fine on its own.

The first introductory chapters cover the superheterodyne receiver, various servicing procedures, and the use of test equipment. The test equipment emphasis is on the multimeter and especially on the signal generator. The tube tester is not considered by the authors to be very useful at all. The authors also expect the reader to be familiar with the basics of electricity. The authors devote much space on the use of the signal generator and this sets the tone for the rest of the book. Circuits had become so complicated by the mid-fifties that signal tracing was about the only way many problems could be found. With the advent of FM and TV, this was especially true. In earlier times, the signal generator was often used more for alignment than troubleshooting and simpler methods could find most problems. However, the authors do emphasize that a balance of different servicing procedures was the best for rapid and efficient servicing. Time was money to the serviceman, so rapid and accurate work was essential. Adhering to strict procedural dogma was unrealistic.

The next chapter is on the understanding and servicing of power supplies. Since power supplies were quite prone to failure and had to function properly before other problems could be addressed, it is logical to start there. However, unlike *Practical Radio Servicing*, the emphasis in this chapter is on transformer operated power supplies. For the radio collector/restorer, this is important. Transformer type power supplies are more complex and the collector is certain to encounter a number of them in his collection. AC/DC power supplies are covered in a later chapter.

A series of chapters follow discussing the operation, problems and repair of all of the circuits and components of a radio starting with the loudspeaker and going back to the antenna. This follows the order that the serviceman would use to repair the set. There is a good discussion of loudspeakers and RF amplifiers which is left out of *Practical Radio Servicing*. A thorough study of these chapters will give the reader a good understanding of all of the circuits found in AC superheterodyne sets.

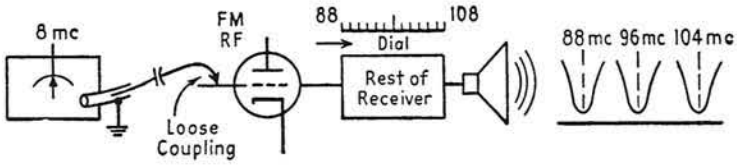
Next comes chapters concerning other types of sets that the repairman was likely to encounter. AC/DC power supplies, auto radios, portable sets, FM and AM/FM sets are covered as well as AM and FM alignment. Much of this information is left out of *Practical Radio Servicing* and yet is useful to most collectors who have at least one of these sets in their collections.

The concluding chapters go through various service procedures based upon the complaint of the owner and the construction of the service bench. The service procedure chapter is quite useful. Many collector/restorers want to get the set at least working a little before doing a complete electrical restoration. This way, if a difficult to find part is needed to get the set going,

the set can be put aside until the part is obtained. This saves a lot of frustration. The chapter on service bench construction is useful to those who want to get into serious radio work. It also shows how one can construct test speakers, antennae and other useful things.

The appendix contains the usual information useful to radio repairmen such as: color codes, common abbreviations, pin diagrams and schematic symbols. There is also a list of film strips that apparently were available as training aids for instructors. The film strips went hand in hand with the material in the book. It would be interesting to find a set of them. The index is fairly extensive and useful.

F-M RF check:



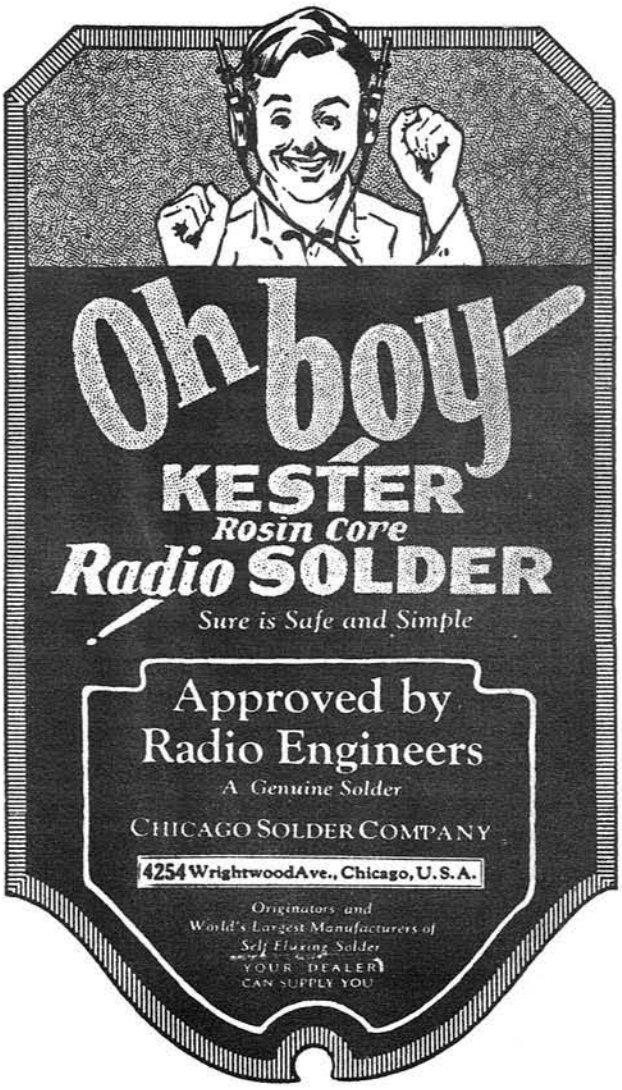
Elements of Radio Servicing, while more detailed than *Practical Radio Servicing,* is not more difficult to study. Since it contains material useful to the general radio collector, *Elements* is recommended. For those collectors whose collections consist entirely of AM AC/DC sets, *Practical* would be acceptable. *Elements of Radio Servicing* is as easy to use as a textbook can be, has almost no math, and one gets the impression that the authors are interested in your learning how to fix radios; not in pontificating from on high.

One interesting omission is that of television. By 1955, television was entrenched in American Society. Color television was just starting. All televisions were expensive and failure prone at that time. One would think that repairmen would do better to learn TV repair at the same time. Perhaps that was going to be another book. Transistors are not mentioned and they were just starting to enter the market too. The pictures and drawings are high both in quality and quantity. Especially useful are service charts placed throughout the book. They offer a "Symptom-Abnormal-Reading-Look For" approach to troubleshooting that can help one find a problem quickly. *Elements* is a fairly common, inexpensive book that should be in the library of anyone who wants to bring their old sets back to life.

If you have any questions concerning vintage radio books, please feel free to contact me at any time.

Perhaps an editorial note should be placed with these reviews that warns people to use isolation transformers especially when working with AC/DC sets and that Variacs are NOT isolation transformers and perhaps even more dangerous when not used with a true isolation transformer. Antique Electronics Supply has isolation transformers and an ad in *Antique Radios Classified* can usually get one.

ed.- Paul was anointed with the "Doc" Herrold award for his sizable contribution in preserving and sharing radio history. He remains the toughest badge to enforce our eight o'clock startup time at swap meets.



VACUUM TUBE VALLEY

Back Issues, Books, Goodies, & Subscriptions

VTV #1 Spring 1995 ***$8 US - $10 Foreign***
Vintage Dynaco Tube Equipment - 1955-77
History and Testing of the 12AX7/ECC83 dual triode
Tube Testing Methods + Early Amplification and Amps

VTV #2 Fall 1995 ***$12 US - $15 Foreign***
Heathkit - The Tube Williamson Years 1950-61
EL34/6CA7 History, Types and Tests
Magnum SE EL509 Amplifier Project by Dave Wolze
1927-34 Western Electric Theater Sound Systems

VTV #3 Winter 1995/96 ***$12 US - $15 Foreign***
Eico Mono Tube Gear - 1955-62
Altec Lansing 604 Coaxial Loudspeaker History
Western Electric 300B History and Listening Tests
300B SE Transformer Listening Tests

VTV #4 Spring 1996 ***$12 US - $15 Foreign***
6L6 History, Types and Listening Tests
Vintage Bookshelf Speakers 1955-1965
Early FM Broadcasting History
HK Citation I & II Amplifier History and Mods

VTV #5 Fall 1996 ***$12 US - $15 Foreign***
The Ultimate FM Tuner Shoot Out
Red Bank Guided Missle Tubes for Hi-Fi
The Birth of the Marantz 10B
Choosing Rectifier Tubes for your Guitar Amplifier

VTV #6 Winter 1997 ***$12 US - $15 Foreign***
Fisher 500 - History, Models and Restoration
A Tribute to Avery Fisher by the Fisher Doctor
6550 and KT88 History, Types and Listening Tests
Loftin-White Amplifier History by Alan Douglas

VTV #7 Summer 1997 ***$12 US - $15 Foreign***
6DJ8 & Frame Grid Tubes + Listening Tests
Altec 1950s Theater Amps and Modifications
The Great Voice - The Peter Jensen Story
Computing with Tubes - The Savage Art
Uncle Eric's Tube Dumpster - 417A/5842

VTV #8 Fall 1997 ***$12 US - $15 Foreign***
EL84 History, Types & Listening Tests
RCA Tube Mfg at Harrison, New Jersey
200 watt OTL Amp Project by Allan Kimmel
300B Listening Tests: NOS and Vintage Types
Bruce Moore Tube Audio Pioneer

Vintage Hi-Fi Spotter's Guide-Volume 1
Over 450 photos & specifications of tube audio gear from the Golden Age of Hi Fi. **86** pp. **$18.95**

Vintage Hi-Fi Spotter's Guide Volume 2
Volume 2 covers equipment not listed in Volume 1. Almost 500 amps, preamps, tuners, etc are depicted. Edition covers early audio and includes a Speaker section with most vintage manufacturers. **88** pp. **$18.95**

Vintage Hi-Fi and Audio Price Guide 1999-2000
Updated price & grading guide for almost 1,000 vintage hi fi amps, preamps and tuners. Includes Vintage pro audio and theater gear. Also, pro loudspeakers, N.O.S. vacuum tubes and audio transformers. **$20.00**

"Vintage Hi-Fi The Golden Era Video"
A one-of-a kind video covering the classic post-war and 1950s home hi fi era. Over 80 classic audio amps, pre-amps tuners, are shown. This video is professionally produced. **34 min VHS NTSC** **$20.00**

The Ultimate Tube Substitution Guide
No tube electronics enthusiast should be without this book. Over 10,000 tubes are listed on 240 pages including: audio, radio, transmitting, and special. Features an audio tube section with tube evaluation. **$29.95**

Vacuum Tube Valley T-Shirts
Two Styles to Choose From!

A) VTV Marching Tubes -"Big Tone"
1 sided available in Burgundy only **$15.00 XL only**

B) VTV Tube Sunburst Shirt with 2-color black & orange art as pictured plus large 2-color RCA tube diagram exploded view on back. (Available in gray) **$20.00 XL only**

C) Official VTV Cap - High quality dark navy cap with silver embroidered "Tube Head" on front. "Vacuum Tube Valley" stitched on back. Velcro size adjustment, 100% Cotton **$18.00**

VTV #9 Spring 1998 - Transmitting Tube Review, Ampeg SVT Guitar Amp, Altec 287W amp, Bargain Vintage Hi-Fi
$12 US - $15 Foreign

VTV#10 Summer/Fall 1998
Story of the 6V6, Hi-Fi radio in the 30s, PP SV572 amp, Ultrapath Line Stage
$12 US - $15 Foreign

ORDER FORM

Name _____ Date _____
Address _____
City _____ State _____ Zip _____
Please Send Me The Following Products

_____ _____ $_____
_____ _____ $_____
Add $5.00 Shipping per order in USA / Add $10.00 - Item Air Mail Foreign Shipping $_____
CA Residents Add 8.25% State Sales Tax (CA Tax) $_____
Credit Cards, U.S. Bank Checks or Money Orders OK **TOTAL ORDER** $_____
Credit Card # _____ Exp. Date _____
Signature _____

Subscribe To Vacuum Tube Valley
The Classic Electronics Journal

$45/year US First Class **$48**/Canada, **$56**/Europe & **$66**/Asia & World

VACUUM TUBE VALLEY
P.O. Box 691
Belmont, California 94002 USA
Phone (650) 631-6550 FAX (650) 654-2065
email - triode@vacuumtube.com

www.vacuumtube.com

Dear Steve Kushman 2/3/99

When the war in the Pacific ended much equipment was just left to the elements, to slowly rust away and sink into the earth.

This was the case at the south east point on the island of Bora Bora. Among the many tracked machines and flotation tanks was this house, right in the center of all this discarded equipment. (Picture enclosed.)

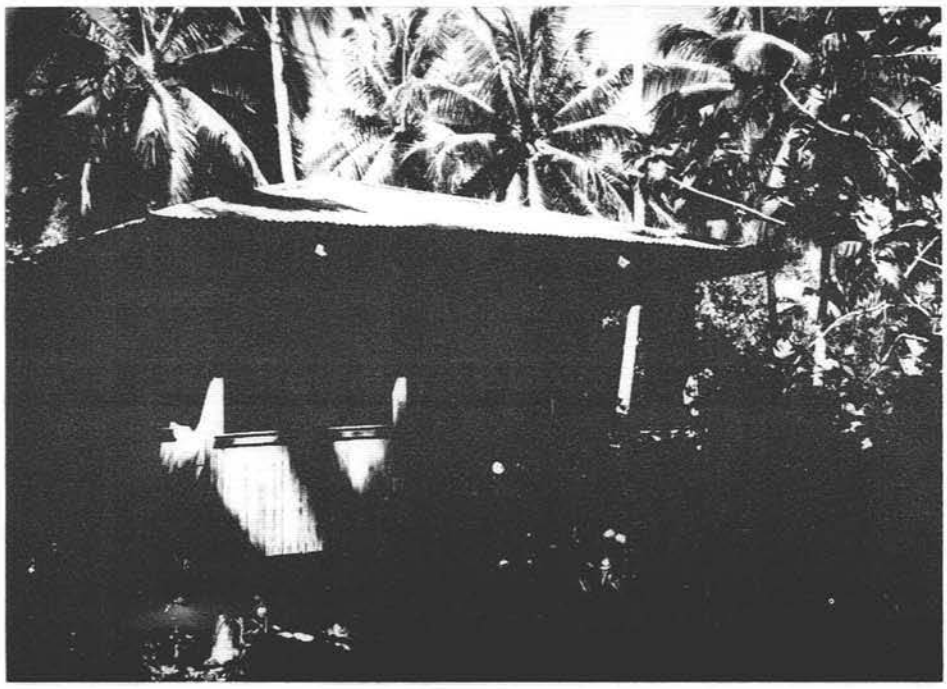
Although abandon it was in good order, and filled with WW 11 radio equipment.

On the opposite side of the island, the north west harbor, is where the yachts anchor and sea planes land. So one day, starting at that place, I decided to take a walk around the island. There was a road built during the war, but I was told that after the war the road, needed elsewhere, so it was dug up and moved, that's what I was told, so no road on my walk around Bora Bora.

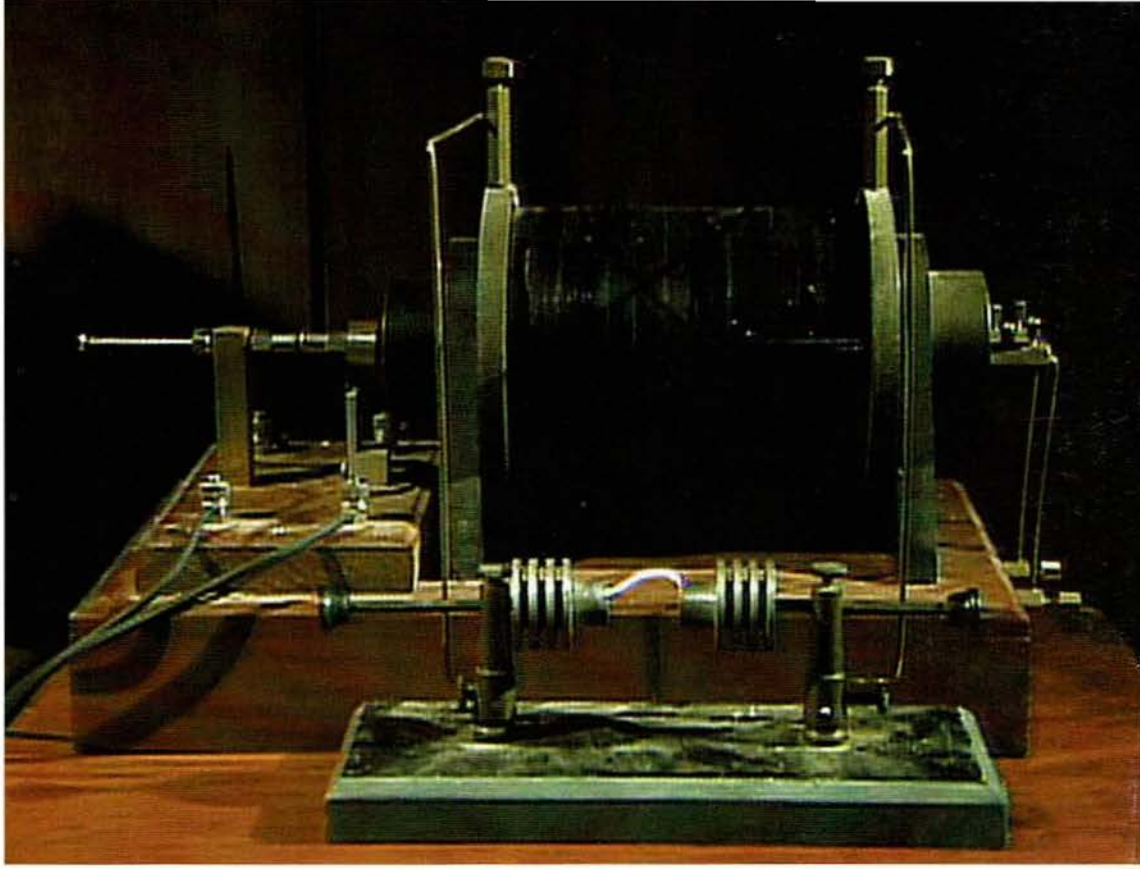
It takes a full day if you stop to look and enjoy where you are at. It was on my walk around the island that I discovered the house full of radio gear. As it was a long walk, the only souvenirs I took were photos.

Are they still there? The bad news is that this was 37 years ago.
The good news is it is just a hard place to get to.

Sincerely Yours
Charlene Hunter
Charlene Hunter...



CONTENTS



Rhumkorff Coil built from scratch by Woody Wilson powering a spark gap

P.O. Box 31659
San Francisco, CA 94131

(415) 821-9800

CHRS on the Internet:
http://www.antiqueradios.com/chrs/

Bulk Rate
U.S. Postage
PAID
Tiburon, CA
Permit No. 278