Volume 33, Number 2 Fall/Winter 2014

Journal of the

CALIFORNIA HISTORICAL RADIO SOCIETY

LIVE AT Alameda

RADIO DAY BY THE BAY 2014

FOR THE RESTORATION AND PRESERVATION OF EARLY RADIO

FROM THE BIRTHPLACE OF BROADCASTING

California Historical Radio Society

HOME OF THE BAY AREA RADIO MUSEUM & HALL OF FAME

The California Historical Radio Society (CHRS), is a non-profit educational 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 enable the exchange of ideas and information on the history of radio, particularly in the West, with emphasis on collecting, preserving, and displaying early equipment, literature, and programs. Yearly membership is $30.

CHRS Museum in Alameda

CHRS has been fortunate to through the generosity of its donors to purchase a home for the CHRS museum and education center. It is located at 2152 Central Avenue. The building was built in 1900 as a telephone exchange.

CHRS volunteers are actively restoring the building to make it optimal for use. Our goal is to create an environment to share our knowledge and love of radio and enable us to create an appreciation and understanding for a new generation of antique radio collectors and historians.

◊

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(415) 821-9800

www.CaliforniaHistoricalRadio.com

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Photos by Mike Adams

Highlights: Auction: 180+ Vintage Radios, High-End Audio & Amateur Gear
Vintage Radio Flea Market with 1000s of items
Broadcast Legends present 'The Lone Ranger'
Golden Gate Radio Orchestra performance

Rear Cover: **Images of the June 4th KSAN Benefit Concert for CHRS**
Photos by Richard Watts

Performers: Cold Blood with Lydia Pense, Rick Stevens, Country Joe McDonald, Big Brother and the Holding Company, The Imperial Messenger Service, Annie Sampson and Sal Valentino from Stoneground, and Dan Hicks (no photo).

KSAN Alumni: Norman Davis, Ben Fong-Torres, Richard Gossett, Terry McGovern, Wes Nisker, Bonnie Simmons, Dusty Street, and Kenny Wardell (no photo).

From the Editor

Once again I've had the pleasure of working with very generous and capable contributors. I want to thank Bart Lee, Norm Leal, John Staples, Scott Schiedt, Roger Vinande and Steve Kushman.

I am always in need of quality content related to radio. If you have something to contribute, I urge you to let me know. I am especially interested in technical content. It can be of two types, a narrow topic in depth or a more broad topic with less and less depth.

It is my desire to continue to improve this journal and provide you with relevant high-quality content. To do this I need your constructive comments. And if you would like to contribute an article in a future issue, please let me know.

Richard Watts, jrchrs@comcast.net ◊

From The President

by Steve Kushman

April 23rd, 2014 is an important date in the history of your favorite vintage radio society. On this day in our 40th year, CHRS took possession of the building located at 2152 Central Avenue in Alameda, now and forever to be known as 'CHRS Radio Central'. Check out Walt Hayden's terrific article on Radio Central's history and our restoration progress.

I am truly awed by the accomplishments of CHRS. First, that our former parking lot radio collectors club has blossomed into a true 'historical radio society' and secondly that we were able, thanks to generous members and supporters, to raise over $1 Million for the purchase of Radio Central. How could we have done this? It happened because for the 10 years we were at KRE we proved we could become more than a collectors club. We showed that we had the knowledge to broaden our horizons and people took notice. With the purchase of Radio Central, we now control our own destiny. I am also very pleased to report that CHRS is flourishing. Our membership is growing and is currently 425. We still absolutely support our radio collector base but now encompass so much more.

For years the main focus of CHRS was the technology and design of the radios themselves. But now, we also focus on the reasons everyone had a radio; it was the voices, music and programs that emanated from these electric boxes in our homes. So to learn about the stations they came from and the people who created them also fuels our passion to tell radio's stories. Our programs, the Bay Area Radio Museum on-line and the Bay Area Radio Hall Of Fame allows us to keep these stories alive through audio, biographies and station exhibits, and share them with new generations of radio enthusiasts. Along with our Society Of Wireless Pioneers program, and CHRS publishing efforts, we have become an important part of the historical community.

Radio in one way or another has had some effect on everyone's life. If you love radio, CHRS offers many ways to become involved and share your passion. You can become a Member for only $30 a year. That includes 2 of these great Journals. But, if you are reading this you are probably already a Member and can help us in other ways. We have a 114 year-old building that needs lots of work. We have to build display galleries, the Maxwell Library, radio control rooms, the Bay Area Radio Hall Of Fame, ham station W6CF, ADA restrooms, our radio repair shop, compact mobile storage, the Garden of Communication Pioneers and more. We also would like to restore the building facade back to its 1900 Mission Revival architectural style. All this takes funding and volunteers. You can help by contributing your time or your dollars, or both. Your donations of artifacts to our Museum are also appreciated. CHRS has a world-class collection of museum quality radios and other gear, 99% of which was donated.

And speaking of donations and volunteering, please notice the large list of donors that made it possible for CHRS to purchase Radio Central. Every single donation has meaning and importance, and from the CHRS Board of Directors we say Thank You to each and every person and group who has made it possible for CHRS to have a permanent home where we will create our West Coast center for radio education and radio history. 'CHRS Radio Central' is the new home of the CHRS Vintage Radio Museum, the Bay Area Radio Hall Of Fame and all things Radio.

It's true that CHRS could not have come as far as we have without those donations, but we have something as or more valuable than donations. We have people. We have historians, collectors, researchers, technicians, builders, restorers, writers, volunteers and dreamers. They are all crazy about radio and passionate about preserving and presenting its history. When we were forced to leave KRE our volunteers were not sad, they were excited about what we had learned and were ready to put this knowledge and their efforts to work in our next adventure... 'CHRS Radio Central'. These volunteers are the heart and soul of CHRS. They come every Saturday and work tirelessly on our many projects. And they also come during the week. Many weekdays you'll find Building Managers Robert Swart, Walt Hayden and lately Kevin Payne donating their time to improve our new home. Our Saturday Volunteer Days have been very successful. We all take a break and have lunch together in our backyard picnic area that Director Denny Monticelli put together for us. And, next time you see Denny, be sure to thank him for the legwork and brainwork he put into finding 2152 Central and guiding us through the acquisition process. I'm running out of space but must mention the heavy lifters; this group is at RC almost every Saturday. They are Robert Swart, Walt Hayden, Denny Monticelli, VP Scott Robinson, John Staples, Jim Bradt, Richard Watts, Cliff Farwell, Scott Harvey, Landscape Manager Larry Drees, Butch MacDonald, Kevin Payne, 2014 Volunteer of the Year Seth Arp, Bart Lee, (Thanks for the lunches!), Gilles Vrignaud, Hil Hampton and his friend Earl. And CHRS runs so well due to the superior behind the scenes efforts of Richard Watts, Mike Adams, Jaime Arbona, Philip Monego, John Stuart, Len Shapiro, Dave Billeci, David Vasquez and Bart Lee. If I've forgotten you I apologize, but remember that all the efforts by all of our volunteers is second to none. Thank You!

What an action packed 6 months it has been for CHRS. We bought Radio Central. We packed and moved thousands of artifacts and boxes. The KSAN Reunion Concert in June was put on as a benefit for CHRS thanks to Kenny Wardell, Bonnie Simmons and Ben Fong-Torres! We, in the shortest time ever pulled off a fabulous Radio Day and netted an astounding $25,000! Thank you to the Broadcast Legends and the Golden Gate Radio Orchestra for their participation. Plus CHRS is now one of the Six Museum Alliance of Alameda. And the CHRS Radio Dog Production of "KSAN Jive 95: The Movie" is underway.

OK, I'm out of space. Please fill out your new renewal forms and donate heavily. The success of CHRS depends on your support and your current membership is important. So, don't miss our next Journal. Renew Now!

CHRS Museum and Building Fund Donors Since 2011

Donor	Donation
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Scott Robinson	124,265
Phillip Monego	119,091
John Staples	100,000
Tom Nelson	41,000
George Patterson	40,000
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Catherine Yronwode	10
Mike Bennett	4

Please enjoy this Journal. I always encourage you to contact me directly with your questions, ideas and comments. I am available at kushseal@flash.net or (415) 203-2747.

Best Regards, *Steve* ◊

CHRS Sacramento Chapter News

Sadly, Dale Tucker recently passed away. Dale had a long career in radio and was dedicated to the Sacramento CHRS Chapter. A very nice article about Dale can be found at www.radioworld.com at the following url: www.radioworld.com/default.aspx?tabid=75&entryid=10247 . We will miss him.

The Sacramento Chapter of CHRS is the successor to the Sacramento Antique Radio Club which was founded approximately 25 years ago. The Chapter currently has about 25 members who reside throughout the Sacramento ◊

CHRS Central Valley Chapter News — by Scott Scheidt, photos by Mick Daniels

Swap meet: The annual CVC Chapter swap meet was held October 5th at the Stanislaus Fairgrounds. The meet was well attended and several sellers brought many interesting items.

Classes: The weekly radio theory and radio repair classes plus the monthly cabinet restoration class continue.

New shop and meeting place: Mark Jensen, a neighbor of Larry Gonzalves, has generously offered the CVC chapter the use of a small unused home on his property for a shop and meeting place at no cost. The CVC Chapter has completed making minor repairs to the structure and has installed benches and fixtures for the shop plus shelving for equipment and parts. The new meeting place, which is near the prior meeting location at Larry Gonsalves's ranch, is at the southeast corner of Commons Road and Bradbury Road in Turlock.

◊

Radio Central – New Home of CHRS

by Walter Hayden

Original exterior front elevation of 2152 Central Ave.

After a huge and very successful fund raising effort, in April 2014 CHRS paid cash for a new museum building in the City of Alameda, California. The building is located at 2152 Central Avenue and is called "Radio Central." Although Radio Central does not have a radio history, it has a communications history.

Radio Central was constructed for the Sunset Telephone and Telegraph Company (ST&T) and opened in December 1900 as the Central Telephone Exchange for Alameda. Radio Central as it exists today was built in two phases. The brick building at the front of the lot was constructed in 1900 and a rear addition was built in 1925.

The original brick building had a Mission Revival front façade. The building was 30 by 65 feet in size and had a main floor where the switchboards were located and a full size basement for incoming cables and auxiliary equipment. Ceiling of main floor was 16 feet high. Manual switchboards were initially operated by 15 women operators from 8 AM to 5 PM, 10 women operators from 5 PM to 10 PM and one operator during the night. Although the office was built to serve up to 10,000 subscribers, it originally served about 1,000 telephone subscribers.

In addition to switchboards, the main floor had a private office and a reception room for patrons wishing to make long distance calls. A matron's apartment was at the rear of the main floor. The matron prepared hot lunch for the operators and generally provided for their comfort. Interior décor was oak furniture, polished floor with rugs thereon, and large plants in pots.

To eliminate the masses of overhead wires on the north side of Central Avenue, subways were built from the new office to Park Street and in the opposite direction to Benton Street.

In December 1924 a building permit was issued to construct an addition with a full basement at the rear of original building. Contractor was Monson Brothers. Construction cost was $22,000. The addition was approximately 35 by 36 feet in size. It included bathrooms, a kitchen, operator's quarters and a new boiler room.

By the late 1930s there were about 14,000 telephone subscribers in Alameda. This neared the capacity of the facilities at Radio Central. In the summer of 1939 the telephone company started construction on a new building at 2100 Central, which is at the corner of Central and Willow. An automatic telephone exchange was installed in the new building and, in 1940, the manual exchange was phased out as the circuits were moved to the new automatic exchange.

Central Avenue in Alameda was known as Harrison Street until 1877 when the name was changed to Central Avenue, so the street name is unrelated to ST&T's Central Office.

The telephone company continued to own Radio Central for several years after it was no longer an exchange. By 1947 the Church of the Nazarene was using the building as a sanctuary. In the mid 1950s, the church created an altar area by installing a raised platform on the main floor of the original building. This work included new interior walls surrounding the raised platform. The church changed the building front façade about the same time. In 1964 the church created a new main entrance on the right side of the building.

In 1974 the church sold the building to the Garner Preschool Learning Center, at which point the building was partially remodeled to make it suitable for a school.

In early 1983 a building permit was issued to repair Radio Central fire damage. This damage may have been in the west wall of the 1925-1926 addition. The fire damage repair permit was issued just after the Webster Service Garage at 2150

Interior of 2152 Central Avenue when it was a telephone exchange (early 1930s?).
Front entrance is at the far end.

Central was demolished in late 1982. The garage occupied what is now the parking lot adjacent to Radio Central. A portion of the garage was very close to the west wall of Radio Central. Perhaps a single fire damaged both facilities. In 1997 the unreinforced masonry of the original brick building was strengthened to better withstand seismic events.

Church Parking Lot adjacent to Radio Central

The parking lot adjacent to Radio Central was once occupied by the Alameda Garage. Lee Cavanaugh (born 1899, died 1974) started working at the garage in 1916. In 1920 Lee bought the garage for $3,500. Alameda Garage became a DeSoto automobile agency about 1930. The garage building was divided into an automobile showroom, a repair shop, a paint shop and a car wash. During the 1930s, the showroom displayed two cars: a DeSoto and a Plymouth.

In 1948 Cavanaugh moved the dealership to 1700 Park Street. Lee's son David M. Cavanaugh worked at the Alameda Garage and subsequently operated Cavanaugh Chrysler on Park Street. The Cavanaugh Chrysler dealership remained on Park Street until it permanently closed about 2007.

By 1979 the Alameda Garage was renamed the Webster Service Garage. In September 1982 the City of Alameda issued a permit to Cavanaugh for demolition and removal of the garage buildings. This work was completed in December 1982.

The lot is now owned by the Central Baptist Church for used by its members. CHRS has an agreement with the church that allows CHRS use of the lot.

The Webster Service Garage that was next door.

Sunset Telephone and Telegraph Company

In 1880 Pacific Telephone and Telegraph (PT&T) was formed with George S. Ladd as first president. In 1883 ST&T was incorporated. Its first president was also George S. Ladd. ST&T was incorporated to operate in all of the Pacific Coast territory outside of San Francisco. It was responsible for absorbing local exchanges and linking them together with long distance service. ST&T was probably always owned and controlled by PT&T. In 1906 the name of ST&T was changed to Pacific Telephone and Telegraph. PT&T decided to take direct control of ST&T operations to better manage the unanticipated rapid telephone growth in the East Bay caused by influx of people after the San Francisco earthquake of 1906. It is uncertain if the 1906 name change applied to all of ST&T or just to operations in the East Bay. ST&T had operations in Los Angeles, San Francisco, Portland, Seattle and many other smaller cities on the west coast. ST&T was headquartered in San Francisco. The California Telephone directory published by PT&T in 1898 contains PT&T and ST&T listings. Logos of both companies are displayed with equal prominence on the directory cover.

Building Restoration Project Update

The sewer line was clogged due to root intrusion and was replaced using a bust-in-place method using high-density polyethylene. This method avoided the need to dig up the driveway and sidewalk. This was paid for by the seller.

All fire protection sprinkler heads were replaced with modern heads and maintenance was performed throughout the system; Two heads were relocated to provide clearance for library bookcase installation. Fire extinguishers were refurbished or replaced. All smoke detectors were replaced. Fire alarm bell was repaired. The system passed the required one-year and five-year inspections.

Emergency Exit Signs were repaired and lamps replaced. Additional non illuminated exit signs were installed.

Mold was removed from a basement closet. The closet will next be restored and repainted.

Basement sump pump was cleaned and serviced. Pump was tested and found to be operating correctly.

Waterproof seal along walkway between the doors on parking lot side of building was renewed. Damaged mortar along driveway side of building was repaired. Asphalt was repaired and a concrete gutter was added to improve parking lot drainage and channel water away from the building.

Main room upstairs — The popcorn ceiling with asbestos and the T-bar ceiling was removed and remediated by a licensed contractor. Walls were removed that had been constructed as a pulpit and sanctuary when the church occupied the building. The original plaster was unsafe and delaminating from the lath; a contactor removed all the lath and plaster from the main room. Now the room is ready to be finished with wall and ceiling treatments, molding, etc. See progress photos right and below.

Main room as it was before demolition. Photo Mike Adams.

Main room after T-bar suspended ceiling, soffits, and asbestos popcorn wall and ceiling insulation were removed. Photo by John Stuart.

Main room after plaster and church sanctuary walls at far end were removed. Photo by John Stuart.

◊

RADAR History and Losing another Ham Band — 77 GigaHertz — to Cars!
(More Consumer RADAR at Work)

by Bart Lee, K6VK

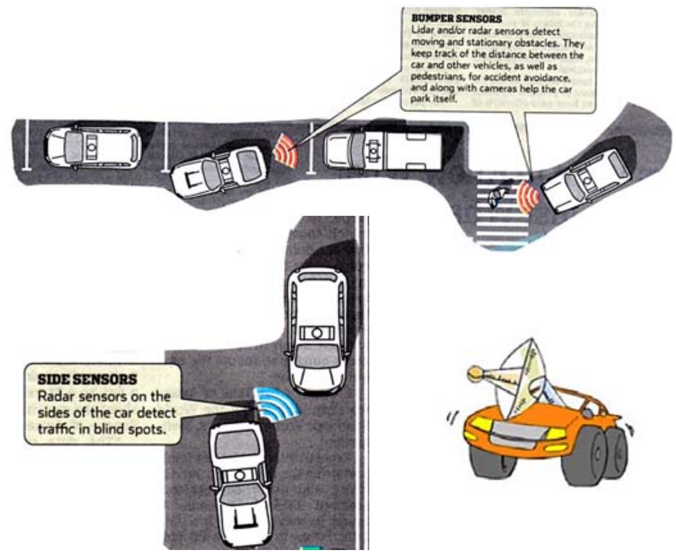
Bart Lee, K6VK, a Fellow of the California Historical Radio Society, holding both FCC Commercial (GROL with Radar), and Amateur Extra licenses.

A result of the work of the Indian physicist J.C. Bose more than a century ago,[1] and Nikola Telsa in 1917,[2] and other pioneers, it seems cars now want to talk to each other and look out for themselves with microwave RADAR. (See Figures 1, 2 & 3).

The father of microwave engineering is the brilliant Indian multi-discipline scientist: Sir Jagadis Chandra Bose, who worked at up to 60 GHz (5 mm wavelength) in 1895. At the end of the 19th Century,

> "… J.C. Bose described to the Royal Institution in London his research carried out in Calcutta at millimeter wavelengths. …Bose used waveguides, horn antennas, dielectric lenses, various polarizers and even semiconductors at frequencies as high as 60 GHz; much of his original equipment is still in existence,… at the Bose Institute in Calcutta." [3]

Tesla also claimed to have worked with millimeter wavelengths.



Figs. 1, 2 & 3: The illustrations of Sensing Cars are graphics by John Gould for the *Wall Street Journal*. [21]
The cartoon car with the parabolic antenna comes from www.comlawblog.com.

The Federal Communications Commission (FCC) has given cars the 76 - 77 GigaHertz (EHF) ham band. That works out to about a four-millimeter (4 mm) wavelength. "Amateur operation at 76-77 GHz has been suspended till the FCC can determine that interference will not be caused to vehicle radar systems" according to the ARRL.[4] The range from 75 to 110 GHz is known generally as the W - band, and often used by satellites.

What the FCC has done is suspend amateur radio activity on the 4 mm band to determine if that activity could cause interference with the automotive systems.[5] These systems will operate as Part 15 intentional radiators, but may in the end go up to 100 watts. Google® may become a big player in this range. It looks like a number of microwave engineers like to experiment at UHF, SHF and EHF, the frequencies of which follow (from Wikipedia):

> Ultra high frequency (UHF) — 300–3000 MHz (1 m–100 mm). Uses: Television broadcasts, Microwave oven, Microwave devices/communications, radio astronomy, mobile phones, wireless LAN, Bluetooth, GPS and two-way radios such as Land Mobile, FRS and GMRS radios, amateur radio.
>
> Super high frequency (SHF) — 3-30 GHz (100 mm–10 mm). Uses: Radio astronomy, microwave devices/communications, wireless LAN, most modern radars, communications satellites, satellite television broadcasting, DBS, amateur radio.
>
> Extremely high frequency (EHF) — 30–300 GHz (10 mm–1 mm). Uses: Radio astronomy, high-frequency microwave radio relay, microwave remote sensing, amateur radio, directed-energy weapon, millimeter wave scanner.

The International Amateur Radio Union (IARU) recommends a 4 mm band from 75.5 GHz to 81 GHz in four tranches. This is the U.S allocation for the Amateur Radio Service and the Amateur Satellite Service. So, what if anything was going on in the 77-gigahertz ham band before the FCC shut it down? And how does one generate a signal in that range? Today's answer is the MMIC:

> "A Monolithic Microwave Integrated Circuit, or MMIC (sometimes pronounced "mimic"), is a type of integrated circuit (IC) device that operates at microwave frequencies (300 MHz to 300 GHz). These devices typically perform functions such as microwave mixing, power amplification, low-noise amplification, and high frequency switching. Inputs and outputs on MMIC

devices are frequently matched to a characteristic impedance of 50 ohms. This makes them easier to use, as cascading of MMICs does not then require an external matching network. Additionally, most microwave test equipment is designed to operate in a 50-ohm environment. MMICs are dimensionally small (from around 1 mm^2 to 10 mm^2) and can be mass produced, which has allowed the proliferation of high-frequency devices such as cellular phones." (From Wikipedia).

Tom Williams, WA1MBA, makes 4 mm (76 - 80 GHz) MMICs for fun, and he also sells them.[6] He got 25 orders from U.S. hams for the calling frequency of 78.192 GHz and two at 79 GHz, ten from Europe on 76.032 GHz, two from Australia at 80 GHz, three from Japan at 77.750 GHz, and four for EME work (Earth-Moon-Earth) at 77.184 GHz. (A photo of his from *QEX* appears nearby (figure 4) — it looks like his MMIC assemblies are about 3" by 2" by 1").

There is also considerable 4 mm amateur radio experimentation in the U.K. The U.K. 4 mm Center of Activity is at 75.976 GHz. As in the U.S., both the Amateur Radio Service and the Amateur Satellite Service have access to the band. But since they drive on the wrong side of the road in the U.K., the British hams may not lose this band to cars. This is so because all the signals from any adopted U.S. automotive safety systems could be backward, at best mirror -image. Britain is not likely to make the needed investment to have a U.K. system for its very much smaller population (64 million), although it could sell it to some other countries that also drive on the wrong side of the road. English hams have communicated at a distance of 80 miles on 76 GHz. They used narrow -band FM. The prior English distance record was 63 miles.[7] (Of course, EME distances are longer; that's Earth-Moon-Earth.) The Australian 76/78 GHz distance record is 139.8 km (87 miles) over a line-of-sight path on both SSB and digital (WSJT & JT65) modes. The current world record of is 252 km.[8]

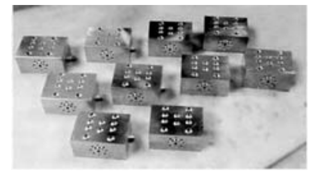


Fig. 4: (Williams caption:) Here is first batch of [MMIC] units after assembly. The first batch proved that we could get good noise figure and what care was needed regarding dressing of the RF ribbon bonds. All These are the "Through Style" Units.

Williams mentions commercial suppliers of Low Noise Amplifier MMICs for amateur use (for twice his price) so there are certainly more experimenters out there on 4 mm. He also mentions power up to 300 milliwatts on 4 mm, and frequencies up to 134 GHz from other MMICs. A microwave history says the first MMIC was put together in 1975, so that's almost 40 years ago,[9] see photos (figures 4 & 5) nearby.

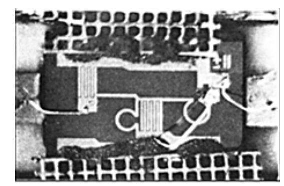


Fig. 5: Second iteration of the first MMIC with higher gain and lower noise. From the History of MMICs, cited in the footnotes.

How did we get into microwave technology, including car Radar, inasmuch as radio started out at long wave frequencies? Or did it? Hertz worked at two meters wavelength in the 1880s. According to the National Geospatial Intelligence Agency, in the early days of wireless:

"In 1904 the German engineer, Christian Hulsmeyer obtained a patent for a device capable of detecting ships. This device was demonstrated to the German navy, but failed to arouse interest probably due in part to its very limited range." [10]

A few years later, explaining how to find a miscreant and rogue who has kidnapped his girl and was flying with her to Venus, in the 1911 series in *Modern Electrics*, Hugo Gernsback's Ralph 124C41+ explains:

"A *pulsating polarized ether wave*, if directed on a metal object can be reflected in the same manner as a light-ray is reflected from a bright surface or from a mirror… . By manipulating the entire apparatus like a searchlight, waves would be sent over a large area. Sooner or later the waves would strike a space flyer. A small part of the waves would strike the metal body of the flyer, and these waves would be reflected back to the sending apparatus. Here they would fall on the *Actinoscope* (see diagram), which records only reflected waves, not direct ones… . From the intensity and the elapsed time of the reflected impulses, the distance between the earth and the flyer can then be accurately and quickly calculated." [11]

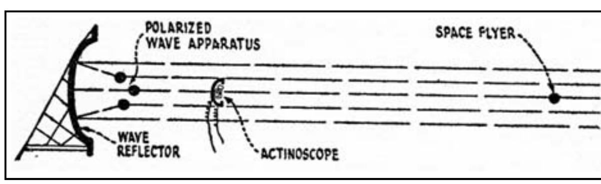


Fig 6: Gernsback's diagram of his ether wave detection and ranging system

In 1917, Nikola Tesla envisioned using the reflection of electromagnetic waves to determine the distance and other characteristics of objects. Tesla was the first to see Radar as an integrated system including a visual cathode ray tube display;[12] Tesla said in a 1917 interview:

"Now we are coming to the method of locating such hidden metal masses as submarines by *electric ray*" replied [Tesla] the electrical wizard. "That is the thing which seems to hold great promises. If we can shoot out a concentrated ray comprising a stream of minute electric charges vibrating electrically at tremendous frequency, say millions of cycles per second, and then intercept this ray, after it has been reflected by a submarine hull for example, and cause this intercepted ray to illuminate a

> fluorescent screen (similar to the X-ray method) on the same or another ship, then our problem of locating the hidden submarine will have been solved." [13]

His remarks stimulated further European research and development in the 1930s.[14] Did Tesla read Ralph 124C41+ ?

Marconi also foresaw Radar:

> "In some of my tests I have noticed the effects of reflection and deflection of these waves (3-meter waves) by metallic objects miles away. It seems to me that it should be possible to design apparatus by means of which a ship could radiate or project a divergent beam of these rays in any desired direction, which rays, if coming across a metallic object, such as another steamer or ship, would be reflected back to a receiver screened from the local transmitter on the sending ship, and thereby immediately reveal the presence and bearing of the other ship in fog or thick weather." [15]

World War II Radar provided the impetus to develop microwave technology. The Germans in WW II worked on short range Radar, the *Freya* system at two meters wavelength.[16] They also had a 10 cm (3 GHz) Radar with a big parabolic dish, as in Ralph's design of 1911. The Würzburg-Riese (giant) radar (FuMG 65) was technically better in some regards than that of the British. But the Germans made the mistake of siting the 10 cm Radar on the French Coast. So Britain sent in airborne commandos to steal it, and steal it they did (Operation Biting and the Bruneval Raid).

Fig. 7, CFT-15-E triode. From the CHRS collections, photo Bart Lee.

British Radar had started out at around 25 MHz in 1936. Power was generated first by silica -envelope tetrode vacuum tubes and then by ceramic tubes. BBC short wave transmissions provided the first test transmissions of this meter -scale "flood" system, the success of which depended on direction finding on the reflections.[17] It was of longer range than German Radar, and the British coordinated the information from their Radar better, thus permitting very brave fighter pilots to win the Battle of Britain in the air.[18]

Fig. 8. Enough micro-wave radiation will turn your eye lenses opaque forever and more than that can cook some or all of you. **Beware!**

Some novel high power vacuum tubes were developed for Radar, including the CFT-15-E triode with a directly heated filament. It operated at 600 MHz putting out a 5 KW pulse for airborne Radar. The nearby image (figure 7) is the CFT-15-E triode.

The primary VHF RF generator in airborne and other millimeter World War Two Radar was the magnetron, developed by the British. The British perfected the magnetron in 1939 for generation of higher frequencies, *e.g.*, 10 KW at 10 cm. This later became the engine of the microwave ovens that have since been manufactured by the millions. (A near kilowatt micro-wave source at about 2.4 GHZ, a shared ham band, is in every one of them — *QST* once ran a conversion article. See graphic (figure 8) of a relevant hazard sign). Some say we traded transmit/receive switch technology for magnetron technology, but the British simply wanted us to make a whole lot of magnetrons for them so they disclosed it.

But high power magnetron Radar put its own receivers at risk. The following image (figure 9) is the 721A, a type of radar T/R switch, a major contribution of the U.S to Allied Radar systems. Pulsed radars using large dish-shaped antennas pointed in the direction of search need to use the same antenna for transmission of high-power RF pulses (megawatts) and then for listening for the faint echoes (microwatts) between pulses. The gas discharge from the transmitted pulse prevents transmission power from entering and damaging the sensitive receiver connected to the same antenna.

What made these Radar receivers possible was the new klystron. Varian (of Palo Alto) starting in the 1930s made high power vacuum tube klystrons, many of which became TV transmitters after World War Two. Small, low -power klystrons provided the local oscillators in Radar receivers, running 60 MHz different from the frequency of the pulses and reflections. Inasmuch as the transmitter and the receiver used the same antenna, a switch device (such as the gas discharge tube in a waveguide) was needed to protect the receiver from the transmitter pulse. This was particularly important because a point contact silicon diode acted as the mixer for the return pulse and the local oscillator, and any transmitter power that got through would fry it.

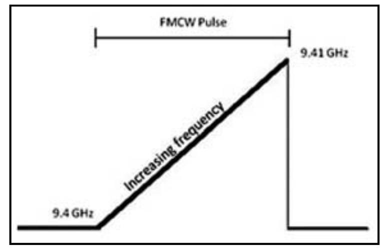
Fig. 9, a Sylvania 721A, a type of radar T/R switch.
From the CHRS collections, photo Bart Lee.

AT&T (the national telephone company back in the day) put in a microwave link between New York and Boston in 1947, three decades earlier than the first MMICs. It used special very high frequency vacuum tube circuits. ("Solid state" was then just a baby in Bell Labs). The "lighthouse" microwave tubes followed in the 1950s. So, microwaves and Radar have been around for a long time, roughly a century in terms of their beginnings. What *is* very new are consumer applications.

Some new consumer "FM" marine radars can discriminate objects as close as six feet, with the power of a cell phone. Some car Radar will likely operate on the same principles. This type of "broadband" marine Radar operates just below 10 GHz — 3 cm. (Amateurs also operate on 10 GHz. The distances possible are hundreds of miles over water).

> "Broadband radar is a generic term for Frequency Modulated Continuous Wave (FMCW), which is a new way to achieve radar signals. The 'Broadband' tag comes from the broad band of frequency it uses to interrogate a target. In fact FMCW compares changes in frequency between the transmitted and received signals to calculate range, instead of the conventional system of timing the interval between outgoing and returning signals. At low power, FMCW radar sends out a long pulse lasting about one thousandth of a second. Conventional radar sends out a short pulse but at very high power." [19]

Figure 10 is a graph of the changing frequency of the FM radar pulse (vertical scale). It goes up in frequency during the time of the pulse (horizontal scale). The reflection comes back at some sent frequency between 9.4 GHz and 9.41 GHz. Inasmuch as the pulse goes up in frequency with time, the initial return reflection at a given frequency, say, 9.405 GHz converts to a distance (speed of light) because the machine knows how long ago it sent that frequency in the frequency-rising pulse, and what it is sending at the time of reception.



(Fig. 10, a graph of frequency *vs.* time for a FMCW pulse.)

As the frequency of the low power FM Radar pulse goes up, here from 9.400 GHz to 9.410 GHz (10 MHz), a simultaneous wide-band receiver can hear a reflection of what was sent earlier and later in the pulse. The closer the received reflection is in frequency to 9.400 GHz, the closer is the reflecting object. This is so because a close object reflects the pulse at the lower frequencies, because that RF energy gets to it first and reflects first, and that earliest returning RF energy is at the lower frequency. By the time the RF energy gets to a more distant object, say 10 miles away, it also has risen to the higher frequency, closer to 9.410 GHz. A reflection that includes that higher frequency has to be more distant and the receiver hears that higher frequency reflection and shows it farther away. Of course such a system actually or virtually rotates, so azimuth appears on the screen showing reflected objects at a distance and at a bearing. A great deal of computational power is needed to make this work, in color with map and chart overlays.

The marine Radar only displays, it does not steer (yet):[20]

The image above shows a boat safely navigating through a vessel mooring field at close range with Broadband 4G Radar.

The same vessel mooring field as seen by eye is incredibly crowded and challenging to navigate through without the aid of radar.

It may be that car Radar will have to use FMCW for near vehicle detection and to keep power low for safety. As with boats, powerful computational power would be needed to make this work. So, *what could possibly go wrong*?

The new automotive Radar and related systems will supposedly keep cars from hitting each other and running into things, according to the *Wall Street Journal*.[21] The *Wall Street Journal* article goes on to note that such automated car systems will be subject to hacking including capture of control of the cars and trucks using the systems.

The "total information awareness" (to use NSA's phrase) that the vehicles will supposedly enjoy will come from not just the 77 gigs Radar, but also Lidar (light detection and ranging), Sonar, video cameras with analytic software and GPS positioning systems.[22] With this new automotive technology, one day everyone will just get in their cars, tell it where to go and have a beer, relaxing for the ride.

But all new cars are now required to have data recorders: everywhere you go and everything you do (with your car, at least) is recorded. This is so the lawyers can use it against you later, of course. The new 4 mm automotive Radar, and the related sensing technologies, will generate enormous amounts of data, and no doubt it too will be recorded — digital storage is so cheap these days and getting cheaper. Soon these cars will also record what signals come from other cars they come near. Then each car will have a record of every other car with which it interacted. For this to work, the energy sent out by each car with have to be labeled with a digital identification packet. That packet may actually be the sensing data sent out. So it won't be like old analog Radar, with just a pulse on a specific frequency. It will likely be a digital data pack so the other car can record who pinged it, and vice versa. Doppler shift can provide velocity and acceleration data.

Then there's the problem of interference. Perhaps each brand or make or style of car and truck will get its own set of frequencies. This would help in identifying other cars in terms of mass and momentum. If spread spectrum techniques can be applied to FMCW operation, then interference issues diminish, as long as all cars operate spread spectrum. Another possible resolution of the interference problem is a digital filter, so that the primary response is to one's own car's digital ping and its echo.

Just "listening" to other cars' digital signals for safety information and recording them is a simpler process because they will not be weak reflected echoes but rather stronger sensing pulses. That's similar to World War Two IFF technology (Identification Friend or Foe): Radar echoes would be very weak, but the return signal from an interrogated aircraft is quite strong in comparison because it comes from a dedicated transmitter on the right frequency. Automotive Radar may well more resemble digital IFF than search modes. But search and find modes (including Sonar and Lidar) will play a role in accident avoidance with objects (non-metallic, like people) and non-responsive vehicles. These search functions can be short range, but the IFF functions would be longer range, and likely aggregate all responding vehicles for analysis and perhaps display to the driver. It could look something like an air traffic control screen, but with selectable filters, as a Google® heads-up display in front of the windshield. A driver could watch his self-driving vehicle thread through obstacles like a boat through a marina. [23]

But the "internet of things" does raise serious hacking issues, especially when the "things" are, for example, fully loaded gasoline tanker trucks moving at 65 miles an hour. Clever but evil hackers will want to figure out how to spoof a returning sensing echo, say, to make such a truck (or many of them) swerve out of the way of a non-existent but spoofed similar truck, maybe in a tunnel. Plain old negligence did that in the Oakland's Caldecott tunnel some years ago with horrific effect. Technology will not always be an unmixed blessing.

73 de Bart, K6VK

(Special thanks to Jim Kreuser, archivist at the Antique Wireless Association in New York for the Tesla text and Ralph 124C41+, and to Denny Monticelli re Lidar.)

References

1 D.T. Emerson, *The Work Of Jagadis Chandra Bose: 100 Years Of MM-Wave Research,* National Radio Astronomy Observatory (1998) at www.cv.nrao.edu/ ~demerson/bose / bose.html.See later text at fn. 17, and its reference.

2 W. Bernard Carlson, Tesla -- Inventor of the Electrical Age (2013) at 379 and its note 23; see Tesla text below.

3 Emerson, *supra.*

4 ARRL at www.arrl.org/ frequency-allocations.

5 The last time the FCC gave away a ham band it was 220 MHZ. They gave it to UPS for something called compandored AM. UPS never made it work, but hams never got that bottom of the 220 MHz band back either. "ACSSB (amplitude-companded single sideband) is a narrowband modulation method using a single sideband with a pilot tone, allowing an expander in the receiver to restore the amplitude that was severely compressed by the transmitter." http:// en.cyclopaedia. net /wiki/ Amplitude- Compandored- Single- Sideband.

6 Tom Williams, WA1MBA, "78 GHz LNA Wrap-up," *QEX,* March/April, 2014 at page 36.

7 *CQ* magazine, March/April 2014 at p. 65.

8 ARRL Letter for June 12, 2014.

9 "Let's start with the world's first MMIC, which was an amplifier. In 1975, a paper published by Ray Pengelly and James Turner entitled "Monolithic Broadband GaAs F.E.T. Amplifiers" sealed their fate as the inventors of the MMIC." History of MMICs: www. microwaves101. com/ encyclopedia/ historyMMIC.cfm.

10 Basic Radar Principles … National Geospatial Intelligence Agency http://msi.nga.mil/MSISiteContent/StaticFiles/NAV_PUBS/RNM/310ch1.pdf. See http://en.wikipedia.org/wiki/Christian_Hülsmeyer for a more thorough discussion of this pioneer.

11 Gernsback, Hugo, Ralph 124C41+, Boston, 1925 (and University of Nebraska Press reprint) p. 207-08. (An Actinoscope is a device for detection of radiation, invented by one A. Larsen in the 19th century in connection with ultra-violet light. Branly filings coherers may have sometimes been referred to as Actinoscopes at the turn of the last century).

12 Carson, Tesla, *supra* at 379; citing H. Winfield Secor, *infra.* The British later pioneered cathode ray tube displays for the earliest Radar.

13 H. Winfield Secor, "Tesla's View on Electricity and the War," *Electrical Experimenter,* August 1917, Vol. 5, No. 4, page 229 at p. 270.

14 According to Carlson, *supra.*

15 Proceedings of the Institute of Radio Engineers, Vol. 10, No. 4, August, 1922, p. 231; quoted in J.L. Hornung, Radar Primer, reprint (Chinese printer?) n.d., *c.* 1948, at p. 207; "Thus, in a few words, Marconi outlined what we now know as radar."

16 Comparable to the 1.5 meter U.S. Navy CXAM and the Army SCR-270, the "Pearl Harbor Radar."

17 The Birth of British Radar, the memoirs of Arnold 'Skip' Wilkins, OBE, (DEHS and RSGB, 2d ed., 2011) is the best history. Wilkins worked for Sir Robert Watson-Watt, who also wrote about the development of Radar Britain and who took out the first patent. Watson Watt later, after the war, said to Christian Hülsmeyer: "I am the father of radar, whereas you are its grandfather." (Wikipedia, *supra).*

18 The U.S. had explored many Radar techniques in the 1930s but lacked the technology to generate high power pulses at VHF and higher.

19 www.rya.org.uk/cruising/ navigation/ Pages/ BroadbandRadar.aspx and its illustration.

20 www.lowrance.com/ Global/Lowrance/ Documents/ Broadband Radar 4G_3G Essential Guide_3406.pdf and its illustration.

21 Ucilia Wang, "How Driverless Cars Know How to Drive," *Wall Street Journal,* March 24, 2014, page R4; acknowledging Paul Perrone, Chair of the Road Automated Vehicles Standards Committee of the Society of Automotive Engineers, for her information on Radar.

22 Denny Monticelli, AE6C, CHRS, suggests the Lidar will focus on close -in objects (and people) and the Radar on more distant vehicles and structures.

23 The first British system for IFF was just a dipole at the meter wavelengths of the early British Radar, mounted on the target aircraft. A motor system then repetitively shorted ("keyed") the dipole to affect reflections back. Wilkins, *supra,* 61ff. German planes just wagged their wings to signal their nationality when returning home.

◊

Radio Beyond Audio and Video

by Norm Leal

For those who may not be familiar with vintage methods of transferring text and graphics by radio, let me provide a brief introduction based on my experiences.

Listening to short wave you will hear signals other than broadcast stations. At first you may think they are interference or jamming. Many are actually digital signals for teletype or facsimile. Most of these signals use Frequency Shift Keying (FSK) Transmitters shift frequency between two carriers 850 hertz or less apart. It takes a very stable receiver, such as R390A, to reliably copy these signals. During the 1960's and early 1970's I would transmit and receive teletype on amateur radio frequencies. Also copied commercial teletype and facsimile signals.

Teletype uses a 5 level code. Each letter is made up of 5 pulses along with a start and stop pulses. These pulses are called mark and space and, in radio signal, correspond to one of the two carrier frequencies that are 850 hertz apart. Teletype normally operates at 60 or 100 WPM. Common machines are Model 15, like seen in many movies, and later the Model 28 teletype. There are many others machines, codes and speeds. In amateur radio, Radio Teletype is abbreviated as RTTY. A good book on the subject is The New RTTY Handbook by Byron H Kreyzman.

To transmit I used a crystal oscillator with diodes switching capacitors to shift the 850 hertz. Transmitting also had to be very stable. Many variable frequency oscillators wouldn't do the job so I built equipment to receive Teletype. I used 88mh telephone toroid loading coils along with .033mf and .066 mf caps to make tuned circuits of 2125 and 2975 hertz, which are the required 850 hertz apart. From there signals would be converted to 60ma pulses for the Teletype.

Each Armed Forces Day from 1962 until 1997 I copied a teletype message from Secretary of Defense and received a nice certificate. After that time RF interference in my area, from lamps, computers, etc., made it difficult for receive perfect copy.

Facsimile pictures are also sent on short wave, The signal sounds somewhat like a barrel rolling at 1 revolution per second. It takes 20 minutes to send a full size picture 12" X 19." Facsimile was commonly used by the press sending pictures, weather maps, or countries where the language needs more than a teletype. Press pictures are sent mirror reverse. I had a RD92 to copy pictures. It uses special conductive, silvered paper. A stylus actually burns a picture by the use of voltage. Paper is a light gray in color and turns black where a picture is burned. Although not as many, both teletype and facsimile, signals can still be found on short wave, just receiving these signals is a hobby in itself.

Model 15 Teletype.

Department of Defense

CERTIFICATE OF MERIT — ARMED FORCES DAY 1997

This is to certify that

NORMAN R. LEAL

has demonstrated unusual proficiency by receiving and transcribing without error the Armed Forces Day message of the Secretary of Defense transmitting via military radio on May 18 1997.

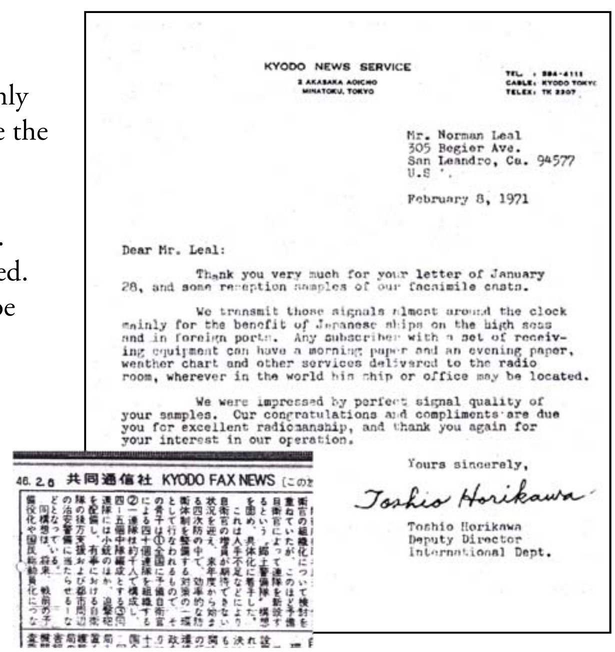
Washington, D.C.

Secretary of Defense

"CELEBRATE ARMED FORCES DAY"

Armed Forces Day Defense Department Certificate.

RD92/UX Navy Facsimile Receiver.



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Mr. Norman Leal
305 Begier Ave.
San Leandro, Ca. 94577
U.S.A.

February 8, 1971

Dear Mr. Leal:

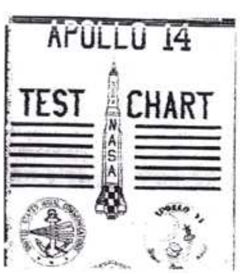
Thank you very much for your letter of January 28, and some reception samples of our facsimile casts.

We transmit those signals almost around the clock mainly for the benefit of Japanese ships on the high seas and in foreign ports. Any subscriber with a set of receiving equipment can have a morning paper and an evening paper, weather chart and other services delivered to the radio room, wherever in the world his ship or office may be located.

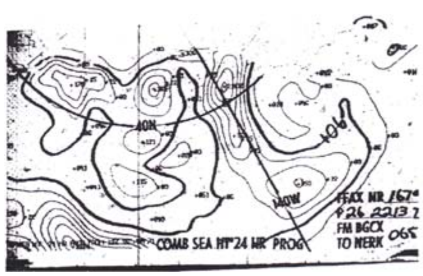
We were impressed by perfect signal quality of your samples. Our congratulations and compliments are due you for excellent radiomanship, and thank you again for your interest in our operation.

Yours sincerely,

Toshio Horikawa
Deputy Director
International Dept.



NASA facsimile.



Weather facsimile.

Facsimile received from Japan and an acknowledgment letter. ◊

Tom Albrecht Vintage TV Demo

Photos by Richard Watts and John Staples

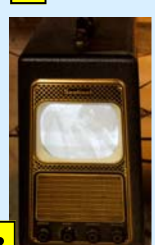
Tom Albrecht opened his home May 10th to TV collectors to view a demonstration of vintage TVs. The approximately 20 sets on display included several from Tom's collection plus sets from other collectors. All the sets were operational, restored to a high quality, and quite impressive. The demonstrations were very well organized and most informative. Conversations and comradery were engaging and interesting. The dark horizontal bar appearing in the photos of the TV CRT images below are only an artifact of the photography and didn't appear in the set images when viewed. Highlights of the day include:

Nat Pendelton demonstrates his RCA TT-5, a pre WWII set. This set had no audio amp, audio has to be played through the radio sitting on the table left (under his arm). On the right is a General Electric HM-171, another pre WWII set. Both sets are from 1939 and quite rare.

1 - Admiral 20X122 10" BW (1948) small Bakelite console.
2 - RCA 621T 7" BW (1946) one of the first post WWII sets.
3 - RCA 14" BW (1958) a classic 1950's styled portable.
4 - GE 805 10" BW (1949) "Locomotive" in Bakelite cabinet.
5 - Crosley 9-407 12" BW (1948) has FM, uses a Dumont chassis.
6 - Philco Safari (1959) first transistor portable, mirror in lid for viewing.
7 - Philco Predicta 9L37 21" BW (1959) the "Holiday."

A

C



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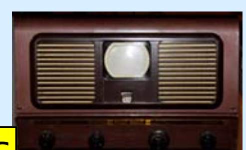

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F

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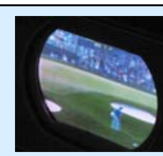


H

A - Philco 48-2500 BW (1948) a projection set that produces a 15"x20" image on the lift-up mirror/lens. It uses a very bright 4" magnetically deflected CRT. The image is projected via 12" spherical mirror through a 7" corrector lens.
B - Sentinel TV-400 7" BW (1948) luggable portable.
C - Philco Predicta 9L37 21" BW (1959) the "Holiday."
D - Philco Safari (1959) first transistorized portable.

E - Hallicrafters 7" BW (1948) has TV channel 1.
F - Motorola 7" BW (1948) nice Blonde cabinet.
G - Pilot TV-37 3" BW (1949) was targeted to college students.
H - RCA CT-100 15" color (1954) one of the first color sets. This is a rare set. Originally sold in 1954 for $1000. The golf photo above the set is the picture the set displayed when it was operating. The golfer did miss the sand trap.

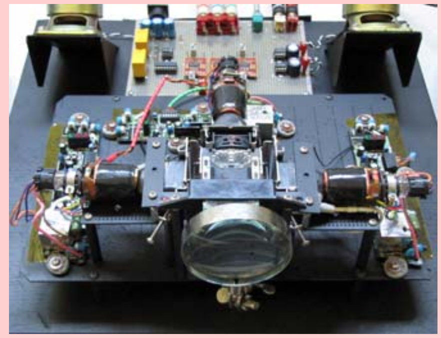
Tom Albrecht demonstrating his Dumont RA-101 Westminster entertainment center with a 20" BW TV, AM/FM/SW, and 78rpm Webster 70 phonograph (1947).

The CRT is automatically raised out of the cabinet and into position via a motorized gear driven mechanism when its lid is lifted.

The TV/FM tuner is motorized. This set has TV channel 1.

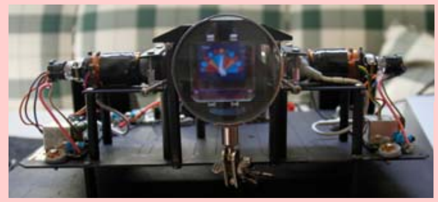
This set has five separate chassis with a total of 44 tubes for the AM/SW radio, TV/FM RF-IF, sweep, synchronization, and audio sections.

The set originally sold for $2,495 in 1947, about the same price as a Cadillac automobile of the day.



Top View

3 small 1" BW CRTs offset 90 degrees from each other. The prism is in the center of the CRTs.



Front View

The tiny image emerging from the prism is magnified for viewing.

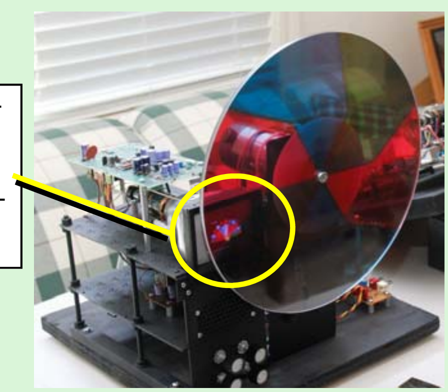
Experimental tiny Triniscope TV made by Richard Diehl

The Triniscope was originally developed by Richard Webb at RCA in 1950 as an approach to build color TVs using monochrome (black & white) CRTs. It uses three CRTs each with its axis offset from the others. Each CRT is fed a signal for one of the primary colors (red, green or blue). Then each CRT projects its image through a color gel filter of the matching color. The three images are then converged into a single image via a prism or mirror arrangement. Triniscope prototypes had a limited viewing angle.

Richard's Triniscope is small because he used 1" CRTs and a prism for convergence. The original RCA prototypes were very large owing to the positioning of large CRTs to obtain an acceptable room size viewable image. The 3-phosphor CRT was developed at that time and proved to be a much more practical affordable alternative for consumers.

The Triniscope has similarities to contemporary color projection TVs which use three CRTs each with a primary color phosphor projected and converged via lenses and mirrors to a single image.

Sequential monochrome images viewed through a spinning disk of matching alternating color filters.



Experimental Goldmark TV made by Richard Diehl.

Originally developed by Dr. Peter Goldmark of CBS in the1940s, this is another approach to displaying a color image with a monochrome CRT. The system transmitted sequential frames of the primary color images (red, green, and blue) to be displayed one after the other on the CRT. This sequence was synchronized with a spinning wheel having alternating color filters so that the red filter would be in front of the CRT when the red image is displayed and so on. The speed of the alternating frames and wheel rotation was chosen to minimize flicker. Just after WWII, the CBS field sequential system competed with the RCA-promoted NTSC system for FCC adoption; In 1951, the FCC chose NTSC. ◊

KPH and Marin Sites Serving Wireless in the Pacific

by Richard Watts

Recently, I was able to visit the historic Marconi/RCA wireless facilities at both Bolinas and Point Reyes. I found both sites impressive to say the least. I believe we are very fortunate to have a site with such important historical significance so close. And further fortunate that the National Park Service — Point Reyes National Seashore working with the Maritime Radio Historical Society is willing and able to maintain and preserve this treasure. If you have not taken the opportunity to visit, I whole heartedly urge you to do so. I believe you will find it most fascinating.

This article draws heavily from the unpublished historical resource study, Wireless Giant of the Pacific—A History of the Marconi and RCA Radio Stations on the Point Reyes Peninsula, authored in 1998 by Dewey Livingston for the National Park Service—Point Reyes National Seashore, and the Cultural Landscape Report: Marconi/RCA Bolinas Transmitting Station and RCA Point Reyes Receiving Station Historic District Point Reyes National Seashore prepared for the National Park Service by the Architectural Resources Group, San Francisco, California and Royston Hanamoto Alley & Abey, Mill Valley, California. I wish to thank Carola DeRooy, Archivist & Museum Collection Manager for the Point Reyes National Seashore for and Richard Dillman for their generous assistance. Additional information drawn from:

The very interesting book, My San Francisco Story of the Waterfront and the Wireless authored by Commander Richard Johnstone in 1965. The late Commander Johnstone was an amateur radio operator in his youth, a Merchant Marine ship-board wireless operator, an operator at KPH 1915-1917, and after WWI, Chief Operator and later a district manager of the Marine Department of RCA at San Francisco.

The Antique Wireless Association Review, Volume 24, 2011 article *Wireless Comes of Age on the West Coast* authored by CHRS Fellow Bart Lee.

The Maritime Radio Historical Society website at http://radiomarine.org/ .

The CHRS Archives of the Society of Wireless Pioneers (SoWP).

CDR Richard Johnstone at KPH, 1918. SoWP Archive.

Early Pacific Coast Wireless

The first wireless transmission occurred in San Francisco in August 1899 when a local newspaper, the *San Francisco Call* utilized it to scoop a story of the impending arrival of the *USS Sherman* carrying troops returning from the Spanish-American War campaign in the Philippines. When the Lighthouse 70 ship of the U.S. Lighthouse services seven miles off shore spotted the ship, it sent a transmission to the receiving station at the Cliff House and was quickly published. In the first decade, San Francisco attracted a large volume of wireless business and became the Pacific coast center of maritime activity. The United States Lighthouse Service had temporarily installed its first wireless set on the San Francisco Lightship in 1899, and soon many Pacific Coast steamers had wireless capability. The U.S. Navy built twelve coastal stations and the Army had at least nine in Alaska.

Between 1900 and 1910 four wireless companies, whose assets would later be subsumed by the Marconi company, installed dozens of ship-to-shore stations along the coast from Seattle to San Diego. These included:

Pacific Wireless Telegraph Company, stations included "A" located at Avalon on Catalina Island and its counterpart "G" in San Pedro. Other Pacific Wireless stations were "SF" in San Francisco; "D" in Port Townsend, WA; and "DA" in Seattle, WA. According to an article in *Electrical Review and Western Electrician*, Pacific Wireless was one of four companies merged to form the Continental Wireless Telephone and Telegraph Company in 1910. Continental Wireless failed in 1912 or 1913 as a result of the prosecution of its executives for stock fraud.

Massie Wireless Telegraph Company, primarily operated stations on the East Coast. They did operate a shore station at the Cliff House in San Francisco, call letters "IAA." Massie sold its West Coast holdings to Marconi in 1912; the remaining Massie holdings were closely affiliated or merged with United Wireless.

American DeForest Company, established the "PH" station at the Palace Hotel in San Francisco in 1904. PH would become a large part of the Marconi/RCA story. The company also operated other stations on the West Coast.

The company ended in 1906 after unscrupulous financial dealings of business partner Abraham "Honest Abe" White, coupled with derogatory media stories that shook investor confidence, stories allegedly planted by Marconi.

United Wireless Telegraph Company, acquired American DeForest Co., including PH, in 1906. They controlled 30 coastal stations from Los Angeles to Alaska and hundreds of installations on ships at sea (see Table 1). In 1910, several executives were convicted of stock fraud. That event coupled with the loss of a legal fight over patent rights with the Marconi Corporation forced United Wireless into bankruptcy in 1911.

Table 1: A list of station locations owned by American DeForest or United Wireless during the period 1900 through 1906 with associated call letters. The third column lists the call letters after the stations were acquired by Marconi. Marconi reduced the number of stations from thirty to nine.

Station	1900 - 1906 DeForest & United Wireless Call Letters	1911 - 1917 Marconi Wireless Call Letters
Avalon, CA	PI	KPI
Los Angeles, CA	PJ	KPJ
Pasadena, CA	DE	
Santa Barbara, CA	DF	
San Luis Obispo, CA	DN	KDN
Monterey, CA	PQ	
San Francisco, CA	PH	KPH
Sacramento, CA	DG	
Eureka, CA	PM	KPM
Marshfield, OR	PX	KPX
Westport, OR	PG	
Roseburg, OR	DO	
Salem, OR	DM	
Portland, OR	PE	
Astoria, OR	PC	KPC
Aberdeen, WA	PF	
Gray's Harbor, WA	PG	
Port Townsend, WA	DS	
Everett, WA	DK	
Tacoma, WA	PB	
Friday Harbor, WA	PD	KPD
Seattle, WA	PA	KPA
Olympia, WA	PY	
Bellingham, WA	PU	
Katalla, AK	PN	
Cordova, AK	PO	
Safety Harbor, AK	RA	
Vancouver, BC	DF	
Victoria, BC	PR	
North Victoria, BC	PW	

(Source: My San Francisco Story of the Waterfront and the Wireless, by Commander Richard Johnstone, 1965.)

The expanding shipping business in the Pacific saw the need for wireless service and rapidly equipped ships with the best wireless sets. As technology improved, communication distances increased from 30 miles a the turn of the century to, at times, over 1,000 miles by the end of the decade. PH had exchanged messages with Matson ships over 1,000 miles at sea, and the SS Alameda and SS Mariposa were heard at 2,000 miles. There was yet no point-to-point wireless service in the Pacific. Undersea cables of the Commercial Cable Company connected many points on the Pacific but that service was expensive. In a 1908 experiment to determine the viability of a long distance wireless link, United's PH communicated with Marconi's HU at Kahuku, a distance of more than 2,000 miles.

The need for expanded wireless service was also driven by an international agreement went into effect on July 1, 1911, requiring a radio operator on many ships, instigating inspections and licensing, and assigning specific wavelengths to stations to avoid interference. Per Johnstone, also effective July 1st, 1911, two-letter call-signs were replaced with three, and U.S. Pacific coast call-signs given the first letter of "K" for coastal stations while a "W" was used for commercial ships; the East Coast was the opposite, a "W" signified a coastal station and "K" was used for commercial ships. East Coast amateur stations call began with a K, and Pacific coast amateur stations began with a "W."

Wireless operators quickly learned distinguishing characteristics that could be discerned among their fellow operators. Johnstone reflected:

> Both landline telegraph operators and radio operators have what we term a "fist." It may be defined as a particular style of sending which identifies the operator, exactly as voice identifies a person. There is a definite "swing" or rhythm which one becomes used to. Also some send slow, some irregular, and some very fast. In my years spent with operators, including actual

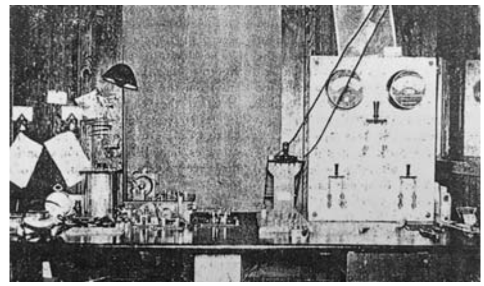
> operating, on testing them for efficiency, I found that the best operators among them favored good music. For instance the John Phillip Souza marches … [or] the "Blue Danube Waltz." ...

The Palace Hotel, first location of PH. It was destroyed by fire in 1906 earthquake.
Source Wikipedia.

KPH

In 1904 American DeForest established a station at the Palace Hotel and used the call letters PH, the hotels initials. Business for the station grew until the earthquake and fire of 1906 which destroyed the Palace Hotel. United Wireless bought PH and rebuilt it on Green St. on Russian Hill.

In 1909 the station was moved again to Hillcrest in Daly City, on the coast just south of San Francisco. In 1911 the station added the required call letter prefix "K" acquiring the call KPH. At that time the station was considered by some to be the most important station on the Pacific Coast.



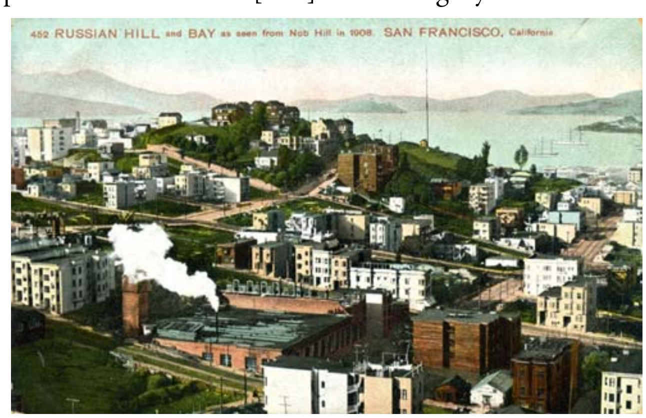
PH operating position in the Palace Hotel.
Source MRHS website.

Johnstone, a former KPH operator, described the Hillcrest station as follows:

> "The "wireless shack" was at the top of a rocky cliff, exactly between the two antenna poles which were 250 feet high. The aerial, or antenna, was 500 feet long. Two 4 x 4 twenty-five foot beams served as spreaders. As the house was in directly in the center, a perfect "T" formed the lead-in cable. Our ground was a problem. The ground was all rock, and a mesh of galvanized wires were laid over several acres of the hilltop. These wires were welded together to form our counterpoise ground. Grazing cows destroyed much of the wire netting by getting their feet caught, and the net developed into a giant tangle.
>
> The transmitter at KPH was a five kilowatt open core transformer with a rotary spark gap, driven by an induction motor. The spark was about the size of a large olive, and could be heard over a mile from the station. Two banks of oil plate condensers replaced the old type Leyden jars. The tone of the spark was known the world over. It was a beautiful 240 cycle note. About 25 to 30 amperes went into the antenna. Actual records of over 6000 mils were accomplished. …
>
> The KPH receiving equipment consisted of two standard Marconi receiving cabinets with carborundum detectors. Model 101 and Model 103 cabinets I believe. … Unbeknown to the Marconi Wireless Telegraph Company, all the operators used their own pet receivers. Up in the attic was hidden a homemade receiver. This unit was built in a little suitcase, and consisted of a loose coupler, a very sensitive galena detector, and a pair of lightweight earphones. The unit was returned to its hiding place every morning at 7:00 A. M., and came out for use again after 4:00 P.M. Contrary to a rumor of the time, KPH did not have a vacuum tube receiver until almost 1917, just before World War One began."

Johnstone further recalls that the KPH station underwent improvements in 1916, including new antennas and installation of a quenched-gap transmitter, but the results were disappointing to the old-timers, who missed the raucous old rotary spark system.

The KPH ship-to-shore operation had many contracts with large shipping companies, but for many years experienced interference problems with coastal stations which had more powerful signals. Johnstone wrote of "large, high-aerial stations up and down the coast [that] would illegally drown out some ships completely, even less than 200 miles away."



1908 postcard of Green Street and Russian Hill. (Source Richard Dillman)

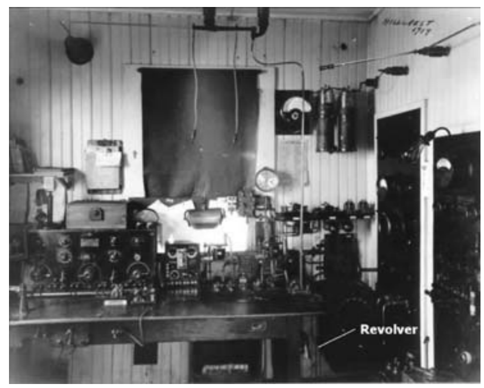
PH station on Russian Hill circa 1908.
Source Courtesy of the Rachel Isbell Branch archive of the ephemera of Arthur A. Isbell, his 1908 photograph and note (via Bart Lee).

KPH competitor, KFS, had a Poulsen arc transmitter which could blank out KPH reception. Even after its incorporation into Marconi's system, KPH remained underpowered while the company pursued its high power point-to-point capabilities. KPH continued operation at the Hillcrest location until the start of the U.S. involvement in World War One in 1917.

KPH at Hillcrest in Daly City circa 1912.
Source MRHS.

The Marconi Expands in the Pacific

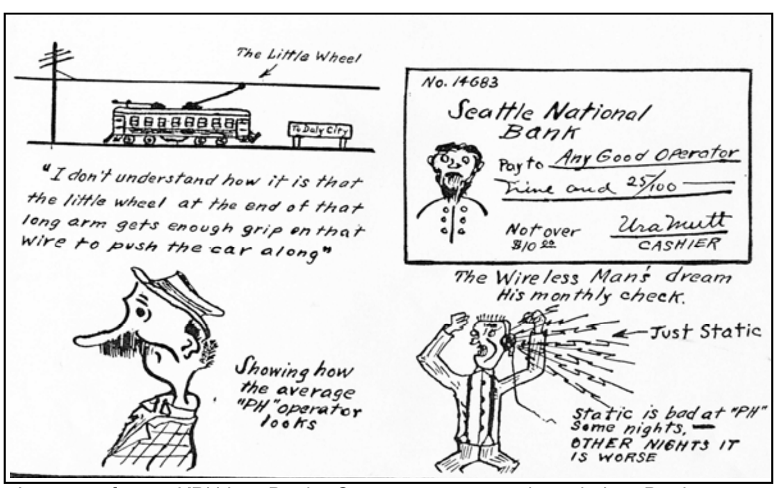
Marconi had established the Wireless Telegraph and Signaling Company, Ltd. in England on July 20, 1897. In October 1899 he came to New York to report via wireless on the America Cup yacht races; his goal was to soon establish communications between Europe and America. In order to use Marconi patents in the United States, he incorporated the Marconi Wireless Telegraph Company of America (MWTCA) in New Jersey on November 22, 1899. The companies' patent pool would include the works of Sir Oliver Lodge, Professor Michael Pupin, Thomas A. Edison and Dr. James A. Fleming, creating a corner on the market with their rights to the most important inventions. Marconi returned to America in 1901 to continue his transatlantic experiments, resulting in the first successful transmissions in December.



Interior of KPH at Hillcrest in 1919. Note the Marconi Model 106 receiver and the outboard audio tube amplifier to the right. Note also the grip of the revolver that was mounted to the leg of the table. Source MRHS.

In the early 1900s, MWTCA grew from holding about ten percent of America's wireless business to a virtual monopoly. The business lost money for more than ten years until the upswing of the 'teens. Most of the early business consisted of manufacturing equipment and supplying ships at sea, as well as training operators and technicians. Marconi's goal, however, was to encircle the globe with high-powered land stations. After the triumphs on the Atlantic, Marconi moved on to the Mediterranean, Russia and other parts of the world, including the Pacific Ocean. Other wireless companies proliferated in the boom.

MWTCA opened an office in San Francisco in 1912, however by then commercial wireless activity on the Pacific coast was well established. In 1912, the MWTCA had yet to operate a station in San Francisco, but had a network of wireless stations connecting the islands of Hawaii, including HU at Kahuku which would later become the high-power station connected with Marin and San Francisco. That year, MWTCA acquired the assets of the United Wireless Telegraph Company and Massie Wireless stations. They also acquired the defunct Continental Wireless Telephone and Telegraph Company providing MWTCA with the west coast stations previously operated by Pacific Wireless. Marconi's acquisitions coincided with the expansion of its Pacific wireless business. In 1913 the company reported that the number of messages handled increased from 228,000 in 1912 to 379,000 in 1913. Between 1911 and 1917, MWTCA had nine coast stations (see table 1).



A cartoon from a KPH Log Book. Cartoons were prominent in Log Books.
Source: A page of a1906 PH logbook reproduced in *Pacific Radio News*, 1917, courtesy of the late Jim Maxwell, W6CF (via Bart Lee).

In 1912 Marconi also began construction of high-power stations throughout their network. In 1912, Marconi technicians decided on a site for the new station north of San Francisco to connect the United States with Hawaii and the Orient. By 1913, high-power stations were under construction at Belmar, New Jersey, and Carnarvon, Wales, and in California and Hawaii, all of which would be operational in 1914. Other systems were being upgraded as well. The Japanese government constructed a station to connect with the Marconi system on the Pacific. In 1915 Marconi would construct high power stations at Marion, Massachusetts and Chatham on Cape Cod to communicate with Stavanger, Norway.

Locations of old Marshall and current Point Reyes receiving sits and the Bolinas transmitter site. Source NPS Cultural Landscape Report May 2012.

Marconi Builds High-Power Station at Marshall and Bolinas

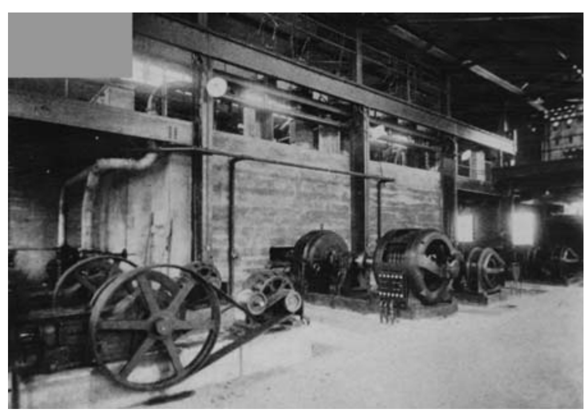
Having a reliable long distance capability necessitated MWTCA to find a new site away from interference. Marconi engineers traveled the Pacific coast searching for the cleanest receiving site. Interference can originate from both natural conditions and competing commercial frequencies so the engineers carried equipment to measure both type. In 1912 the engineers decided upon the Point Reyes area as it was not only a very clean site but in close proximity to its western headquarters in San Francisco.

The transmitting station would be located on the ocean's edge near Bolinas; The receiving and operating station would be constructed south of the town of Marshall twenty miles to the North. The twenty mile separation between the two stations was necessary as the tremendous power of the transmitting facility would interfere with the reception at the receiving site if the two sites were much closer. The stations were designed to be dedicated primarily for high-power point-to-point service communicating exclusively with stations in Hawaii. The Hawaiian stations in turn would act as relays to Asia. The high-power point-to-point station at Bolinas would have the call letters KET. KPH was to remain at the Hillcrest location continuing to provide ship-to-shore service.

Bolinas, the location of the transmitter site, was and still is a small coastal village. Founded in the Gold Rush, the town attracted lumbermen, fishermen, boat builders, dairy farmers, and tourists seeking a cool coastal destination. At that time Bolinas had no electricity, all dirt roads, and a small wharf that for the local schooners. Marconi engineers selected a site two miles northwest of the town, a flat and grassy mesa overlooking Duxbury Reef and the Pacific Ocean. In May 1913, MWTCA purchased 643 acres of Bolinas ranch land to accommodate the transmitting station and support buildings plus a large antenna field.


Marconi transmitter building (Building 1) and cottage 1 (circa 1920). Source MRHS.

The station at Bolinas would require a tremendous source of electricity to power its two 300 KW transmitters operating on 6,700 meters (44.77 kilocycles (kc)). Pacific Gas and Electric Company constructed a 20-mile long, 11,000 volt line from the Northwestern Pacific Railroad's powerhouse at Alto, near Mill Valley. The line passed over the rough, wooded terrain of Mt. Tamalpais to Bolinas with commercial power terminating at Woodville north of Bolinas; the MWTCA ran the final mile to the transmitting station underground. Nearby towns of Willow Camp (Stinson Beach) and Bolinas tapped the new line, bringing many 20th century improvements to the households there.


Marconi transmitter building interior showing what may have been the drive motor for the original 230kW rotary spark gap transmitter. The belt driven machines to the left appear to be compressors (pre-1920). Source MRHS.

Construction included four major concrete equipment buildings, a power house, hotel and two cottages plus wood frame outbuildings including a garage, cottages and shacks for technical apparatus. The largest of the structures, the power house, was two stories high with massive reinforced concrete walls and steel framing, large multi-light wood-framed windows and a bi-level roof with tiled hipped-roof clerestory units. The concrete foundation required additional piers and foundations for huge motor generators, disc dischargers and other machinery. A cooling tower with a massive concrete foundation stood west of the powerhouse, overlooking the ocean bluff.

The hotel would serve visiting technicians and dignitaries as well as some of the operating staff as needed. Built with two stories and a tile roof, 18 sleeping rooms plus a kitchen and common area, the hotel featured landscaped grounds and a tennis court nearby. Two matching cottages also with tile roofs would house the Engineer-in-Charge and the Assistant Engineer. A wood-frame cottage near the ocean bluff would house the Chief Rigger.

The Bolinas Transmitting Station site had nine, 300-foot-high masts that held the point-to-point service antennas. The masts were made of pressed steel, were 30 inches in diameter, and arranged in three rows of three to support a 2,000-foot by 600-foot rectangular antenna composed of 32 wires. Another 32-wire antenna was located at ground level, and a metal "earth plate" was below ground level in the ocean below the low-water level. Each of the 300-foot-high masts set on a concrete base eight feet square and was supported with 12,500 feet 1-inch diameter steel guy-cables cable to four 10-foot cube concrete anchors. Porcelain insulators had to be inserted at regular intervals along the guy-cables to prevent radio frequency energy absorption. The first transmitter was a 230kW rotary spark gap, the standard Marconi transmitter of the day.

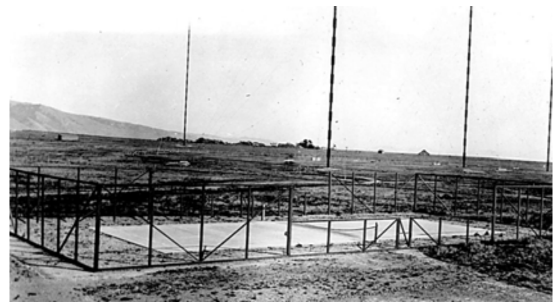
For the receiving station site, MWTCA purchased 1,125 acres south of the small town of Marshall on the Tomales Bay. Construction began mid 1913. The structures included the operating building on the north side of the property, a 35-room hotel for staff and visitors, two cottages matching those at Bolinas, a power house and various wood-frame outbuildings. Reportedly, the company spent $226,000 to build the Marshall station alone. As at Bolinas, the major structures were built of reinforced concrete and steel with tile roofs. MWTCA telegraph lines connecting Marshall and San Francisco stretched over the hills to the community of Woodville.

Civil engineer John C. Oglesby recalled in an August 3, 1957 article in the Independent-Journal, the extensive receiving antenna system installed at Marshall:

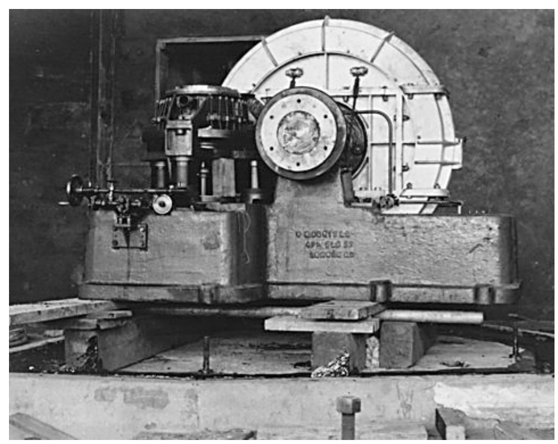
> "They [Marconi Wireless Telegraph Company] wanted to get a beam to China. So they had to run an aerial line 12 miles long on the great circle that took in China at this station. We ran the thing back into Chileno Valley. It had to be anchored in water so we dug a well and put the termination of the line into water. Then they wanted a beam for Tokyo. We ran a line from Marconi to Tocaloma on the great circle. We had Paper Mill Creek to terminate the line. But this never did go into service. A discovery was made that two ordinary power poles set approximately 40 feet apart with wires draped between them crossing the great circle . . . did the same service as the long aerials."

The Marshall Receiving Station sent messages to the Bolinas Transmitting Station in Morse code. To avoid interference by incoming radio waves, outgoing messages were sent by landline (a lead-sheathed telephone cable) to Bolinas where they were in turn transmitted by the

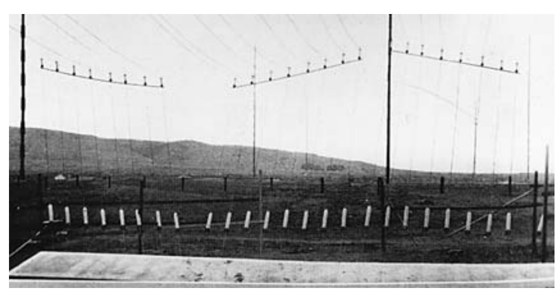
Marconi Hotel at the Bolinas site (1920 ca).
Source MRHS.



Tennis court and antenna fields at Bolinas site (circa1920). Source MRHS.



Believed to be the rotary spark for the 230kW Marconi transmitter. The words on the casting read W MACKIE & C, 47 1/2 OLD ST, LONDON EC. Source MRHS.



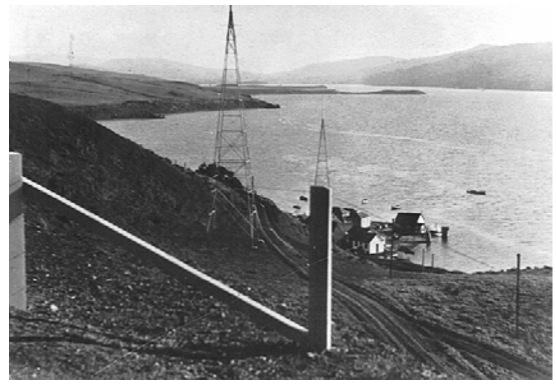
Down leads from the original Marconi antenna connected to the anchor along the east side of the Marconi Transmitter Buildingat Bolinas site (1914).
Source MRHS.

high-power transmitter to the receiving station in Koko Head on Oahu. In reverse, the transmitting station at Kahuku on the north shore of Oahu sent messages to Marshall.

Marshall hotel and operations buildings (1914). Source MRHS.

Per a Society of Wireless Pioneers article "The Haraden Pratt Story", Haraden Pratt, an assistant engineer at the Bolinas station, found the assignment a challenge. He experienced missing or incorrect blueprints and an unreliable delivery system for the equipment. Horse-drawn wagons carrying equipment got bogged down in muddy roads and the ocean steamer service operated on the whims of the tides and weather. "To make matters worse, my only technical assistant electrocuted himself." Pratt recalled there were other problems as well:

> At this high-power Marconi station, some 2,000 amperes of current flowed in the local oscillatory circuit through bus-bars which were twenty-four inches wide. When the power was first turned on for the initial test, the building filled with smoke from burning paint on the beautiful steel and iron bus-bar supports, which became excessively hot. Entire new supports of bronze had to be made in San Francisco to replace the iron and steel.



An antenna tower at Marshall next to the Tomales Bay. Source MRHS.

KET Point-To-Point Service Comes On Line

Despite ongoing technical problems, the transmitting station began operation on September 24, 1914. The great Marconi station opened that day with a ceremonial message between dignitaries of San Francisco and Hawaii. One writer characterized the event as "a victory over place and time the like of which only the living generation has experienced, and it is doubtful whether our sons or yet our grandsons will witness another triumph on so gigantic a scale."

At two o'clock the first message was sent via wireless from Governor Pinkham of Hawaii via the Kahuku station to the Marshall receiving station where it was further relayed from Bolinas via Western Union land lines to President Wilson in Washington D.C.:

> "With time and distance annihilated and space subdued through wireless triumphs and impulse, the Territory of Hawaii conveys its greetings, profound respect and sympathy to Woodrow Wilson, President of the United States, as he so earnestly seeks the blessing of peace and good will for all men and all nations."

The Bolinas operator relayed the response from the president:

> "May God bless the nations together in thought and purpose and lasting peace."

The opening of the station was no doubt a blow to the undersea cable companies, whose monopoly and high rates would come to an end. At the start of regular service, rates were 25 cents a word for regular messages, one dollar for the first ten words of a lettergram, and one and a half dollars for the first twenty-four words of weekend lettergrams. Wireless business would soon get a another boost by the opening of the Panama Canal increasing maritime activity in the Pacific.

An article in the Public Service Magazine, October 1914 described the operation at Bolinas:

> Energy is supplied by an 11,000-volt 3-phase transmission line … . This is stepped down to the proper voltage through four transformers. Two of these transformers are normally held in reserve. They supply power for the frequency changers, auxiliaries, exciter sets, air compressor motors, blower motors, fan motors, and the motors driving AC generator sets furnishing power for the operation of signaling circuits, all of induction motor drive.
>
> The current supplied by the frequency changers is again stepped up through five transformers of special design, one being held in reserve. All of the above units are in pairs, allowing one complete frequency changer and set of auxiliaries to remain in reserve. All units are each interchangeable. The switching arrangements allow any transformer to be cut out on both high and low sides, the step-down transformers being connected to the 11,000-volt feeder line through remote control oil-switches placed in vaults underneath the switchboard gallery.
>
> The high voltage circuit charges a large condenser which, in turn, discharges twice per cycle through 24-inch wide copper strip buses across the spark gap, located in a sound-proof vault.

The compressors supply air for cooling and regulating the discharge, ventilation being supplied with fans. The condenser discharges in series with an inductance, constituting the primary of an oscillation transformer, the secondary of which is connected directly to the aerial-earth system through two regulating coils. Eight 300-foot tubular steel masts support a 32-wire rectangular antenna about 2000 feet long and 600 feet wide. Directly below this is an elaborate ground system of 32 wires besides an earth plate buried in the ocean below the low-water level.

KPH operations at Marshall. Operators are using Western Electric model 509 headphones while manipulating their bugs and IP-501 tuners with outboard stage of audio amplification. Note the land line telegraph sounder. Source MRHS.

Signaling is done manually or automatically, at either Marshall or Bolinas, and the arrangement makes it possible to operate the transmitter at very high speed. A small bench board contains the instruments and switches controlling the automatic circuits. Lightning protection is afforded by four disconnecting and grounding switches located in the incoming aerial line. Lighting and small power for the entire plant is stepped down to 110 volts through two 25 KVA 3-phase transformers. A machine shop is located in the main generator room. Two rooms on the second floor provide space for an office and an operating room. Here the operator has in front of him the necessary switches for the changing over from transmitting to receiving, lamps being provided to indicate to him the position of the controlling apparatus.

The power-house thus resolves itself into two sections: the first being virtually a sub-station containing switching apparatus, step-down transformers and generating equipment proper, the second comprising the radio equipment proper. All the buildings are of structural steel and reinforced concrete construction."

The Bolinas Transmitting Station took on the call letters. Its Hawaiian counterpart had the call letters KIE. In the years after the Marin stations opened, many advancements in wireless technology increased transmission distances around the world. A radiogram received in San Francisco from Papeete, Tahiti made headlines in 1916 which noted the astounding distance of 4,000-miles covered. That year the Marconi station received signals from Hanover, Germany, a distance of approximately 7,000 miles. Marconi opened service to Japan in July 1916 creating the longest commercial link in the world. Marconi established service between Bolinas and Funabashi, a government owned station ten miles from Tokyo, via the Hawaii Marconi stations. During testing, Japanese messages were received directly by the Marshall station, an amazing feat for the time. Commercial service opened on November 15, 1916. Rates to Japan were set at eighty cents per word, as compared to $1.21 charged by the undersea cable companies.

Pacific Wireless During World War I

When the United States entered World War I on April 6, 1917, the Navy took control of all wireless stations including the, by that time, 53 MWTCA stations. The stations were either closed or operated by the Navy. The high-power stations at Point Reyes was renamed NOW. The KPH facility at Hillcrest was closed, but the staff enlisted as Navy personnel and continued to operate the KPH receivers when they moved first to San Francisco then to Yerba Buena Island. Traffic was minimal due to the communications blackout.

During the war MWTCA was effectively out of the communication business but their 20,000 square-foot manufacturing plant at Aldene, New Jersey received millions of dollars of equipment orders from the American government. Marconi technology aided the war effort in immeasurable ways, providing facilities, new equipment and trained personnel.

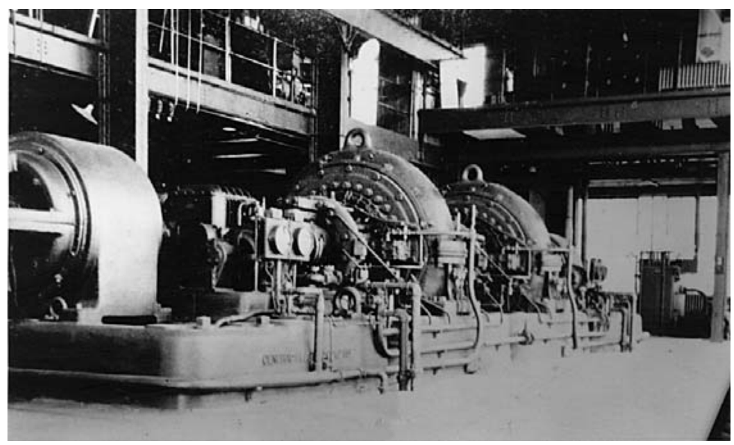
The U. S. Navy takeover had a broad effect which would change the face of the national and international wireless business. Included in the Navy takeover were all of the communications patents, the lifeblood of the wireless industry. According to RCA historian Kenneth Bilby, "through its wartime powers, the navy had coalesced a bickering and fragmented wireless industry into an instrument of national utility." At war's end in 1918 the Navy purchased 45 of the coastal stations they had taken over from Marconi for $789,500; The stations at Bolinas, Marion Massachusetts and New Brunswick were be returned to the Marconi company effective March 1, 1920.

Commercial radio changed significantly following the war's end in 1918. The number of stations declined when the Navy purchased forty-five of the coastal stations it had taken over from Marconi. Because there were so many advances made in radio during the war, many of the lower-power coastal stations were, or would soon be, out-of-date and scrapped. Perhaps the greatest change was that many Americans in industry and government, including Navy officials, believed that the British-owned Marconi Company should not have a monopoly over American wireless communications; that is, they believed that communications systems should be American owned. In 1919, this sentiment led to the formation of the Radio Corporation of America (RCA), and that year the Marconi Wireless Telegraph Company of America sold its stock to RCA. The high-power stations at Marin, as well as those in Hawaii and New Brunswick, were part of this transfer. Marconi sold the properties at Bolinas and Marshall to RCA in March 1920; in April, his company was dissolved.

RCA Assumes Ownership

Like its predecessor, RCA was a radio communications monopoly, this time with the blessing of the U.S. government. The original merger was between the General Electric Company (GE) and Marconi Wireless, with GE having the controlling share of stock. But in order to be competitive, RCA needed a consortium of other large companies to build the patent pool. RCA approached its competitors, American Telephone and Telegraph Company (AT&T) and Westinghouse Electric Company, both of which agreed to support the Americanization of wireless communications. Another business, the United Fruit Company, joined the deal, since its fleet of banana boats relied on wireless. These companies exchanged their patents for preferred stock, and were the major shareholders of the new corporation. Together they owned more than 70 percent of RCA and almost 2,000 patents; most important was the vacuum tube.

Although RCA had begun to experiment with bringing radio to a mass audience, it returned its attention to upgrading its wireless stations and expanding the wireless network. RCA engineers drew upon the company's many resources and rapidly developed and installed the latest technology in the shore stations and expanded the wireless network. At this time, vacuum tube transmitters were being installed on ships around the world, but tube technology for land transmitting remained experimental.



Interior of Marconi transmitter building showing the two 200kW Alexanderson alternators (1920s). Source MRHS.

A major transmitter technology shift was the availability of Alexanderson alternators, developed by GE during World War I. In 1921, the 230kW rotary spark gap was replaced by two Alexanderson alternators, each with 200kW of power, that were operated on a frequency of 26kc under the call KET. The multiple tuned antenna for the Alexanderson alternators was supported by the existing Marconi-era 300-foot-high steel masts. The shift to the Alexanderson system enabled RCA to provide more reliable communications over longer distances at less expense. The Marconi spark system used undamped waves that were inherently broad in character and the Marconi antenna system was inefficient in its use of energy; In contrast, the Alexanderson system (the alternator, magnetic amplifier and multiple tuned antenna) was much more reliable and efficient producing continuous waves similar to modern transmitters, and the multiple tuned antenna made much more efficient use of energy.

During the 1920s, RCA was able to make these and other advancements throughout its network. It dominated the international communications field because it owned most of the important patents in radio technology. Using such new devices as vacuum tube transmitters and improved antenna design, it set speed and efficiency records in the transmission and handling of international messages. By the early 1920s, for example, the company's traffic increased from 18 to 23 million messages and increased the company's gross income by 50 percent. Its ship-to-shore operations experienced similar growth.

RCA inherited KPH from the Navy in 1920 and chose to restart the service at the Marshall facility. Frank Shaw, who had worked at Hillcrest and possibly the original PH, reopened the station that April. Raymond Walling, an assistant of Shaw's, wrote 56 years later in a 1977 Society of Wireless Pioneers article, "The Rebirth of KPH —1920:"

> Within a matter of several days KPH was open for business. The transmitter was a shipboard model P-8 quenched gap rig operating at about 1 1/2 KW. It was installed in a small "Chick Sales" type of a building at the base of one of the transpacific 365' towers. The antenna was a 4-wire flat-top on spreaders and suspended from the top (or near top) of the tower at a sharp angle to a ground anchor.

After restarting the station in Marshall/Bolinas in 1920, RCA's marine competition included the Federal Telegraph Company, Globe Wireless Company, Kilbourne-Clark Company from Seattle, Haller-Cunningham Company, Gray and Danielson Company, Ship Owners' Radio Service and Independent Wireless Company. Competition was brisk and hundreds of experienced radio operators were available after their wartime training and service. Ships sailing under the United States Shipping Board were assigned commercial stations so as to spread around the business.

KPH operations at Marshall. The IP 501 receiver has been relegated to a shelf while pride of place is occupied by a home made medium frequency receiver in front of the operator to the left. This receiver was said to be very sensitive but not very selective. To the right is Frank Geisel, the most famous manager of KPH (1930s).
Source MRHS.

Adoption of Short-Wave

By the 1920s, high frequency short-wave communication, which had previously been discounted as useless, had been shown to be more effective over large distances than low frequency communication. However, the existing mechanical transmitters – rotary spark gap and alternator – could not accommodate high-frequency communication. The development of high power vacuum tube transmitters facilitated transmitter designs that were effective for short wave service. This enabled the transition to short-wave radio communications.

RCA telegraph window in San Francisco.
Source Point Reyes National Seashore Museum, Collection # PORE 9755)

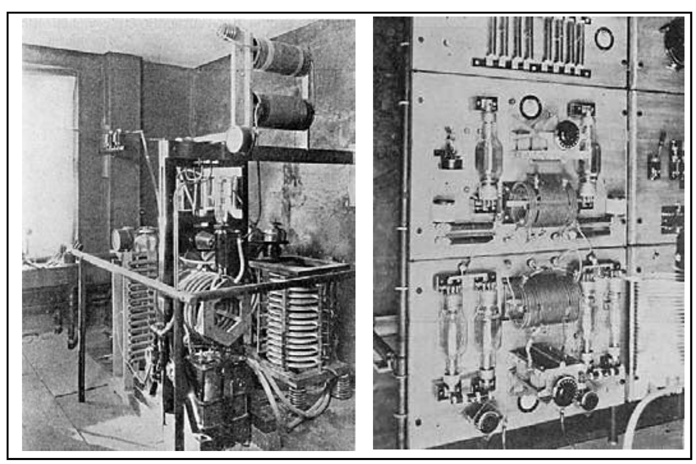
In 1929, RCA began a major expansion of its West Coast operations to employ short-wave technology and to respond to an increased demand for communication with Asia and the South Seas. RCA enlarged the Bolinas Transmitting Station to accommodate twenty short-wave circuits, and constructed several new buildings. The primary goal was to increase the trans-Pacific circuits to include China, Manchuria, Siberia, Java, French Indochina, Manila, New Zealand and Australia, in addition to the established connections to Hawaii and Japan.

RCA would come to have 24 shortwave circuits operating at Bolinas, each with their own 3-letter call sign. These included: KEB 6825.5kc, KEL 6860kc, KEI 10620kc, KKQ 11950kc, KEM 15490kc, and KQG 18000kc.

Most of the antennas at the Bolinas transmitting station in the first years of the short-wave era were dipole. Over the course of the 1930s, however, RCA replaced the dipole antennas with diamond-shaped rhombic antennas for increased efficiency. As part of the new short-wave operations, RCA mothballed the massive Alexanderson alternators at the transmitting station and began sending signals through water-cooled vacuum-tube transmitters that were connected to broadside curtain antennas, fishbone-type antennas, and rhombics, which eventually comprised the majority of antennas at the site. Teletype with printers replaced much of the time-consuming Morse code communications.

The new short-wave circuits required a larger antenna field, for which the company purchased a 120-acre ranch directly to the south of the Marshall station in 1928. In addition, in 1929, RCA purchased the 1,472-acre James McClure Ranch on the Point Reyes Peninsula to build a new short-wave receiving station, the Point Reyes receiving station, to replace the outdated long-wave receiving station at Marshall.

Short wave receiving was more prone to fading than lower frequency transmissions. To address this antenna networks were built in a redundant fashion. This approach, known as “diversity,” entailed having multiple antennas tuned to the same frequency and a receiver that continu-



First KEL shortwave transmitter (left) and experimental 95-meter master oscillator and intermediate amplifier units (right) circa 1930.
Source MRHS.

ously selected the antenna with the strongest signal. Accordingly, RCA employed triple diversity at the Point Reyes receiving station, constructing three large antenna fields to support point-to-point service. A dedicated array of antennas was directed toward each city with which the station communicated including, for example, Honolulu, Singapore, and Papeete in French Polynesia. Open wire feed lines were carried on H-frames from the dedicated arrays in each of the three antenna fields, known as A, B and C, to a dedicated feed line termination frame adjacent the receiving building. A 4-wire feed line was used for each antenna, and each 4-wire line transitioned into a balanced line that was then routed into the station. Receivers on the second floor of the receiving building captured the messages and relayed them via landline to the Central Radio Office (CRO) in San Francisco.

Unlike Marconi, RCA coordinated the operation of the point-to-point service through a CRO in San Francisco. Specifically, the point-to-point operators at the Marshall Receiving Station tuned the receivers to get the best possible signal which was then sent to the CRO for copying by hand or inked tape. Inked tape was a paper tape on which a siphon pen recorded incoming Morse signals via an undulating line that represented the dots and dashes of the Morse code; operators would then "read" the undulating line and type the message. Outgoing messages were keyed at the CRO and sent by wire line to the Bolinas Transmitting Station for transmission. This arrangement remained following relocation of the Receiving Station to Point Reyes, until the end of the point-to-point service in 1973.

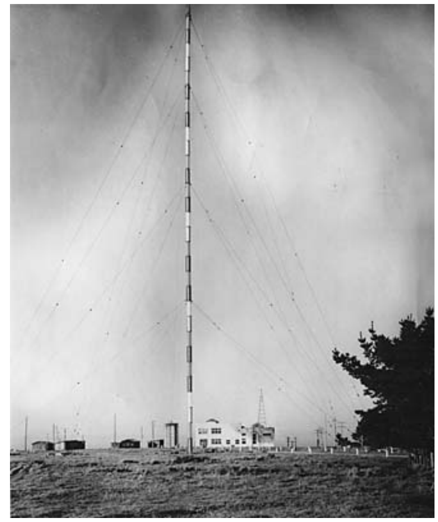
The new RCA stations at Bolinas and Point Reyes went into operation in 1931. RCA continued to use the Marshall Station for its marine or ship-to-shore service, station KPH until America joined World War II in 1941.

As part of the new operations, the Bolinas transmitting station mothballed its massive Alexanderson alternators and commenced sending signals through new, water-cooled vacuum-tube transmitters located in the new building. Bolinas antenna fields consisted of separate broadside curtain antennas aimed at the various destinations around the Pacific. Later, there were fishbone-type antennas, so named for their distinctive shape, appearing as huge vertically mounted fish, as well as rhombics, which comprised the majority of antennas at the site. The KPH transmitters remained in the old Marconi transmitter building (Building 1) and served as part of the ship-to-shore service.

Although the Great Depression slowed profits at RCA, the corporation survived and thrived. By 1936, RCA communicated with forty-seven countries out of its Marin stations, from where operators could relay messages to just about anywhere on the earth.

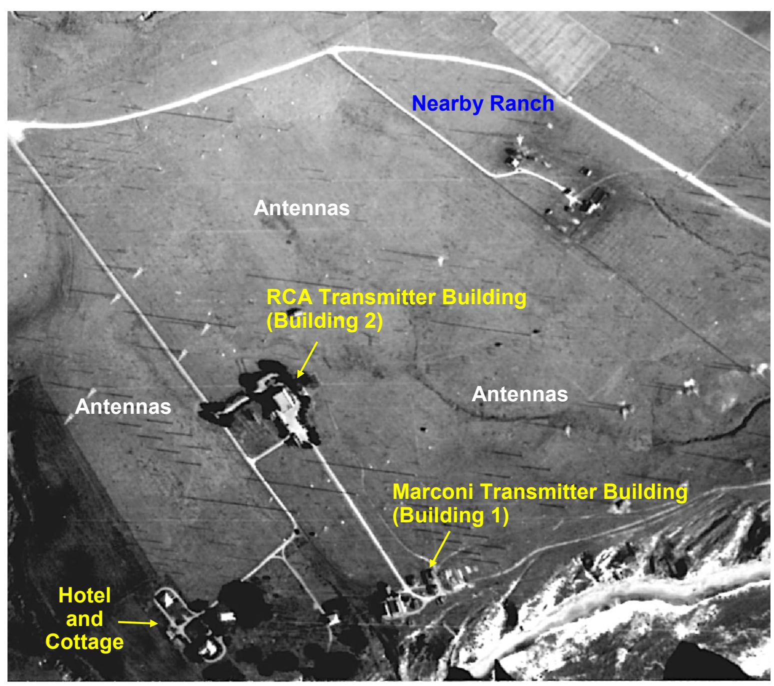
Radio Operations during World War II

In 1941, America's entrance into World War II altered the course of operations for RCA. RCA went into full-time production toward the war effort, producing equipment and components for walkie-talkies, radar, sonar, and navigation systems such as Loran and Shoran. The corporation also made available to the war effort its coastal stations



Marconi transmitter building and one of the 300' Marconi towers. By the 1940s the towers were painted alternating colors for visibility (1951). Source MRHS.

Riggers working one of the 300' Marconi towers (1930s). Source MRHS.



1942 aerial view of the Bolinas site. Note shadows cast from antenna towers.
Source Point Reyes National Seashore Museum, Collection # PORE 9755

and personnel. RCA provided the Army with coded Japanese messages it received at its coastal stations, which were decoded and distributed to high military command. Sarnoff himself advised the president on strategic communications issues.

The war also affected the operations of RCA's Point Reyes stations. Although the government did not take over the station as it had in World War I, it did have exclusive use of them. Apparently for security reasons, the government required RCA to shut down the Marshall Station, through which news of the attack on Pearl Harbor was relayed, a day after the attack. The station never reopened. RCA monitored Japanese transmissions and reported daily to the FBI. Because it considered the Point Reyes Peninsula a crucial and vulnerable setting for possible enemy attack, the Army set up a command post at the Point Reyes Receiving station and built a barracks and mess hall for the Coast Guard beach patrol.

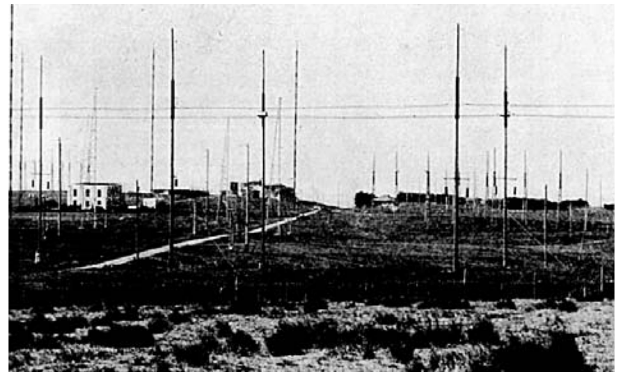
At Bolinas, the Alexanderson alternators were used by the U.S Navy during WWII for communications in the Pacific theater. Specifically, RCA restarted one Alexanderson alternator for naval use in the Marconi Transmitter Building, while the Navy purchased the other alternator and moved it to Hawaii. During the war, RCA also upgraded the Marconi long-wave antenna at the Bolinas Transmitting Station site for use with Alexanderson alternator.

The Post-War Years

Following WWII, RCA modified its stations on the Marin coastline in response to its renewed operations and to expand communications with the Pacific Rim. RCA shut down the Alexanderson alternator at Bolinas, which it had returned to action for the Navy during the war. In the 1950s, RCA removed some of the 300-foot-high antenna towers, built during the Marconi era. Those that remained were used by RCA's ship-to-shore operation, known as the Radiomarine division, in the 1960s.

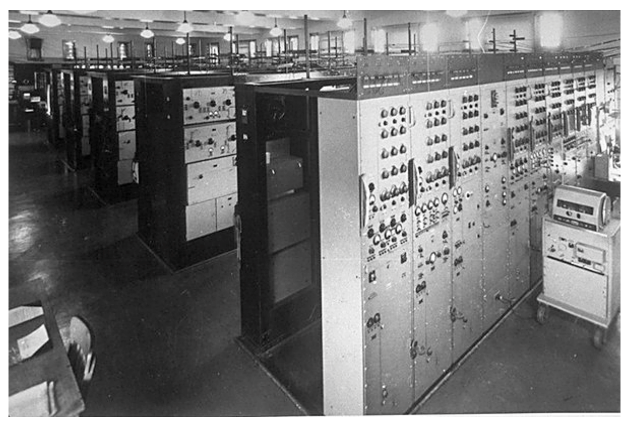
In 1945, RCA's Radiomarine division moved the KPH equipment from Marconi-era Receiving Station in Marshall to the Point Reyes Receiving Station. The Point Reyes station, which had been taken off-line in 1941, returned to the airwaves on January 1, 1946, providing telegram service to ships at sea via Morse code. The ship-to-shore station occupied a small corner of the receiving station's lower floor, while the point-to-point operation used the rest of the facility. The sending operation for KPH was at the Bolinas Station using transmitters in the Marconi transmitting building (Building 1) operated remotely from the Receiving Station.

RCA needed to enlarge its facility at Bolinas to handle the increased traffic across the Pacific. In 1959, the company added onto the transmitter building (building 2), doubling the facility's size. RCA had purchased 470 acres for transmitting purpos-



Antenna fields at Bolinas site (1930s). Source MRHS.

RCA transmitting building (Building 2) constructed in 1931. The two 300-foot antennas visible behind (1940s).
Source MRHS.



Original point-to-point receivers at Point Reyes.
Source MRHS.

Transmitter gallery in Building 2a. Vintage 1950s vintage RCA plus 1990 vintage Henry transmitters.
Source MRHS Point Reyes

es in the late 1940s and early 1950s and it was here, in the early 1960s, that RCA erected one of two antennas for sending signals to Tahiti; the receiving antenna was located at Point Reyes. Following completion of the transmitter building expansion, RCA built a series of 800-foot rhombic antennas, which were popular for their versatility, minimum maintenance requirements, and adequate directive qualities. High frequency antenna feed lines were supported by wooden H-frames as they left Building 2A before being distributed to the individual antennas in the field. The older 300-foot fishbone antennas, while more efficient than the rhombics, took a great deal more maintenance and were scrapped.

RCA receiving building at Point. Reyes (1960s).
Source MRHS.

By 1964, RCA's Marin stations had sixty-five point-to-point circuits. However, by 1974 it would remove all the circuits in its conversion to satellite communications. RCA replaced receivers on the upper floor of the station with satellite equipment. Technicians installed three large satellite antenna dishes next to the Receiving Station building. The conversion to satellite removed the need for vast antenna fields; Rhombic antennas were removed or switched over for use by KPH. Many of the antenna structures were left standing in place, and remain standing today.

KPH operation position (1951). Source MRHS.

RCA held patents on satellite technology and intended to become an industry leader. The satellite business was successful in its first two years of operation handling a variety of communications including live television feeds from around the world. Even though it had the best technology available, it was unable to match the competition.

The company's maritime radio business, on the other hand, continued to function well, adding SITOR (simplex teletype over radio) technology and new receivers featuring digital tuning to its existing Morse code operation, which greatly enhanced finding and changing frequencies.

The three transmitter types from the 1950s period were designated by RCA as H, K and L sets. The H sets are by far the most complex. Designed for point-to-point service, they are Independent Sideband (ISB) capable and can transmit a total of four data channels. The K sets have three cabinets and are for Morse and data only on a single channel. The L sets have four cabinets and a modulator so they could be used for audio circuits. When the point-to-point service ended in 1973 these transmitters that were converted to Morse or SITOR service for KPH. They remained in service until the late 1980s when they were abandoned in place. All K and L sets and one H set have been restored by the MRHS.

In the late 1970s, RCA began to downsize operations in Marin. Land use around the stations had changed in 1962 with the creation of Point Reyes National Seashore. RCA retained its Point Reyes Receiving Station property as an inholding within park boundaries; the Bolinas Transmitting station would be part of a later addition to the seashore. In 1977, with the end of the point-to-point system, RCA sold most of its Point Reyes and all of its Bolinas properties to the Trust for Public Land, a conservation organization.

National Park Service Acquisition of Transmitting & Receiving Station Properties

RCA Glōbcom, RCA's subsidiary in charge of the Marin facilities, retained 23 acres surrounding the Point Reyes Receiving Station buildings and driveway. The Trust sold the remaining land, around 1,191 acres, to the federal government in 1978 at which time it became part of Point Reyes National Seashore and managed by the National Park Service. RCA did retain use of Building 2A, partial use of Building 1 and the antenna fields. RCA also leased back 100 acres of KPH antenna lands from the Park Service. RCA believed that the term of the lease would be short as company officials anticipated that they would phase out the marine service within ten years. Around this same, Congress was going to expand the Seashore boundaries to include RCA's facility at Bolinas. Many of the Bolinas facilities including the hotel, cottages, and a portion of Building 2 have since been leased to Commonweal, a non-profit.

RCA further declined in the 1970s. In 1985, RCA was sold to General Electric. They renamed the facility GE Americom while retaining company name of RCA Glōbcom. Two years later, GE sold RCA Glōbcom to MCI International, Inc., which operated the station under its subsidiary, Western Union International. Although MCI invested approximately two million dollars in the operations at KPH, the investment was not enough to improve business performance. To cut costs, MCI transferred operation of WCC at Chatham to Point Reyes by remote control in 1992. An operator handled Atlantic traffic in the KPH operating room, making the place a true around-the-world-station. Business decline continued and MCI made additional cuts, turning off the old BL-10 transmitter BL-10, decommissioning Building 1 and relinquishing its half of Building 2 to the National Park Service.

MCI continued to operate KPH and WCC until 1997, but put KPH up for sale in 1995. Two years later, after attempting a merger with British Telecom, MCI announced the station's closure. On June 30, 1997, KPH sent out its last message and turned off its transmitters at Bolinas, leaving the receivers at Point Reyes on to keep a symbolic watch over the airways. Globe Wireless purchased the license for KPH and continued to operate the station using Morse code and SITOR for two more years. Specifically, Globe Wireless operated the station remotely via Morse transmitters at the KFS transmitting station in Palo Alto and SITOR transmitters in Rio Vista.

The National Park Service purchased the remaining 23 acres of the Point Reyes Receiving Station on October, 29, 1999. That year the Maritime Radio Historical Society was formed with the goals of documenting, preserving and restoring the artifacts of maritime radio history and to preserve the skills, traditions and culture of the professional radio-telegraphers who operated the stations. They have been very active in the restoration of radio equipment and antenna structures at Bolinas and Point Reyes. In an agreement with the National Park Service, they run the only commercial Morse code coast station still operating in the hemisphere under call KSM. Globe Wireless permits MRHS to re-activate KPH from the original Point Reyes and Bolinas stations on its original frequencies once a year on July 12 for their annual "Night of Nights" event to acknowledge and honor the history of Morse communications and the men and women who were part of that profession. The MRHS volunteers and park staff continue to maintain, preserve and restore both the operational equipment and the antennas, while MRHS continues to receive and transmit messages through two of the last remaining intact coast stations in the United States.

On this page are photos taken during my recent visit to the Bolinas and Point Reyes stations.

Driving through a tunnel of cypress approaching the Point Reyes receiving station.

Richard Dillman at an operating position in the Point Reyes receiving station.

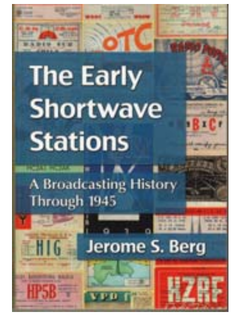
The Press Wireless PW15 transmitter in operation in Bolinas Building 2A.

Steve Hawes explaining the MRHS restoration of the H model transmitter.

Steve Hawes in the Building 2A operations room. ◊

Book Review: Jerry Berg's History of Short Wave Radio (in Four Volumes)

by Bart Lee, K6VK



Omnibus Review of Jerome S. Berg:

On the Short Waves, 1923-1945, Broadcast Listening in the Pioneer Days of Radio (1999)
Listening on the Short Waves, 1945 to Today (2010)
Broadcasting on the Short Waves, 1945 to Today (2012)
The Early Short Wave Stations (2013) (Cover shown to the right)

Radio on short wavelengths opened up the world. Commercial and governmental interests exploited the discoveries of the amateurs in the early 1920s. They had found that wavelengths 200 meters and down could girdle the globe: the short waves compared to longer wavelengths then in use. The broadcasting craze of the 1920s featured a desire to hear distant stations ("DX"). The short waves on which stations began to broadcast in the late 1920s and early 1930s, mostly governmental, made world wide DX a nightly event. Hugo Gernsback exclaimed in 1926, "I cannot imagine any greater thrill, than that which comes when I listen, as I often do, to a station thousands of miles away. It is the greatest triumph yet achieved by mind over matter."

Like local broadcasting before it, the short wave broadcasting of the 1930s generated enormous enthusiasm. *Radio News* in June 1930 reported, "The growth of interest in short-wave broadcasting is nothing short of phenomenal." [1]

Jerry Berg has now chronicled the history of that phenomenon. We all owe him a debt of gratitude. He has written four very good books indeed. Everyone who has ever tuned a dial above the AM broadcast band ought to buy them. You'll like 'em.

The great telecommunications revolution began with "What hath God wrought?" in 1844 leading to "The Victorian Internet" as well as the modern Internet and the World Wide Web. Telephones in the 1880s added tone of voice and individual connections. Wireless telegraphy freed communications from dependence on cables. Radio carrying sound and music exploded on the world scene in the 1920s, uniting local, regional and national linguistic areas by way of shared music from opera to folksingers, jokes, entertainment programs and news.

The development of short wave radio in the late 1920s, with its long distance ranges, opened the whole world to the music, news, entertainment and propaganda of an increasingly hostile international order, soon to degenerate into war. During that Second World War, radio also played a part. Jerry Berg first began to document these developments some years ago. The domestic radio manias of the 1920s translated to the international short wave scene, with its own enthusiasts, a popular literature, distance-dedicated listeners (listening for "DX," not program content), program listeners, colorful QSL-cards to verify hearing the distant signals, and radio stations designed to persuade as well as entertain.

Fig 2: 1935 QSL card from Argentina.
Author's collection.

On the Short Waves, 1923 -- 1945, Broadcast Listening in the Pioneer Days of Radio (1999): in this, Jerry Berg's first book, he tells in overview the story primarily of short wave listening. Of course Jerry sets forth who the broadcasters were, and in the increasingly tense 1930s, what they were trying to do. But he provides great detail on the listeners, not only the hobbyists and the casual, but also the World War Two volunteers who monitored tirelessly for news of prisoners of war, in order to notify their families.

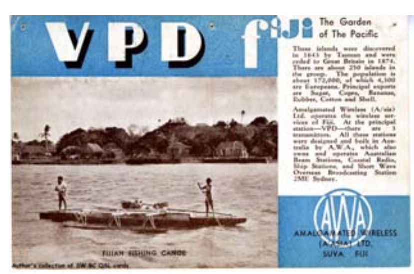


Fig 3: QSL cards from Fuji.
Author's collection.

The people who listened to short wave radio in the 1930s undertook the contemporary challenges of frequencies, wave bands, day and night conditions and multiple languages, especially German and Spanish. (See two QSL cards verifying reception, in the mid-1930s, Figures 2 & 3). Many nations, however, beamed program in English to North America. In the midst of the Great Depression, short wave radio created a new technically elite class of internationalists, mostly young, male, and radio-adept. The geography of maps came alive with the sounds of voices, music, parades and rallies — about which one could sometimes read in the next day's newspaper.

Short wave radio, as Jerry tells its story, made much of the nation directly aware of other nations. Short wave radio brought the voices of the world directly into our homes, not only our "radio-rooms" (however modest) but into our living rooms as well. Unedited, unmediated and un-spun, we could hear the world and make up our own minds. DX took on meaning, and the book lays it out. Even to this day, a short wave radio provides an ear to the world, especially for travelers, and we should be thankful to Jerry for telling its history so well.

This first book distills station histories, listener publications, ephemera (*e.g.*, QSL cards and EKKO stamps), personalities, clubs and the events of the world, into 272 pages of well-written and superbly illustrated text. Outstanding as this first book is as a source of historical material, it is even better for enjoyable reading by anyone with an interest in radio, its powers and its development. Not until the coming of the World Wide Web on the Internet has a technology had so much impact on the world. (Television's local reach limited its immediate effects, albeit broadening the power of images of all sorts, all censored, for better and worse, as well as inundating us all in dreck).

Jerry's fourth book on short wave closes the circle of listening and broadcasting from 1901 to 1945 with his focus on the early stations: THE EARLY SHORT WAVE STATIONS (2013). This radio history is as good as it gets. He subtitles this: A Broadcasting History through 1945. He approaches short wave radio chronologically, telling this story year by year. He illustrates the stations and the industry, and some of the literature of short wave listening. QSL cards from now ancient and rare broadcasters abound.

Preliminaries come first of course (Marconi and de Forest), and then it's broadcasting in the ether. The higher frequencies of short wave radio -- higher than the AM broadcast band of 500 KHz to then 1500 KHz — enjoyed much more ionospheric skip at night, and for frequencies above 10 MHz, in the day as well. Broadcast band stations had been heard internationally in the 1920s. There wasn't much interference in those days. The shorter wavelengths, the higher frequencies, regularly leapt from continent to continent. Moreover, in the 1930s countries had much to say to each other on the radio, sometimes actually shouting into the microphones. Both Fascism and Communism took to the airwaves before sending waves of troops against each other and into peaceful countries also.

Geophysics also played a role in short wave radio's development. As the book relates, short wave broadcasting took off in the late 1920s. The "Radio Craze" put a broadcast band receiver in almost every home. People had a growing interest in hearing more, even from other countries. The sunspots accommodated: from 1925 through about 1931 the eleven-year sunspot cycle peaked. The emanations from the sun charged the ionosphere. The radio waves bounced around the earth in a relatively quiet ether, free of most of the modern noise sources.

As the 1930s progressed, geopolitics in Europe and Asia heated up. So did the ionosphere, rising from a low in about 1935 to a peak in about 1940, the start of World War Two. (See figure 4). At home in America, on so many radios with short wave bands, people could listen directly to the convulsions of the world. So too through World War Two, the belligerents had at it, in the ether as well as on the battlefield. Americans on the home receivers could follow every short wave broadcast announcement from around the world. These came from every warring nation, including even Lord Haw Haw for the NAZIS. This book details exhaustively what these stations had to say, and the technologies of how they said it, including frequencies and powers.

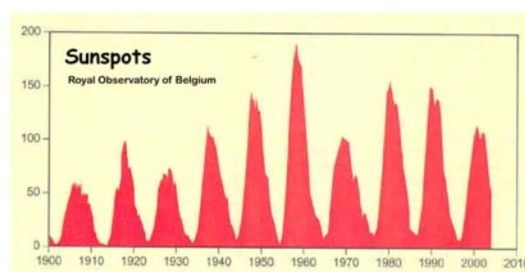


Fig 4: Sunspot activity from 1900.

Much then happened after 1945, and Jerry also turned his considerable skills to shortwave radio in the Cold War in his second and third books. As many hoped he would, Jerry brought his history up to date:

> LISTENING ON THE SHORT WAVES 1945 TO TODAY (2010);
> BROADCASTING ON THE SHORT WAVES 1945 TO TODAY (2012).

Jerry has now, in these four volumes, written the definitive history of short wave radio. After Jerry's first history, the pressing questions for historians as well as enthusiasts was: will Jerry write again to cover post-war, cold war and modern day short-wave radio? Well, he did, and it's great work, and then he went back to the early broadcasters as well. His is as complete a survey of short-wave radio as can be imagined. Jerry is an archivist as well as a historian, especially given his role in the leading listeners' newsletter *Numero Uno*, since about 1970, and his founding of the QSL-card archive Committee to Preserve Radio Verifications (CPRV) now at the University of Maryland's Library of American Broadcasting.

Listening recreates the romance of hearing DX on radios that glowed in the dark (before transistors and chips); it reminds one of the pleasures of the radio magazines reporting new stations and receptions that might be achieved, and new radios to lust after. (That HQ-180 on the cover of *Popular Electronics* in 1963 emanated a magnetic attraction at least as strong as the red headed model tuning it!)

Jerry's analysis of the short wave audience is adept. Jerry has been active listener since 1958 and his record of the clubs and their roles is definitive. His chapter on the literature of short wave listening provokes nostalgia strong enough to drive one to eBay to buy some old magazines. The Listening book alone is a major contribution to the history and sociology of modern technology.

The companion book, Broadcasting, is even better. Here one finds the post war stations of yesteryear, so often heard only in the dark of cold winter nights. (See Cold War graphics, figure 5). From the BBC's empire, to radio ZQI - Jamaica, Jerry lays out just about all that can be known of these stations. His approach is year by year, so the arc of short wave radio appears from its post war renewal through its glory days to today's "just one of many media" role. For those of us who go back in radio now fifty years, Jerry's reprise is a technical triumph. It is also a pleasant reminder of the thrills of connecting to the voices, music and personalities of the world's cities and countries. This we did most often sitting in the dark wearing headphones. We were oblivious to the mundane "real world" because we were living in an even more real world, far more interesting and sometimes exciting (and often at 4 AM). Short wave radio opened up a new dimension of experience. Yet one had to seek it, and train oneself in its arcane equipment, its antennas, its seasonal and diurnal variations (not to mention sunspots and their effect), and learn to focus the mind on the aural and not the visual.

Jerry has now detailed the history of shortwave radio with these four books. Every radio history enthusiast should own these books. So should every library covering the history of technology.

A great virtue of these four books is the detail provided in the scholarly notes and sources. If it happened in short wave radio, it's in these books. Each features a thorough index. In this regard, the first book presaged the massive scholarly apparatus of the next three books; but those sources and notes are always in the back: "take what you need, leave the rest." (Jerry, likely by reason of his professional legal expertise, is a masterful manager of information). These books are great companions to the old radios, from the gleaming living-room consoles to the little tabletops with modest short wave coverage. All of these radios brought into our homes the whole world. We owe a debt of gratitude to Jerry Berg for documenting this age and telling its stories so well. He continues to do so on his website: http://www.ontheshortwaves.com/index.html

Fig 5: Cold War ephemera: QSL cards, pennants, and a Radio Moscow pin.
Author's QSL archive.

Now, short wave radio ain't what it used to be, of course, but then little is anymore. Still, any evening I can hear what must be relays of the Asian stations (*e.g.*, *China Radio International* via Cuba), and the few Europeans left (*e.g.*, the just now defunct *Voice of Russia* could have been very interesting with Crimea in the news — Crimea! The "Valley of Death" into which the six hundred rode!) Then, of course, every night appears *Radio Havana Cuba*, like a cold war time warp, even on the C.I.A.'s *Radio Swan*'s old frequency of 6 MHz (later *Radio Americas*). Any morning the Asians fly over the Pacific until sunrise. *Radio Australia* provides interesting programming every day. North Korea still praises the work of the 99th People's Congress for the Advancement of Kim Ill Sung Thought; Christians still explain if not promise Salvation. The *BBC* still tells the truth, even if it's mostly on FM now, although Singapore got through to the West Coast in the mornings. Even as an unreconstructed DX hound, I have come to enjoy the *China Radio International* programming — like the boy said, on radio the pictures are so much better. Even the Chinese Firedrake jamming music is fun, in small doses.

Short wave radio as a hobby has the present advantage of active sunspots. But noise levels are high, and justify all the technology of weak signal amateur radio, such as digital noise reduction — just don't expect to enjoy classical music that way. Loop antennas make a great deal of sense in today's noisy environments, as do modern software defined radios, such as the WinRadio models. No matter what the gear, just listening to short wave radio is an historical exercise.

The future of the history of short wave radio, however, is now in multi-media. Historians can find and process the extant sound recordings. These can be linked to the old radios of the day, and the QSL cards and other literature, and the news media of the day. Websites such as Jerry's can present the sound of the stations as well as the detail of the stations.

I am personally indebted to Jerry for his generous help in providing materials from the Committee to Preserve Radio Verifications (CPRV), and a pre-publication draft of his FINE TUNING article on which his first book was based, for my presentations on short wave radio history at conventions of the Antique Wireless Association. Jerry Berg writes great radio history and we are all the richer for that.

Book Reviews by Bart Lee, K6VK, WPE2DLT, Fellow of the California Historical Radio Society in History. © 2014. Correspondence is invited: KV6LEE@gmail.com.

Please see the publisher's website: www.mcfarlandpub.com, the order line for which is 800-253-2187.

Notes:

1 The *Radio News* quote above is that which Jerry uses to introduce the decade of the 1930s in THE EARLY SHORT WAVE STATIONS; he quotes Hugo Gernsback in ON THE SHORT WAVES, 1923--1945.

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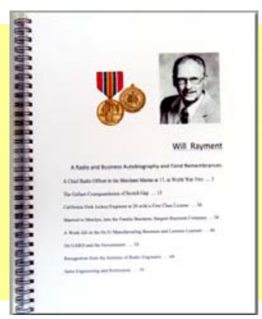

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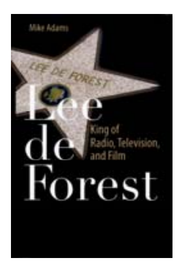

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