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Journal of the

CALIFORNIA HISTORICAL RADIO SOCIETY

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. Formed in 1974, CHRS promotes the restoration and preservation of early radio and broadcasting. Our goal is to enable the exchange of 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 ($40 non-USA).

CHRS Museum in Alameda

CHRS has been fortunate, 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.

Please come visit us any Saturday 9am to 3pm. Visitors and groups welcome at other times by appointment; Contact Steve Kushman.

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Contact us:

CHRS, PO Box 31659, San Francisco, CA 94131
or info@californiahistoricalradio.com

Visit us at: www.CaliforniaHistoricalRadio.com

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From the Editor

This journal features a breadth of topics. John Staples presents his restoration of an RCA TK-76 video camera. Wayne Overbeck illustrates the evolution of technology with a focus on amateur radio. John Staples details the design and operation and uses of an inexpensive and highly useful Network Analyzer, the NanoVNA. Bart Lee presents an archival article of Henry Joe Poy, an early Wireless pioneer. The covers display recent CHRS activities. I wish to thank all the authors for their articles, support, and scholarly contributions.

I am always in need of quality content related to broadcast radio, ham radio, and television. 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 depth. Enjoy . . .

Richard Watts, jrchrs@comcast.net

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From The President

by Steve Kushman

Thanks to all of you who donated to our fundraising drive to help CHRS fund the completion of our Bay Area Radio Hall Of Fame (BARHOF) gallery & KCHR control room. Thanks to our very supportive contributors CHRS has had another very successful fundraising campaign and again has fulfilled our goal.

You may remember the BARHOF Gallery in our former home, the KRE Building in Berkeley. A nice intimate room with the walls filled with framed pictures of the members of the Bay Area Radio Hall Of Fame. That was a few years ago.

The old BARHOF Gallery at KRE.

It was planned to have the BARHOF Gallery remodeled a year ago, however we were forced to deal instead with flooding in the basement which was a major project (BTW Not a drop of moisture was found inside the building this year!). Now we've made great progress in renovating the BARHOF Gallery.

The new BARHOF Gallery with the video wall display.

Instead of a wall of pictures, CHRS is taking an innovative approach to present our BARHOF Members. It is creating a 24-foot long interactive video gallery with three 65" flat screen monitors. Together, the monitors will slowly scroll the images of BARHOF inductees. Then by using the display's iPad tablet one can select an image. The image will then enlarge, display text bios, and play associated audio clips.

The Radio Hall Of Fame Area also features our NBC Radio, serial #2, Rangertone Chime Machine working display. Early radio broadcasting displays will be featured including a 'Doc' Herrold exhibit. See the original KJAZ tower top beacon. And what vintage radio studio replica would be without an organ... well we have a Hammond and it works. We have a wind-up Victrola, other vintage broadcasting gear, radio station wall art and the KMPX clock that Tom Donahue carried out of the station the night of the strike.

The NBC Chime Machine.

The renovation included wall construction, a window, new ceilings, light fixtures, flooring, electrical circuits, acoustic wall tiles, wall trim and wainscoting, TV monitors, AV distribution system, software development for the Radio Hall Of Fame Video Mural, paint, and other materials. This room and our KCHR control room are two more areas that reflect the importance of Bay Area radio broadcasting. This has been another big project but we are almost done. Thank you to our volunteers and donors who are making this happen. The team working on the new gallery are Mike Adams, Steve Kushman, Andy Wellburn, Rick Rubin, John Stuart, John Staples, Kevin Payne, Seth Arp, Chris Chapman, Richard Watts, and Len Shapiro.

CHRS is most grateful for the support of our generous donors to this campaign: Jon Winchell, Betty Cosmos, Gilles Vrignaud, Cynthia Edwards, John Stuart, Denny Monticelli, Bonnie Simmons, Jaime & Anne Arbona, Earl Hammers, Kenneth Miller (CHRS Founding Member), Vincent Plantanida, Heidi Gerster, Andy Wellburn, Miles Steuding, Audrey & Eric Enstrom, Len Shapiro, Kim Wonderley, Joan Drees, Steve Kushman, Jack Bethards, Doug Faunt, Maureen Dillinger & Charles Novak, Walter Chapman, Robert Herendeen , Ron Lathrop, Robert Montinegro, Graham Hunter, Jim Cirner (Founding Member, Harold Hoogasian and Greg Giusso.

CHRS is thankful and very appreciative for these donations. Just because we have reached our goal doesn't mean donations stop. You too can join in and choose to make a timely contribution to CHRS. Remember we are all unpaid CHRS volunteers so every dime you donate goes directly into funding the costs of renovation and improvements, the implementation and maintenance of our exhibits and programs, and operating Radio Central. Still time to make your New Year tax deductible donation to your favorite Non Profit vintage radio organization... CHRS.

Thank You! Please send your donations to CHRS, P.O. Box 31659, San Francisco, CA, 94131. Or visit us on the web at *www.chrsradio.com* . ◊

From The Chairman

by Mike Adams

Operating a Museum: What Would It Take?

What would it take to make our building at 2152 Central in Alameda a popular destination for the Bay Area museum-going public? What would it take to go beyond the hobby attraction of our 100 years of wireless and radio devices and be known for the educational stories of communications history? The Directors and Staff of CHRS need to know what it would take for our large room currently full of radios to be a must-see experience. What would it take to be loved by all ages? What would it take to be a useful educational attraction? What would it take to become relevant in this museum market?

I am hopeful the year 2020 is going to be the year that we can start to transition from a crowded radio warehouse into what Director Denny Monticelli calls "Museum Lite." This is our challenge. I believe that to do this right we must begin by understanding what we owe our loyal base and what already works at Radio Central: Examples like our very popular and often standing room only radio repair shop supervised by Scott Robinson; John Staples' creation of a first class working television display; our ham radio station, W6CF; our communications library and archives managed by Bart Lee. Richard Watts continues to edit and publish our Journal and original scholarship, and President Steve Kushman has just led a group in the years-long design and construction of the Bay Area Radio Hall of Fame. Finally, our annual big event, Radio Day by the Bay, continues to attract an impressive family audience. We pledge that if it works we'll keep it.

I promise you, our members, that we are mindful of your support. Through your generosity CHRS has its own building and the support to move toward a museum and education center. Now with your continued help we must move to the next step. We must create and share the significance of our historical resources with our Bay Area audiences in waiting. We'll need to build and promote something that is enticing and become a "must see" destination. We have to be compelling, engrossing, and entertaining. In other words we have to compete with the smartphone and create an experience that will attract and fascinate all ages. This is our 2020 challenge, the creation of a museum that appeals to people who have never considered visiting a radio museum. We have been investigating best practices and lessons learned.

What follows in this column are points made by two large radio history-focused museums. the SPARK and Antique Wireless Association (AWA) museums. These two organizations are somewhat comparable to CHRS in size and purpose; each began as hobby group. My points of contact were Lynn Bisha, curator of the AWA Museum in New York and John Jenkins, President and CEO of the Bellingham Radio Museum, now the Museum of SPARK in Washington State. I asked each organization for general comments and then posed a list of questions regarding what works and what doesn't.

A Tale of Two Museums

AWA, SPARK and CHRS share some important attributes: First, all finally own their buildings. CHRS began as a parking lot collector club and with some luck was able to occupy the Art Deco KRE studios for ten years where we created radio exhibits and staged public events. AWA created a small museum in a historic house in Bloomfield NY, but its main pre-museum purpose was its annual worldwide conference. Today AWA owns a number of buildings for their massive holdings, perhaps the largest historical wireless collection anywhere. The SPARK Museum is housed in what was once a giant furniture store in Bellingham WA.

Even though all of us hoped that fellow hobbyists would arrive at our facilities in droves it didn't happen. With the collector audiences too small to support a viable museum, we began to aspire to be museums with educational objectives. So far, we three museums have kept our static displays because they are still popular with our original collector base.

Web page for the Antique Wireless Association Museum.

Now, we at CHRS are working to expand our skills and learn about marketing, school science curriculums, STEM, and museum curation. We become more creative in designing engaging exhibits that will grab and hold the interests of all ages including the 10 year old whose only experience is with smartphones. We who own hobby/collection museums have some work to do. An approach may be to start with the smartphone and work backward in time.

Web page for the SPARK Museum in Bellingham WA.

Toward the Bellingham Turnaround

Before we get answers to our questions, consider this advice from CEO John Jenkins of the SPARK Museum, formerly the Bellingham Radio Museum, "The most important lesson: If you want to be successful you have to be attractive to the general public, not just collectors, aficionados, or people over 60 who think fondly about the 'good old days.' You have to appeal to families, to kids. It's all about the experience people have when they visit, not about the collection." Note that the SPARK Museum no longer uses "radio" in their title and their website has no photos of radio collections. They still display their large collection but do not market it. Mr. Jenkins was the founder and purchased the building, but a great collection of radios did not make the museum successful. Says John, "while it's true that over the years I have provided support to the museum in one way or another, the most significant being buying the building, all that did was keep the doors open while we struggled to find a way to make the Museum viable, which for its first 12 years, was not." It has been the result of a significant change of brand (and I mean that in the broadest sense) from the "Radio Museum" to the 'SPARK Museum.' The biggest example of this change is a focus on visitors and visitor experience, and not on objects. It took me a long time to figure out that visitors wouldn't make the 1.5-hour trip from Seattle to see one of the two surviving original Edison "hook" light bulbs... or a complete collection of Atwater Kent breadboards... or the only known Collins Wireless Telephone... or ... you get the idea."

Mr. Jenkins tells this story of his turnaround: "First, I talked to the local Bellingham business owners, some of whom offered honest criticism: 'Several of us (the property owners downtown) secretly hope you DO go out of business.' Needless to say, I was shocked. He went further to tell me that they thought the museum was a bit of an 'eyesore' and looked more like an antique store or flea market than a modern museum. Antique stores move into neighborhoods that are in decline, not an up and coming neighborhood like we want the arts district to be."

I realized he was right. We DID look like an antique store. Our windows along the sidewalk were filled with radios and other old stuff, carefully placed and proudly displayed. The beautiful 1911 brick building was hidden beneath old plaster stucco, installed sometime in the 1960's, and the once stunning red awning that ran across the entire front of the building was now a sad, faded pink."

He learned about museums: "I began talking with marketing and brand experts. Some of them I knew from my Microsoft days, some of them I paid for their time, but it wasn't much. I visited every Museum I could and talked with their directors and staff. I hired a contractor to restore the facade of the building to its 1911 splendor. Again, it wasn't a lot of money, mostly demolition of the stucco and a new paint job. I developed a vision document and goals, I started brainstorming new names with friends & acquaintances. I stopped having board meetings."

One of the folks I spoke with said 'You need a major attraction. Something unique that will attract people from Seattle and Vancouver, and once they've been here, they'll want to come back with their friends.' I told him we already had this amazing collection. He said 'no, you need something really cool!' I thought our collection WAS pretty cool but by then I got his point. He was a museum expert, not a collector. I was learning the distinction was much more important than I had ever considered."

John's search for cool: "The coolest, most exciting electrical thing I knew of was a Tesla coil, the bigger the better. We had a couple of smaller ones at the Museum and they were always extremely popular. So I started looking and eventually found a stunning 8' tall coil that was sitting idle in a Cirque du Soleil warehouse in Las Vegas. We got a really good deal on it, got it shipped to Bellingham, and built our 1 hour "MegaZapper" electrical show around it." As you'll read, success has followed. Tesla was right!

Questions asked during January 2020

Here are my questions and the answers of SPARK's John Jenkins and AWA's Lynn Bisha, and CHRS, me, edited for this column.

1. ***What are you now doing and what have you planned to get first time visitors into your museum?*** Writes SPARK CEO Jenkins: "We try to be the cool place to be - fun, innovative, campy. We are about the wonder and mystery of electricity. We sell tinfoil hats

in our gift shop. We have the MegaZapper and the Cage of Doom. We are the #1 indoor attraction on Trip Advisor and Google, and we work hard to stay there. Lots of emphasis on social media. We also have a strong education program, thousands of kids come through on field trips (our "SPARK Science" field trip is a big hit) and then come back with their families. We focus our marketing (mostly internet) on Seattle and Vancouver."

Exhibit map of Bellingham Museum.

AWA Curator Lynn Bisha lists several educational and social events that appeal to new audiences: "We have 'Night at the Museum' for the adults. This is every other month on a Wednesday night. This is a presentation that might be a hokey form of 'Hee-Haw' presented as a radio show, a wine tasting, a talk by a local historian on WHAM Rochester radio station. We have also had success with Radio 'Fab Lab.' This is a youth program on Saturday mornings. The kids are taught theory, and build projects such as a 1 transistor transmitter, a code practice oscillator, an audio amplifier. They get to keep all of the tools and are encouraged to try other projects at home. So far we have graduated 70 kids in ages from 7-16. We require that the kids attend with an adult. Sometimes the adults are very surprised on how much they and the kids enjoy themselves." CHRS: We have had successful classes but all were technical/shop-focused that attracted the hobbyist base.

2. ***Do you serve two or more audiences, older hobbyists/collectors and curious citizens/school groups? How do you market your museum to each?*** SPARK: "We don't market to collectors/hobbyists at all. We have what is probably one of the greatest collections of radio & early electrical devices in the world (certainly on display), but there are not enough collectors out there to support a Museum. Besides, the collectors know about us, they will come anyway. Our marketing is pretty much all broad, family based. Our education program is focused on elementary school, primarily because elementary school classes spend the entire day with one teacher so it is much easier to plan field trips. Middle & High School is much tougher because the kids' time is divided in the day between several teachers. The education program is critical not only because of the direct financial impact but also the community will get behind an institution that is having a significant positive impact on their kids."

AWA: "We market through word of mouth, Ontario and Monroe county visitor bureaus, Senior groups, bus tour operators, local schools (3rdand 4th grades currently), and a local group of home school parents. These are contacted locally in person. We are advertising in the local Finger Lakes visitors publication as well as several other magazines." As with CHRS and SPARK, AWA is well known by their local hobbyist/collector groups and AWA has a large paid membership.

3. ***Do you have paid staff? What do they do?*** SPARK: "We have 2 full time employees. A Program Coordinator does pretty much everything, including running all programs with the help of volunteers. We have a Director of Operations, also our lead educator. He keeps the building running, helps me a ton with various projects, gets the bills paid, deals with our vendors, etc. I am the President. I am a volunteer. I do most of the scholar/exhibit work, give lectures, work with the board and community leaders, provide executive direction, write grants, write books, etc. My plan is to hire a third full time employee in 2020 to take over the management stuff so I can spend more time on things I enjoy, like exhibit development, writing, & enjoying my retirement." AWA: "There are no paid staff at AWA, our budget wouldn't support it."

CHRS is considering how it might one day be able to afford a paid Director position. Before moving forward I recommend that the Board talk to SPARK CEO Jenkins about his experience: "We had spent $300K on three executive directors who, despite being outstanding individuals, had failed to raise any significant financial support."

4. ***How do you recruit, train and reward volunteers?*** SPARK: "Before our brand change in 2012 most of our volunteers were retired men interested in radio. Now they are younger and many are students. We advertise in the free volunteer sites, but mostly word of mouth and via our intern program with the local University and community college. We have a training program. We also have a volunteer appreciation event every year."

AWA: "We recruit through radio clubs, word of mouth, and visitors to the museum. Training currently consists of videos, and one on one training during museum hours." At CHRS we do not "recruit" volunteers, instead volunteers come from our collector base and from the local community. Volunteer education is done on the job. We do have annual awards for top volunteers.

5. ***How does your location affect your visitor numbers?*** SPARK: Greater Bellingham's population is about 90,000. Vancouver BC is 60 miles away and Seattle is 90. I'm not sure we could have a museum like ours in a large metro area. We have many hands-on exhibits, and many artifacts are where they can be touched. It's one of the things we think is important, where visitors can get up close to our collection."

AWA: "We are 10mi from Rochester, 75mi from Buffalo, and 90mi from Syracuse. Our visitors do come from a wide range of distance. Especially during the summer travel months. A more central location in the city might help, but is out of the question. We currently own all of our real estate free and clear." CHRS is attracting more public interest since it moved from KRE to Alameda.

6. ***Do you see a disconnect between the largely technical content of your publications and the young new audiences you hope to attract with more general history topics? What media have you planned to appeal to new and younger members? Can one publication serve both groups?*** SPARK: "Our publications and programs are not technical at all. They are directed at a general audience that is interested in science and the history of technology." AWA: In addition to the Review and the Journal we put a quarterly free publication on the web site called "Museum Sparks." CHRS: Because of the breadth of our service we maintain three websites, our main, our Bay Area Radio Hall of Fame and Society of Wireless Pioneers. A single twice-yearly Journal is mostly technical/historical.

7. ***Do you use Social Media? Is it effective?*** SPARK: "Yes and Yes." AWA: "We are just dipping our toes into social media. We are in the process of dramatically updating our web page, and we have a presence on Facebook. As of the first of the year, we are starting to utilize Instagram and Twitter." CHRS: We have two Facebook pages, one for the radio technical hobbyist-historian and another for the Bay Area Broadcast Hall of Fame, radio announcers and programs, entertainment based.

8. ***What are your visitor numbers?*** SPARK: "About 20,000 this year. 60% of those are from beyond a 50 mile radius. So we do attract a lot of visitors from Seattle and Vancouver. In fact, we know from our surveys that visitors who came from more than 50 miles away, primarily to see Spark, spent about $1.5M in the local economy in 2018. Last year the chamber of commerce gave us the 'Tourism business of the year' award. AWA: "About 2,500 per year. We are open year round, on Tuesdays and Saturdays." CHRS: We are still building the main exhibit area, so we are not officially open to the public.

9. ***Do you have any annual fundraisers? Memberships?*** All three museums profiled in this article own their buildings so there is less pressure on the budget, especially in a high cost area like our Silicon Valley. CHRS ongoing operations require about $25k a year which is paid for by various fundraising events including our annual Radio Day and through generous donations. Donations also provide a basis for building renovation and for the creation of exhibits. AWA: "Fund raising events include the Spring Meet flea market and auction, and the convention flea market and auction. Rarely we might do a fund raising by mail for a very special reason like we did to buy Building Four." Their Ham Shack Development Fund Goal was $165,100. So far we have collected $114,118." SPARK: "We're about to do our third annual fundraiser auction. The first one raised about $70,000, the second about $50,000. I call them both very successful. This is not a large community. This was after several years of 'friend raising' and honing our message as to why the community should care about and support The Museum."

Bellingham has figured it out – how to survive as a radio museum. Out of several decades (2001 to 2013) of lackluster operation as a "radio" museum, the Spark turnaround has been leveraged with a Tesla Coil and hard work and a bit of show business by CEO John Jenkins. Spark discovered what works for them and their service area. It is a cautionary tale for like museums, and it proves you can have new audiences and retain your collector's soul. You just have to find your "cool."

Lessons Learned

To our peers in the collector community we must seem like we already have the basis for a radio museum. We have the big three, right? We have a building, we have radios and we have a membership knowledgeable in the stories of radio's past. But is it really enough? I remember the final days of the Perham Foundation's Foothill Museum in the 1980s, this too with the combination of property (hosted by the college), radios and people. Perham Foundation had an impressive collection and committed volunteers. Yet that wasn't enough to insure its success. Today the Perham Foundation is a fading memory.

So it is critical that we learn from these past experiences and the experiences of peer organizations like SPARK and AWA. CHRS Directors have already visited several successful local museums, all of which had stories eerily similar to AWA and Spark. We hope we can discover the right track toward success. But as a reader of this, a CHRS member, please weigh in, email or talk to us, give us your ideas, ask us questions. Think about what kind of experience that your children and grandchildren would seek out and willingly visit. Consider how we merge the communications story of today with that of yesterday and make it relevant. Think about the smartphone that everyone has in their hands and invent an app or interactive program that follows an exhibit. And if you have experiences, skills, and interests that can help us realize our future, please join us!

Thank you.

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CHRS Central Valley Chapter News

by Mick Daniels

The Central Valley Chapter finished out 2019 with its annual Christmas luncheon which was well attended by members and family. The luncheon was also an opportunity to recognize long-time member and Chapter Vice-Chairman John Wallin with the CVC's Western Air Patrol Award, given in recognition of his tireless contributions of his time, energy and repair expertise. John is one of the Chapter's invaluable "go to guys" at the weekly repair class. Good job John!

The new year also brings change, as the CVC bids farewell to its Chairman (and all -around tube guru) Rich Lane who is retiring and moving to the beautiful state of Washington. I, as the newly elected Chairman, assumed the CVC leadership role at the club's January meeting in a not so solemn swearing-in ceremony using a copy of "Electronics for Dummies." All kidding aside, I look forward to the leadership challenges ahead. As for my background, I have been a longtime club member with a soft spot in his heart for mid-30's Zenith sets (shades of Eddie Enrique). My interest in antique radios dates back to my teen years in the Seventies growing up in Alameda listening on a Zenith 6-S-229 to old radio programs played at night by Bay Area station KYA.

John Wallin receiving the CVC Western Air Patrol award.

Once again the CVC staffed a booth at the annual Model-A Swap Meet held at the Stanislaus County Fairgrounds in Turlock California. The Model-A Swap meet features more than just classic auto related items and draws a huge crowd each January. As such, the meet is one of the highlights of the CVC calendar and an excellent opportunity to reach out to the public as well as potentially attracting new membership. There were many curious attendees visiting the CVC booth and asking questions about or sharing reminiscences of vintage radio. Club members sold several radios including some restored vintage automobile radios.

Central Valley Chapter meetings are held on the third Saturday of the month at the Chapter's club house at the corner of Commons and Bradbury just outside of Turlock; check the CVC website for the meeting start time. Repair classes are held at the clubhouse between 6:00 and 8:00 PM Wednesday evenings. For an update on all our activities, visit CVC at www.cvantiqueradio.com .

Wednesday evening radio repair class and gathering. Members busily working on their own projects and getting help when needed.

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Radio Central Update

by Richard Watts

Original circa 1900 exterior front elevation of 2152 Central Ave.

Volunteers make it happen . . .

Saturdays are busy with lots going on. Building renovations are nearly complete thanks to the dedication and efforts of talented volunteers. The latest accomplishment is the new Hall of Fame Gallery and Broadcast Studio. The Radio Central education center and museum is really coming together. Now displays are being designed and set up; these include the Television Gallery and W6CF Ham Shack.

There is still much to do to make this happen and keep it going. There are a variety of activities that will appeal to all ages and almost any interest.

Come join us and make a difference . . .

Walt Hayden and Robert Swart working side by side.

In remembrance, Robert Swart, a very dedicated and committed supporter of CHRS, recently passed. He was a key contributor in nearly all the renovation projects both at KRE and at Radio Central. He, along with Walt Hayden, Cliff Farwell, Larry Drees, and Steve Kushman were the driving force in the major construction projects at RC. He was a perfectionist and very structured in his approach. The quality of workmanship and finish in the RC renovation are greatly a result of his attention to detail. He will be missed.

Denny and others representing CHRS at Bay Area antique events.

Paul & Edith help with landscaping.

Seth is among many who are busy in the shop repairing, restoring, and teaching.

Hall of Fame gallery -- in progress.

Hall of Fame gallery -- nearly complete.

The RCA TK-76 ENG Video Camera

By John Staples, W6BM

Once upon a time, video reporters filmed an event, rushed the film back to the studio to be developed and run through the telecine to be aired. In the late 1960's electronic Electronic News Gathering (ENG) cameras came on the scene, but they were large and required a near-by camera control unit. At the 1975 NAB meeting RCA introduced the TK-76 ENG camera, self-contained with an external battery pack that could provide broadcast-quality video to a portable video recorder or to a microwave link to the studio.

The TK-76 went on the market in 1976 and became an instant hit, selling for $35,000. The camera was sized to be the same form factor and weight of 16 mm film cameras used at the time, about 18 pounds. This facilitated a rapid replacement of film cameras without an extensive learning curve.

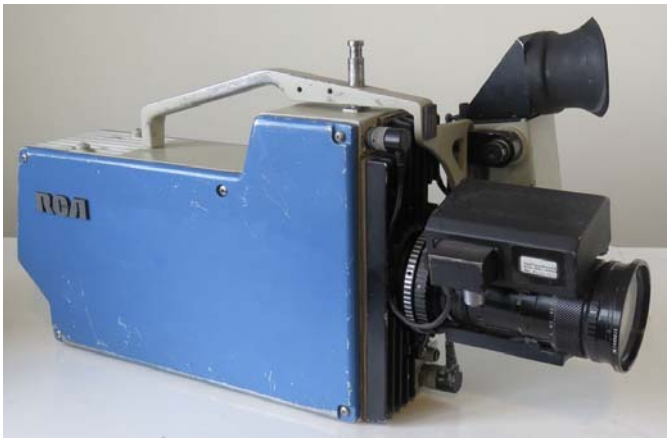
I was able to purchase one of these cameras in nonfunctioning condition but otherwise complete. I have been able to restore it to operating condition.

I will take you on a tour through this landmark camera, including photos of a prototype and a studio camera based on the TK-76.

RCA TK-76 camera left side.

The TK-76 provides a NTSC 525-line composite video signal of broadcast quality over a wide range of illumination levels. Several automatic functions needing few set-up adjustments put out a quality signal seconds after start-up. A color bar generator is included.

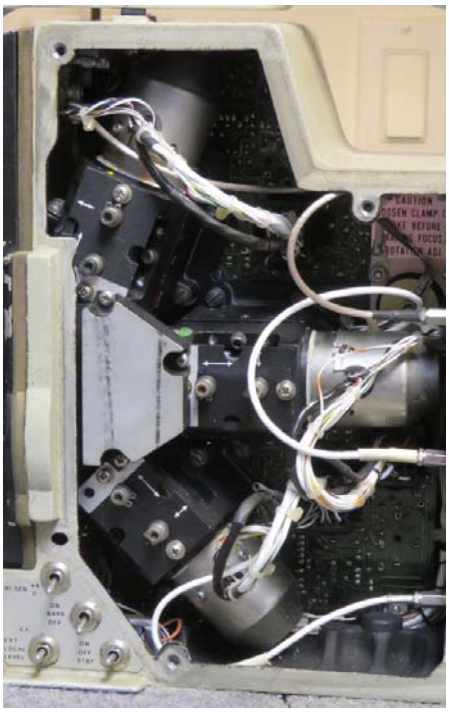
The interchangeable Angenieux zoom lens with a motor-driven variable iris accommodates varying light levels. A 1.5 inch B&W adjustable-position viewfinder includes tally lights for on-air, video tape running or about to run out, and battery pack condition. The white balance is set by a single button-press.



RCA TK-76 right side.

The zoom lens focuses the image through a prism to three plumbicons image tubes. The zoom range is 9.5 to 143 mm with a maximum aperture F-stop of 1:18 (T-index of 1.20). Both the iris and the focal length (zoom) have motor control, but only the iris motor is enabled. The lens is fitted with an Arriflex mount for interchangeability. The iris can be manually controlled, but is usually switched to automatic control, as the plumbicon tubes do not have a sensitivity control function by changing the target voltage.

Angenieux-zoom type 15 x 9.50 lens.



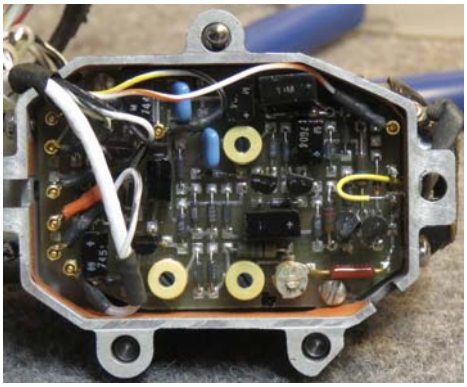
Red image tube top, green center, and blue below; the prism at the left.

Three selectable optical filters are provided between the lens and the sensors: clear, and two that correct 3200K to 5500K light, so the camera can be used outdoors after being white balanced indoors. A lens cap function is also provided.

Color video cameras divide the image into three color bands: red, green and blue. The camera uses three 17 mm plumbicon image pickup tubes behind a prism with filters that separate the colors. The entire optical subassembly is separately shock-mounted to insure long-term alignment.

Looking in the plumbicon eye.

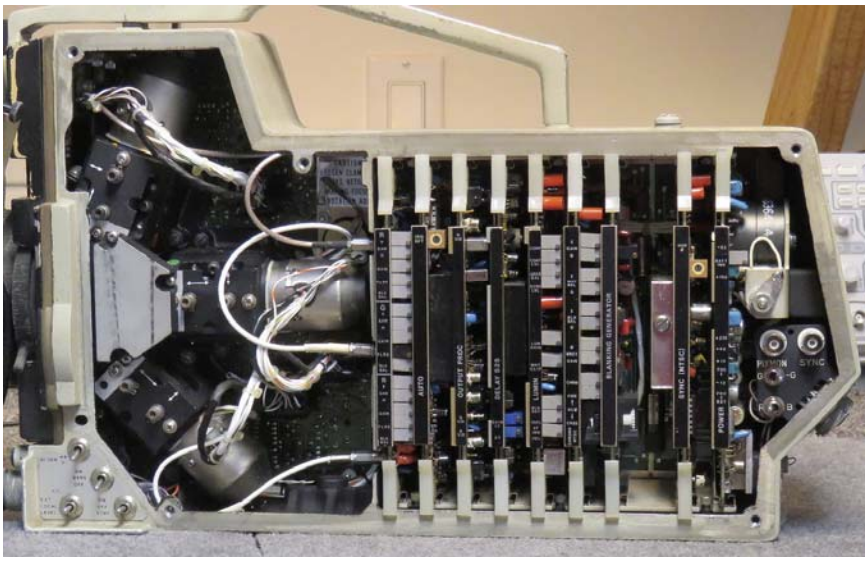
The three pick-up tube assemblies include horizontal and vertical scanning coils, shielding, electrostatic focusing electrodes and a video preamplifier to amplify the signal from the plumbicon target.



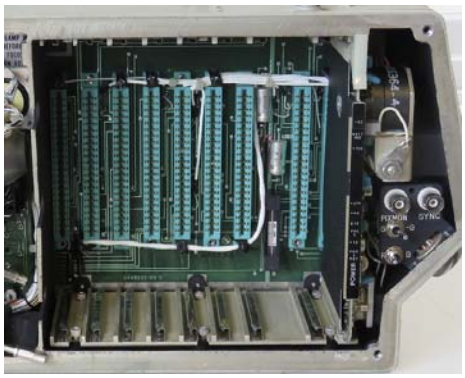
Video Preamplifier under the plumbicon.

The electronics are contained on nine plug-in circuit boards, with the deflection circuits on a tenth board behind the up front by the optics. The video amplification and processing proceeds from the left to the right, with the right-most board the power converter that supplies all the operating voltages.

The plug-in cards provide the video processing, including a comb filter, chroma encoding, a sync generator, a delay line for aperture equalization, the color bar generator, gamma correction and automatic iris control. Additional switches and video connectors at the rear are used in setting up the registration of the three image tubes.

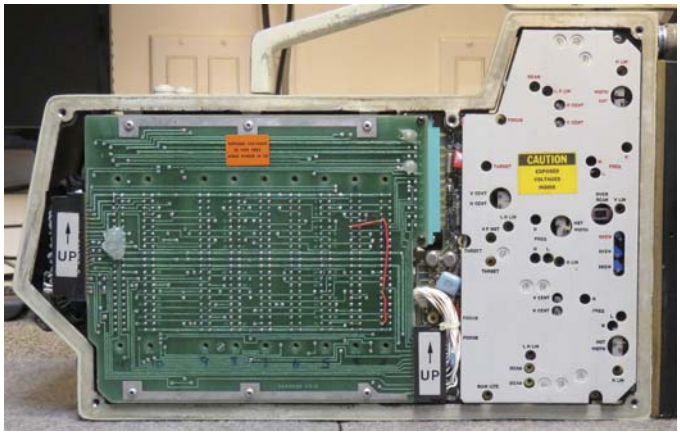


Nine plug-in circuit boards to the right of the optics.



The card slots on the backplane.

The backplane is on the right side, along with the adjustments for the deflection module toward the front of the camera. Beside the mechanical registration adjustments, the width, height, linearity and centering of the deflection waveforms are controlled here.



Backplane and Deflection module.

The 1.5 inch monochrome viewfinder provides a bright image through a lens to the eyecup. Originally a pentaprism inverted the picture, but it was replaced by a mirror for this camera, which did not invert the nomenclature on the tally lights. (The horizontal deflection had to be reversed.) The source of the video image is selectable from the camera itself, from an external video source, or a version of the signal with a visible marker for flesh tones to help set the iris aperture.


Monitor Eyecup and CRT.

Switches at the lower left control the image source for the viewfinder, control the color bars signal, the video amplifier gain and the master power. In the standby position, the plumbicon heaters are activated but all other power is off.

Common function switches.

The interface to the camera includes a 12 volt power connector, the composite video output on a BNC and an 18-pin connector to the video recorder or the microwave link. The interfact includes a 4-amp fuse and a spare. (Not yet installed.)

A separate matching AC-powered 12 volt power supply was found on the web.

Interface connectors and fuse.

Matching AC-powered 12 volt power supply.

The camera usually operated from a 12-volt battery pack worn on the waist of the operator and gave about 90 minutes of operation.


12 volt battery pack.

Repairs and Operation

So, what was needed to put this camera back into operation? First, a lot of study. The camera came without any documentation, but the very generous Chuck Pharis provided a complete manual for this camera. This was essential in repairing the several problems.

Color bar generator operational.

Some of the solid-state components, rectifiers and transistors were found to be dead or shorted. Bad capacitors were replaced. Broken connections between the plumbicons and the preamplifiers were found. After the power supply was repaired, the color bar generator worked. Signals were traced from the plumbicons through the processing stages, fixing problems along the way.

An exciting time when getting a camera to work is "first light", that is, an image starting to appear on the monitor. Once this occurs, optimization and detailing can begin. A number of specialized alignment charts help adjust the registration of the three pickup tubes. The famous 1930s RCA Indian Head pattern helped adjust the focus and measure the resolution. The CHRS journal cover provides a colorful test image.

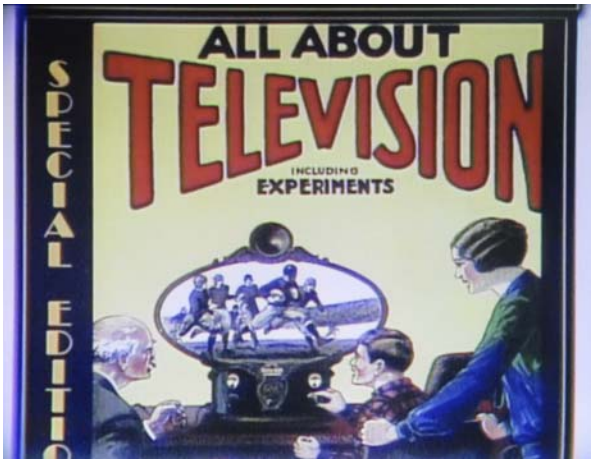
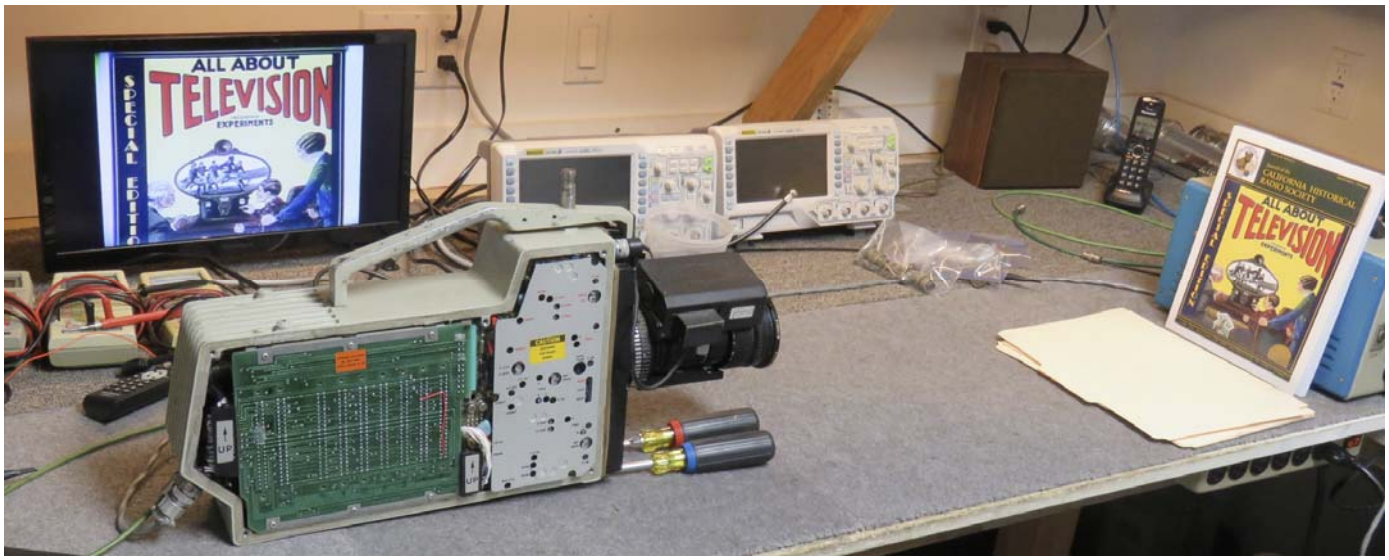
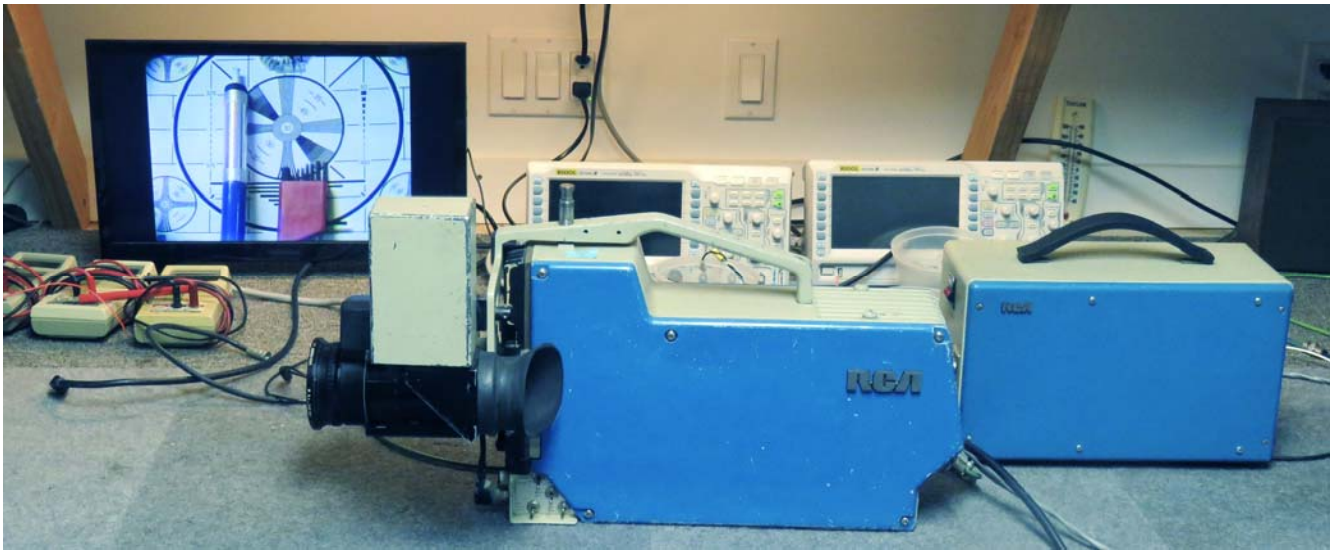


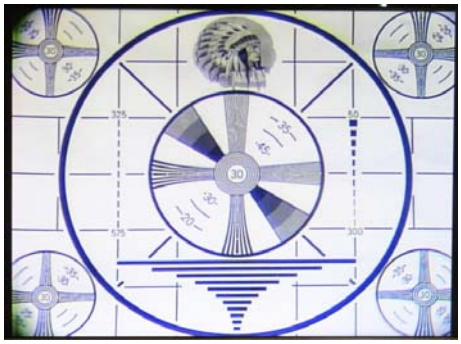
Image from the camera of the CHRS Journal Special Edition -- a special issue everyone should read.



CHRS Journal Special Edition on stage.



Camera and matching power supply viewing an Indian Head chart with colored objects.



Indian Head Resolution Chart.

Here is the requisite shot of the Indian Head resolution chart and an outdoor shot displayed on a small Trinitron monitor.

Several other test charts were prepared to facilitate registration and color tracking setup.

Outdoor shot.

A picture of a prototype of the TK-76 showed up on the web in a different configuration. I would guess that it is just a non-functioning mockup. The final camera has a much more pleasing shape.

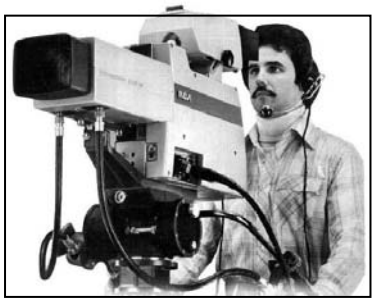
The TK-76 camera was incorporated into the TK-760 studio camera by adding a new case and more electronics. The TK-760 camera would be connected to a camera control unit that contains the usual controls and adjustments found in studio cameras.

Early TK-76 mock up.

Acknowledgements

Don Sharp and Steve Garaventa for the camera and Chuck Pharis who supplied the manual.

TK-76 inside the TK-760.



Studly TK-760 camera operator.

John Staples, W6BM.

The author takes a selfie through the TK-76 camera. ◊

From Spark To FT8: Old Versus New Technologies in Amateur Radio

By Wayne Overbeck, N6NB

Since its introduction in August, 2017, the FT8 digital mode has exploded in popularity in both HF and VHF amateur radio. By the end of 2017 more FT8 contacts than CW or SSB contacts were being confirmed on Club Log. Even before FT8's launch, its digital forerunners, the earlier WSJT modes and JT65HF, had already changed amateur radio in many ways.

Editor's note: For those not familiar with FT8, it is a digital frequency-shift keying signal format, analogous to various current JT formats, that are used by amateur radio operators for transmitting and receiving data. For FT8, the data is encoded using 8 frequencies which are spaced 6.25 Hz apart; the entire signal is only 50 Hz wide. As this article emphasizes, FT8 is just the latest next step in the many, many decades of ever evolving radio technologies.

Perhaps the best way to see FT8's wide acceptance is simply by monitoring the HF bands. It is often possible to see many FT8 traces on a waterfall display on a day when little or no activity can be heard in the CW and SSB sub-bands.

Created by Dr. Joe Taylor, K1JT, and his development team (particularly Dr. Steven Franke, K9AN, in the case of FT8), these new modes first revolutionized Earth-Moon-Earth (EME) and meteor scatter communications in the early 2000s, then swept into other amateur radio uses.

All of this has not happened without controversy. There are those who say these new modes are "destroying amateur radio" and making the efforts of thousands of hams to build big, powerful stations meaningless. Dr. Taylor first encountered that kind of sentiment at worldwide EME conferences early in the new millennium. A number of amateurs, especially in Europe, had built enormous EME antenna arrays and legal-limit transmitters, only to see people with smaller antennas and more modest power start working a lot of the same DX that they could work—by using the JT modes.

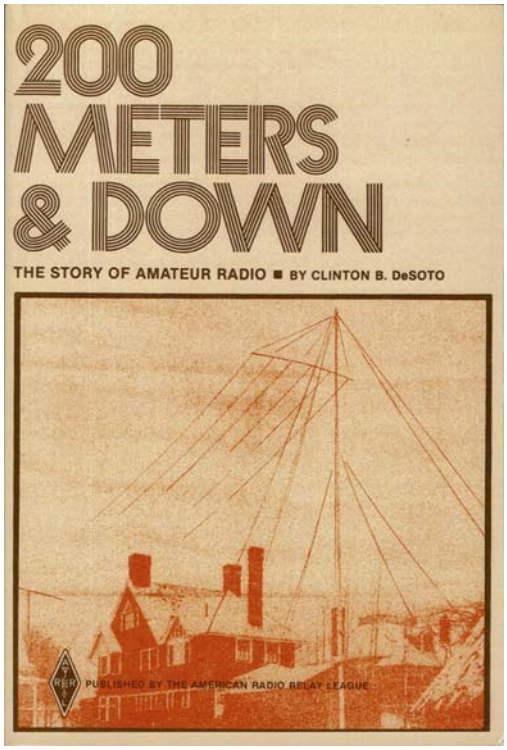
The controversy over the growing use of digital modes is not likely to end soon. However, this is by no means the first time a new technology has emerged to challenge or even supplant older technologies. Over the last 100 years, those who had invested heavily in an older technology have been displeased again and again when something new rendered their technology obsolete. Sometimes old and new technologies coexist side by side, but in one early case federal rules eventually banned an older mode, a story told in Clinton DeSoto's classic history of amateur radio, *200 Meters and Down*.

Soon after radio amateurs got back on the air after World War I, the established spark-gap transmitter technology was challenged by "chirp" stations running much lower power with vacuum tubes—but working greater distances. At first, the noisy spark-gap stations were dominant even using wide-banded regenerative receivers. But after World War I, new stations with quiet, low-power vacuum tube transmitters and more selective superheterodyne receivers--a wartime invention of Maj. Edwin Howard Armstrong—began outperforming the spark giants. Spark-gap transmitting stations quickly became dinosaurs.

A crucial turning point was a series of trans-Atlantic tests in late 1921. Paul Godley, 2XE, went from the U.S. to the U.K. and set up a excellent receiver in a tent in a rainy, foggy place on the coast of Scotland and listened for signals from North America. He heard a lot of signals, and it turned out that most of them were coming from vacuum tube

transmitters, not spark gaps. The results of this test were summarized in 1936 in *200 Meters and Down*. On page 74, author DeSoto wrote:

> "*The definite, incontrovertible superiority of c.w. over spark had been demonstrated. The rank and file began to concede the victory to the slide-rule minority. It was a year before spark was generally relegated to the scrap-heap, three before it sank into oblivion. But with the lesson of December, 1921 emblazoned before the eyes of amateur radio, the future of tube transmission was assured.*"



Underlying these words was a crucial point about amateur radio. When a new technology is invented, it takes a while before the devotees of the old yield to the new—if they ever do. In this early example, it was not just stubbornness that caused the spark advocates to resist change. DeSoto pointed out that even a small, low-power transmitting tube cost $8 in 1921 dollars. By 1936, a similar tube could be purchased new for 69 cents! At first it wasn't just the "slide-rule minority" that had prevailed—it was a minority with extra money to spend. But with component prices falling while performance was increasing, spark-gap transmitters were banned from the U.S. airwaves by federal law in 1927. Illustrating the bitterness of the spark-vs.-vacuum-tube transition, hundreds of spark transmitter devotees left amateur radio instead of moving to “chirp” transmitters.

In nearly a century since these early trans-Atlantic tests, similar battles between old and new technologies have been fought again and again.

One such battle that is often compared to the modern FT8 controversy is the one fought between amplitude modulation (AM) and single sideband (SSB) advocates in the 1950s.

Before World War II, the scientific community was well aware that SSB was a better mode than AM for long-distance point-to-point voice communications. By the late 1930s there were military and commercial SSB links operating in several parts of the world. That was happening for several reasons. For one thing, SSB is superior to AM by around 9 or 12 dB in communications efficiency. On AM, half of the transmitter power is wasted on a carrier that doesn't enhance communications but does create a mass of heterodynes on the receiving end in crowded band conditions. Transmitting two audio sidebands instead of just one wastes another 3 dB. And still more signal is wasted in receivers that must copy a broadbanded AM signal instead of a much narrower SSB signal. Moreover, the transmitted duty cycle is much lower on SSB, allowing a transmitter to deliver far more power output for a given amount of plate dissipation.

But all of these scientific realities didn't change the dominance of AM in amateur radio voice work for many years after SSB's technical superiority was proven. There were some practical realities that could not be ignored. For one, an SSB system was hideously expensive in the 1930s. The stability requirements of SSB drove the cost well beyond what most amateurs could afford. Most hams didn’t even consider SSB before the war. For another, building such a system back then was way beyond the technical capability of most hams. And SSB had an image problem. The "Donald Duck" sound of voices on SSB was easy to ridicule.

After World War II, some of that changed. Low-cost military surplus ARC-5 transmitters had amazingly stable variable-frequency oscillators that worked at 5 MHz, making it easier to generate a stable SSB signal on 20 meters (14 MHz) and 75 meters (4 MHz) with an SSB exciter operating at 9 MHz (adding 5 plus 9 yields a signal at 14 MHz, while subtracting 5 from 9 produces a signal at 4 MHz). But it was still a technical challenge to get on SSB. That challenge

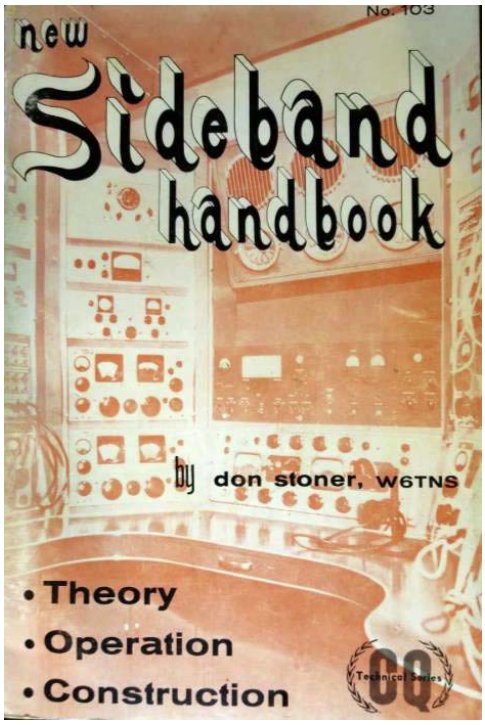
started to disappear in the 1950s when most major transmitter manufacturers began making SSB exciters, led by Central Electronics with its high quality 10A, 10B and 20A exciters, and then with its 100V transmitter (shown right).

Central Electronics 100V Transmitter.

Unfortunately, Central Electronics was acquired by Zenith Electronics about 1959 and then withdrew from the amateur radio market. That was a major loss, but by then Collins Radio, Hallicrafters, E.F. Johnson and others were also making SSB transmitters (in big boxes).

As Central Electronics was fading from the scene, Collins Radio became the dominant force in the high-end SSB market. Collins had identified military applications for SSB systems but also marketed its products to well-heeled amateurs. Its mechanical filter technology established a new standard of excellence for SSB and the Collins 75A4 receiver/KWS-1 transmitter combination became the station of choice for those who could afford it. Later Collins launched the S-Line with snazzy new styling and top performance.

Collins also popularized the concept of *transceivers*. The KWM-1 represented a new approach to amateur radio—a complete SSB transmitter and receiver in a single compact package with one knob to tune both the transmitter and receiver. Then the KWM-2 arrived with S-Line styling and coverage of all HF bands in one box (the KWM-1 covered only 10, 15 and 20 meters). But for young hams like me in the 1950s, Collins equipment was out of reach.



In 1958, Don Stoner, W6TNS, offered an affordable alternative: double sideband. In his *New Sideband Handbook*, a 1958 CQ publication, he described simple circuits for DSB transmitters with the carrier suppressed but without the filtering required for SSB. I built a DSB transmitter in 1959 and it worked well, but DSB wasn't SSB and I didn't feel welcome in the clubby world of SSB round-tables. I put the DSB rig away and saved up to buy a Heathkit DX-100 for AM phone, which was still where most of the action was in the late 1950s.

Heathkit DX-100 Transmitter.

As a young ham in the 1950s I operated several contests on AM before SSB became the mainstream voice mode on the HF bands. The high point for me was 1959 Phone Sweepstakes. I finished second in the Los Angeles section at age 16, running a Heathkit DX-100 transmitter (shown at left) and Hallicrafters SX-101 receiver to a 2-element cubical quad for 10 and 15 meters up 25 feet at the center (not very high even by 1959 standards). The guy who beat me (W6LNW) was #2 nationally, using much bigger and higher antennas than mine.

QST published a list of the equipment used by all of the section leaders in those days. In 1959 almost all of the winners were running AM transmitters like Viking Valiants, DX-100s or the earlier Viking I and Viking II rigs, not SSB equipment.

What was contesting like in the AM era? Phone contesting didn't seem all that different back then--except for the awful QRM caused by heterodynes from adjacent AM carriers. With my DX-100 (about 100 watts of high-level plate

modulated AM), I could hold a frequency and *run* all day on 10 or 15 (but not 20 or 40). The other alternative was the *search and pounce* operating technique and it was a pain. Without a transceive mode you had to manually zero-beat every station to get on his (or her) frequency before calling.

By the time I returned to contesting after college, things were different. By 1965 almost all of the section leaders listed in QST were running SSB rigs and operating the contest mainly on SSB. At the same time, overall voice activity was increasing dramatically. In 1959 Sweepstakes, CW logs outnumbered phone logs by a 3:1 ratio. By 1965, the ratio of CW logs to phone logs was only 5:4. There were more phone logs than CW logs in SS for the first time in 1970, according to tallies by Ellen White, W1YYM (now W1YL), who wrote most of the SS articles for QST in that era.

I think the key turning point in the popularization of SSB was the introduction of the Swan 120, Swan 140 and Swan 175 transceivers about 1961. These were low-cost single-band transceivers that introduced thousands of hams to SSB. They were far smaller than most previous SSB equipment. In one small box there was a complete transmitter and receiver that offered remarkably good performance for the price and size. Many of us operated mobile with a Swan single -bander in a car in 1962 or 1963. Herb Johnson, W6QKI, the founder of Swan, had come up with a breakthrough product.

Soon Swan offered the three-band Swan 240, also at a modest price. Then Swan launched the 400, a five-band transceiver. It had an outboard VFO, but it was still compact and affordable. The VFO could be mounted under the dash, with the rig itself in a car trunk. Swan then squeezed the VFO inside a five-band transceiver and launched the Swan 350. That was probably Swan's most successful product and it introduced thousands more hams to SSB. But by then Swan had a lot of competition in the SSB transceiver market. National was making the NCX-3 and NCX-5, while Hallicrafters launched the SR-150 and Heathkit produced the SB-100 as a five-band transceiver kit. Then there was the Galaxy 5 and later models from the successor to Globe Electronics. Drake announced the TR-3 as a five-band transceiver with one KHz dial calibration like the Collins S-Line, but without the Collins price. There was also the mostly-solid-state SBE-33 transceiver. By the time Kenwood announced the TS-520 and Yaesu produced the original FT-101, SSB had arrived.

Perhaps a sign of the changing times came at the 1966 ARRL Southwestern Division Convention. By then AM operators were on the defensive. They were outnumbered and most realized their mode was technically challenged. At the ARRL Forum a group of AM operators asked for the HF bands to be partitioned into separate SSB and AM sub-bands to protect AM's dwindling turf. The ARRL leadership said a flat "NO." AM has remained a nostalgic favorite ever since, but not the mode you choose to work most contests or chase rare DX. SSB had become mainstream in HF amateur radio, but it took 30 years. As this transition was under way, another technical revolution was happening, of course. The world was moving from vacuum tubes to solid state — a transition enormously important but a subject for another day.

A similar battle of modes was fought on six and two meters a few years later, but the combatants were mainly AM and FM. At first most amateurs on six and two used AM, as did their HF counterparts. But in the 1960s (in California, at least), technical gurus from the land-mobile community started setting up amateur FM repeaters and remote bases. Once again, they were bringing an established commercial technology to the ham bands. There was a lot of talk about converting surplus Motorola and GE "Pre-prog" (right) or "Progress Line" radios for amateur use.

CHP GE “Pre-Progress” Series Mobile Radio, 1952.

But there was also a rival trend under way. Imported FM radios began to appear in America, supplanting the commercial radios on the ham bands. That led to new turf wars between the barons of land mobile and local radio clubs that saw an FM repeater as a way for their members to stay in touch. Repeater coordination battles flared up everywhere. AM got lost in that shuffle. Amateurs put their Clegg 99ers, 22ers and even their Clegg Zeus monsters in storage. The mainstream was now occupied by FM. However, weak signal CHF operators moved their niche interest to SSB from AM in the 1960s and 1970s. That move was inevitable once Heathkit, Swan and Drake started making six-meter SSB transceivers and transverters for two. You could buy a Heathkit SB-110, Swan 250 or Drake TR-6 (at right) and work people you never dreamt of working back in AM days.

Drake TR-6 Transceiver.

Now we have still another transition under way. The WSJT-based digital modes are booming in popularity. Not many of us remember when vacuum-tube CW rigs supplanted spark, but some of us did see SSB become mainstream first on HF and then for VHF weak-signal work--while FM was supplanting AM to become mainstream for most other VHF operating. We also saw compact solid state rigs replace vacuum tube "boat anchors" in ham shacks everywhere—even as big vacuum-tube AM transmitters were proudly restored by nostalgic hams worldwide. For us the debate about FT8 brings a sense of deja vu.

Personal computers and the Internet have revolutionized life on Earth in thousands of ways. Amateur radio could never escape this pervasive influence. From worldwide Internet-based remote control of amateur radio stations to software defined radio technology, the digital world has forever changed ham radio. FT8 is one more manifestation of our changing times. Although it is not likely to replace the traditional CW and analog voice modes altogether, it provides a new alternative for long-distance, weak-signal communications.

The Author

Wayne Overbeck holds a Ph.D. from UCLA and a J.D. from Loyola Law School. He was first licensed in 1957 and was a professor at California State University, Fullerton from 1968 until 1973 and from 1980 until he retired in 2003. He authored 20 editions of a college textbook, Major Principles of Media Law, and also served four terms as an elected vice director of the American Radio Relay League. See *http://n6nb.com*

A postscript: Much historical information about both broadcasting and amateur radio can be found at the California Historical Radio Society's 7,500-square-foot museum in Alameda. The museum has an impressive collection of restored radios in addition to an extensive radio library.


CHRS Library and Archive.

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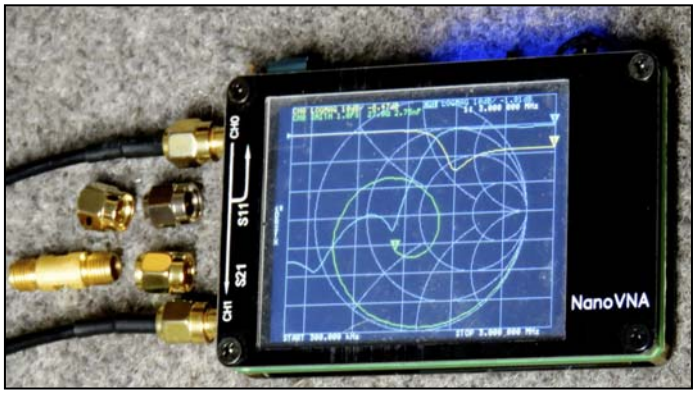
The nanoVNA Vector Network Analyzer - An Analysis

By John Staples, W6BM

This small electronics wonder has appeared to the ham radio and RF measurements community with a surprisingly versatile new RF diagnostic instrument for a price of just a few dollars.

Here we have, in a small package, a vector network analyzer that covers 50 kHz to 900 MHz the size of a credit card.



The nanoVNA Vector Network Analyzer.

In order to keep this note to a reasonable length, I will assume that the reader is already knowledgeable about RF measurements, complex impedance and has the ability to read a circuit diagram.

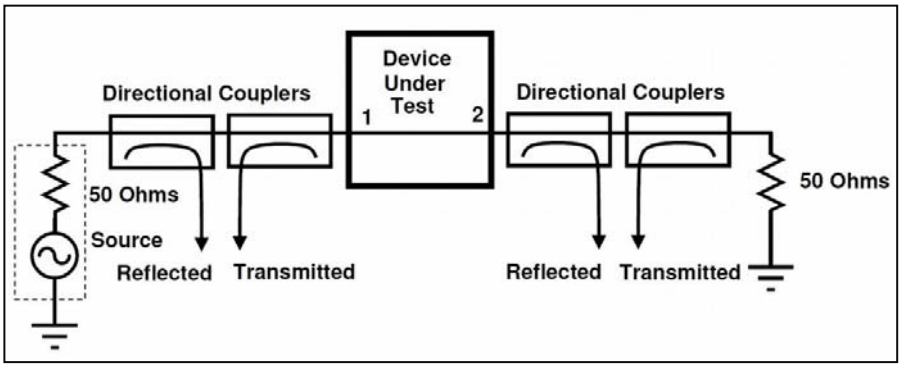
The nanoVNA was invented by a very clever Japanese engineer, Tomohiro Takahashi (a.k.a. edy555) from Hokkaido, and is now cloned by numerous Chinese manufacturers and available through many web sites. Searching the web with "nanovna" will bring up many sales sites.

Many YouTube videos explain the operation of the nanoVNA, some good, some not so good, but I will instead analyze the device itself, and present information not seen in the videos.


Tomohiro Takahashi is the Japanese engineer who designed the nanoVNA.

Simple Specifications	
Nominal Impedance	50 ohms
Frequency range	50 kHz to 900 MHz
Number of data points per scan	101
Minimum frequency increment	100 Hz between points
Power requirement	5 volts through USB connector, internal battery
Display	2.8 inch touch-sensitive 320 x 240 TFT, color
Number of save registers	5, register 0 loaded on bootup

Basic Vector Analyzer Configuration



Basic Vector Network Analyzer Diagram.

A network analyzer comprises an RF source with 50 ohms internal impedance to drive a two-port Device Under Test (DUT). Directional couplers sample the RF transmitted to and reflected from port 1 of the DUT. At the exit port 2, directional couplers sample the signal transmitted through the DUT and the reflected wave from

Basic Vector Network Analyzer diagram.

the 50 ohm terminating resistor. Since no signal is reflected from the 50 ohm terminating resistor, the second reflected wave directional coupler is not needed.

Thus, three signals are measured: the transmitted wave and the reflected wave from port 1 of the DUT, and the transmitted signal from port 2. The Vector Network Analyzer (VNA) compares the wave reflected from port 1 and the transmitted wave from port 2 with the initial wave transmitted from the source to port 1. From these measurements the two-port characteristics of the DUT are calculated. The magnitude and phase comprise a vector, a quantity of two components, which differentiates it from a Scalar Network Analyzer, which measures only the magnitude of the transmitted and reflected waves. The phase measurement provides more information about the response of the DUT.

A two-port network is often characterized by its S-scattering parameters, which are the complex ratios of the reflected and transmitted wave voltages normalized to the incident wave voltage. For the configuration shown in the basic diagram:

S_{21} = transmitted wave amplitude through port 2 / incident wave amplitude

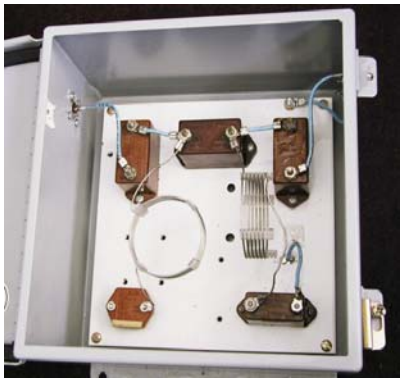
S_{11} = reflected wave amplitude from port 1 / incident wave amplitude

where the incident wave is measured by the transmitted directional coupler at the DUT input port 1.

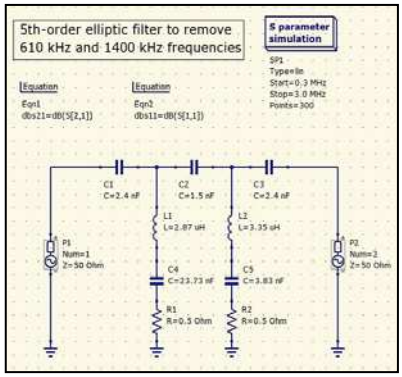
Two more parameters are often measured for a two-port network: S_{12} and S_{22}, which are equivalent to the S_{21} and S_{11} parameters measured with the ports 1 and 2 of the network exchanged. These can be measured by physically exchanging the connections to the network, or by moving the RF source to the other side of the measurement configuration at the 50 ohm terminating resistor.

Example: The KRE broadcast band notch filter

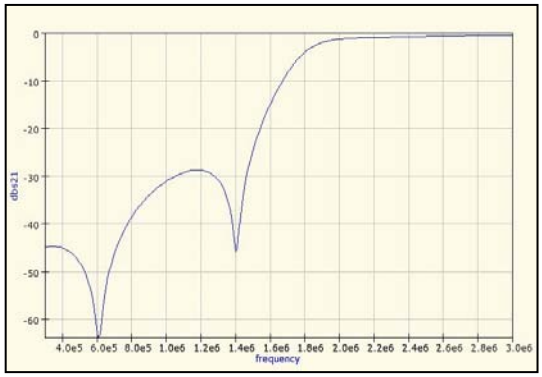
The most popular measurements made by hams are antenna impedance measurements and filter measurements. One example is a filter provided for the W6CF ham radio station when at KRE, where two AM broadcast transmitters on 610 and 1400 kHz occupied the same building. The ham radio antenna picked up a dangerously large signal that had to be attenuated to allow operation of the ham equipment. A filter was designed to notch out those two frequencies but allow operation at frequencies above 3 MHz and to permit high-power transmission through the network.



KRE Broadcast Transmitter Filter.



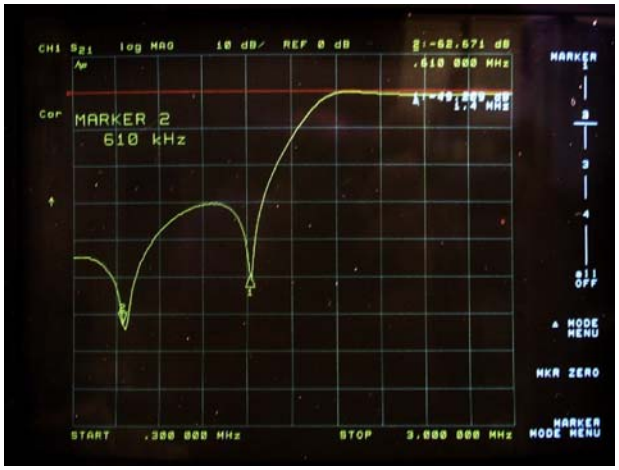
Broadcast Filter Schematic.



Simulated Broadcast Filter Response.

The interactive and open-source RF simulation program *qucs* was used to design a filter with notches at the required frequencies.

The response of the filter was measured with an HP 8753C VNA with an HP 85047A S-parameter test set, and also with the nanoVNA. The HP equipment cost $36,800 in 1991, or $67,800 in today's dollars, and the nanoVNA is available for less than $40, a factor of more than 1000.

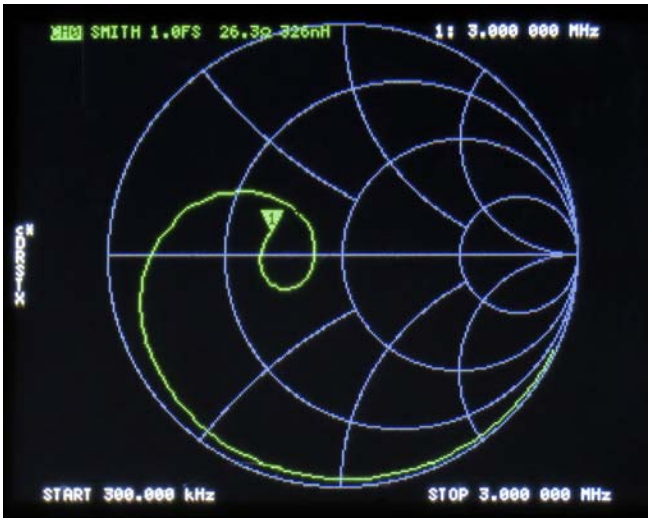


HP 8753C response measurement.

The HP image shows the measured response of the filter with markers at the two notches. The frequency span is from 0.300 MHz to 3.000 MHz. The notch depths correspond well to the *qucs* simulation.

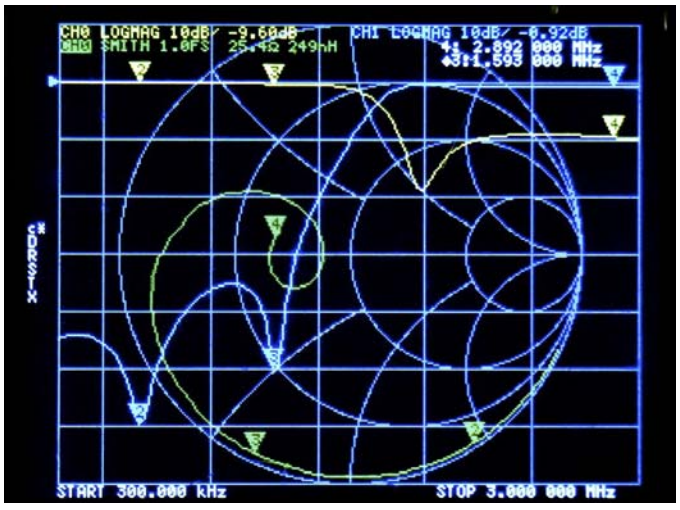
The measurement with the nanoVNA with two markers agrees very well with the HP measurement, including the notch depths. In the nanoVNA plot, CH0, the yellow curve, is the reflected wave S_{11} and CH1, the blue curve, is the transmitted wave S_{21}.

nanoVNA S_{11} (yellow) and S_{12} (blue) measurement.



nanoVNA Smith Chart presentation.

In the nanoVNA Smith chart, the green curve plots the complex input impedance of the filter network.



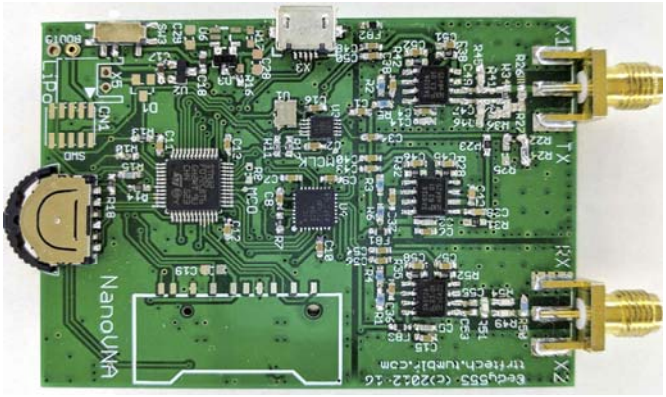
nanoVNA single combined image.

All these can be combined in a single, somewhat cluttered, image.

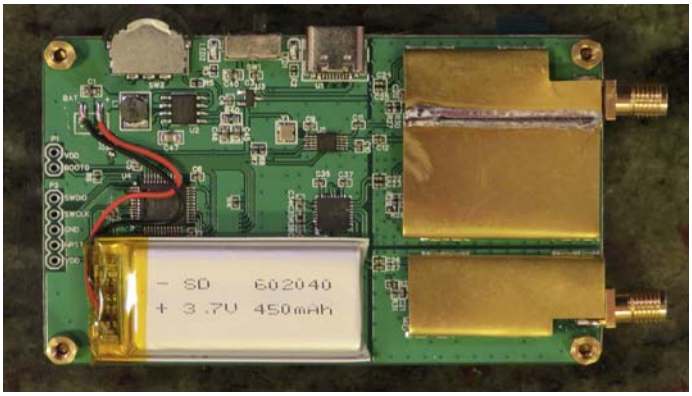
Note that the Smith chart mode includes the value of an equivalent series resistance and either capacitance of inductance values at the frequency denoted by the marker. VSWR and phase shift traces are also available.

All functions are available through the touch screen display, and the markers can be "pulled" along the trace using the touch screen.

The nanoVNA Circuit Details

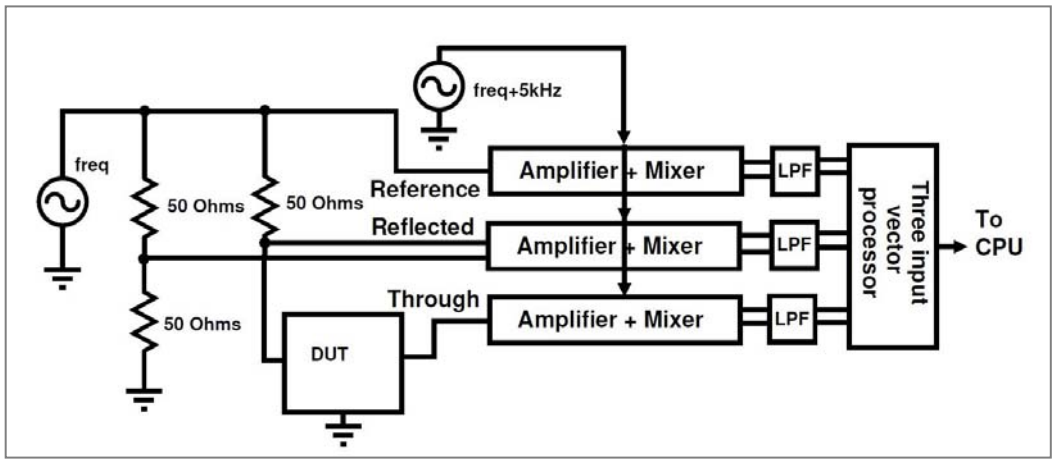


Prototype nanoVNA.



nanoVNA as delivered.

The photo at the left appears to be of a hand-soldered prototype, and the one at the right is of the unit I received. The top SMA connector supplies the signal to the port 1 DUT and the lower one the received signal that passes through the DUT from port 2. Three receivers are seen toward the right (and under the shields). The one on the bottom is for the transmitted signal, the one on top is for the received signal, and the third receiver in the middle monitors the signal generated by the source.



nanoVNA simplified block diagram.

The three receiver IC chips use a Gilbert-cell (double balanced mixer) with a noise figure below 6 dB give a conversion gain of 14 dB.

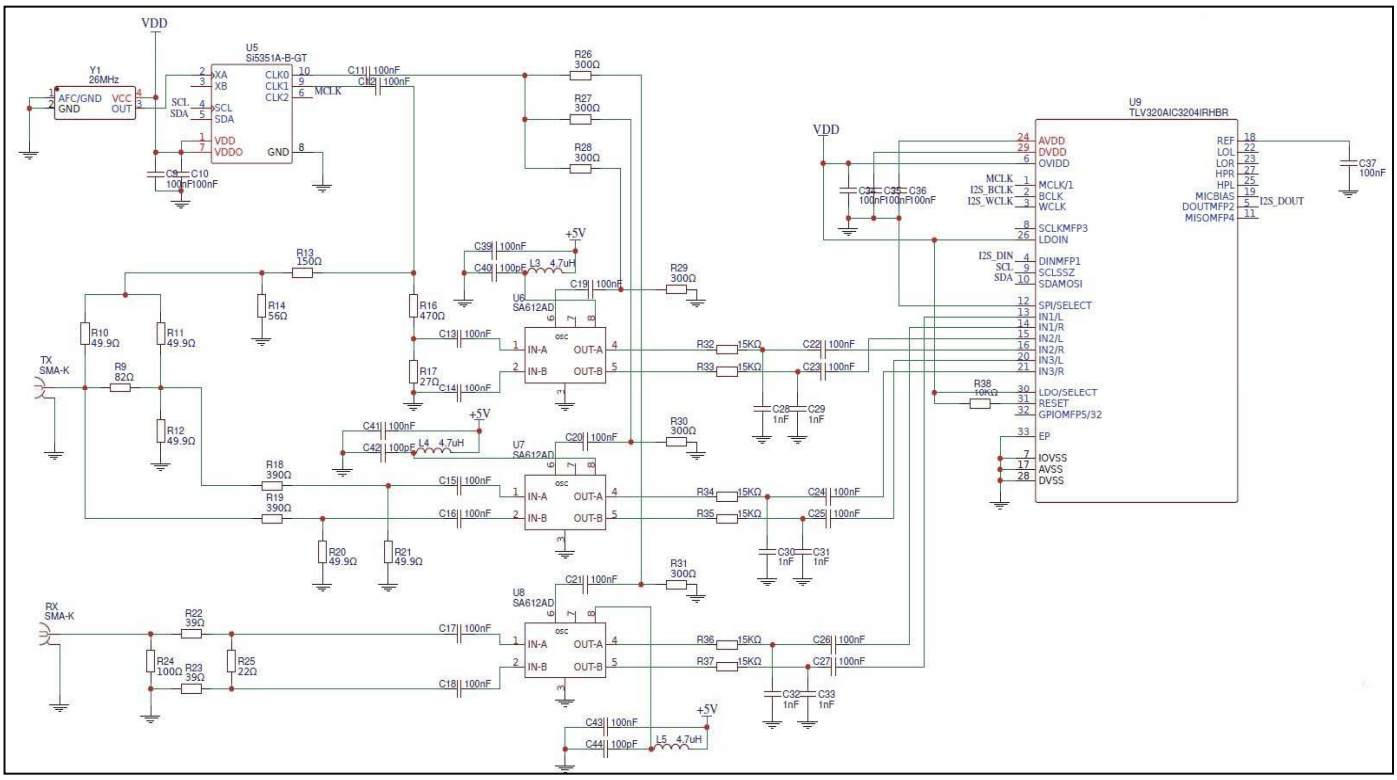
In the top middle of the board, a frequency synthesizer and a 26 MHz crystal oscillator chips generate three independent frequencies.

One frequency generated is the RF test signal, another provides the local oscillator (LO) for the mixers in the receivers, and the third output is a fixed 8 MHz clock for the computer.

The intermediate frequency (IF) output of the receivers is 5 kHz, so the LO tracks the RF 5 kHz high during a 101 point frequency scan, controlled by a data stream from the CPU. Each receiver is followed by a low-pass filter in the IF path that attenuates frequencies above 5 kHz.

Below the synthesizer is a three-input ADC that converts the 5 kHz analog IF signal to digital format for use in the CPU, the larger chip to the left. At the left top of the board are the power controller and USB interface chips. The touch-sensitive TFT screen and its controller are on the opposite side.

Note that in the simplified block diagram no RF directional couplers are used. Instead, the DUT is placed in one leg of an RF bridge, comprised of three 50-ohm resistors, with the DUT in the fourth leg of the bridge. The differential output of the bridge is fed to the balanced input of the Reflected receiver, which has a high common-mode rejection. The impedance of the input port of the DUT is calculated by the CPU from the magnitude and phases of the Reference receiver and the Reflected receiver signals and is displayed as the S_{11} parameter. Likewise, the transmitted S_{21} parameter is calculated from the signals from the Through receiver and the Reference receiver.



Partial nanoVNA schematic, showing the RF and IF sections.

The partial schematic shows the three receivers in the middle with the transmit and receive ports to the left, the crystal oscillator and synthesizer at top left, and the analog-to-digital converter at the right after the low-pass filters. Not shown are the CPU, the power controller and USB interface and the touchscreen and its interface.

NanoVNA Operation

The nanoVNA is controlled through the touch-sensitive TFT screen and a toggle switch at the top of the unit. A tapered wood pointer makes a good interface to the screen. It does not have to be conductive.

Five configuration save registers are included. They contain the data used to normalize the response set by a SOLT (short, open, load, through-put) calibration procedure. The nanoVNA comes with three SMA terminators, a short, an open and a 50 ohm resistor, along with an SMA barrel and two 33-cm SMA coaxial cables. Register 0 contains the factory calibration with the reference plane right at the location of the SMA connectors on the board. On boot-up, register 0 is loaded. The other four registers contain alternate user calibrations and are retained during power-off. The calibration procedure requires the SMA terminator on S_{21} to be connected in turn to the transmit (C0 or S_{11}) port, and the through calibration connects the C0 port to the C1 on S_{21} port with an SMA cable. In addition, the isolation measurement with the ports isolated from each other is added to the saved data. The calibration data can be stored in any of the five save registers.

The frequency range is 50 kHz to 900 MHz. The internal RF source generates a square wave, but only the fundamental (or the third harmonics, see below) is accepted by the receivers.

The frequency sweep is entered either as a start and stop frequency, or as a center frequency and a frequency span. The sweep span can be zero, generating a CW frequency.

The phase reference plane can be moved, and the scale factor and baseline reference adjusted via screen menus.

Besides log magnitude and Smith chart plots, phase, delay and VSWR can also be plotted.

NanoVNA Extended Frequency Range

The frequency synthesizer itself covers 50 kHz to 300 MHz. So how can the range be extended to 900 MHz? The 300 to 900 MHz range uses the third harmonic of the square-wave RF reference oscillator. The square-wave contains no second harmonic, and the third harmonic amplitude is one-third of the fundamental.

To scan the 300 to 900 MHz segment, the tracking LO frequency offset is set at 5 kHz / 3 = 1.667 kHz. Then, the third harmonic of the LO is 5 kHz higher than the third harmonic reference oscillator, and a 5 kHz IF signal is generated. Other IF responses are rejected. The switch to third harmonic is automatic during a scan that exceeds 300 MHz. A small glitch at 300 MHz is sometimes visible on the trace.

The difference in reference amplitude for the 300-900 MHz segment is corrected by the reference signal amplitude in the reference receiver, in software and in the calibration procedure. The baseline noise level in the 300-900 MHz segment is slightly higher, and can sometimes be seen above the -70 dBc floor of the display.

NanoVNA as a Scalar Network Analyzer

The nanoVNA already does this. The displayed parameters S_{11} and S_{21} are the ratios of the magnitude of the voltage reflected from and transmitted through the DUT, referred to the voltage excitation of the input port without the phase information as displayed on a Smith chart.

Comparison of the nanoVNA to a Spectrum Analyzer with a Tracking Generator

Some spectrum analyzers can be coupled with a tracking frequency generator to simulate a scalar network analyzer. The amplitude response of a DUT can be determined, but not the reflection coefficient or the phase response of the DUT as only the throughput signal S_{21} is detected. One possible advantage that the nanoVNA does not have is the possibility of a frequency offset between the SA and the TG, to analyze, for example, superheterodyne receivers where the input and output frequencies differ by a fixed amount.

NanoVNA as an Impedance Bridge

Using in the Smith chart mode at a single frequency (or at the frequency of the marker), the series equivalent impedance at the S_{11} port is listed as a resistance in series with a reactance, expressed as a capacitance or inductance, depending on reflected phase. The values are quite accurate from a few to several thousand ohms. Use the lowest CW frequency, 50 kHz, for the test to minimize error due to the coaxial cable to the test impedance.

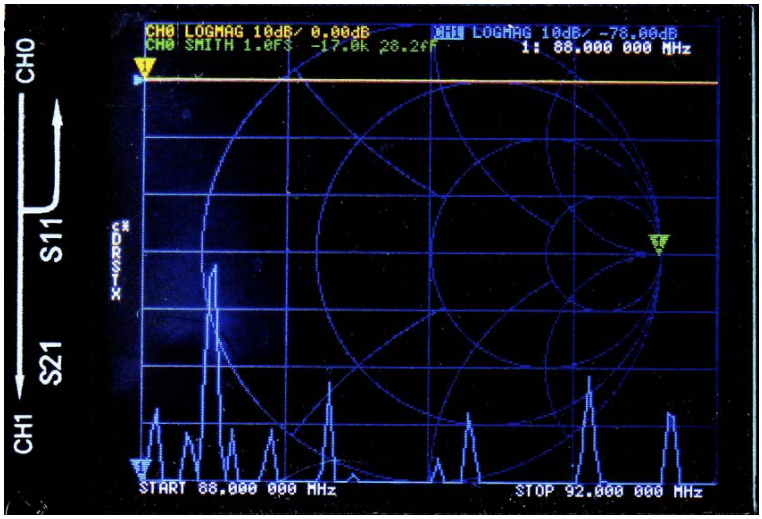
NanoVNA as a Signal Generator

The nanoVNA will generate a square wave over its fundamental range of 50 to 300 MHz with a fixed output level of about -13 dBm. The frequency span can range down to zero, or when scanned, produces one scan about every 1.2 seconds. Above 300 MHz, the output frequency will be one-third of the indicated frequency. The frequency error is less than 0.5 ppm of the indicated value.

NanoVNA as a Crude Spectrum Analyzer

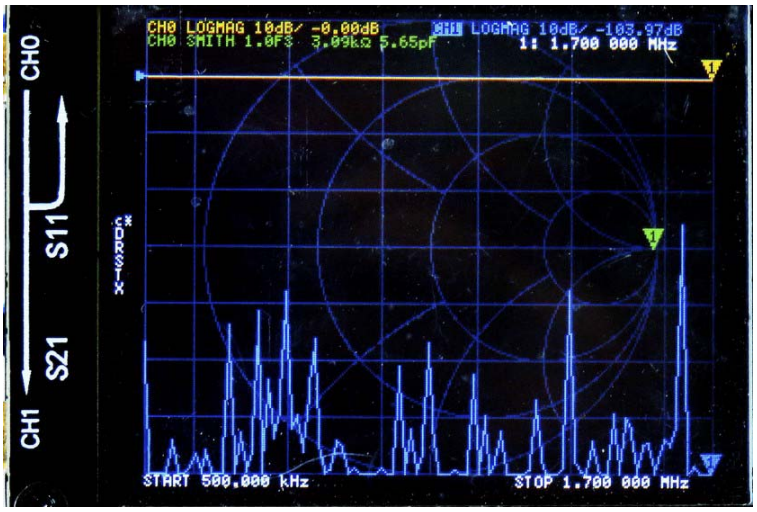
The intermediate frequency (IF) is 5 kHz, so for every input frequency, an image response is found 10 kHz below the indicated frequency. For very narrow scans, the image response can be seen and rejected.

For very large frequency spans, the received frequency and its image will be 10 kHz apart, which may be small compared to the scan width, so the response peak will include the received frequency and its image 10 kHz below. In this case, the nanoVNA can be used as a somewhat useful spectrum analyzer with a frequency resolution of a few kHz and an accurate amplitude response.



FM Spectrum from 88 to 92 MHz.

Here is a scan of the "good" part of the FM band, 88 to 92 MHz. A short wire was connected into the receiver SMA connector. The scan is 4 MHz wide, so the two responses, the "real" response and its image response 10 kHz lower merge into a single peak, whose center-of-gravity is 5 kHz lower than the indicated frequency. KQED is the large 88.5 MHz signal to the left.



AM Spectrum from 500 to 1700 kHz.

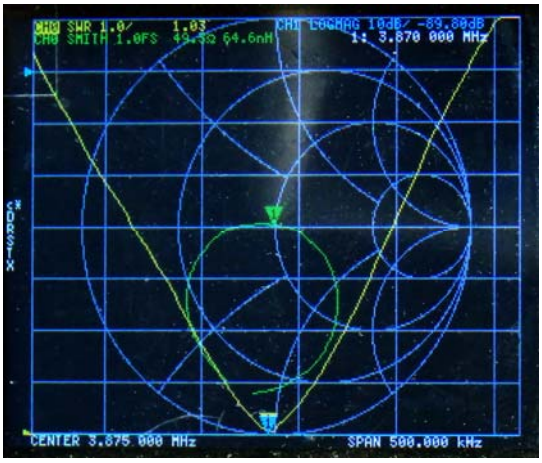
Here is a scan of the AM broadcast spectrum from 500 to 1700 kHz with a short wire antenna. The span is 1200 kHz, so the real and image response combine in each peak. The strongest station at 1640 kHz is at the right hand end of the scan.

The vertical scale and the baseline position are both adjustable parameters through the touch-screen menus.

NanoVNA as an Antenna VSWR Analyzer

This is probably the most useful feature for the ham radio operator. The S_{11} port of the nanoVNA in scalar mode duplicates the function of a graphical VSWR analyzer.

Here is a nanoVNA VSWR plot of an antenna with its tuner resonated at 3870 kHz, the 75 meter West Coast AM frequency. The center frequency is 3870 kHz and the frequency span is 0.5 MHz. The cursor indicates a VSWR value of 1.03 at resonance (3.870 MHz), and the green Smith chart plot indicates an impedance very close to the 50 ohm at the center point on the impedance circle. The resistive part of the antenna impedance is shown as 49.5 ohms.



VSWR Plot of 75 meter antenna with tuner.

The information from the Smith chart, the real and imaginary parts of the antenna impedance, map onto the adjustment of an antenna tuner, whose controls roughly tune the resistive and reactive parts of the antenna impedance.

NanoVNA as a TV Alignment Generator

The nanoVNA does not have to be used in 50 ohm matched systems. It can be used as an alignment generator for radio and television IF amplifiers, for example. The nanoVNA is loosely coupled to the input and output of the IF amplifier through DC blocking capacitors and large resistors, say 10K ohms. Up to four frequency markers are available and other log vertical scale factors and a linear vertical scale factor are available.

Here is the IF gain vs. frequency for a 1948 Pilot TV-37 3-inch TV set.

Plot of the Pilot TV IF amplifier tuning response.

Summary

The nanoVNA proves itself as a competent instrument with performance competitive with much more expensive instruments at a small fraction of the price. The design uses off-the-shelf components in a very clever configuration with a friendly and intuitive touch-screen menu-based control interface.

Many clones of the original design are on the market. Make sure that you get one with the accessory SMA terminators and SMA cables, the included rechargeable battery and shields on the critical receiver ICs. Quality varies.

The mechanical design and firmware are all open-sourced. The firmware is written in C and python and can be found on the github website under edy555. Numerous firmware patches have been published for various, somewhat dubious, upgrades, such as extending the upper frequency to 1.5 GHz.

The Author

Dr. John Staples, W6BM, designs, constructs and tunes particle accelerators at the Lawrence Berkeley National Laboratory with vector network analyzers. He also collects and restores antiquarian electronics instruments and television equipment.

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Henry Joe Poy, Wireless Pioneer and Naval Radioman

An Archivist's transcription, lightly edited, and commented by Bart Lee, K6VK

Henry J. Poy,US Navy photograph *circa* 1923; the tag dates from 1919.

Henry J. Poy started out in wireless telegraphy as a boy in Oregon around 1914 with a spark coil and the self-assigned callsign YC. He got a First Class U.S. government radio license from the Department of Commerce on March 19, 1918 (Number 6610) at the age of 16, permitting him to go to sea as a radio operator, in 1919. Please see the following story that he wrote for the Society of Wireless Pioneers.

After YMCA radio school in Portland, he had shipped out on the Alaska commercial run in 1919. He then joined the US Navy in June of 1919 serving in San Francisco, San Pedro and the Canal Zone. In 1923 he served in China and Japan. He served on the SS *Jefferson* and the SS *Buttonwood* in 1919. Much of his nearby story tells of those days. His record of his adventures illuminates the East Asia of the early 20th Century and Navy life as well. (It is very sad in some parts and very funny in others). He returned to the US in 1925 serving at the Navy radio station NPG in San Francisco.

Then in 1927 he joined Federal Radio (soon ITT) here in the Bay Area. He served at radio station KFS in Palo Alto, and KWT. Retiring in 1964, he again went to sea on the SS *Overseas Joyce* and the SS *Hannibal Victory* (callsign KKMN), through 1966.

"Hank" (Henry Joe or Jue) Poy told much of his radio story to the Society of Wireless Pioneers (SoWP), of which he was a member – SGP2351, in the 1970s. His historical account follows; it has been lightly edited from his (and others') documents submitted to the Society of Wireless Pioneers (now a program of the California Historical Radio Society: www.californiahistoricalradio.com and www.SoWP.org).

His Story

I was R/O [the Radio Operator] on the SS *Jefferson*/ [callsign] WAJ of the ALASKA [commercial shipping] line, in 1919, only 16 at the time, and born of Cantonese parents, who were converted to Christianity in Portland, Oregon. I finished the YMCA radio school and Mr. Twogood was happy to know I was headed for Seattle to take the FCC [then Department of Commerce] examination from Insp. Wolfe which was atop the LC Smith building. I had studied "wireless" [telegraphy] very earnestly and was the first one in high school to have a crystal receiving "loose coupler" of the "rolled oats" genre that could bring navrad [Naval Radio station] NPE (100 miles away) in R- 5 [clearest reception] on a Baldwin receiver [i.e., headphone].

Inspector Wolfe passed me on a grade of 85, and their office told all persons around I was the first Chinese wireless operator (PY [probationary operator]) to ship out from Seattle. With a telegraph First [Class license] in my pocket, and heart full of thankfulness, I left the FCC office and reported to the SORS [Ship Owners Radio Service] at dockside. To my surprise, they wanted me and they didn't want me. Looking questionably and surprised at me, they put me through a strict question and answer test. My work qualifications were being challenged. I wrenched the documents from the inside coat pocket and the YMCA wireless diploma. Both were legally signed by authorized agents of the U.S. government and the YMCA authorities. Confronted with these documents was enough to belay their efforts to further questionability. In high school I carried five subjects which included Latin and math. I proceeded to a two-hour class in Cantonese at a Chinese mission school. Clarence and Bill, my two brothers, followed the same routine each day. One eventually became a mining engineer from Golden, Colorado, and Bill became an M.D. from Northwestern.

The SORS (Ship Owners Radio Service) had a large vacancy list for the rest of the traveling season to Alaska. Their need was great. How could they turn me down? Peace between the two World War belligerents was not signed as yet, and many former ships' operators were not discharged from the armed services. Then, the normal pay was very seldom over ninety dollars [a month]. I was very anxious to get assigned to my first career job as a wireless operator. So I told SORS in rebuff. I was getting "hot under the collar."

This logo appears in the story as posted in the SoWP publication of Poy's documents.

"I can speak Cantonese and become the steamship's Chinese interpreter. The SS *Jefferson*, the SS *Alaska,* the SS *Yukon*, the SS *Mariposa*, they all carry two to three hundred Chinese cannery workers to and from Alaska salmon packing plants." It was something going for me, even though there was no need for an interpreter. However, it was just an impromptu remark. My only amateurish attempt at translating was at an American-learning class for Chinese immigrants at the mission school in Portland where father was a layman-superintendent.

"Is this your right age, 16?" he asked. "Yes, I will be 17 in October." I added, "I have lived and worked the Alaska salmon canneries for three of my summer years. My father's cousin, Mr. Lock, was cannery foreman for Alaska packers. Sitka, Taku and Bristol Bay canneries are not new to me. I am husky at 140 pounds and used to do the 48-pound cases by piling them "eight high." I was fighting for my legal rights and felt that 1 was being unreasonably questioned. This SORS man probably possessed a bit of superiority complex, knowing I was of Chinese heritage. He apparently wasn't going to assign me to an official sea-going ship of the U.S. maritime company. "If you are hesitant in signing me, I will report back to the FCC. They will give me a letter of recommendation to the United States Shipping Board (USSB) to an assignment on newly constructed ships of the Standifer Shipbuilding Company." At the "Y" school, the bulletin board was pasted with notices of vacancies for "ops" to take the new ships on trial trips down the coast. They paid $135 per month, room and board plus wireless uniform. They're rock 'n' roll trips.

Well, after much hemming and hawing, they assigned me as 2nd operator aboard the SORS (Kilbourne & Clarke [equipped]) passenger ship, the SS *Jefferson* leaving Puget Sound for Southeastern Alaska via Juneau and many cannery ports. As I predicted, the ship provided first class passage for 100 passengers and 200 steerage passengers.

The crimpy-looking wireless room [was] not much over a crib-size stall. The one-half kilowatt quenched-spark transmitter with its loose-inductance coils and the ancient carborundum crystal sliding tuner was crammed against the forward bulkhead. The senior operator, whose name I've forgotten, was a crispy old "vet" of unknown repute. Much older than myself . . . had a slight slump on his back . . . red pimply face . . . and carried a domineering visage. WAJ was my "beginner's" job, and my position was not promising. The only words the man would say: "Take over the watch, China boy." I began fidgeting with the delicate "catwhisker" [wire probe] . . . and loudly came the [Canadian coastal radio] station "VAE" . . . the sending operator had a "Mary Pickford" swing. Our ship was rounding Juan de Fuca Straits. My associate frightened me much. He was a man of the WORLD. I was just a kid.

Undeniably, as a "Y" wireless operator, I was a greenhorn amateur on my first commercial adventure. Twisting the big tuner knob, a loud but mushy signal came down the flat-top antenna via the copper lead-in to my loose-coupler. I was a bit confused from the heavy static but full of anxiety. Jiggling the "catwhisker" to a more sensitive spot on the galena crystal, I grabbed a pencil and nervously translated this "mushy" signal. Lo and behold! I never heard such a hairy note. WAJ WAJ de WAW WAW WAW QRK? ar . . . The *Admiral Watson* calling the *Jefferson*! Believe it or not . . . the "China boy's" first official call.

But suddenly, the signals stopped abruptly. The static disappeared. The ship's stern was jumping and leaping with each turn of the props. Each bump was like riding the railroad ties. I threw the main switch to activate the M.G. [motor generator] which was quite noisy. The quenched spark gap was even more disturbing, but like all 60 cycle rigs, it had to heat up a bit. Whew! I saw liquid leaking from the rim of the quench gap. The hi-frequency was arcing all over the place. I depressed the key thinking the dampness would disappear. My hands were all tied up . . . between the ugly catwhisker and the damping gap, I was all butterfingers. The ship's prop slowed a bit . . . the call from the *Watson* came in louder than ever. 1 found a good spot on the crystal, so I managed to answer feebly. WAW WAW de WAJ ga K . . . The 600 meter [signal] was loud and clear. After all, he was on his way to Alaska so he was not too far distant. He quoted his name: "Theron Bean, 2nd opr here ... who you?" Of all things, it was my old buddy at the YMCA Portland. He was a Jefferson High student and now officially established wireless operator on the *Watson*. What a joy it was! "This is Hank Poy of Washington High. Headed for Skagway, Alaska." The reason for the "mushy" signal . . . the WAW had a mercury rectifier transmitter aboard. Our direct QSO [radio communication] was a thrill, both of us being out at sea. I was very proud of my accomplishment. I gaped at the black and white "spark" insignia on my shoulder with distinguished pride. The "China-boy operator" slantingly smiled with glee.

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I should have mentioned before that my father's family lived in a KwangTung village [in Western Guangdong, China] and came over on a three-masted schooner from Hong Kong. It took the barkentine three months to cross the Pacific. He knew no words in English, but was armed only in youthful courage and a strong body with willingness to work.

Jue Poy, my beloved father, a Presbyterian layman, was of the ancient order of Toishan's village hierarchy. He was many times addressed as Reverend Poy. He preached very often from the mission pulpit in his "Sze-Yup" [Taishanese] dialect, which was difficult to render as educational to the younger aspirants. Only the elders were his peers.

After a stint working on the Pacific railroads, he became a true Christian through his friendship with the Reverend Mr. and Mrs. W. S. Holt of the Presbytery in Portland. With hope and a great determination, he was made and assigned as head chef of a large boarding hostelry with 8 or 9 Chinese aides. He married my beautiful mother, who was trained in Christian living and a devout member of the mission.

I really don't know how they did it. Father was 55 when I went to Washington High. I was 13 after graduation from Stevens School, and third oldest in a family of seven kids. Father was making $150 per month in 1917, bought himself a seven-room house on a lot 50 x 100. He had no days off. His only transportation from home on the east side of the Willamette River to his job was by no coaster-brake bicycle with wooden rims and solid rubber tires. For night riding, he had to light up a carbide lamp. The streets were rough and unpaved. In the early years before the 1911 revolution in China, he sported a long pigtail with a silken skull cap with a red button. His only English utterance during his teen-age was: "*Hoh-la-mah?* Come-look-see-me," etc. After ten years of mission school, he then escalated to: "How are you, sir, and do come and visit me sometime" with a sparkle in his eyes. Mrs. Murphy, his boss and owner of the boarding house was proud of her chef.

Everything that a 16-year old high school boy wanted or wished he could do, Mother would always nearly agree [to] but at the end, she would say, "Ask your father." I had a Portland paper route on the east side which brought in a measly stipend. It was enough for carfare to and from Cantonese school and a weekly band practice on Stark Street's Chinese Chamber of Commerce building. We had a Chinese student band of 35 pieces called the New Era band. Mr. Herman Lowe, the Chinese immigration interpreter was the owner and manager. He was wonderful and always successful in booking New Era in the yearly Rose Carnival parades. We wore a dressy blue uniform and caps. The boys struck up a rhythmic tune and marched proudly down Broadway under "Stars &Stripes": The first Chinese band of 35 pieces ever to gallantly play before tens of thousands of applauding spectators. We brought great respect to the Chinese people of the city.

I was to receive with honor a diploma from the "Y" radio school and business college. At the end I was able to receive and copy the Continental Morse code on a typewriter at 20 words per minute. I also was accomplished at "touch typing" at 50 w.p.m. This touch typing put me in good standing with Federal Telegraph Company of San Francisco when visual tape telegraphy became standard procedure in 1927. HB/SF is still the office call for [Federal]/ Mackay/ ITT's office on Mission Street. "Fifteen words for the price of ten" was Mackay's gimmick that brought the company to national prominence. West coast officials were A. V. Tuel, Capt. E. H. Dodd, H. L. Rodman, E. V. Baldwin and J. T. Chatterton.

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Hank Poy joined the U.S. Navy after World War One, and served in the Pacific in the Asiatic Fleet. He wrote up, for the Society of Wireless Pioneers (SoWP), much after the events, the story of his involvement in the relief efforts after the Tokyo earthquake of 1923, and later events. Japan in World War One had been a United States ally. About the 1923 Tokyo earthquake, he later summarized:

> Approximately 60 seconds before noon (on Saturday) September 1, 1923, came the greatest shock of a gigantic earthquake which destroyed the densely populated areas of Tokyo, Yokohama, Yokosuka and Odawara. The tremor of great magnitude hardly left a building undamaged. The noonday shock was followed by a long chain of aftershocks and potent seismic waves which destroyed great portions of the city of Katakura. The serious aftershocks caused gigantic conflagrations which broke out in many areas. The underground water pipes were ruined by the tremor [which] made it impossible to check the spread of the conflagration. Many thousands of refugees took to the underground shopping centers, only to lose their lives when the flames swept through from three sides. The combined losses from earthquake and fire were estimated at 140,000 human lives and 100,000 injured and wounded. There were 40,000 people missing. Many could not be identified. The loss in property was from 4 to 5 billion yen.

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Radioman Poy wrote up longer story about his work before and during the earthquake's aftermath, which follows (SoWP LR 2712211807001; Henry Poy Memoirs.) He starts his history with pre-earthquake life in Dairen, Manchuria, China.

(1) Sociable city of Dairen — South Manchuria

The menfolks still sported a long braided queue down their backs while the Manchurian women waddled around in awkward looking shoes. Their feet were bound tight with texturized tape fabric when they were just babies. It had been in vogue for centuries. It was fashionable to be bound, and for those who left their feet unbound were considered from a mediocre class family.

The ships of the U.S. Asiatic fleet were disbanding after weeks of battle maneuvers and target practice. The flagship *Huron,* which I was on, dropped its anchor off the coast of South Manchuria near the seaport of Dairen (*Lu-ta*). The city of Dairen was under Japanese control. In 1923, the sea port was quite a thriving terminal for the Manchurian Transcontinental Railway. The population was over one million, composed mostly of Manchus, Chinese, Koreans, Japanese and Russians. The people were aggressive and dedicated to their civil government. They were proud of their beautiful tree-line streets, their efficient city transportation and its efficient public utilities. There were not many busses in 1923, but the efficiently manned tramways ran down the main business center to the train depot and then circled around to return up town like the cars did on "Market St." in San Francisco.

Shady trees still green with large leaves in late August brought fond memories of the states of Oregon and Washington, the evergreen country of the "great Northwest." I was touring the town, transferring from rickshaws to horse drawn buggies, called Russian "Droshky." They were light and open, four-wheeled carriages. The driver sat high in front with a commanding view. The rear passenger seats were shining white cushioned seats. It brought back sweet memories of our childhood days of 1911-12 in Portland Oregon. The craze in private transportation amongst the more affluent society was four-wheeled buggies with fringes on top.

Sometimes I would get off riding the Droshky and took to 'legging' it in the commercial area. Most of the shops and stores were elegantly displayed with superabundance of merchandise.

It had a touch of modern Japanese "Know-how." They kept the sidewalks and streets very clean, always ready to sweep and wash down each business night. Large signs and posters were advertised in Japanese, Chinese and Pidgin-English. Their English ads brought a little laughter to the foreigner: passing a mediocre massage-salon — "Will rub up and down till you fall to nice dreams"; passing a corner apothecary — "Clap today, gone tomorrow - try the nice herbs"; passing a Geisha tea-parlor — "Have delicious teas and girls for sale."

Notwithstanding the 'fanciful' English — in the famous "Yoshiwara" districts where the Japanese geisha girls reign supreme, there were large elaborate tea pavilions with colorful and attractive entrance halls. The legend says when the Japanese military took over as potentate of South Manchuria, the 'sensuous' Gen. Satoh under his command would tolerate only the [most] graceful of the grace[ful] 'geishas' in his area. No[thing] was too good for his officers and men. Japanese from the most affluent society in Dairen came for a night's entertainment. They were dressed in the finest of garb — silk and satin gowns with large obis [sashes] of colorful designs. Beautiful Japanese women escorted by the affluent business men [were] wearing the native wooden shoes. Like native Japan — the ladles carrying colorful silk ivory fans — gracefully kowtowing deeply to the senior-age folks with the greatest of respect. Their deep-seated traditions and customs kept the foreign society aloof from this sphere of relationship.

The large settlement of "White" Russians remained away in their own exclusive coterie. The tall Russian 'bourgeois' whirling his ivory-carved cane majestically escorting his blond 'russky' girl gracefully alit from a sleek black Russian 'droshky' with two shining black steeds. Uniformed doormen came out from fashionable 'Cossack' lounges to escort the handsome couple to the door. It was twilight and the colorful neon lights were switched on for the evening customers. Inside, the Russian 'combo' was filling the air with tunes from Moskva. Already the majestically set tables in the orchestra area were fully occupied, and the Russian belly dancers had received their cue to enter the arena. The Russian pom-pom drums and girls with their noisy castanets were beating away.

Meanwhile, the gay crowd was busy lifting their right elbows, and tightly clenching and waving their sparkling glass[es] of rich wine and champagne. A form of toasting was at hand. Chinese generally use the term "Kam-bay"; the "Yanks" as we were called, used "bottoms-up"; but why didn't the Russians use their own term of "Ka-watz"? They repeatedly toasted the Skandinavian term of "Skoal"; skoal! These former Russian citizens escaped across the Russian border during the revolution as refugees … to find solace and comfort [in] Manchuria's Harbin, Kalgan, Charhar, Dairen and Chinese seaports to the south.

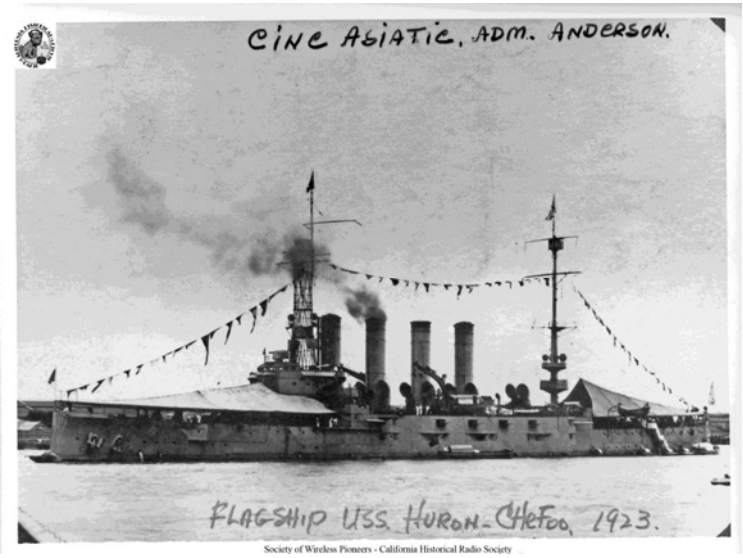
(2) The Earthquake alert of 1923

An alarming news broadcast from Japan was received in the ship's wireless room. On Sept 1, 1923 the USS *Huron*, flagship of the Asiatic fleet was anchored in the harbor off the port city of Dairen, south Manchuria.

The Japanese wireless stations JOS, JOR and JOU were sending out urgent calls to their naval squadrons and their commercial ships at sea to return immediately to Japan or the nearest port to assist in a national emergency. Yokohama and Tokyo and suburban cities and towns [had been] jarred by a major earthquake with entire towns afire and many thousands feared dead was the gist of the disastrous news. The dots and dashes emitted from Tokyo were in the Japanese Kana code. Unfortunately, the USS *Huron's* only radio operator who was an expert in receiving Kana was ashore on liberty. For us who remained aboard,

we were able to detect the immediate urgency of the broadcast when a CQ CQ came through the 600 meter band reporting the heavy damage and fire caused by the earthquake.

These later communiques were transmitted in English from a foreign ship operator who was able to intercept and translate the nature of its emergency in the Morse code. It was also intercepted by radio amateurs on the ham bands. In response to the emergency call, all the ships of all nationalities in the vicinity of Japan changed their course 180 degrees and with all boilers steaming full blast headed towards Yokohama, Tokyo, Kobe, Nagoya and Osaka. The ether in and around Japan was all agog with dots and dashes. Interceptions of flash messages from American President Lines ships and code messages from Canadian Steamship liners indicated they also had received the call for help in a national emergency. They all turned back and headed in a ships' race to help out.



U.S.S. *Huron*, China, 1923; photograph from and annotated by Henry Poy.

It wasn't long that urgent communiques from the U.S. Government and the defense department were broadcast across the high-powered 500 KW transmitters of NSS/ NPG/ NPM/NPO/ NPN in a chain relay to all ships and stations of the Pacific and Asiatic fleet. The American Admiral aboard the USS *Huron* was designated the senior foreign naval officer afloat. He was to proceed full steam to arrive in Yokohama bay as soon as possible with food and provisions of tents and all the medical aid that could be fostered. Seven destroyers of the US Naval 38th division were abruptly interrupted in their maneuvers and target practice to speed at 35 knots to Japan to render all the human aid possible. The Navy's great supply ship the USS *Blackhawk* was ordered to load up at Chafoo, Shantung province with millions of dollars in emergency supplies for immediate dispatch to the flaming cities of Japan.

Here on board the flagship *Huron*, the news was flashed to everyone aboard to prepare all hands to unfailingly support this great mission of mercy, and to make great sacrifices of food, blankets and provisions necessary to sustain human life. We loaded up with bituminous coal in the big holds to overflowing even unto the compartments of our sleeping quarters into the hammock bins. Canned goods and frozen meats were stored to the fullest capacity. Straw mats and reed baskets were a part of the supplies.

In Dairen, our shore patrol was heavily augmented by additional men carrying bull horns up and down the area announcing the recall of all navy men to return to their ships immediately. Their shore liberty was abruptly terminated. It didn't take very long to muster them. The call for aid was being answered. We all were dedicated to this great mission of mercy. The ship's crew of 75 men in the engine room, usually called the "Black gang" consisted of the chief engineer and his assistants: such as enginemen, machinist-mates, firemen stokers who fed coal to the hot burners. To keep 18 boilers steamed up at full blast required an additional 25 stokers. The order from the chief of staff was to keep the 18,000 ton armored-cruiser running at top speed of 20 knots. A call for volunteers from all branches of the ship's crew was issued through the loud speaker system. The shifts would be on a basis of 4 hrs on and 4 hours off until arrival in Yokohama bay. A great response came from those who were off duty hours [who] volunteered. Men from the wireless gang; hospital apprentices, strikers for yeoman and storekeepers; seamen and coxswains from the deck gang; all answered the call for needed coal shovelers and fire-stokers. It was a dirty and dusty job below decks. The temperature in the boiler room was 102-107 degrees Fahrenheit. Non-firemen not acclimated to the intense heat would pass out from exhaustion. However, we all volunteered to help stoke the fires and man the shovels in the engine room. We all prayed for strength and endurance.

(3) Batten-down the hatches — anchors aweigh

With all hands present and accounted for, the famous USS *Huron*, a four-stacker of World-War-I vintage with all 18 boilers at full blast and the high-powered (30 KW) radio arc transmitter pounding at high speed, finally aweighed anchors. Never in the history of the ship's legend had its engine power ever reached its top peak as on this mission of mercy to a beleaguered nation. As we pulled out of the Yellow Sea port — the ship's compass duly read 40 degrees a hard west into a heavy wind and churning sea. Reports received by radio and weather stations read gale warnings over 40 knots from a south-westerly direction

— and possibly reaching typhoon intensity in 24 hours. Came the blast from the ships loudspeaker: "Prepare for the worst! Tighten all hatches, secure all ports, roll up all tarps fore-n-aft, and shore-up all the coal on the decks." We were in for a rough voyage, the ships turbines [relentlessly] driving thousands of horsepower on to the propellers. A heavily loaded armored-cruiser with 4 smoke stacks with steel-netted conning towers and 8 armored parapets of 8 inch guns would have been able to ride through the storm. The "EYE" of the Typhoon was located at a point 150 miles S.S.E. off the coast of southern Honshu Islands, traveling at a slow speed westerly at 15 MPH. Storms of this nature were known to suddenly change course. We were ready for the wors[t].

There were no coffee-breaks or rest periods. Those found loafing were immediately asked to shuttle black coal across the deck to coal apertures and shoots to the hot engine room. The storm was blowing the loose coal dust — and soon the entire ship was blackened. The white-skinned sailors took on a dark pigmented color. The white hammocks usually stowed in their respective lofts were layered with coal dust.

Never did the *Huron* (which [had been] called the *South Dakota*) ever emit such a trail of dark black smoke from its four stacks. Every so often, the engine room was given the order to use their blowers, which would cause the smokestacks to emit the black soot that was accumulated in the exhaust system. It was the size of snowflakes only turned dark, and [it would] float in the atmosphere and stick to your skin, like a spotted leopard.

It wasn't but a few hours at sea, the medics carrying portable oxygen equipment and bottles of ammonia, [who] were followed by a corps of stretcher bearers. They ventured into the hot engine room to resuscitate the victims of heat-stroke. The redhot furnace was opened for a periodic stoking, and with the furnace door wide open — the heat from the red burning coals shot out as from a gun turret, knocking out the stokers at hourly intervals.

On time off from radio watches, I volunteered to shovel coal from our compartment-blackened sections to coal shoots below. It was hard enough for us who were not inured to hard work. We sweated during the sultry weather under cloudy skies. The loss of salt from our bodies often caused exhaustion, which tended to make one vomit and suffer dizzy spells. We were given [a] teaspoonful of salt in fresh water from the scuttlebutt. Those who suffered seriously were made to lie down with the head low and clothing loosened. What a relief it was for the overheated stoker to emerge into the fresh cool air! Instant resuscitation!

Way across the ocean to San Francisco, our busy staff of wireless operators was rapidly burning up the air with their dot-dash method of sending news to both Navy and commercial communication companies, namely, Mackay Radio station KFS. The SF Navy station was NPG. Like the ship's engine room, the carbon arc chamber of the high power wireless transmitter was running continuously hot. It was seldom shut down during this emergency, and then only shortly for a period of long distance reception.

The insulation of the very high frequency coils was a thin coat of rubber. Just before the operator ignited the arc chamber with pink alcohol, he would always check to see if the big antenna switches were thrown to the right and also check to see if there were any of the ship's mascots, Pago, the southsea Monkey or the 3 year old cat, Pinky were snoozing on the warm insulated coils, which were just inside of a large port-hole. Over anxiousness to get the emergency dispatches to the States, the operator forgot to look and check — The high power switches were thrown to the right and the alcohol was added to the chamber to create the high arc voltages and the high frequencies, when a big animal-sounding whoosh — the only sight noticeable was a frightened hairy monkey leaping through the open porthole into the stormy sea. The first tragedy of our errand of mercy.

(4) Fire on the Radio Antenna — Sept. 3, 1923

On September 3rd, the heavy seas became violent — churned up a strong typhoon traveling northward from the southeast tip of beleaguered Japan. Tokyo and Yokohama were being wracked up by a severe earthquake of over 7.0 on the Richter scale.

The sleek-looking armored cruiser *Huron*, the flagship of the senior naval officer of the Asiatic fleet, was truly exhibiting its seaworthiness and stamina far beyond the call of duty. Against a formidable storm, the mighty cruiser rose to the occasion. The powerful engines having released every important cubic foot of steam power into each and every piston, [this] caused the undaunted cruiser to shudder and *shimmy* at the powerful onslaught of towering waves. Manufacturer's maximum speed capacity on smooth seas was 22 knots, but today, the *Huron* broke its own record by bravely maintaining a speed of 25 knots in a swollen sea. The ship writhed and tossed; sometimes it dove like a jack-rabbit into a high crest which brought the towering seas over the wing of the bridge deck. From abaft, simultaneously the ship's stern would lift high above the waterline, causing the gigantic power relayed to the propellers to spin freely above water. It emulated the 4-stacked destroyers of the 4th division in high seas. But their tonnage was minimal (1800 tons) compared to the *Huron's* 20,000 gross tonnage.

The typhoon-bred antics of the *Huron* shook and tossed the wooden yard-arms and the fragile cage-like antennas. Thirty kilowatts of high frequency current was being transmitted into the ship's antenna each time the wireless operator depressed the

Morse-like hand key. Urgent communications had to be established with both land and sea stations in this, a humane call in time of national disaster.

Looking up at a loosened guy wire which broke from the wooden yard-arm, I saw gigantic high voltage sparks grounding to a metal guy, which would have been fatal if touched by human hands. Each lurch and pounding of the ship brought on a flash of electric charges leaping across the live cage antenna the loosened guy 100 ft above deck. A moment before I was able to reach the ships radio center, the wooden arm was on fire. The ships power antenna could very well unloosen itself from the insulated fastenings to the spar and the ships towering mast.

Having wended my way through the ship's passageways, it seemed like it took an hour before I reached radio center. The wireless operator on duty was Mac, the oldest sailor (in time served in the Asiatics) of the radio gang. He was *pounding* the brass both energetically and very professionally, trying to reach the west coast of the USA. I found him squatted on a swivel chair with both of his long legs crossed under his buttocks. It did not deter his efforts to exercise his proficiency as a radio operator. With tight cushioned ear phones strapped to his head and confined to a narrow receiving booth, he failed to hear my warning.

"The radio yard-arm's on fire!" He kept pounding away. I ran quickly to the arc room to pull the main switch to the transmitter where the relays were activated. The powerful motor generators ceased to operate and the arc chamber deactivated and the alcohol valve turned off. Mac mustered up the entire radio gang. He was aware of what happened after he had been deprived of key control. "All hands report to the boat deck, the radio yard-arm is afire," he bellowed to his aides. Yes, it was now a roaring fire, 100 ft up on the mast. The fat bo'suns mate ran to the iron cleats and began lowering the flaming mast pieces to the deck below. "Is the radio antenna deactivated? I don't want to risk myself on a high-voltage wire, ya' know," the mate called out. "Yeah, I decommissioned the radio room, lower it away," I replied and gestured. The gale was blowing a storm near 60 miles an hour. I had to admire 'ole Mac', who had the situation well under control. He ordered his strikers to fetch an emergency antenna from the store room. It was to be a tremendous task to have to replace a high antenna during a whirling gale and violent swells, which washed over the bridge deck. The hustling work crew bared their bodies down to their 'skivvies.' They were reluctantly getting a briny sea bath.

Commander-in-Chief of the Asiatic fleet, Admiral Anderson, was temporarily deprived of communication facilities, and the *Huron* was weathering a typhoon at sea. Blow me down, I thought wildly. What would all the contacting ships and naval stations on land think? All of a sudden they lost all radio contact with the Admiral and his flagship. They could dream up any unforeseen incident that might befall the USS *Huron* in storm areas. Down below at radio center, with all the powerful receiving speakers turned on, I could hear numerous stations calling us: "A6W, A6W, are you ZAN ZAN, what, seems to be wrong?" We already had been out of radio control for 60 minutes. We just couldn't answer. ["ZAN" means "no signals"].

(5) FOR WHOM THE BELL TOLLS

The good ship USS *Huron* arrived in Tokyo bay after a technical delay of ten hours or more. Rumors had it that the Koreans who had been reluctant subordinates to the Japanese rulers were fomenting riots and enhancing the conflagration. In the Tokyo - Yokohama area, there lived over 100,000 Koreans and 44,000 Chinese. The prevailing rumors caused the central authorities to enact martial law and hold all foreign and alien personnel for investigation. Many innocent people fell under the popular fury caused by the unverified reports. The U.S. Navy was a bit flabbergasted by the continued reluctance of the port authorities to permit American vessels to enter Tokyo bay for aiding in rescue operations.[1] The *Huron* had amply loaded at Chefoo large supplies of meats and food provisions for the needy refugees. The *Stewart*, a 4-stacker destroyer, was dispatched at top speed to Yokohama to report conditions in advance, only to be denied entrance to Tokyo bay. The USS *Borie* was quickly dispatched to Nagasaki to pick up medical supplies for the thousands of wounded. The USS *Rizal*, another 4-stacker, was kept on the alert at Dairen, and acted as an important radio relay communication ship for C-in-C Asiatic. The gigantic US Navy supply ship USS *Blackhawk* was quickly dispatched to the port of Tsingtao for immediate supplies. The remaining destroyers of the 38th division, accompanied by the commander of destroyer squadrons Asiatic (COMDESRONS), were also dispatched to aid the needy Yokohama city. Destroyer divisions forty three and forty five were in ChinWangtao under preparations for an immediate emergency call.

After the entrance delay, the *Huron* proceeded to anchor a few thousand yards off from the breakwater that disappeared under the surface during the first and subsequent shocks. We arrived to experience a long chain of after-shocks. It caused mini-tidal actions in the bay. Many of those structures on the hill-side of Yokohama that were weakened structurally by the original shocks, finally came tumbling down and crashed on to the rocky coastline. It was quite visible from the decks of the anchored ships. Then came across the P.A. system the Admiral's directives: "Hear Ye, all those aboard having two woolen blankets, prepare to donate one for humanitarian need ashore. Also to tighten your belts. All fresh meats and

vegetables are to be distributed to the needy to prevent starvation. You will subsist on canned and frozen foods until further notice." Obviously, there were no dissidents. For several weeks diet, it was 'beef skin and cream,' and 'pork and beans' with black coffee.

A select volunteer group was chosen to lead a [Chaplin's] search party ashore. The report was [that] the modern facilities of the U.S. Naval hospital on the hillside had burnt to the ground.

It was indeed an unpleasant task. The stench from burning bodies penetrated the whole area. With the aid of some of the fortunate survivors of the hospital, we were lucky to have been able to identify some charred bodies by identifying rings, watches and personal jewelry. The charred corpses were officially tagged.

Then came the kerosene gang to finish off the open-door cremation. The remaining ashes [were] stored in lead boxes which were labelled and sent back to the States over both American and Canadian liners.

Our search patrol was equipped with white face masks. Death, besides its sting, carried a penetrating stench of burnt and unburnt corpses of over 140,000 victims. I crossed a burnt-out bridge and from a steel strut was suspended a partial burnt out body of a female. She was just barely hanging by the support of a few strands of her hair. To the left or the right, no matter which direction one turned, was the sad plight of thousands of refugees begging for food or medical attention. Death to some was the easy way out.

Hospital; photograph from and annotated by Henry Poy.

Volunteer search party; photograph from and annotated by Henry Poy.

(6) SEARCH AND RESCUE MISSION — SEPT 1923

The outside world had realized the magnitude of the catastrophe and wholeheartedly gave instant response and sympathy to a stunned Japan. The ship's personnel besides donating their fresh provisions had already surrendered half of their woolen blankets. The U.S. Asiatic fleet formally presented $5 million dollars in supplies, while the American Red Cross made a similar contribution, besides quantities of medical supplies. The foreign ships in the Japanese harbors offered their kind services by taking care of refugees and supplying first aid to many sufferers. The great sympathy manifested by the United States in this hour of suffering and the superb service rendered by the American Ambassador Cyrus Woods, are the wonderful memories that no Japanese would [be] likely to ever forget. Even to this very day, discounting the man-made tragedy of the atomic disaster at Hiroshima, it's seemingly unbelievable that in so brief a space of time without warning that a densely populated city of Japan could be swept out of existence in 60 seconds.

We were informed while on a search and rescue mission that day of after-shocks, [that] multitudes of refugees had [sought] temporary haven under the roof of a gigantic cement warehouse, when there was an instant tremor causing the building to collapse killing thousands of people.

The cities in the area had hardly cooled off before reconstruction plans were already instigated by the Mayor of Tokyo. The Reconstruction board hired an American, Dr. Chas. Beard, formerly a New York City municipal researcher to make a general survey of the city. Private persons were also anxious to rebuild their homes and businesses as speedily as possible. It wasn't long

that the banks had weathered the financial crisis after nine months, and the progress was near phenomenal. Schools and parks, homes and businesses began rapidly to emerge from the ashes of Sept. 1st, 1923.

American ships, both commercial and U.S. shipping board vessels, plus an armada of warships from the U.S. Asiatic fleet had gracefully remained until they themselves were suffering near depletion of fuel oil and supplies. The huge Japanese harbor hosted the greatest number of vessels of all flags at any one time. It was a symbol of international hope and sympathy for a devastated nation. The multitudes of ships of various sizes and nationalities were so closely anchored that one could almost traverse the length of the bay by foot from ship to ship. One glorious scene still imbedded in the deep inner sanctum of my memory was the greatest display of electrical brilliance when the thousands of magnificent ships switched on their warm and friendly lights to illuminate the grandest floating city of "HOPE." It was a symbol and expression of deep heart-felt sympathy to a sister nation from the other nations on the globe.

The *Huron*, a great ship of mercy, was weighing its mud-clogged anchor in the cool of the evening. She saved many lives and gracefully fed many mouths. The ones on the beach stood silently with tearful eyes and thankful hearts. The survivors of stout heart will remain to rebuild a greater metropolis of the future.

The *Huron's* stalwarts stood emotionally at 'attention' as the graceful cruiser turned 180 degrees. They departed with heavy-hearts and deep condolence for [the Japanese's lost] loved ones. As the ship smoothly faced the high Yokohama hills towards the bay entrance, and the door to the open seas, there was pervading the silence at an auspicious time — the music of "Auld lang syne." Oh! What a beautiful evening, with the NIPPON sun setting in the western hills as a "SAYONARA" to my shipmates of the *Huron.* The "ORIENTAL SUN" will be rising brighter for NIPPON, in the rosier days ahead.

The Commander-in-Chief Admiral Anderson was proudly acclaimed for the heroic services rendered by the American Navy. The *Huron* had other errands to complete. The ship was way behind schedule. Much had to be done to get caught up. The ship's crew was ready to clean and scrub the dirty ship. Decks needed 'holy-stoning' and the guns and armor needed polishing.

As the ship picked up speed through the mouth of the bay, we passed numbers of harbor revetments [protective walls] and military redans [angled walls], which seem to have been constructed as underwater fortifications.

The *Huron* on smooth seas, charted a course to the "Pearl of the Orient," Shanghai China. I was originally assigned to a radio receiving center for Naval Radio Shanghai. For these many years, I've never found out, was this playful shipmate ribbing me — He said to me while eyeing floaters in the bay: "Dead women float up, dead men float down."

[Dated] *U.S.S. Huron, 1923* [Signed] *Henry J. Poy, Radioman*

(7) Poy addendum — from a letter to the Society of Wireless Pioneers in the 1970s

I arrived in Chefoo in July 1923, stationed on the CinC's [Commander-in-Chief] flagship USS *Huron*, which took me on a rescue mission to earthquake-shaken Tokyo Bay.

We all forfeited several weeks' pay, a blanket each, surrendered our fresh foods and vegetables, living in austerity to help the ravaged Japanese. Admiral Anderson was senior officer afloat for the foreign fleets and donated large funds from the U.S. flotilla present.

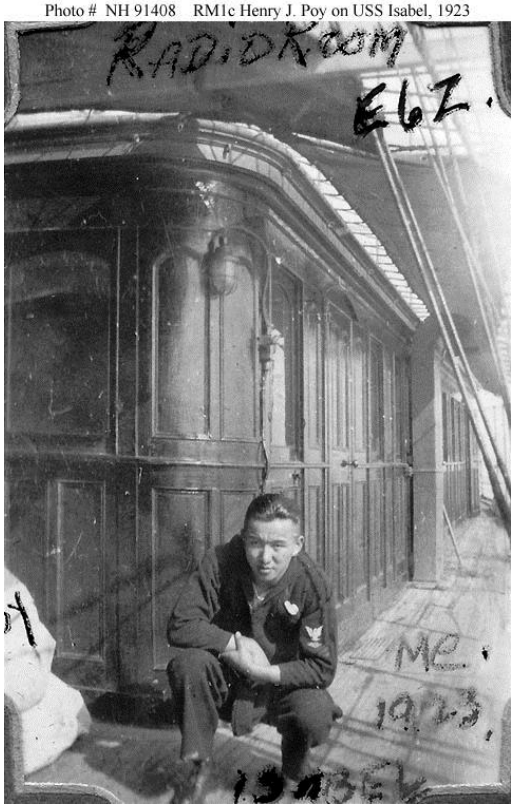
Then I was transferred to ComYangPat [Command Yangtze Patrol; Shanghai, callsign] E6Z, in the USS *Isabel.*

Rumors of large scale warfare between the powerful warlords brought *Isabel* upriver to protect Americans. I was on various landing parties. We seized illegal shipments on fast junks flying the American flag.

I spent several months in Hankow, some of it on shore patrol and trying to improve my Mandarin lingo.

When there was a vacancy in USS *Asheville,* temporary SOPATCOM [Navy South China Patrol Command] in South China, I requested a transfer by paying my own way — down the Yangtze on Jardine's [SS] *Suiwo* to Shanghai, where I located so many Chinese-American friends.

Photo # NH 91408 RM1c Henry J. Poy on USS Isabel, 1923



Poy wrote on this photograph: Radio Room E6Z Me 1923 Isabel. [2]

A US patrol boat on the Pearl River (Canton); Photograph annotated by Henry Poy – note the range of the ½ KW wireless aboard: 100 miles radius [3]

While waiting for a President liner for Canton, I frivolously danced away the contents of my money belt. Evening games of *mah jong*, and performing the light fantastic at the Astor and Cathay hotels. Nothing but to search the Yangtzepoo docks for a China tramp.

The [SS] *Kwong Li* was a dirty coaster, slow boat to south China, carrying live sheep on the open deck and anthracite coal aft. My double occupancy roommate was a rich silk merchant in his sixties who constantly smoked the opium pipe. With the little steamer bouncing up and down and the odor of the opium, I was swooning away in the gray smoke, though kindly alerted by my roommate for a VIP meal of broiled salt fish and pork with steamed rice, which he consumed like a starving horse.

I ventured out on deck when the old coaster almost flipped in a monsoon off Foochow, and saw the last of the livestock swept into the sea. At last, coming up the Pearl River, I was spotted by *Asheville's* deck watch with my bag and hammock, a U.S. bluejacket, well overdue. And the rest of my cruise was spent in South China.

Acknowledgements

Thanks to John Dilks, K2TQN for digitizing onto a CD scans of some of Henry Poy's story as it appeared in the SoWP *Sparks Journal*, and Thanks to CHRS Deputy Archivist Bob Rydzewski for pulling together and scanning the available SoWP files, and thanks to Judy Mears for internet research for photographs and sources.

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1) Masashi Kuratani, *Disaster Relief Operations by the Imperial Japanese Navy and the US Navy in the 1923 Great Kanto Earthquake*: Focusing on the activities of the on-site commanders of the Imperial Japanese Navy and the US Navy (JMSDF Staff College Review Volume 1 Number 2 English Version (Selected)).
https://www.mod.go.jp/msdf/navcol/SSG/review/1-2/eng_1-2-4.pdf

2) Re USS *Isabel*: U.S. Naval Historical Center Photograph. Photo #: NH 91408 Radioman First Class Henry J. Poy, USN Outside the after deckhouse on USS Isabel (PY-10) in 1923. The original print was marked by the donor with ship's radio call letters. Note the fancy woodwork on this deckhouse, which was installed aft of Isabel's mainmast during the 1920s. Collection of Henry J. Poy.
https://www.ibiblio.org/hyperwar/OnlineLibrary/photos/sh-usn/usnsh-i/py10-o.htm

3) USS *Pampanga*: Naval History and Heritage Command Title: USS PAMPANGA (PG-39) off Shameen Island, Canton, China, in 1924. Caption: USS PAMPANGA (PG-39) off Shameen Island, Pearl River, Canton, China, in 1924. Collection of Henry J. Poy. Writing on original image, including radio call sign "NQT", is by Mr. Poy, a radioman with the Asiatic fleet in the mid-1920's. Catalog #: NH 100057 Original Creator: Collection of Henry J. Poy Original Medium: BW Photo, Original image.
https://www.history.navy.mil/our-collections/photography/numerical-list-ofimages/nhhc-series/nh-series/NH-100000/NH-100057.htm

Editor

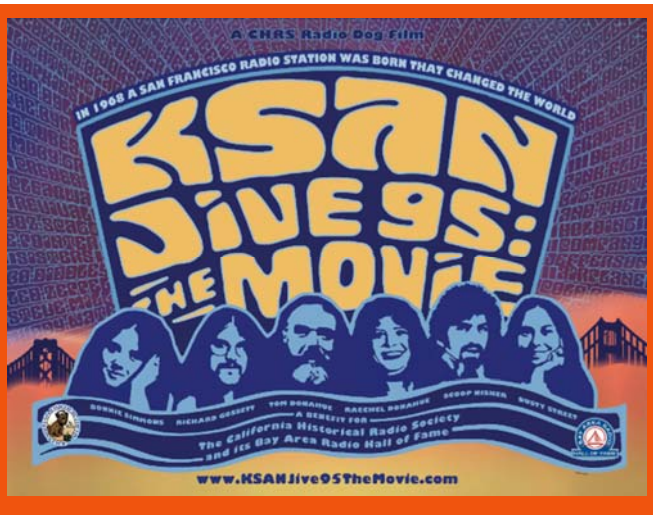
Bart Lee, K6VK, is the CHRS Archivist and a Fellow of the California Historical Radio Society in History. ◊

KSAN Jive 95: The Movie

Our CHRS Radio Dog Production, **"KSAN Jive 95: The Movie"** continues in production. But making a feature length documentary is costly. We are seeking to raise $150,000 to produce this film. The KSAN Jive 95 story is perfect for CHRS to tell and immortalize in film as it is an important part of our mission to preserve and present local radio history. KSAN, during the period 1968-1980, was pivotal in the development of our popular culture. This film will raise awareness and refresh remembrances of a time when a radio station could create change and really make a difference in so many ways.

Part of our recent grant from the Rex Foundation was earmarked toward the KSAN Movie project. We commissioned famous poster artist Wes Wilson for a movie poster. Wes and his daughter Shirryl Bayless collaborated to create this outstanding poster.

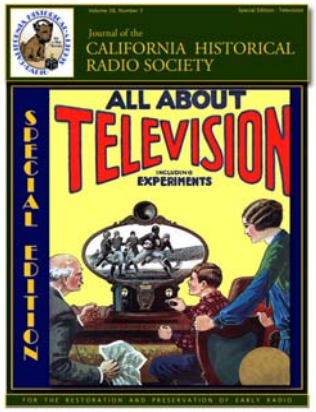
Now it's your turn to help. Please visit www.ksanjive95themovie.com and see how you can get great perks for donating to this project and help to preserve the KSAN Jive 95 legacy.



CHRS Publications

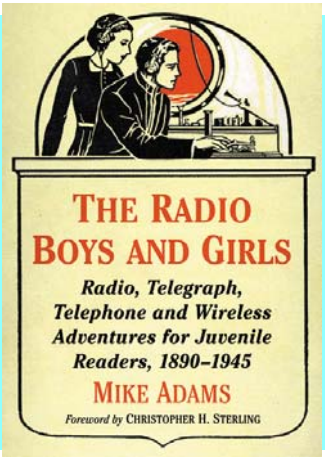
CHRS Journal Special Edition — Television a compilation of original articles on television, including articles by Malcolm Baird on his famous father, British television pioneer-inventor, John Logie Baird, Don Godfrey's historical bios on CF Jenkins and Philo Farnsworth, plus restoration and technical articles from John Staples and others.

Available at Amazon.com



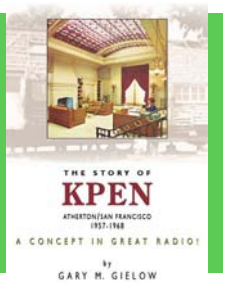
The Radio Boys And Girls—Radio, Telegraph, Telephone and Wireless Adventures for Juvenile Readers 1890-1945 covers more than 50 volumes of wireless and radio themed fiction, offering a unique perspective on the world presented to young readers of the day. The values, attitudes, culture and technology of a century ago are discussed.

Available at Amazon.com



The Story of KPEN: A Concept in Great Radio! CHRS member and Broadcast Legend Gary Gielow has written a new book chronicling the tales of two young men from Stanford, he and James Gabbert, who brought Stereo and new ideas to the FM radio band in the late 1950s and 1960s. This book is the definitive history of KPEN 101.3 FM, the 2015 BARHOF Legendary Station. 100% of the proceeds benefit CHRS.

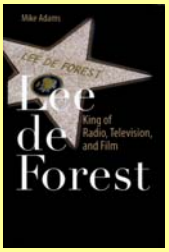
Available in the Museum Store or on the website.



Behind the Front Panel: The Design and Development of 1920's Radio by David Rutland has been remastered by Richard Watts for CHRS. With emphasis on radio technology, Rutland describes the development of 1920s tubes and radio circuitry designs by De Forest, Marconi, and other inventors and manufacturers. A classic!

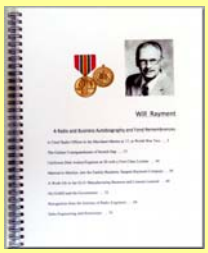
Buy at Amazon.com

Also available in the museum store



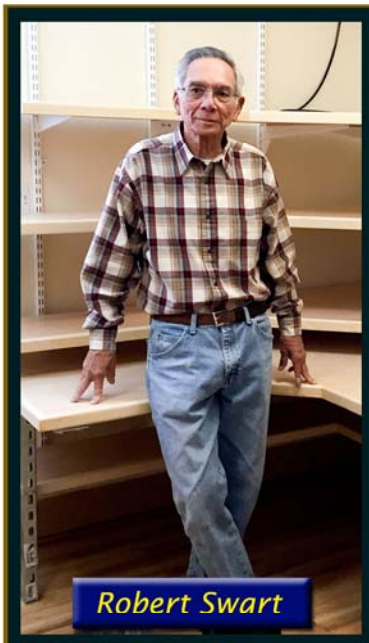
Lee de Forest

Bay Area Radio



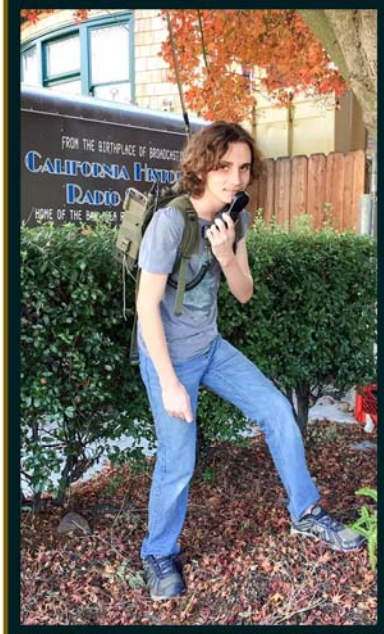
Will Rayment

KSAN Live Jive CD



Robert Swart

We are CHRS



Holiday Festivities