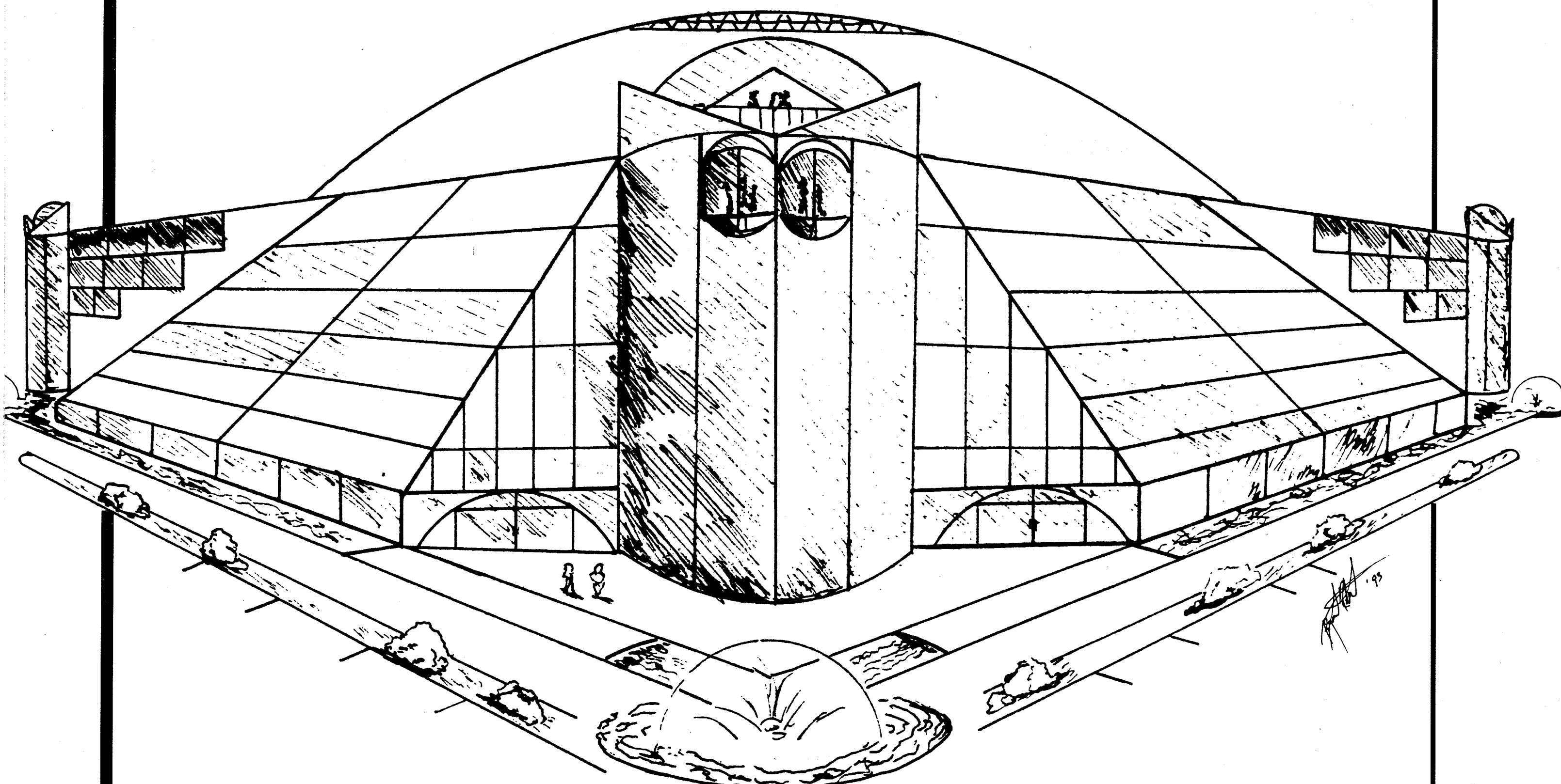
PROCEEDINGS OF

THE RADIO CLUB OF AMERICA, INC.

Founded 1909, New York, U.S.A.

May 1994



TeleDOME

***In This Issue*:**

Think of it as a mobile "workstation" that delivers everything on the menu.

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All the essentials you need to get the most from your system. Excellent Tx/Rx specs in lowband, VHF, UHF and 800 MHz models. 22 or 99 channels. Up to 110 Watts. 10 Watt external audio. TOT. BCLO. 41 tone and 83 digital squelch codes. Fast 40 channels/second priority scan.

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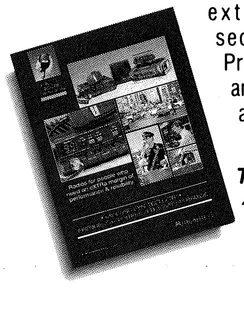

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Proceedings of The Radio Club of America Volume 68, Number 1 May 1994

CONTENTS

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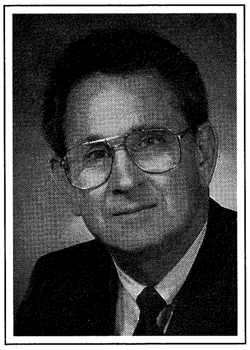


President's Message

By Mal Gurian

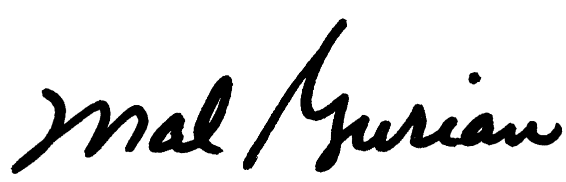
It was 1969 when I first became a member of the Radio Club of America. I am just as much impressed today as I was then with the caliber of different personalities the Club has attracted and invited as members. Scientists, inventors, engineers, physicists, plus a variety of other professional and business people, all with a common goal to share good fellowship through the aims of the Club's constitution. Today, almost 1,200 members reside and work in different geographic areas of the United States and other countries. The achievements earned by some of our members have and will continue to make history. Early technical triumphs such as the "regenerative circuit," Armstrong's "feed-back circuit," the "Hudson coated filament," "neutrodyne," "superheterodyne," "FM broadcasting" and "Eltz's square-law condensor" are just a few of the developments that became reality through the genius of some past Radio Club of America members.

Eighty-five years of recognized standing has allowed the free interchange of ideas among our membership and indeed has proven to be rewarding.

It is a privilege to be associated with this fine organization that is rooted deeply in wireless history dating to the year 1909. Past members Major Edwin H. Armstrong, William Finch, Louis Alan Hazeltine and Allen B. Dumont — just to name a few — never will be forgotten. Our Club always will be grateful for their great contributions to mankind.

Promoting radio scholarship funds to worthy students through our Grants-In-Aid Committee, growing a Legacy Fund and honoring industry pioneers and those who have contributed to the art and science of radio and electronics are the continued challenges of the Radio Club of America.

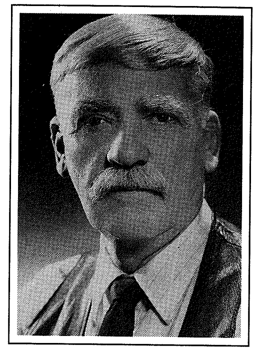
I am honored and proud to serve as your 34th president. Like the presidents before me who are still extremely active in this great organization — Frank Shepard, Jerry Minter, Frank Gunther, Fred Link and Stuart Meyer. I pledge to be as dedicated, and hopefully as accomplished, as these fine men continue to be.



Mal Gurian, Radio Club President

TeleDOME: The Television Studio That Really, Shoulda, Oughta Be Built

By Don Erickson
Illustrations by Bryant Robert



It has 200 cameras. It has 200 lights. It has 100 microphones. It's a floating dome. It "writes" television literature. What is it?

It's TeleDOME, the first real television studio that is designed for a total audio and video production facility. All of its hardware is instantly available for use. The design allows television productions to cut their "set-up" and "strike" time by fifty % or more.

The domed ceiling, the walls and even the floor allows for cameras, microphones, lights, sets and property pieces to be ready for use almost instantly, and 90 % of all cables and wires are not in the way cluttering up space and creating placement problems for crew and equipment.

If you are an inventor-engineer, a design engineer or what I call a "creative engineer," perhaps after reading this you might let me know if this is a studio that can be technically created to do all the things you are about to encounter. This is my ideal television production house; whether it can also be a reality I'm not quite sure.

To my knowledge (limited, incomplete and subjective), there has never been such a concept. Though the equipment of the audio-video industry has come a long way since the 1950s, the facilities housing this equipment usually remains the same—primarily a rectangular room/space. And, in almost all cases I've seen in the past four decades, one wall of this traditional TV studio has been "lost" to store cameras, cables, props, outlets and sometimes a window into a control room.

This studio is so novel, it might be considered a piece of hardware itself. (And the design even may be patentable.)

Let me briefly describe how this studio design came into being. The studio is the result of four decades of working in commercial television studios, college educational studíos, private production-house studios, renovated movie houses-into-studios, renovated radio studios, large warehouses and assorted high-ceiling rooms.

After I left commercial television, I began to teach all kinds of mass media courses (42 in all!), especially TV production. I knew there had to be a better way to make the actual production of a show or commercial, a news or entertainment piece easier and more visually effective and to allow for far more camera and microphone options for the writers, producers, directors, crew and performers.

What I always wanted was an all-seeing, all-hearing video environment. When the Japanese brought out their small format 1/2-inch tape equipment in the early 1970s, I realized I could now have everything — all in TeleDOME.

I eventually held all the production job titles that early television demanded: camera, crew, director, producer, audio, telecine, set design, lighting and production director.

This experience was invaluable in teaching TV, and I discovered that my methods, the projects I assigned and even my criteria for grading were significantly different from my teaching colleagues who either did not ever work in a "live" production setting or who taught production with only their own college studio experience to rely on.

I once had to create a philosophy of teaching for an employment oppor-

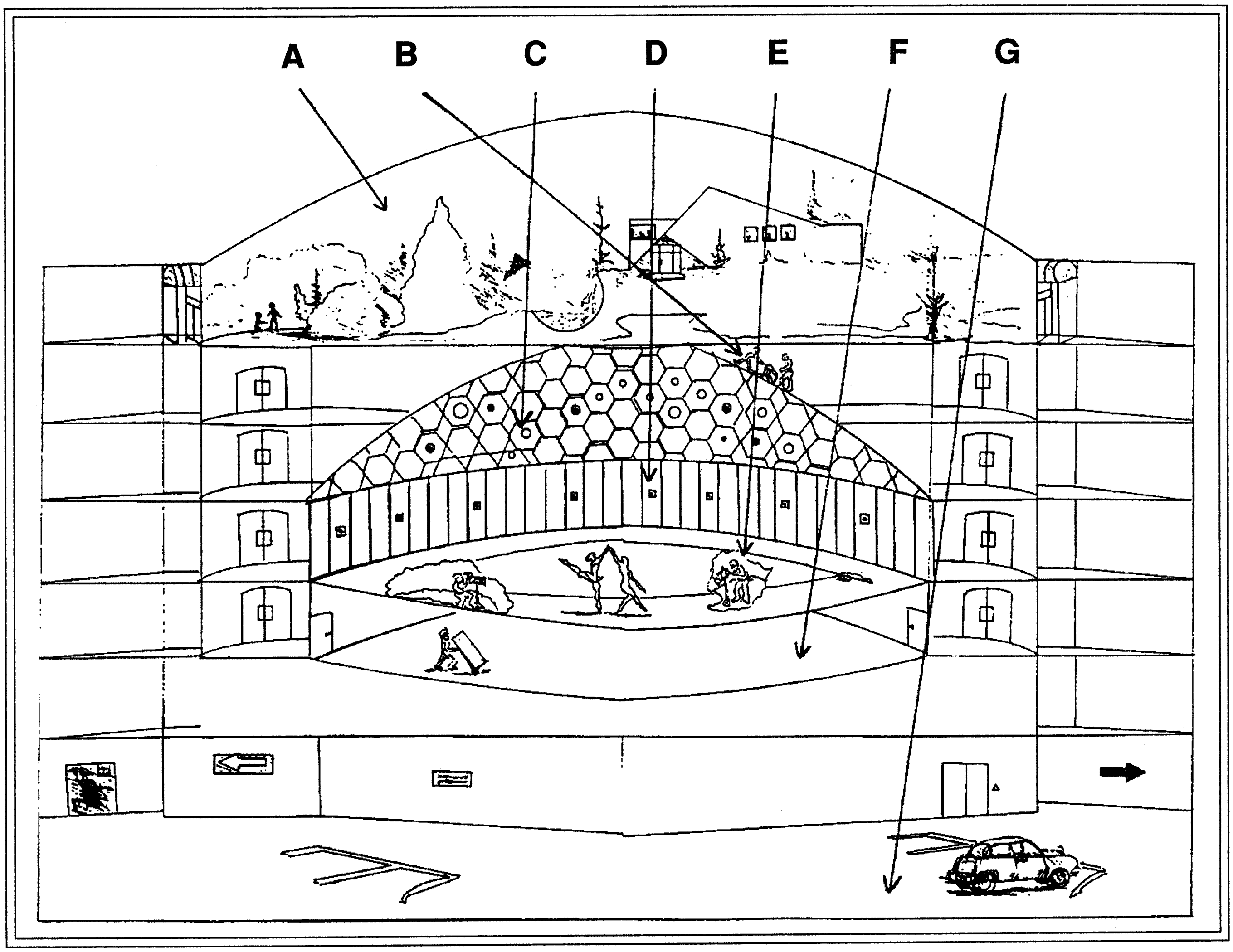


Figure 1. Cutaway view of TeleDOME shows, from top to bottom, (A) atrium domed greenhouse that includes a swimming pond, waterfall, small stream, picnic areas, and video productions may also be shot in this natural setting; (B) the domed studio is seen with workers servicing equipment from outside the dome where there are several service levels; (C) ceiling of dome contains receptacles housing cameras, microphones, lights; (D) circular walls have hidden cameras in them every 5° around the entire studio; (E) on the studio floor two cameras and their operators are camouflaged as set pieces; (F) basement under studio can be used for throughout-the-floor video shots and will contain equipment for one or more revolving stages; (G) sub-basement is a parking garage.

tunity ... and it had to do with teaching television production. Thus, I was forced to think about "my approach," which turned out to be an attempt to show the student how to *visualize* content.

Most educational studios, then, had two or three cameras (seldom state-of-the-art ... *there's* an understatement), and the curriculum always favored or demanded the teaching of formats (news shows, variety shows, drama, etc.). No time or projects usually involved learning the *medium* of sending pictures and sound.

To make matters worse, the time restrictions of a class (anywhere from the usual 50-minute "hour" to maybe three hours) created unrealistic deadlines for a class to set the studio up, rehearse, tape and clean up (strike).

What I always wanted was an all-seeing, all-hearing video environment. When the Japanese brought out their small format 1/2-inch tape equipment in the early 1970s, I realized I could now have everything—all in TeleDOME. (See Figure 1.)

TeleDOME is like a television womb, so to speak, with its myriad cable "placentas" hidden and attached to outside levels where engineers and technicians can install, repair, replace and service most equipment with an ease never before attainable. The main studio (there is a smaller, conventional studio attached to this domed one) is a dome that "floats" within a larger building, and the ceiling, walls and floors are all accessible from the outside.

The lucite-like walls in the dome (more of an umbrella shape) go straight up for 12 to 16 feet. The apex is 25 to 30 feet high. The reason for the straight wall section is based on the current aspect ratio of the

TV screen—3x4 (that is, 3 units high and four units wide).

When a camera points at long shots of performers in sets, you need to be able to prevent "shooting off set", so most camera people and set designers know that you must be able to have their sets in the same ratio, 9 feet high and 12 feet wide, for example.

The "ceiling" of the dome has many evenly-spaced recesses to house cameras, lights, microphones. There may also be rods or wires that extend down into the studio so that normal theatrical "flats" can be set up to create traditional indoor scenes with walls. As will be noted later, much of the content in this kind of studio will be shot "in the round."

The floor is made of the same translucent material as the walls and ceiling. It is possible to light this studio from conventional lights in it or from outside the dome; that is, lighting that is placed inside the larger building housing the dome can be aimed directly onto the walls, floor or ceiling.

A 360° rainbow could, for example, encircle the entire studio while a single dancer could be shot with any or all of the several hundred cameras (and equally several hundred angles).

Because the dome is built on a platform within the larger building, it makes installation, servicing and repair of this large amount of equipment relatively simple. Servicing levels or floors are anywhere from six to eight feet high and are outside the dome, encircling it. There is also access for servicing underneath the dome.

The larger building also contains offices, make-up rooms, showers, storage, construction and sleeping quarters for performing guests from out of town. Plus a lot more that includes editing rooms, control rooms and even an underground garage for employees. (See Figure 1.)

The prototype dome should have a floor diameter of about 75 feet. I've designed four similar studios with significant differences. If built, this array of domed studios from coast to coast could easily broadcast "live" from six to 12 hours a day. The significance of "live" broadcasting will be made clear throughout the remainder of this article.

Outside of the dome are three to six directing booths or control rooms. These booths allow a live broadcast or a taping to be simultaneously directed by two, three, four, five or six directors. Why? It has to do with one of the business aspects of this studio—to create a market for the growing number of people who like "cult" movies and "director cuts" (movies that the director re-edits the way he wanted).

This studio lends itself to creating different versions of the same performance. The Company (owning the studio) has a competitive edge by being able to rebroadcast a performance and guarantee that it will always be "different" in some way (mostly visual, but also aural differences and special effects differences). TeleDOME encourages "style" in video.

Because music video is so pervasive today, it may be the best example of what TeleDOME could provide for a new kind of visual music package—and have no serious competition (unless a competitor builds a TeleDOME). TeleDOME offers something like this: A music video (popular, folk, classical, rock, western—you name it) gives the performer(s) a chance to do a "live," one-take performance.

This method retains any of the possible benefits of a live performance (with all the joys and risks that such performance entails). Special effects can be generated during the performance. It is the essence of much of TeleDOME's broadcasts (live or taped) to capture the feel and look of live theatre while incorporating all the optical, electronic and mechanical effects into the performance. This also saves thousands of dollars in post-production time and wages.

Here is just *one* special effect (SFX) that, itself, has myriad ways of being used.

Built into the walls are hidden cameras spaced every five degrees of a 360° circle. These cameras are mounted on tracks that boom or pedestal up or down from almost floor level to six feet.

The cameras are concealed in such a way as to be able to "shoot" directly across the floor (at a 180° angle) and still not be seen in each others' viewfinder (there-fore not seen on the home screen). (See Figure 2, next page.)

A lone dancer in the middle of the circular floor can be "shot":

(a) simultaneously by all 72 cameras. What will it look like? No one will know until the studio is built and put into service!

(b) with cameras 1, 3, 5, 7, 9, etc., while superimposing over this cameras 2, 4, 6, 8, etc.

(c) with cameras 1, 3, 5, 7, 9, etc. at 1/4-second intervals all around the 360° arc of the studio.

(d) with cameras 1, 3, 5, 7, 9, etc., going clockwise, while superimposing over this image views from cameras 2, 4, 6, 8, etc., going counter-clockwise. There are more variations to this effect than possible to document. And these variations are not even shot with the main cameras! (See Figure 2.)

Floor cameras (with camera people manning them) used during performances (in-the-round) will be camouflaged as set pieces so they, too, can shoot into each others' field of vision and still not be recognizable. This article could not begin to describe the virtual limitless video variations possible ... indeed, until it is built, even those variations probably could not be tallied.

Just as a music fan may buy one or two versions of a symphony to get different conductors or orchestras, just as one can buy a short version and an extended version of a popular song or disco, just as you can now get several versions of a movie (original, colorized, director's cut and an uncensored version), so TeleDOME makes it easy and desirable to create multiversions of the same performance for original broadcast, re-released versions, taped-for-cable, rebroadcast for different markets, etc.

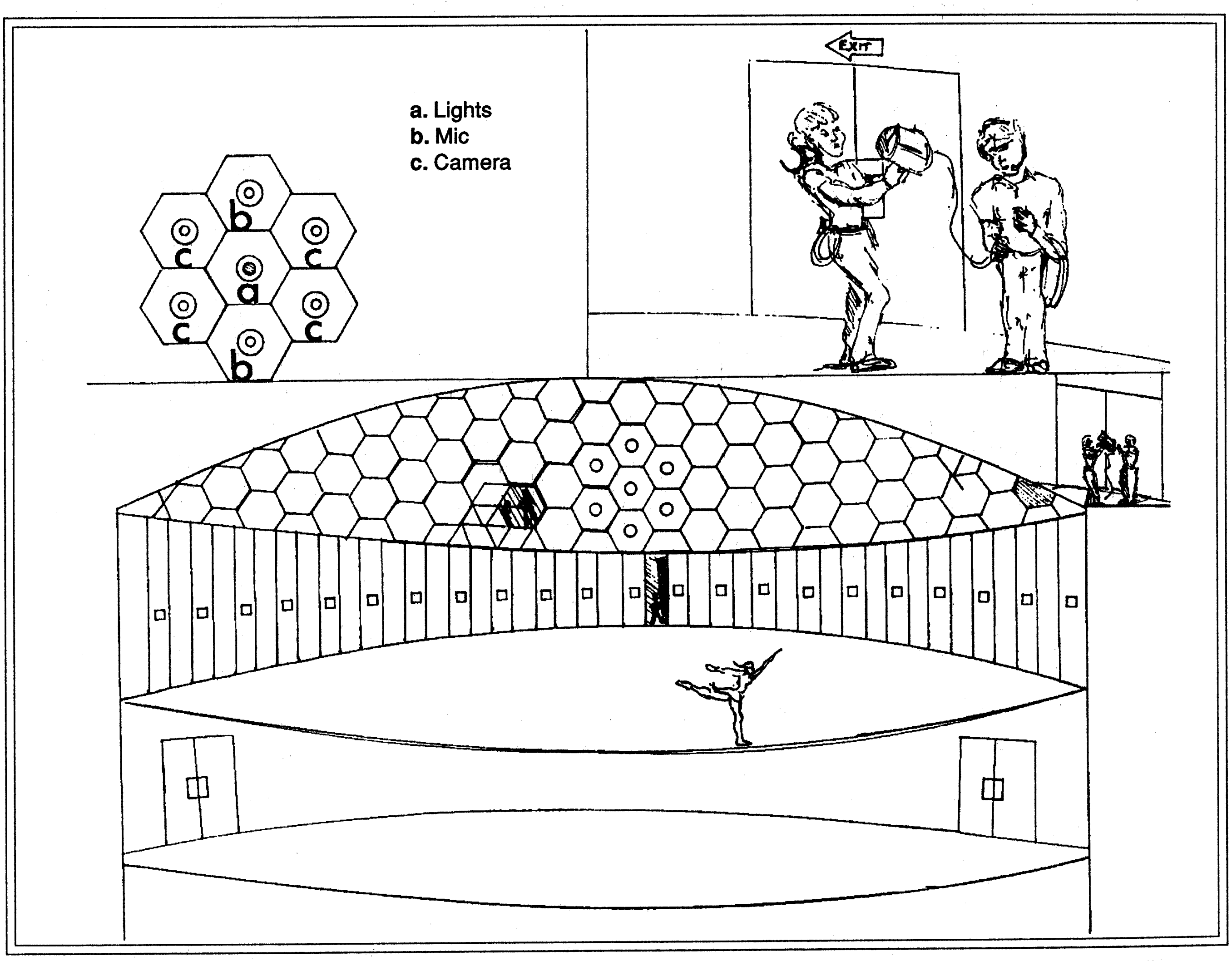
The commercial value of anything produced in this studio is more than significant since anything it "visualizes" will (most of the time) have its own "look."

What it amounts to is simply a new way to package the same old eight plots and everything else the human condition offers; dramas, performing arts, new and documentaries.

In fact, one of the new genres of content I see available with this studio (and with the help of worldwide electronic field production and satellites) is the all-live documentary. Such a documentary is possible and desirable because the studio portions and remote portions can all be broadcast "live" *and* uncensorable.

This type of production means that the documentarian need not compromise his/her message with dilution or other views. In "regular" FCC-regulated broadcasting there is still the Fairness Doctrine.

However, it should be noted that *never* did the FCC ask for both sides (or however many sides) to be included in the *same* program. "Fairness" meant that particular issue was balanced out over a full year of broadcasting.



▲ *Figure 2. Top left is a ceiling configuration with cameras, microphones and lights housed for instant use. Ceiling and walls contain about 200 cameras, 50 or more directional and non-directional microphones and scores of quartz lights (spots and broads). Top right is a blow-up of technicians replacing a lighting housing on one of the service levels allowing equipment work to be done outside the dome rather than on ladders from studio floor. Circular walls show hidden camera opening spaced every 5°. These cameras can also be boomed (moved) up and down on a track from almost-floor level to about eye level. 180° shots of performers can be used without seeing the opposite camera. Under studio is a level for special through-the-floor shots and/or housing equipment for one or two revolving stages and under this level is a parking garage for employees, performers and special guests.*

TeleDOME as school and apprenticeship

Some of the content of this studio may require 60 cameras, another, 17, and another, 135. The producer/writer/director can and will determine what they need by learning to use what is available. It's for sure that during the beginning period of production much of the content will be High Tech Electronic Wallpaper! The "plot" will no doubt be drowned out by over-using everything.

To train people for this studio, there is a school-internship program associated with The Company. Commercial television has never seen fit to train its personnel, relying more on union politics, nepotism, favoritism, dubious college and vocational degrees and certificates and the whims and prejudices of distant personnel departments that never have to *work* with the people they hire!

Not so with TeleDOME.

It is intended that only the finest and most committed people will become its students and perhaps future employees. The training program will last from six to twelve months.

Graduates will have learned the *medium* of television, the visualization of *any* content. If not employed by The Company (TeleDOME), they should be in such demand that none will go unemployed—as with graduates of The Harvard Business School ... or is it School of Business?

I'd like to think of this as in the same mold as the Medieval Guilds (but without their faults).

I've stressed the visual elements, but equal emphasis is given to audio (with as many as 200 in-place and remotely-operated microphones), to lighting, to set design, to drama, to comedy, to dance, to journalism, to computer art and animation. TeleDOME will be a complete production and marketing facility as in the mold of the old Hollywood empires—a sort of MGM of Television.

The cost of such a studio is well within today's building and equipment costs. For "live" broadcasts, cable broadcasts, tapes for VCRs, laser disc reproduction and for recording in 3x4 aspect ratio, 16x9 aspect ratio, HDTV (high definition television) stereo and discrete quadraphonic, TeleDOME can broadcast and record all this and have a storehouse of video to sell, rent and lease to national and international markets.

Because no one (in person or in writing) has convinced me that today's videotape is anywhere near a "permanent" record (what with time and air eating away at oxides and base), most master recordings will be duped to laser disc (no doubt digitally mastered). Much of what this studio turns out can be sold or syndicated to regular TV, cable TV or worldwide TV after its initial broadcast.

What I need to know from one of you readers is how much of my description of the technical demands of this studio can actually be done. Can 100 cameras be "on air" at one time? Can 20 microphones be hooked up in such a way that an actor walking across the floor for 75 feet triggers each mic automatically by voice frequency?

So a director doesn't have to look at dozens of monitors at once, can a system be developed so he can easily use multiple cameras? Can ceiling-installed cameras, lights, mics, etc., be on some sort of *quiet* "drops" or pulleys or pantographs? Can a computer be used to pre-program the use of multiple cameras, mics, lights, etc.?

If my words and the illustrations make sense, I'd love to hear from you about the feasibility of "manufacturing" this studio. I need one of those practical-theoretical-dreamer inventor-engineers who invent-as-they-go when the need arises. I suppose I'm deeply affected by the likes of Edwin Howard Armstrong, who, were he alive today, I'd try to get to *do* it! I'm an Armstrong fan, and may even call it The Armstrong TeleDOME.

Other examples, and how to make $195 million a year

Here's just one way TeleDOME cuts down on rehearsal time and manages to catch the extra impact of "liveness" from the performers.

Each actor in a play, for example, has assigned to him/her three cameras (manned by people). These camerapersons are instructed to keep a usable (on-air) shot of the actor (a cover shot, a medium shot and a close-up shot) 100 % of the time. Other cameras (remotely operated) also cover the action from a variety of angles. Each "main-character" camera is hooked up to its own separate videotape recorder. The entire action of all the main characters thus is recorded for future editing and re-editing.

If, then, there are seven characters, that means there are 21 basic cameras shooting the action and 21 VCRs recording that action. Other cameras also hooked up to VCRs record 2-shots (two people in same frame), 3-shots, reaction shots and cover shots. The camera people know how to keep their assigned actor framed and composed in their viewfinder *constantly* so that the director can "take" that camera at any time.

Yes, this is easy to do as I've done it with my own students. Dress rehearsals are always taped in case the action is exactly what the director wants.

A live broadcast of this play will be easy to do with a minimum of rehearsal time. Any future taped rebroadcasts can be enhanced by editing into that particular master tape any unusually good shots that have been saved on the multiple VCRs.

TeleDOME is a perfect partner for "live" satellite

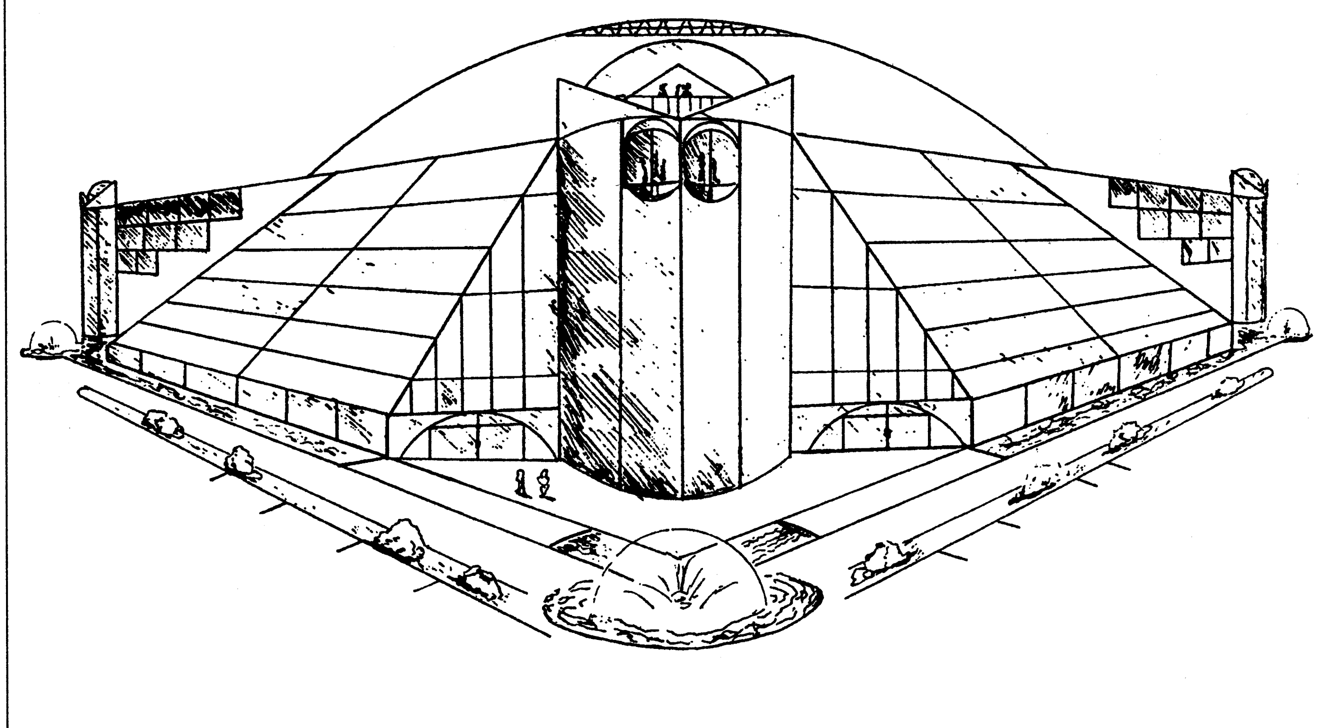


Figure 3. *TeleDOME is a complete television production facility whose major, unusual feature is a circular, domed studio "floating" inside the main building. To carry out this concept, a second atrium dome is seen on the roof. This visible dome houses a complete greenhouse with plants and trees from both temperate and sub-tropical climates. The four corner towers house passenger and freight elevators and fire escape stairs. The outside, slanted glass walls turn dark in bright sunlight. Fountains at all four corners are part of the air conditioning system.*

broadcasting. I believe satellite dish owners would gladly pay up to $25 per month for a broadcast service that gave them from six to 12 hours of guaranteed all-live broadcasting. If three such TeleDOMEs were built (East Coast, Midwest and West Coast), you could have a live network that switched from one studio to another for continuous broadcasts. Obviously *any* studio *anywhere* can be part of this live broadcast network.

Three such studios could take advantage of the truly staggering amount of talent available in the U.S., talent represented by people who still do not have access to the outlets of commercial TV, cable TV and other forms of taped entertainment. Such a network would bring back (permanently) The Golden Days of Television.

Even though the 1950s and '60s had a lot of filmed shows (*I Love Lucy* is on film, and I believe *Honeymooners* is on kinescope), those "Golden" moments are significantly "live." Television, as a medium, is *only* unique when it is live. All other edited TV is similar to film in that it is *not* live, but pre-recorded.

An "all-live" *cable* channel (in addition to the satellite distribution to dish owners), with no advertising (a so-called Premium Channel) would also be a lucrative market for the output of one or more TeleDOMEs. Cable TV service is expected to penetrate 65% of U.S. households by 1995. (It reaches 63 million at present.)

Consider this (sorry about the cliche!):

If you charged a cable subscriber only $5 a month and gave the local cable company half ($2.50)—an unheard of offering—and you kept the other $2.50, with only 10% of all U.S. cable subscribers taking TeleDOME's service, that would bring $195 million annually in revenue. (10 % of 65 million households is 6.5 million households that pay $2.50 a month for twelve months.) If 50% of the households took the service, the annual revenue would total almost $1 billion a year ($975,000,000)!

This article has discussed two lucrative markets for the video output of TeleDOME; a premium cable channel and a premium direct-satellite channel. In each case annual revenues are based on capturing a conservative 10% of each market and based on current subscribers and owners.

A third market is to make customized tapes for The Business Market (bars, discos, hotels, motels, resorts). Again, if only 10% of those owning VCR's and

TV monitors for use with their customers use the service, the annual revenue is about $20 million.

A fourth market is customized tapes for the home VCR market ... a potential market of about 70 million U.S. homes! Getting 10% of this market to spend only $100 per year generates almost 3/4 of a billion dollars a year.

Another source of income is the re-selling (syndication) of all original telecasting to both domestic and international outlets that wish to broadcast these as reruns. There's much more to the marketing aspects and if you'd like to know more contact me at the address at the end of the article. All markets combined (using the 10% market penetration) come to just over one billion dollars. This is not a prospectus offering ... I just want those interested in the practical side of such an undertaking as TeleDOME to realize its vast financial rewards!

Well, that's the end of the main part of this article. The remaining space is filled with some information about myself and my illustrator. I feel you ought to have some more information so you can have some faith that I do know what I'm talking about.

After all, I'm a relative "nobody" ... known only to a handful of television personnel plus several thousand students. This part will surely be boring, so most of you can skip to end where I give an address to write to if you care to respond to my technical questions. I'd love to hear from any of you who share my enthusiasm for production and "live" TV.

I am in awe of those inventors and engineers who have given us the incredible hardware of this age. I'd love to be in the company of such people and watch this studio being built. (Skip to end.)

My father, Harry H. Erickson, worked for Frigidaire, Stewart-Warner, Admiral and RCA (Cherry Hill).

When I was a boy in the 1940s in Chicago, dad brought home a prototype television set from Stewart-Warner. The set had its tube in a cabinet that was pointed UP at the ceiling and a mirror mounted under the lid. One watched TV by opening the lid to a 45° angle, and the mirror reflected the picture to the viewer.

What did we watch? For hours? An Indian Head test pattern, Krazy Kat cartoons and "professional" wrestling (which was just as phoney then as now—only in black-and-white sans costumes).

My first job out of college in the 1950s was as an assistant sports editor in an El Paso, Texas, TV station. Then I went to Florida and Georgia to work as TV cameraperson, floor crew and production manager of all-live broadcasting (7:30 a.m. to 2 a.m.!).

I wrote more than 600 one-minute "live" commercials during this period—produced them, directed them and often announced them.

After videotape was invented and slowly installed in local stations (1957-1960), the TV executives of America were delighted that they could cut down on crews and technicians that were needed for the (often) 18-hour day of live production. Commercials and shows could now be taped in a convenient 8-hour period, and even late-night newscasts were sometimes simply repeats of the 6 o'clock news. The fun and excitement of so much live TV ended.

So I left to take a Ph.D. in Communications at the Urbana campus of the University of Illinois. That led to teaching mass communications, media and TV production courses for the next 25 years.

I've been a Chairperson, Dean, won a Best Teacher Award at Brooklyn College and ended my teaching career at The College of the Bahamas (Nassau). I left teaching in 1991 and now am starting a career of writing and consulting—and hopefully getting TeleDOME built in my lifetime.

My illustrator, Bryant Robert, is a young man in his twenties that I have known since he was 10 years old. He has a Bachelor's degree in Fine Arts (graphic design major) from the University of Nebraska at Lincoln. He's spent some years in Europe and now lives with his wife in Denver.

I asked him to do the black-and-white illustration for this article and the color slide transparencies used at the TeleDOME presentation at the November, 1993 Technical Symposium.

I also asked him to design the architectural concept to house the dome and primary building. It was his idea to include the rooftop atrium dome. This larger outside dome carries out the basic idea of the hidden interior dome visually, and the atrium dome is a year-round greenhouse used for "outdoor" TV sequences. It has an employee recreational area, a public restaurant and picnic area, a pool, a waterfall and a lens iris at top that opens for natural air conditioning. (See Figure 3.)

The four corner towers are both decorative and practical, two of them containing a freight elevator and a passenger elevator. As a designer, Mr. Robert has the ability to listen to an idea and transfer it to a visual concept that is just what his client wanted—with enhancements.

I'd love to hear from any member(s) of RCA who understands what I'm trying to achieve with TeleDOME. Do you see it as a feasible and viable undertaking—that is, the electrical and electronic aspects? I *know* the marketing aspects are sound!

After my TeleDOME presentation at the November Symposium, several audience members made some very encouraging comments to me. One such member, Tony Sabino (President of Regional Communication, Paramus, NJ) gave me a possible answer to the problem of a director trying to use several hundred cameras at the same time. Mr. Sabino's solution was to have a director wear a kind of headset that allowed him/her to look at a large (perhaps 3x4 feet) monitor that shows the studio dome in quadrants ... and by using a type of virtual reality set of goggles/headset, the director "sees" that portion of the studio where he/she want to "take" a camera ... pushes a button and wherever the director is looking, it triggers a camera within the area he wants. A computer (hooked up to cameras and headset and button) triggers the camera where the director's eyes are focused on.

The computer will then automatically display that camera/angle/perspective on a preview monitor, or "take" the shot "on the air". Mr. Sabino did not stop there! He also suggested this studio be the first to broadcast Virtual Reality programming. He envisioned both a studio audience and a home audience using Virtual Reality glasses/headsets/buttons.

"Buy a Virtual Reality Headset and be your own director — allows your imagination and curiosity to be totally random, rather than be directed by someone else." That was penned by him on a note to me. And it makes great marketing sense. Home viewers (if this IS technically possible) will be able to control camera angles — and perhaps even content. Studio audiences, wearing such equipment, could also control camera angles ("you'll never have a bad seat in the house!"). My thanks to Mr. Sabino. The first cable/satellite channel to provide a Virtual Reality concept to their audience ought to reap a fortune.

To close, here is a *selected* list from the 42 courses I've taught that emphasize just the Television aspects of my experience:

- Four courses in TV production (basic, advanced, innovative, live).
- TV Production (graduate level).
- Color Problems in TV Production (graduate level).
- Broadcasting & Society (graduate seminar).
- Broadcast Rhetoric: How The Screen Persuades (graduate).
- Alternate TV (small format TV for business, personal, medical).
- Writing for Radio & Television.
- Television Criticism (reviewing, criticizing, ethics, aesthetics).
- Broadcast Advertising.
- Sight, Sound & Motion (storyboards, slides, video/audio).
- TV Program Planning.
- Colloquium in Broadcast Problems.
- Electronic News Gathering (ENG), basic.
- Electronic News Gathering (advanced with live cable news show).
- Intensive Videotape Workshop (3/4" U-matic and VHS).
- TV Studio Production For Corporate Television.
- ENG Techniques and Editing.
- TV Station Operation.
- TV Performance.

The remaining courses taught are in advertising, public relations, oral communications, business and corporate communications (small group, interpersonal, letters and technical report writing), print and broadcast journalism, communication theory and psychology, and introductory courses in mass media.

Those are my credentials. If you'd care to respond, write me at 110 Bank St., Apt. 3F, New York, NY 10014.

I have far more material on the marketing and technical aspects of TeleDOME that simply could not fit into an article of this nature. Major Armstrong fans will remember just how much his Alpine, NJ, FM station (W2XMN) set high standards for FM broadcasting.

This, from his biographer Lawrence Lessing:

"The historical significance of Station W2XMN has never been widely realized. Armstrong lavished on it all the care and attention to detail of which he was prodigiously capable. With this station, the first full-scale one of its kind, many basic contributions were made to ultrashort wave communications ... In the development of power tubes and other vacuum tubes to operate at these frequencies, Armstrong acted as a goad ... bombarded ... manufacturers with observations, criticism, and suggestion that gradually drew forth adequate tubes." (From *Man of High Fidelity: Edwin Howard Armstrong* by J.B. Lippincott, New York.)

In the same way, I'd like the creation of TeleDOME to force the creation of a production facility that sets the standards for sight and sound, color and detail in every extant broadcast format (through-the-air, tape, disc; 3x4, 16x9, mono/stereo/quad, HDTV). And when the production people create the programming with this ultimate video "writing" tool, the results, I predict, will be called a "body of visual literature." Even content that may be glossy, even soap-opera-trashy, will be called "video literature," albeit dubious!

The Living Legacy

By John E. Dettra Jr.

The Radio Club of America honors persons who have distinguished themselves in the field of radio at the annual banquet in New York and publishes the *Proceedings of the Radio Club of America* to record the history of radio and to give credit to those who have contributed to the advancement of radio and its associated technologies. Another function of the Club is to provide financial aid to deserving students of telecommunications or electronics at various colleges and universities which is administered through the Grants-In-Aid (GiA) Committee.

The Grants-In-Aid Fund has grown over the years by private donations and bequeaths of our members. At this time nearly $14,000 is divided each year among 13 schools. The grants are made with the request that the money be applied to the tuition of a specific student and that the recipient acknowledge the grant. Most of the grants are made at public school functions where a local member of Club can make the presentation. The responses are very gratifying, as in many situations, the grant makes the difference whether the student can continue on with their education or not. Some donations have been large enough to endow a specific grant to a school of their choice. The endowments that are part of the Fund now are in the names of Poppele, Finch, Grebe, Meyerson and Biggs. The GiA Committee makes sure the Fund continues to grow and that the grants are well within the interest received from the Fund. The Fund is only used for tuition assistance and occasionally an award to a student for specific research paper.

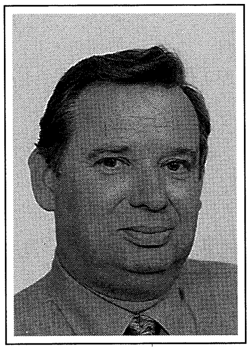
At the present time, the GiA Committee is making grants to students enrolled at the University of Cincinnati, Southern Methodist University, Capitol College, Polytechnic University, Armstrong Memorial Research Foundation of Columbia University, Georgia Institute of Technology, Stevens Institute of Technology and the Virginia Polytechnic Institution. In addition, the GiA Committee makes a grant to The Foundation for Amateur Radio from which three scholarship awards are made in the name of the Radio Club of America to students at various colleges. A special award is made to the Radio Club of Junior High School 22 N.Y.C., which has a very successful, unique program using amateur radio in teaching English and communications skills. As the Fund increases, other colleges are being considered.

The Grants-In-Aid Fund has grown over the years by private donations and bequeaths of our members.

The GiA Committee consists of Directors Ken Miller and John Dettra, with ex officio members including the treasurer and president. Donations are tax-deductible and should be sent to the treasurer. Inquiries are most welcome and should be sent to either committee member.

The Radio Club of America, founded in 1909, has distinguished itself for recognizing the technical contributions of individuals and recording its history. It is known as well for the preservation of its heritage by financially supporting young students studying to carry on the advancement of radio communications.

John E. Dettra Jr. (F) is a director of the Radio Club of America. His amateur radio station call sign is WB4NBF.



Differences Between Tube-based and Solid-state-based Receiver Systems and Their Evaluation Using CAD

By Dr. Ulrich L. Rohde (F), KA2WEU/DJ2LR/HB9AWE

This paper is a summary and excerpt of a presentation of "Overview of State of the Art of Modeling the Dynamic Range of VHF, Microwave and Millimeter Receiver Systems Using Computer-Aided Design" given at the VHF Conference, Sept. 19-20, 1992, at Weinheim, Germany.

The purpose is to show the advantages that modern solid-state design has compared to tube design, including some of the weaknesses more inherent in the design than the technology. A good example is that, even 30 years ago, one was able to build better mixers than usually were used, as seen in some rare examples of receivers.

It has been shown that the weakest point in past designs has been the understanding of how to design good mixers.

The rapid advances in the development of semiconductor devices have allowed us to develop transistors that work well into the millimeter wave area. Looking back to 1960, when tubes such as the 6CW4 and 417A were the dominant devices for building VHF and UHF receivers, the improvement of noise figure and sensitivity has been dramatic.

Many people have wondered whether the actual dynamic range, which is the ratio of the maximum input level (close to the 1dB compression point) to the noise floor, really has been improved. In addition, in the "old days," it was necessary to build all circuits prior to being able to evaluate them.

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Today's technologies allow us to do feasibility studies. Because preamplifiers and mixers are part of the chain of the system that largely affects the overall performance, the following modeling capabilities are mandatory:

1. Modeling of noise figure of low-noise amplifiers.
2. Modeling the 3rd-order intercept point of amplifiers.
3. Modeling the insertion gain/loss of mixers, including noise figure.
4. Predicting the phase noise of an oscillator.

I have decided, for historical reasons, even to revisit vacuum tubes to have the same point of reference as to the simulation of the noise figure.

Tables 1A, 1B, and 1C are sets of equations for tubes, bipolar transistors, and FETs to calculate the necessary noise parameters.

Modeling of noise

Figure 1 (on page 14) shows the equivalent noise circuit of a two-port device.

The set of equations for this linear system is device independent, but the actual coefficients in the equation reflect the device parameters. During the last few years, these noise equations have been expressed in z-parameters, y-parameters and, today, s-parameters, for which today's modern measuring equipment uses 50 ohms as a reference using precise terminations.

Initially, as in 1960, z-parameters were used, but at higher frequencies there are no "open" circuits because of stray capacitance. From 1965-1970, the so-called y-parameters were considered, which required a short circuit at the output.

At high frequencies, short circuits do

A. **Tube Parameters**

$$R_n = \frac{3.2}{S} \quad [1]$$

$$R_e(Y_{cor}) = \sqrt{R_e(Y_{11})^2 + 2p \cdot \omega^2 Cg{*}k} \quad [2]$$

$$I_m(Y_{cor}) = \frac{2_p \cdot f_0 \cdot C_g{*}k}{10} \quad [3]$$

$$F_{min} = 1 + 2\sqrt{2} \cdot p \cdot R_n \cdot f_0 \cdot Cg{*}k \quad [4]$$

$Cg * k = \Delta C_{gk}$ from cut-off to bias for normal operation.

Table 1A.

not exist. Modem transmission lines in microstrip technology with precision 50-ohm terminations allow s-parameters to work at frequencies as high as 100 GHz. A detailed mathematical derivation of this can be found in *Microwave Circuit Design Using Linear and Nonlinear Techniques*.[1]

Modern CAD programs, such as SuperCompact/ Microwave Harmonica, take measured values of F_{min}, G_{opt} and R_n at one frequency, such as 10 GHz, and then by using a de-embedding technique, allow accurate noise prediction over a wider frequency range. This prediction is done by solving a set of linear equations and expanding the frequency range from a few hundred megahertz to an upper cutoff frequency determined by the validity of the equivalent circuits of the device.

Typical values for R, P and C are:

R = 0.1 1
P = 0.2 3
C = 0.0 1

In many instances, you can assume C to be 0, R to

B. **Bipolar Parameters**

$$F_{min} = \alpha \frac{R_B + R_{OPT}}{R_e} + \left(1 + f\frac{f^2}{f_b^2}\right)\frac{1}{\alpha_0} \quad [5]$$

The optimum source resistance is

$$R_{OPT} = \left\{ R_B{}^2 - X^2{}_{OPT} + \left(1 + f\frac{f^2}{f_b^2}\right)\frac{R_e(2R_B + R_e)}{\alpha_0 \alpha} \right\}^{1/2} \quad [6]$$

and optimum source reactance is

$$X_{OPT} = \left(1 + f\frac{f^2}{f_b^2}\right)\frac{2\pi f C_{Te} R_e^2}{\alpha_0 \alpha}$$

where

$$\alpha = \left\{ \left(1 + f\frac{f^2}{f_b^2}\right)\left(1 + f\frac{f^2}{f_e^2}\right) - \alpha_0 \right\}\frac{1}{\alpha_0} \quad [7]$$

$$R_n = R_b\left(A - \frac{1}{\beta_0}\right) + \frac{R_e}{2}\left[A + \left(\frac{R_b}{R_e}\right)^2\left[1 - \alpha_0 + \left(\frac{f}{f_b}\right)^2 + \left(\frac{1}{\beta_0} - \left(\frac{f}{f_b}\right)\left(\frac{f}{f_e}\right)\right)^2\right]\right] \quad [8]$$

where

$$A = \frac{1 + \left(\frac{f}{f_b}\right)^2}{\alpha_0^2}$$

$R_e \approx 26mv/I_e$

I_e = emitter DC current

provides a convenient set of equations for representing the low-frequency noise performance of a bipolar transistor. Unlike Fukui's formula, the new expression does not involve the unity current gain frequency f_T; and f_b denotes the "cutoff" frequency of the common base current gain α\f.

Table 1B.

C. GaAs FETS

$$F_{min} = 1 + 2\left(A\sqrt{A^2 + A + B}\right) \quad [9]$$

$$R_n = R_g + R_s + \frac{R}{g_m} + \frac{P}{g_m}\left[1 + (\omega C_{gs} R_T)^2\right] \quad [10]$$

$$R_{S,OPT} = \frac{1}{\omega C_{gs}} \sqrt{\frac{g_m(R_S + R_g) + R(1 - C^2)}{P} + (\omega C R_T)^2} \quad [11]$$

$$X_{S,OPT} = \frac{1}{\omega C_{gs}}\left(1 + \sqrt{\frac{R}{P}}\right) \quad [12]$$

where

$$R_T = R_g + R_S + R_i \quad [13]$$

and

$$A = \left(\frac{\omega C_{gs}}{g_m}\right)^2 R_T P g_m \quad [14]$$

$$B = \left(\frac{\omega C_{gs}}{g_m}\right)^2 \left[PR(1 - C^2) - P g_m R_i\right] \quad [15]$$

The R, P and C values are device parameters for noise modeling.

Table 1C.

be 0.1 and P proportional to I_d/I_{dss}^2.

The actual calculation of the noise figure is done by using F_{min}, G_{opt} and R_n.

The noise factor can now be determined:

$$F = 1 + \frac{G_u}{G_g} + \frac{R_n}{G_g}\left[(G_G + G_{cor})^2 + (B_G + B_{cor})^2\right] \quad [16]$$

$$F = 1 + \frac{R_u}{R_g} + \frac{G_n}{R_g}\left[(R_G + R_{cor})^2 + (X_G + X_{cor})^2\right] \quad [17]$$

The noise factor is a function of various elements, and the optimum impedances for best noise figure can be determined by minimizing F with respect to generator reactance and resistance.

This gives:

$$R_{On} = \sqrt{\frac{R_n}{G_n} + R^2_{cor}} \quad [18]$$

$$X_{On} = -X_{cor} \quad [19]$$

and

$$F_{min} = 1 + 2G_n R_{cor} + 2\sqrt{R_u G_n + (G_n R_{cor})^2} \quad [20]$$

To distinguish between optimum noise and optimum power, we have introduced the convention On instead of the more familiar abbreviation opt.

At this point, we see that the optimum condition for minimum noise figure is not a conjugate power match at the input port. We can explain this by recognizing all noise sources present at the input, not just the thermal noise of the input port. We should observe that the optimum generator susceptance, $-X_{cor}$, will minimize the noise contribution of the two noise generators.

In rearranging for conversion to s-parameters, we write:

$$F = F_{min} + \frac{G_n}{R_G}\left|Z_G - Z_{On}\right|^2 \quad [21]$$

$$F = F_{min} + \frac{R_n}{G_G}\left|Y_G - Y_{On}\right|^2 \quad [22]$$

from the definition of the reflection coefficient,

$$\Gamma_G = \frac{Y_O - Y_G}{Y_O + Y_G} \quad [23]$$

$$r_n = \frac{R_n}{Z_0} \quad [24]$$

the normalized equivalent resistance

$$F = F_{min} + \frac{4 r_n \left|\Gamma_G - \Gamma_{on}\right|^2}{(1 - |\Gamma_G|^2)\left|1 + \Gamma_{on}\right|^2} \quad [25]$$

$$r_n = (F_{50} - F_{min}) \frac{\left|1 + \Gamma_{on}\right|^2}{4\left|\Gamma_{on}\right|^2} \quad [26]$$

$$\Gamma_{on} = \frac{Z_{On} - Z_0}{Z_{On} + Z_0} \quad [27]$$

The noise performance of any linear two-port sys-

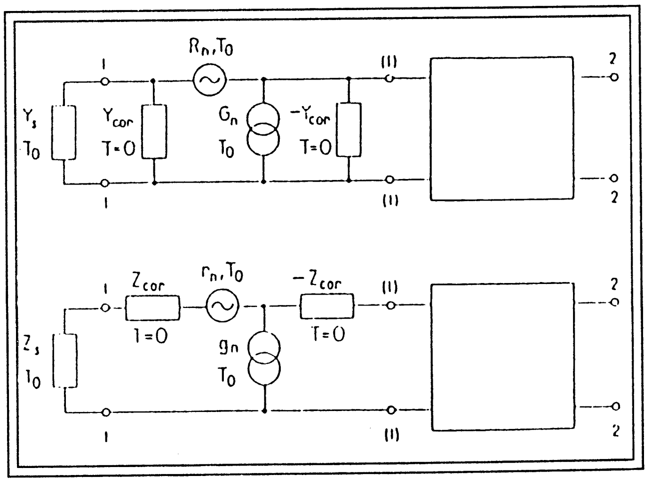


Figure 1. Noisy two-port representation in Y and Z matrix form.

tem can now be determined if the values of the four noise parameters, F_{min}, $r_n = R_n/50$, and T_{On} are known.

The factor of 3.2 in the equation for R_n for tubes (the equivalent noise resistor) has to do with cathode temperature. This factor applies to triodes only. For pentodes and tubes with larger numbers of grids, the value varies between 5 and 7.

It can be seen that the source for the noise in the high frequency range is due to effects either from thermal contribution or Schottky noise.

The so-called equivalent noise resistor determines the minimum noise figure at low frequencies—those above the frequency of flicker noise or other surface-related noises. In its simplest form, the noise factor $F = 1 + R_n/R_g$. R_n stands for the equivalent noise resistor, and Rg is the value of the generator impedance. The lower the R_n, the lower the minimum noise figure becomes.

At higher frequencies, parasitics begin to contribute, particularly the input capacitance and feedback capacitance. The feedback and input reactance determines the correlation between the Johnson noise (thermal noise) and the Schottky noise. The Schottky noise is determined by the emission of the device and is equal to 2IQ, with I being saturation current and Q the charge of an electron.

The correlation coefficients, described as magnitude and phase, are the combination of the fluctuation of both noise sources. From this introduction, two immediate deductions are possible:

1. Devices with higher gain or higher transconductance have lower noise. Also, devices with smaller input capacitance have lower noise.

2. Any parasitics that cause unwanted feedback, either capacitance or inductance, will change the noise.

As a result, one can compensate the noise at particular frequencies and apply "noise" feedback. This step will result in almost simultaneous matching of the operation point for best gain and best noise operation.

Low-noise operation assumes an operating point in the linear region, but does not address the issue of large signal handling capabilities. An oscillator or mixer is a hybrid in the sense that an active device is being "pumped" with a large ac current or ac voltage swing. As a result, some of the nonlinear parameters are changed as a function of drive level.

In the case of a mixer, an external oscillator pumps and/or switches the nonlinear devices between two states (on and off), and a mixing between several tones occurs. This type of mixing is referred to as linear mixing, and the basic goal is that the active device is either on or off.

Things not being ideal, there still are interactions during both the on and off conditions, particularly during the cross-over time. In the on mode, modulations due to a change in currents can occur, specifically modulating G_m, and in the off condition, due to large voltage swings, the dynamic capacitance will vary significantly.

In the case of an oscillator, the active device operated in the region of negative resistance and will start to oscillate into a resonant circuit that determines the resonant frequency. The purity of the signal depends on the flicker noise contribution, specifically due to amplitude or phase variations.

Verification circuits

As promised, we first are taking a step back into history to look at a set of tube converters.

These tube converters have been built with either 6CW4 tubes or 417As. Figure 2 shows the schematics of very popular Ameco converters, and Figure 3 shows an equally popular 417A two-meter converter.

The reason these tube converters were considered is that I wanted to be able to look at the relationship between modeling and measurement. Table 2 provides a listing of the small- and large-signal performance and indicates the measured performance versus predictions

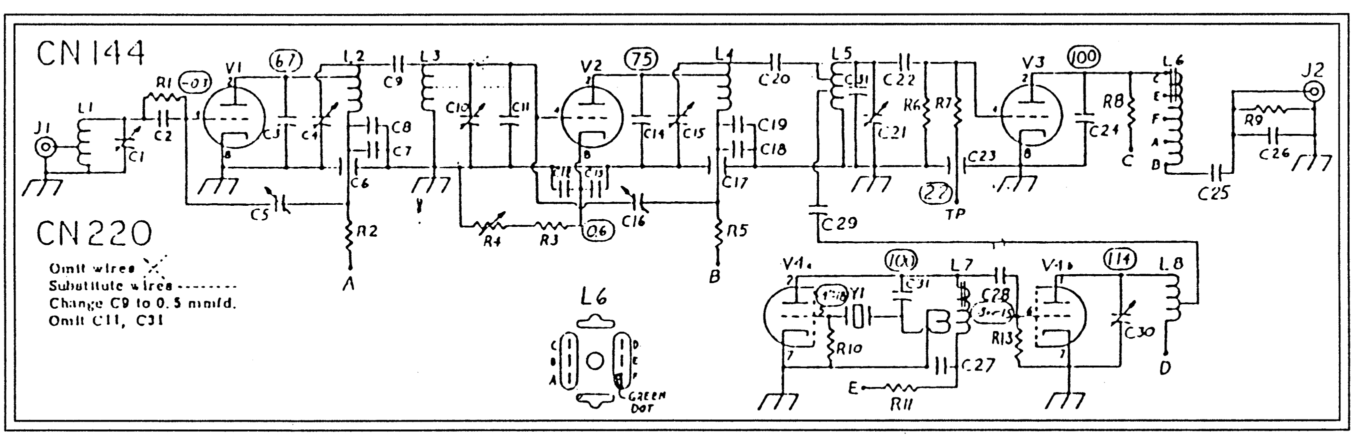


Figure 2. Schematic of Ameco converters.

Ameco		417A		Bipolar-Cascode		MOS-FET		GaAS-FET	
Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated	Measured	Calculated
P_G = 20dB	21dB	P_G = 20dB	21dB	P_G = 20dBm	22dB	P_G = 20dB	21dB	P_G = 20dB	21dB
NF = 4dB	3.8dB	NF = 1.6dB	1.7dB	NF = 0.8dB	0.79dB	NF = 0.7dB	0.65dB	NF = 0.4dB	0.42dB
IP_3 = 0dBm	1dBm	IP_3 = 5dBm	+5.5dB	IP_3 = 7dBm	6.5dBm	IP_3 = 10dBm	11dBm	IP_3 = 10dBm	10.5dB
Tube-Mixer		Tube-Mixer		Diode-Ring +20dBm		Diode-Ring +20dBm		Diode-Ring +20dBm	
Q = –4	Q = –2.8	Q = 3.4	Q = 3.8	Q = 6.2	Q = 5.71	Q = 9.3	Q = 10.35	Q = 9.6	Q = 9.58

Q = Figure of Merit = IP_3-NF

In the case of the Bipolar and FET versions, a high-level double-balanced mixer has been used. Indications are that the limitations in this design are given by two factors: 1) the IP_3 of the double-balanced mixer and 2) the gain distribution of the system, including the matching. For stability reasons at VHF, MOS FETs can be handled better than GaAs FETs.

Table 2. Converter test data.

using Compact Software's Microwave Harmonica program for simulation.

I then took the basic design shown for the 6CW4 converter and replaced the tubes with bipolar transistors, then MOS transistors, and finally GaAs FETs.

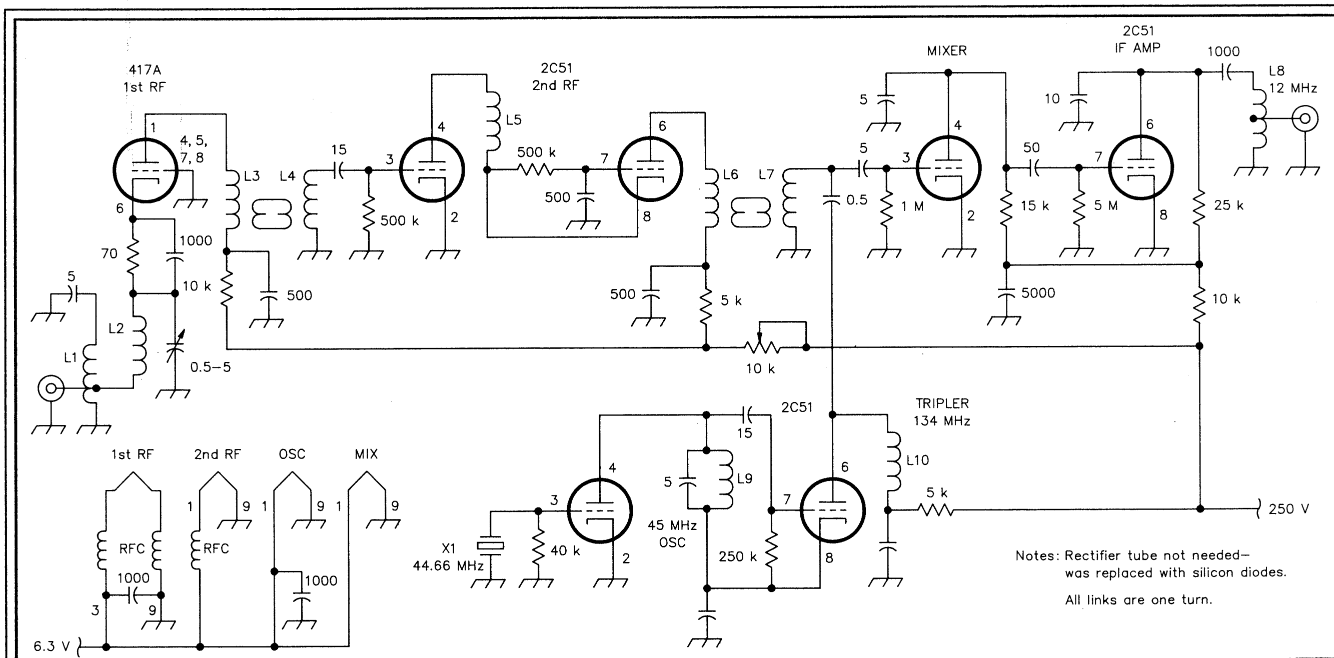
The result of this simulation is also shown here, and the following Figures 4-8 are a set of simulations for the various devices at different current settings for the neutralization.

In the case of the 6CW4, the differences in the noise matching are dramatic, as is the change in gain.

By using a cascode arrangement of Siemens bipolar transistors, I obtained the best noise figure thus far (approximately 0.76 dB), but also obtained the highest gain and the least feedback. This is directly attributable to the high reverse isolation.

If I substituted the bipolar cascode with a dual-gate MOSFET, the resulting noise figure is about the same, but it can be seen from the curves that the selectivity is vastly improved. This means that, for the same noise figure, more suppression of interference is possible.

Finally, if we look at the GaAs FET, the minimum noise figure available is approximately 0.2dB. But this is not quite achieved in the circuit because of input



L1 – 5 turns, tap at 1 turn, #24 enam, 0.2" L x 0.1" D, brass slug.
L3 – 3 ⅔ #24 enam, 0.2" L x 0.1" D, brass slug.
L4 – 4 #24 enam, 0.2" L x 0.1" D, brass slug.
L6 – 4 ⅔ #24 enam, 0.2" L x 0.1" D, brass slug.
L7 – 4 turns #24 enam, 0.2" L x 0.1" D, brass slug.
L9 – 9 turns #24 enam, 0.2" L x 0.1" D, brass slug.
L10 – 5 turns #24 enam, 0.2" L x 0.1" D, brass slug.
L8 – 37 turns #30 enam, 1⁄16" L x ½" D, tap at 6 turns, iron slug.
L2 – 6 turns #20 enam, ½" L x ⅛" D, brass slug.
L5 – 6 turns #20 enam, ¼" L x ⅛" D, brass slug.
C9 – 2-3 twists of small-gauge hookup wires.
RFC – 1-2 μH RF choke.

Figure 3. Schematic of 417A two-meter converter.

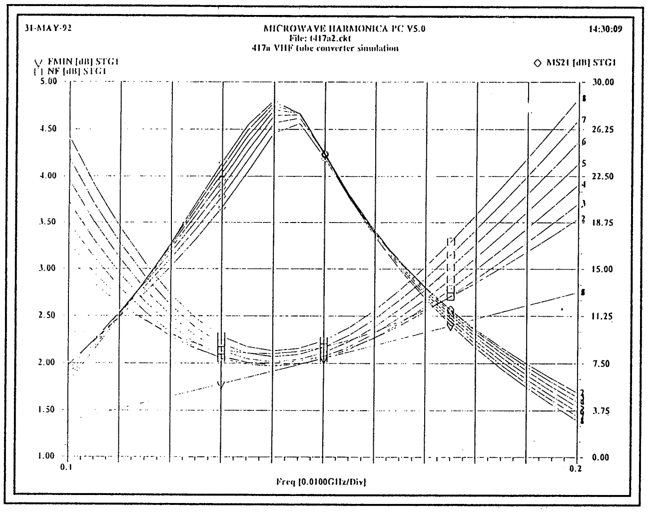


Figure 4. *Simulated minimum noise figure. Noise figure and gain as a function of input matching. For the 417A tube, note that F_{min} as per definition is matching independent.*

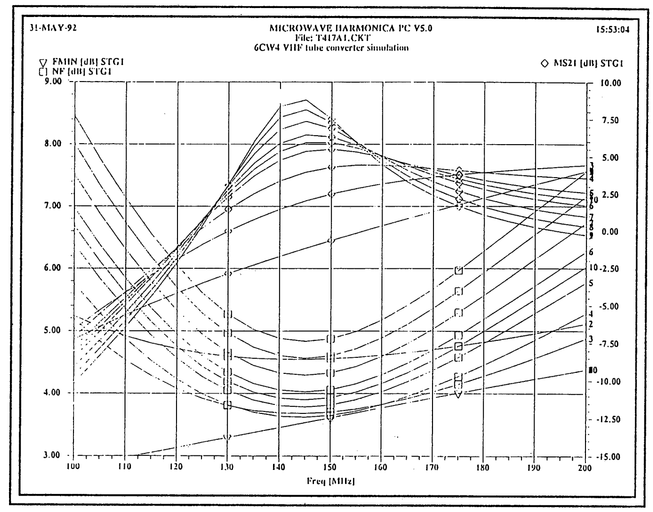


Figure 5. *Simulated minimum noise figure. Noise figure and gain for the 6CW4 VHF tube. Due to the significant feedback without neutralization, there is a lot of Interaction of noise figure and gain as the input matching changes.*

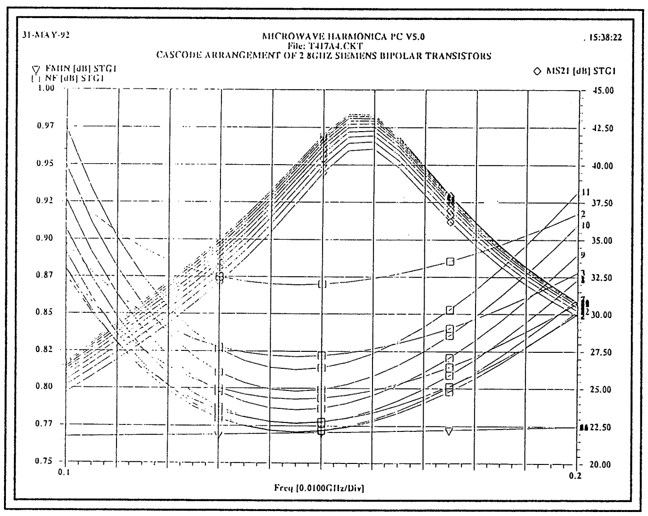


Figure 6. *Simulated minimum noise figure. Actual noise figure and gain for bipolar cascode stage. Note that changes of the noise figure in percentage are very small because of the high reverse isolation which is common to all cascode arrangements.*

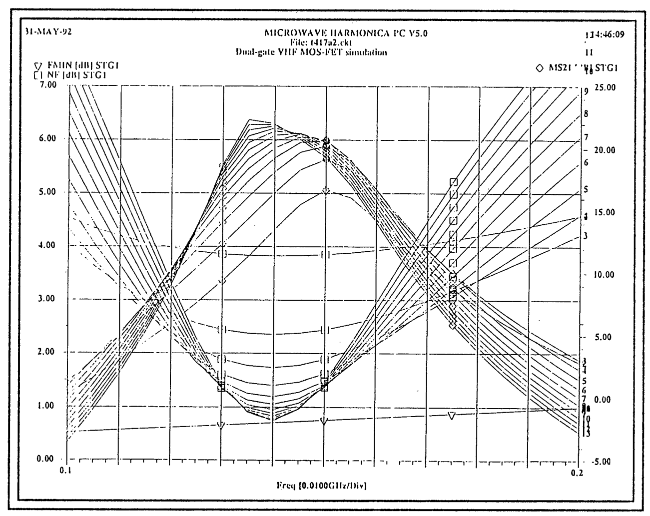


Figure 7. *Simulated minimum noise figure. Noise figure and gain of a dual-gate MOS stage. This type of arrangement is much more sensitive to changes in the input match, which equally effects noise figure and gain.*

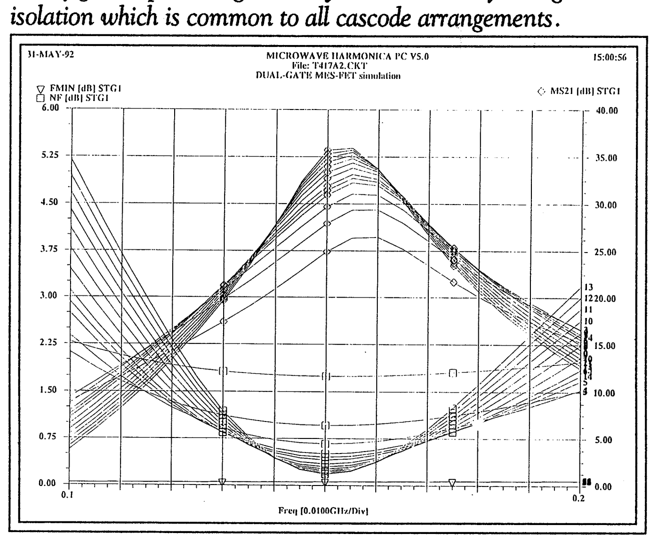


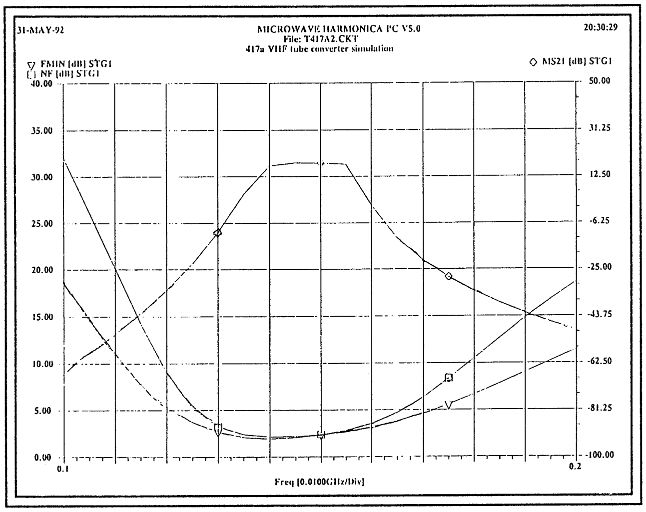
Figure 8. *Simulated minimum noise figure. Noise figure and gain as a function of input matching. Dual-gate MESFETs are much less sensitive to matching changes.*

matching losses.

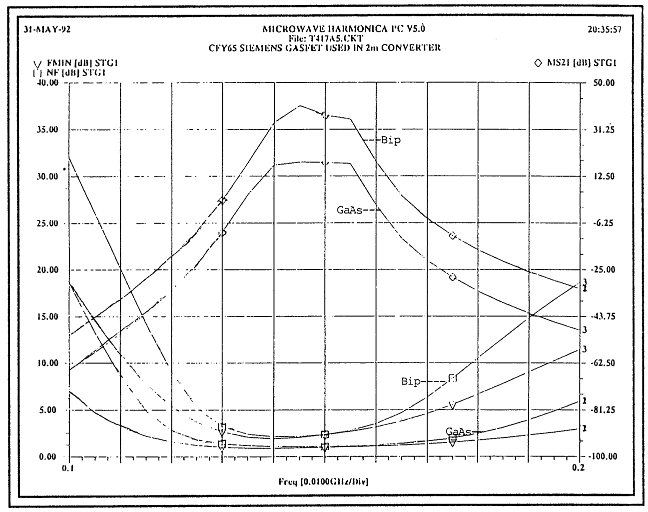
It is also useful to compare the best tube converter with the best GaAs FET converter. By substituting and replacing the tubes with GaAs FETs, a system noise figure of approximately 1 dB is achieved vs. 1.6 dB with the tubes, as shown in Figures 9 and 10 (next page).

Because the converter typically consists of a preamplifier and mixer, we should look into the nonlinearities of the mixer. Figure 11 (next page) shows the phase plan of the active (tube) mixer at the output. The plum-shaped curve is caused by the LC tuned circuit at the output.

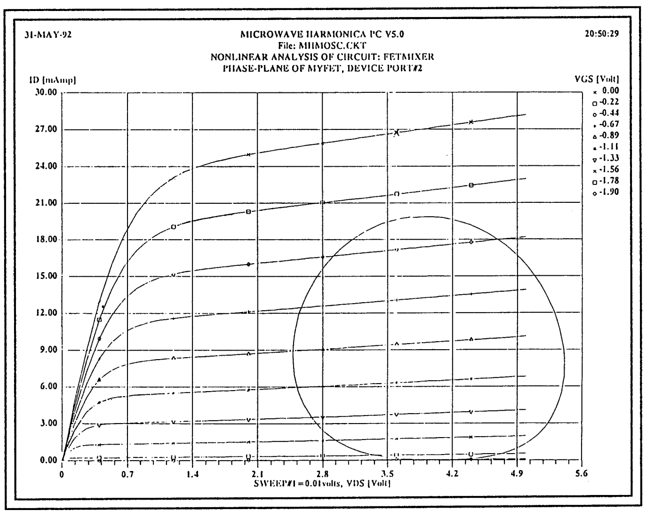
The diode mixer (four high-level diodes) is simulated in Figure 12 (next page) showing the spurious output, which is lower compared to the single-ended tube mixer of Figure 11.



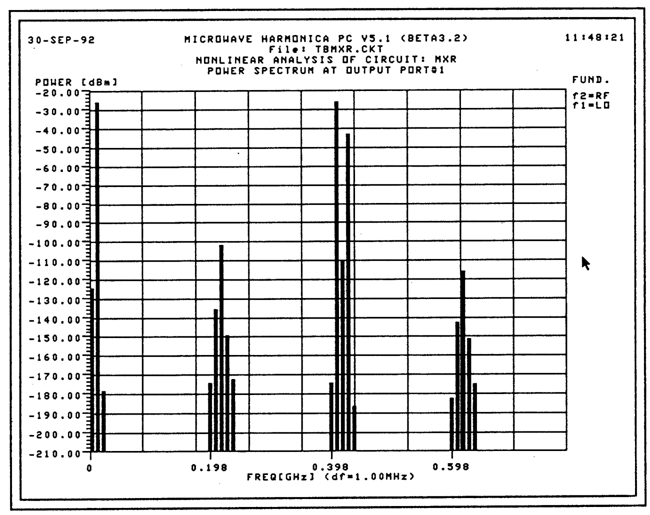
▲ *Figure 9. Overall noise figure and gain of the 417A converter. Note that the minimum noise figure and predicted noise figure agree quite well.*



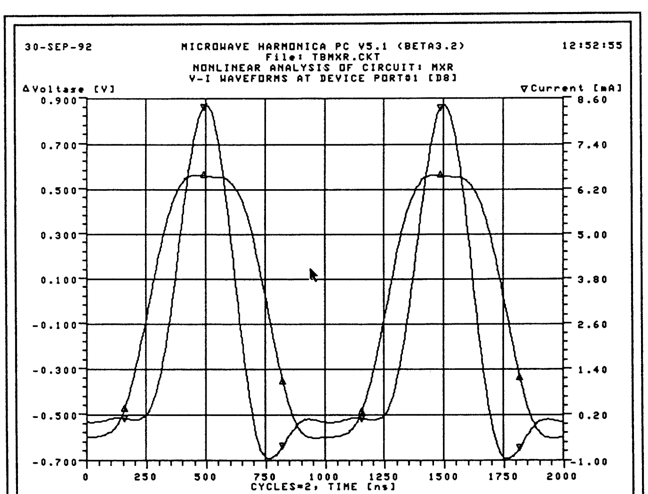
▲ *Figure 10. Overall, gain and noise figure of both the bipolar and GaAs FET version of the converter. Due to some feedback phenomena, the bipolar version does not show the same flat performance as the GaAs FET.*



▲ *Figure 11. Dynamic load line of a tube mixer where a modified FET model was used to simulate the tube mixer.*



▲ *Figure 12. Simulated output of the double balanced mixer shown in Fig 14. Please note the extraordinary suppression of the harmonic frequencies, due to this clever symmetrical circuit.*



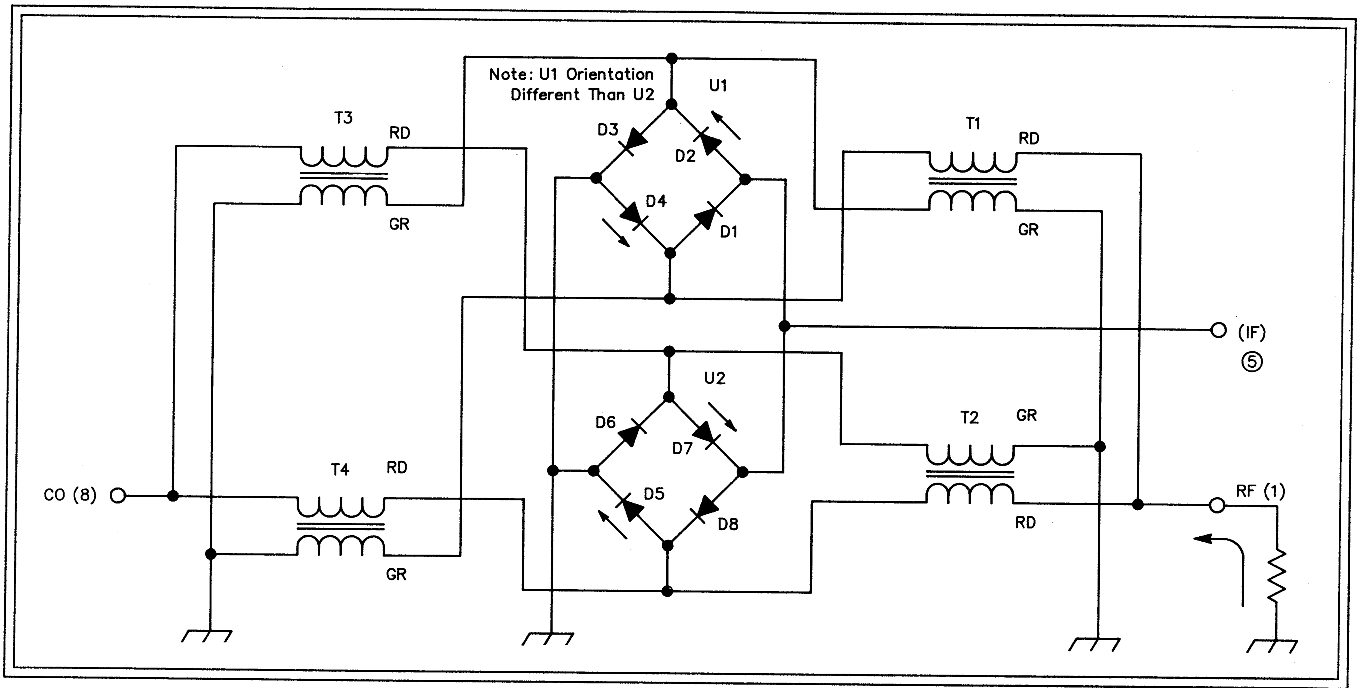
▲ *Fig 13. Simulation of currents and voltage inside the double-balanced mixer at one particular diode. The high harmonic content gets canceled because of symmetrical circuit as can be seen from simulation in Fig 12.*

Figure 13 shows how powerful the diode gating is by analyzing current and voltage of distributed waveforms inside the diode mixer. This high-level double/double-balanced mixer, type CPL206 made by Synergy Microwave, is shown in Figure 14.

Needless to say, the intermodulation distributed characteristics depend highly on the ferrite material, the exact matching of the transformers and, of course, selection of high-level diode mixers. These mixers typically require +17 dBm to +23 dBm of LO power.

Some practical circuits

Figure 15 shows a simplified schematic of the input stage of a tube circuit-based RF input stage, with a double-tuned input stage, the pre-amplifier and triode mixer.

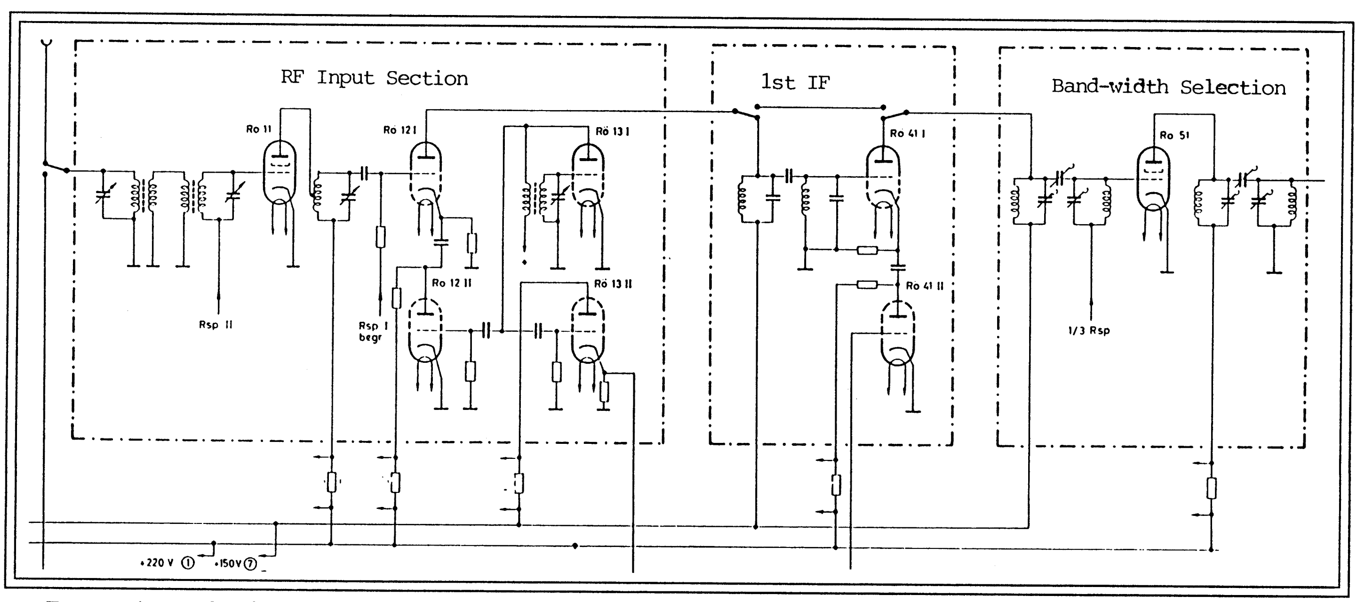


▲ *Figure 14. Circuit diagram of a double/doubly balanced mixer. Because of the simple construction with its transformers, this type of mixer provides much higher isolation and only a slight increase of component cost. This mixer shows the best performance in dynamic range.*

The other two triodes are the actual oscillator for the first LO and its driver for the mixer and output stage. The second chamber contains the second mixer and second LO driver, and the last chamber contains a system of switchback filters for different bandwidths. This 1960 design (Rohde & Schwarz EK07) had an intercept point of +30 dBm and used a combination of RF feedback and distributed AGC.

The novelty in this design at the time was that even the mixer received AGC voltage and that the triode mixer was linearized by proper RF feedback. An equivalent VHF/UHF design approach shown in Figures 16 and 17 (next page).

Figure 16 shows a bandpass filter for the FM broadcast band, which precedes the high-dynamic-range tuner. This tuner is part of an FM relay receiver that is used to receive FM broadcast stations on mountain tops and then to modulate an on-site FM transmitter. This FM transmitter frequency has 10 KW output power and is only a few hundred yards away from the receiving



▲ *Figure 15. Simplified schematic circuit diagram of the 1960-vintage Rohde & Schwarz EK07 receiver. It uses a double-tuned input stage, pentode pre-amplifier synthesized local oscillator with a mixer similar to modern dual-gate mixer applications. Note that AGC voltage is even applied to the mixer for high intercept performance.*

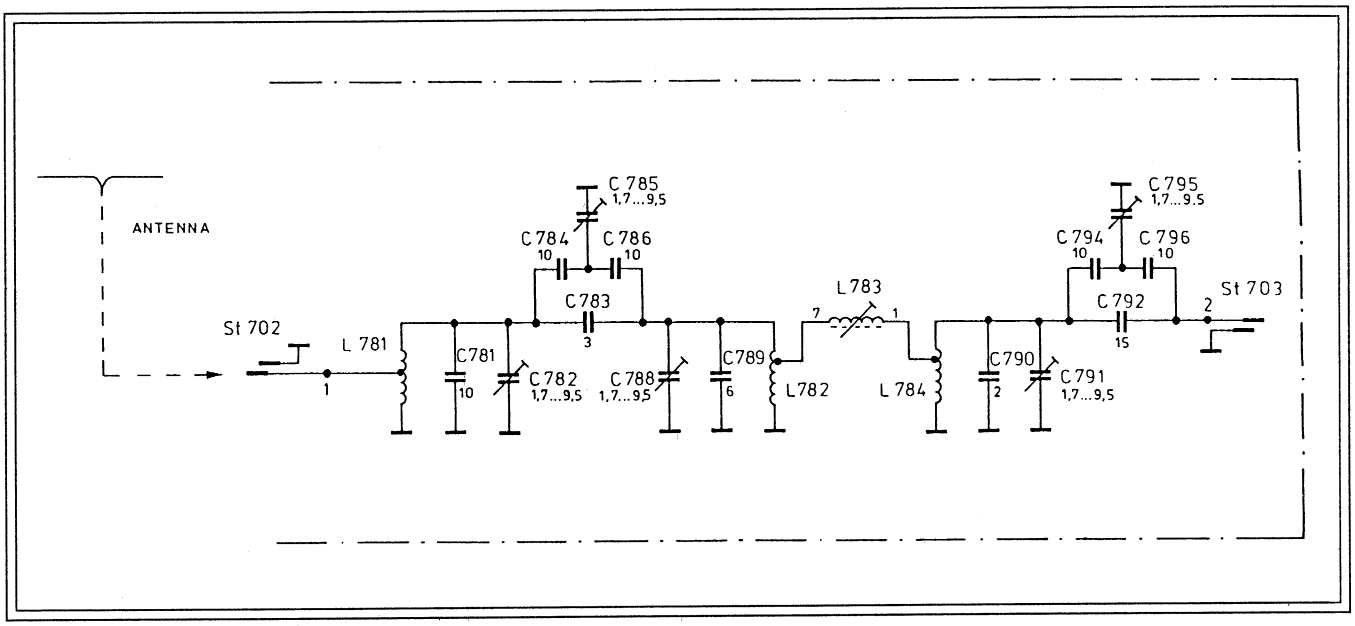


Figure 16. *Input bandpass filter for relay receiver.*

station.

The relay receivers, therefore, must have a huge dynamic range. The relay receiver tuner shown in Figure 17 uses a PIN diode attenuator in the front end for automatic gain control and several tuned stages prior to the mixer.

Two FETs are used in parallel to increase the dynamic range of the pre-amplifier, which is necessary to compensate for the loss of the bandpass filter between the pre-amplifier and the mixer. Such high selectivity is required in this hostile environment where so many large signals are present. The double-balanced mixer is one of the CL family made by Synergy Microwave.

At the output of the mixer one finds a diplexer and grounded-gate amplifier for a precise 50-ohm termination. In this environment, you can imagine the need for high performance of the receiver, which has an intercept point of +23 dBm and a noise figure of 2 dB.

Modern CAD tools have been used to perform feasibility studies. A CAD tool is available on which linear and nonlinear circuits can be simulated simultaneously. It can show the output spectrum like on the spectrum analyzer, the beat note for the two tones at the output and even the increased level of voltage and current at different points of a three-stage distributed amplifier.

Because of the beat-note phenomena, on the CAD tool the output load line shows a wider color band than one would obtain from a single tone.

Conclusion

It has been shown that the weakest point in past designs has been the understanding of how to design good mixers.

Ever since the introduction of the 417A, low-noise input stages at frequencies as high as 150 MHz were available. The microwave area requires modern GaAs FETs.

Measurements and simulation agree quite well, which indicates that modern CAD tools are quite capable of making good predictions. The major differences between the tube designs and bipolar transistor/ GaAs designs lie in the matching techniques between the stages and compromises among selectivity, noise figure, and losses.

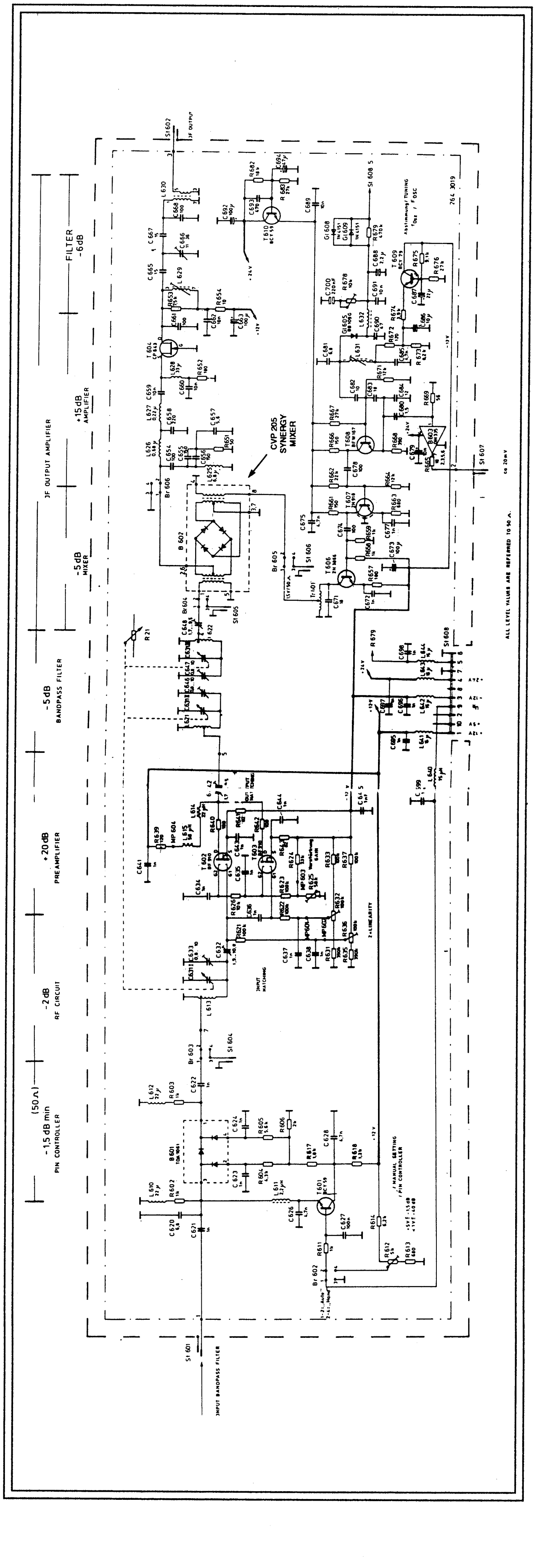
I would like to thank all the radio amateurs who supplied me with converters, either gratis or at the advertised purchase price, for this project, and they are: John Abbruscato, KC5GB; Martin Dew, K3RGH; Martin Feeney, K7OYB; David Knepper, W3BJZ; Charles Lustick, K3HSS; Jacob Makhinson, N6NWP; John Pivnichny, N2DCH; and Earl Shinn, K5KAC.

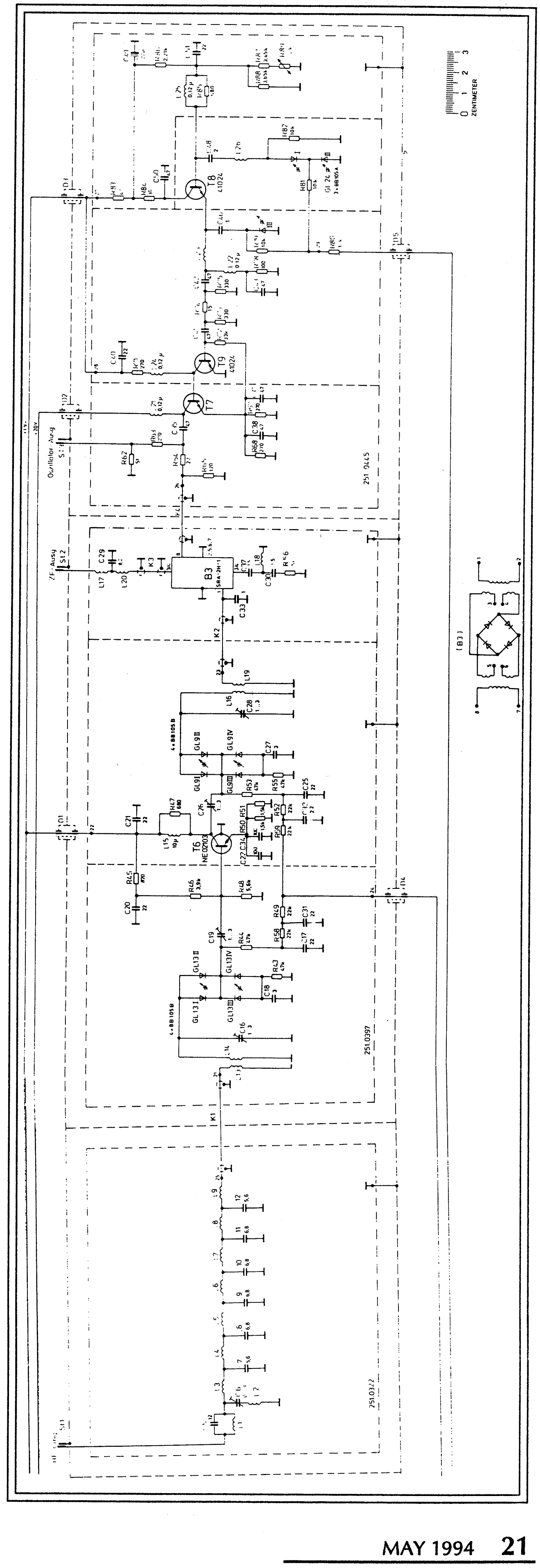
I would additionally like to thank those radio amateurs who responded to my project, but whose converters I had to refuse due to the overwhelming response.

(continued on page 26)

Figure 17. Schematic of input stage of an ultra-high dynamic relay receiver. Following the input filter shown in Figure 16, a PIN diode attenuator is responsible for extending the AGC range. Two dual gate MOSFETs in parallel are chosen for better simultaneous matching for noise and gain. Each transistor, therefore, contributes to the output current which increases the dynamic range by at least 3 dB and the gain is up by about 6 dB. Sufficient gain is provided to offset the loss in the following band-pass filter and the double-balanced mixer.

Figure 18. An added circuit showing an all-bipolar solution for high performance.


FILTER -6dB
+15dB AMPLIFIER
3F OUTPUT AMPLIFIER
-5dB MIXER
-5dB BANDPASS FILTER
+20dB PREAMPLIFIER
-2dB RF CIRCUIT
-1,5dB min (50Ω) PIN CONTROLLER
CVP 205 SYNERGY MIXER
INPUT BANDPASS FILTER
ALL LEVEL VALUES ARE REFERRED TO 50Ω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GROUNDING
AND
LIGHTNING
SOLUTIONS
COAX TO 6GHz
BROADCAST & MILITARY
TO 80 KW
12-80VDC @ 50A
3ø POWER TO 480VAC
STRIKE COUNTERS
TOWER/POWER/PHONE
CHEMICAL
GROUND SYSTEMS
BREAKDOWN
TESTERS
HIGH CURRENT/ENERGY
LOW CAPACITANCE SHUNT
4-23 GHz MICROWAVE
DOWNCONVERTERS
TWISTED PAIR
(TO DS-3 RATES)
The "GROUNDS" for Lightning & EMP Protection
PolyPhaser Corporation
VIDEO &
TUTORIAL BOOK
SINGLE POINT
GROUND PANEL
LAN/VIDEO
ENTRANCE PANELS
OVER 1500
MODELS
200 STOCKED
CUSTOMIZATION
AVAILABLE
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Ero E. Erickson, 1910-1993

A tribute by Eva H. Erickson

My brother, Ero E. Erickson, died of congestive heart failure in Chicago on Saturday, Sept. 4, 1993. His funeral was Tuesday, Sept. 7, and he was buried in the cemetery across the street from his longtime Chicago home on Pioneer Street.

Ero and I were always close. We communicated often, and we were very competitive. Our credo was "Anything you can do, I can do better." Often, he bested me, but then again, just as often I bested him.

Our parents were Hilma Marie Backman and Juhan Ilmari Kalmgren. According to my younger brother, an Ellis Island official decreed his name was Erickson because since his father's name was Ero, which is Eric in Swedish. They were teenagers when they immigrated from Finland in 1905. They met in Ishpeming, Michigan, and were married there in 1909. We children — Ero, Don (Tauno) and I — were born there.

When Don was two and Ero was six, the family moved to Waukegan, Illinois. Our Father was an iron-ore miner who had been blacklisted. He refused to testify on behalf of the mining company regarding a mine accident that was fatal for several Finn miners. In Waukegan, father became a carpenter and remained in the trade for the rest of his life. He died in 1957.

Ero's schooling started in Caspian, Michigan, where Mother and we kids were visiting mother's sister, Aunt Hilkkus (Hilda Ranta). The kindergarten experience continued in Ishpeming and then in Waukegan, Illinois. Grade school continued there through fifth grade.

But Ero failed to pass into sixth grade. He attributed this failure to still thinking in his mother language Finnish and needing to translate into English. So he was slow to answer the teacher and would say "I don't know." This didn't sit well with the teacher. Every since that time Ero has wanted to erase those words from use and frequently admonished, "Don't be an I Don't Know."

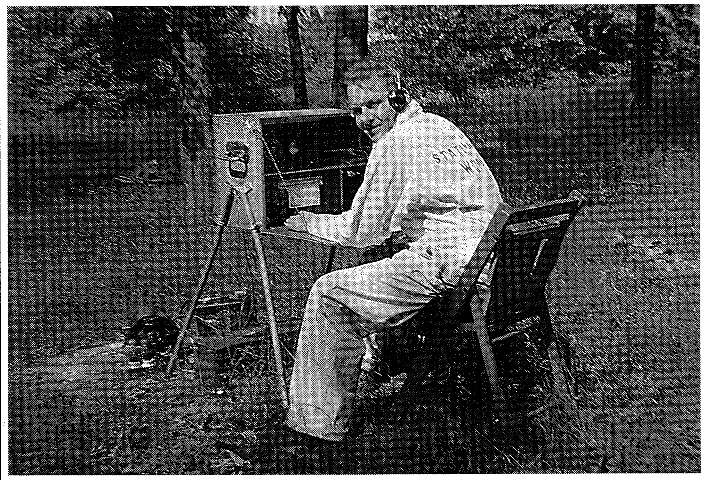
Ten-year-old Ero came home to tell his mother he was leaving town. She arranged to send him to the Kaleva, Michigan, farm of her oldest sister, Fiina, and her husband, David Maki. There he attended a one-room school until he moved to the Commonwealth, Wisconsin, farm of Aunt Hilkku and her husband, Jack Ranta. Again he attended a one-room school.

Communicating, writing and photography were also Ero's passions...His knowledge of radio history was extensive. He was a reporter, a commentator, a protester, a satirist, an essayist, a teacher and very definitely a person of influence.

Ero bragged about graduating at the top of his eighth-grade class. I was quick to remind him that he was next-to-the-bottom of his class, for there were only two members in that 1924 graduating class.

Back home in Waukegan, he attended Waukegan Township High School, graduating in 1928. At some time during those years, he got his first taste of sailing. Lying about his age, mother got him a summertime berth as a dishwasher and cabin boy on the *S.S. George Stephenson*, a Great Lakes freighter. During high-school years, he also ventured into the field of radio, building his own crystal radio set. The big third floor attic of our house had wires dangling here and there.

Ero said that his interest in radio and wireless communication arose before crystal-set days. He remembered walking around the cinder path near the Channing, Michigan, railroad station and hearing some ticking sound coming from the building. Again he responded to those sounds of telegraph when, a number of years later, he delivered shipments of five-gallon cream cans from Aunt Hilkku's farm to the Florence, Wisconsin, railroad station. Out of those experiences came his lifelong interest in wireless telegraphy.



Mobile radio transmission in the woods back in the 40s.

In the early 1930s Ero commuted via the North Shore Lines from Waukegan to the Merchandise Mart in Chicago to attend the RCA Institute, a school of wireless operators. He earned a Second Class commercial license and also took the necessary examinations to qualify as a ham radio operator. His assigned ham call letters were W9HPJ, which remained his until the 1970s, when he failed to renew his license within the required time. Relicensing brought him the call letters KA9DYS.

As a ham operator he was in contact with other radio hams all over the world. His ham transmissions from KA9DYS were done in Morse code, and I was told his touch on the transmission key was recognized without acknowledgment. Now he has become a Silent Key, and his transmission key went into his casket and his grave.

In 1935, after all the eventful years at sea, Ero wanted to return to the Midwest. He served as wireless radio operator, briefly, on the freighter *S.S. L.E. Block* and on the *S.S. North American*, an excursion ship out of Chicago.

In 1936, he became a radio officer for Pennsylvania Central Airlines. He was first stationed at Mitchell Field in Milwaukee and later at the Cleveland Air terminal.

I benefited from his airline appointment. Since air travel in 1936 wasn't heavy, the airlines issued flying passes for family members of officers on a stand-by basis. That meant you flew if there was a seat available on the plane. Ero got such a pass for me to fly from the Washington, D.C. terminal to Mitchell Field, my first experience flying. What a story in itself that was, but this is not the time or place to tell it. I did stop off in Cleveland to visit Ero overnight.

Glen E. West of the new Illinois Police Radio Bureau called Ero in 1936 to come to Springfield to be a radio telegraph operator for the Interzone Police Radio Network on a temporary assignment. He stayed for 30 years with the Illinois Police Radio.

First, Ero was stationed in Springfield, Illinois, where he met and married Betty Burwell in 1937. There, daughter Linda was born. Betty died in 1959.

In 1939, Ero moved to Chicago, his home ever since. He became first an operator and later the second supervisor of the Illinois Police radio station at Irving Park and Harlem Avenue. Here he stayed until his retirement, and then devoted full time to his already growing business, Erickson's E-Lectronics Company, which installed, maintained and serviced two-way mobile radios. At the time of his death, he still owned and operated that company.

Organizations

Radio was not only Ero's lifetime career, but also his lifetime avocation. If there was an organization or activity within reach whose focus was radio or wireless telegraphy, he belonged to it. He was a member of a long list of local, regional and national organizations. Very often, he served in some official capacity as president, vice president, historian, newsletter editor or board member.

He had life memberships in the Society of Wireless Pioneers, the Association of Police Communication Officers (APCO) and the Quarter Century Wireless Association (QCWA). He also belonged to the National Association of Business and Educational Radio (NABER) and many others.

He was a fellow in the Radio Club of America, the first and most prestigious radio club in America. He was recognized for 29 years of service in public safety communications and for being the publisher of "Rain Static." He also served as a member of the board of this prestigious organization for a term.

Ero's recognition from various radio associations are many. Among them are a Veterans Wireless Operation Certificate in recognition of having used arc or spark transmitters at sea, marine Coast Guard stations, commercial or military stations and a 1980 recognition from NABER for his windy column "Wind Static," which had delighted NABER members since 1965.

In 1980, the Coast Guard gave him an honorary appointment as a Coast Guard admissions officer, the highest honor extended to a civilian. It accompanied a certificate of appreciation for technical electronic engineering in the field of radio direction-finding, which is used in search-and-rescue operations for lake vessels in distress.

Communicating, writing and photography were also Ero's passions. He wrote a "Rain Static" column for the APCO publication. When this ceased, he wrote a "Wind Static" column for *Business Radio Action*, the NABER publication. The columns were devoted to discussing radio and what had happened over the years, what was happening now, and what was being proposed to happen through changes in regulations.

His knowledge of radio history was extensive. He was a reporter, a commentator, a protester, a satirist, an essayist, a teacher and very definitely a person of influence. He received many of what he called "fanny letters" and shared them with me. I was privileged to have Ero send me copies of his letters and writings, and his columns, sometimes in their very first form. Even though I didn't understand the radio jargon, I delighted in reading his observations.

Inveterate collector of paper that I am, I saved all his many writings, all filed year-by-year in folders. Since his death, I have been reliving the honor and awe of his radio life as they are revealed in these writings. The collection belongs in some central archives and would make fascinating reading 100 years from now.

In addition to the two published columns, Ero also wrote his own newsletter at his own expense called *Rain Static*, after APCO no longer published the original. His newsletters were full of news about the various radio organizations he belonged to, about members and meetings held and to be held. They were full of well-identified photos. Ero usually had his camera with him when he went to a meeting. He also contributed news to other radio newsletters.

It was in the writing that Ero and I were most competitive and where he always bested me. He, as a telegrapher, could boil down an idea into 10 words, whereas I would need several sentences. He was always taking me to task for my syntax and redundancy in expressions. Morover, I think he knew how to make words *dance*. What follows are a few quotes from some columns of his.

(1973) The cyclical course of electronic communication in the current century contrives to be the cause of incomprehensible complexity as well as a conglomerate of unconsciousness curiosity.

(1973) Not knowing the real "nuts and bolts" of the "science" of numerology, it would appear in this computerized age, you have a real "nothing if you don't know your numbers".

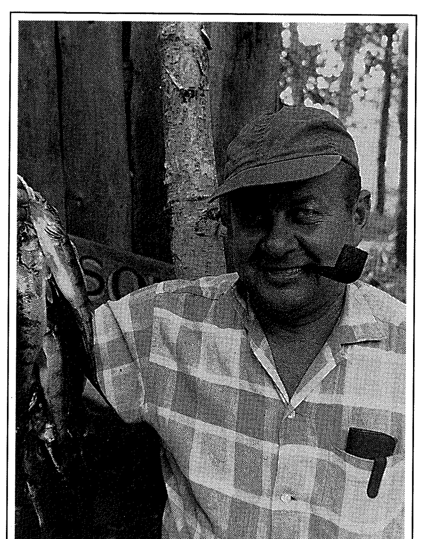
(1981) It is customary to describe any difficult period or uncertain national political flux as having a profound pressure and stress upon our noble "Ship of State," which is variously viewed as sailing in troubled waters.

Distilled down to the radio regulatory level, that's the troubled feeling I have about the FCC, which is envisioned as facing not only troubled waters, but in fact is in the clutches of a full-blown hurricane. Obviously, all of the fancy canvas in form of auctioning frequencies, the lovely lottery schemes and the flying job of nylon de-reg is in shreds — with small chance of replacement in face of budget cuts.

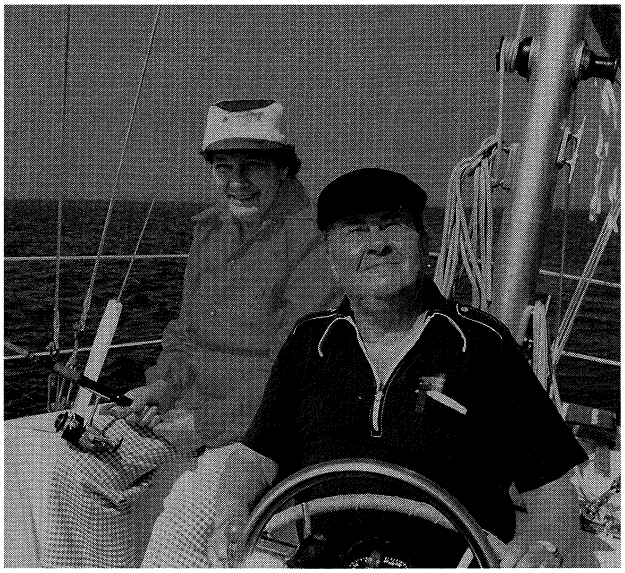
Other interests

Ero's other abiding interest was in what the family fondly called Erickson's Lost lake Lodge in Upper Michigan. In 1942, our father, younger brother Don and his father-in-law bought, for unpaid taxes, 80 acres of woodland, previously owned by a timber association. Father, being the excellent carpenter he was, built his and Don's cabins, starting out small and adding as years went by. He also built a "real" Finnish sauna on the lake shore and a boat house next to it.

It was a summer retreat and a haven for mother



➧ *An avid fisherman, Erickson loved catching his Lost Lake perch.*



The "Ol' Salt," here with wife Sylvia, always yearned to return to the sea. This picture was taken on Lake Michigan near Washington Island. The boat was built and owned by an old radio friend.

and father during their lifetimes. Since mother's death in 1968, what used to be the parents' cabin became Ero's. He did much to update the cabin's facilities and to maintain the structure. Many are the weeks that have been spent there by all of us, enjoying the very Finland-like terrain, small hills, pines and birch trees and the lake. Many are the friends who have shared the delights of this woodland beauty spot and who have experienced the delights (or terrors) of being inducted to bathing the sauna way.

It was here that Ero met Sylvia Haubrich. I invited a good friend to visit my mother that summer when I was away in New York City attending summer session at Teachers College, Columbia University. Florence Durkee brought Sylvia with her. Ero and Sylvia were married in 1964.

A tribute to Ero requires a whole book, not these limited pages. So many of his other radio organizations and the full range of his activities in them have not been mentioned. Other interests, like fishing and boating and sharing in community activity, writing letters to editors or important people, sharing in Civil Defense during WWII, and involvement in church activities and wide reading interests deserve attention. For now, this is the best I can do as I say so long to a very special brother.

Eva H. Erickson is Ero E. Erickson's sister. She lives in Iowa City, IA.

Differences Between Tube-based...
(continued from page 21)

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Recommended reading

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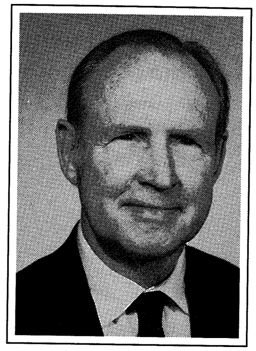
Ulrich L. Rohde is president of Compact Software, Chairman of Synergy Microwave Corp., and a partner of Rohde & Schwarz, Munich, West Germany, a multinational company specializing in advanced test and radio communications systems. Previously, he was the business area director for Radio Systems of the Radio Corporation of America (RCA), Government Systems Division, Camden, New Jersey, responsible for implementing communications approaches for military secure and adaptive communications. Having studied electrical engineering and radio communications at the universities of Munich and Darmstadt, West Germany, he holds a Ph.D. in electrical engineering and an Sc.D. (hon.) in radio communications.

In 1990 Dr. Rohde was appointed Visiting Research Professor at New Jersey Institute of Technology, Department of Electrical Engineering, Newark, NJ. Dr. Rohde is also a member of the staff at George Washington University and as an adjunct professor teaching in the Electrical Engineering and Computer Sciences departments gave numerous lectures worldwide regarding communications theory and digital frequency synthesizers. In addition, he held the position of Professor of Electrical Engineering at the University of Florida, Gainesville, teaching radio communications course.

Dr. Rohde has published more than 50 scientific papers in professional journals, as well as four other books: Communications Receivers: Principles and Design, *McGraw-Hill, 1987;* Digital PLL Frequency Synthesizers: Theory and Design, *Prentice-Hall, 1983;* Transistoren bei hoechsten Frequenzen, *in German, 1965, (on microwave transistors). His latest book,* Microwave Circuit Design Using Linear and Nonlinear Techniques, *with co-authors George Vendelin and Anthony M. Pavio was published by John Wiley & Sons, NY, January 1990.*

Dr. Rohde is a member of the following: ETA KAPPA NU Honor Society, senior member of the IEEE, Executive Association of the Graduate School of Business-Columbia University, New York, the Armed Forces Communications & Electronics Association, fellow of the Radio Club of America, and a life member of the Amateur Radio Relay League. He holds an Extra Class U.S. amateur license (call sign KA2WEU, 1991) and is an ARRL accredited VE. He is known for his German call sign DJ2LR (1956) and Swiss call sign HB9AWE (1973). He also holds an FCC General Radiotelephone Operator License.



Joe Fairclough and the 22 Crew

By John G. Troster

No doubt most readers have heard of Joe Fairclough, WB2JKJ, and his "22 Crew." Some of you have talked to them on the air from their classroom station in lower Manhattan, New York. The background story about Joe Fairclough (clough rhymes with snow), and the 22 Crew is a heartening success story of uncommon interest. Joe used his own inspirational junior high school experience to help the new generation of students he now teaches.

After 11 years of teaching non-responsive kids, Joe realized something had to be done. Conventional classroom methods were just not working. These were street kids, most of whom disliked and misunderstood authority, were unmotivated, bored with books, and, as Joe says, "could care less about 'See Spot run.' In fact, most would just as soon shoot Spot as see him run."

Motivation needed

Joe reached back into his own experience as an unmotivated 12-year-old seventh-grader. It was at that point he was introduced to amateur radio by an electric shop teacher. Radio got Joe interested in *something*, something that absorbed his attention. His students at Junior High #22 needed a *something* to propel them into being interested, too, to give them motivation and to hold their attention. Amateur radio had been his catalyst, so why couldn't it work for his students?

Joe developed just such a "something," an original and immediately successful teaching program that turned on the light for students heretofore almost given up for hopeless. His inspiration led him to rewrite the standard curriculum for the seventh and eighth grades, using amateur radio as the theme. Teach students the Morse code, then, via the code, teach them spelling, vocabulary and other subjects. When Joe introduced this new idea to the school superintendent, the reaction was "Morris Code? Sure, I know him, he lives on Third Avenue."

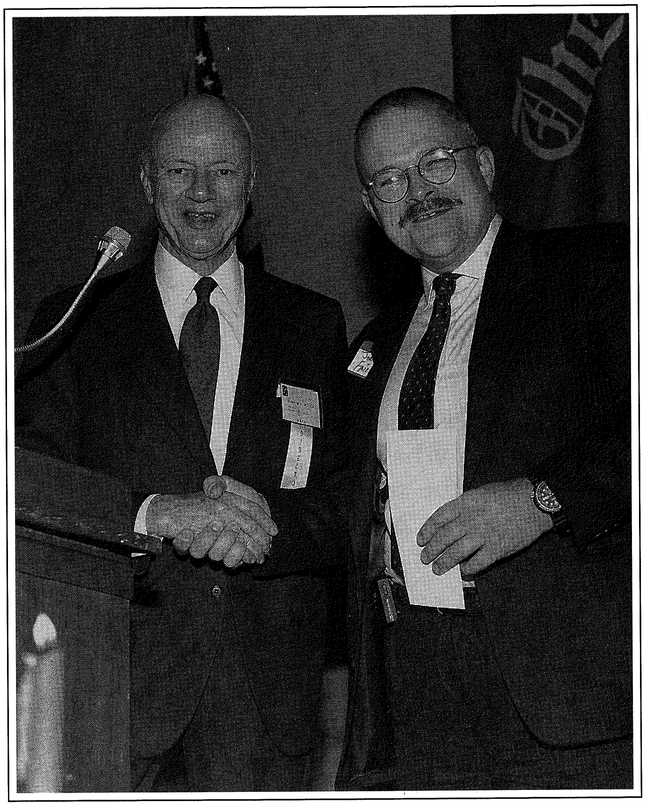
But, Joe had hit them where it counts — the wallet — and the selling point was that it would not cost the school a nickel. Joe, in his enthusiasm, promised that the kids would fight to get in, rather than out, of the classroom.

Teach students the Morse code, then, via the code, teach them spelling, vocabulary and other subjects.

Joe's brainchild

The EDUCOM-Education Thru Communication began in 1979 as an English class with, as Joe put it, "30 of the most difficult kids the district had to offer — kids so bad they were kept in one room all day instead of traveling with the rest of the population."

The program was a big success, and today, 13 years later, Joe teaches six classes of 30 students each daily. This curriculum, conceived and developed by Joe and using ham radio as an educational theme, now is printed by the New York City Board of Education. Says Joe, "I have become president of the Radio Club of JHS 22 NYC Inc., a non-profit organization that works to use ham radio as a theme for teaching in schools all over the country, not necessarily to make hams, but to make better kids who can read, write and learn about self-



◆ *Grants-In-Aid Committee Chairman Ken Miller gives Joe Fairclough a check for $1,000.*

respect and respecting the rights of others by communicating and listening — learning there is more to life than drug dealing, danger filled streets — that there is life west of the Hudson."

Brooklyn Dodger fan

Joe was born just a long jump over the East River in Brooklyn. However, he grew up farther out in Queens and, according to him, "aside from girls, baseball and the Brooklyn Dodgers," high school was Ho humm. He did enjoy the social studies, but was not much for math and science. He played on the PAL baseball team mostly because his father was the coach. But a sense of duty emerged early in his life, and he began to communicate with underprivileged kids who could not see well enough to read.

It was in seventh grade when Joe's electrical shop teacher helped him and three other kids to get their ham tickets. Young Joe emerged as Technician Joe, WB2JKJ, with an enthusiasm for amateur radio that would be life-long. After high school, he went to Long Island University where he activated the ham club and became captivated with the university as a way of life. He earned his degree with a "marketing major" and a "teaching minor" and decided that he wanted to teach.

In between, a traumatic experience: The Dodgers left Brooklyn for Los Angeles! Joe wondered what was left to believe in? Well, how about a switch of allegiance to the Yankees? Why not? He's been in that mode ever since.

Teaching career

After graduation in 1968, Joe taught business courses in high school. Along the way he picked up an M.S. degree in marketing. When the business curriculum was phased out in an economic crunch, he moved to Junior High School #22 in the lower east side of Manhattan. (If you're from Nu Yawk, that's pronounced "Minhaaattin.") They asked, "What language do you speak?" He replied, "English." So, Joe was assigned to teach English. He bought some books and began to prepare for this assignment.

After a few years, it became crushingly clear that "Dick and Jane" were not going to make it in JHS #22, and that's when he got the unique inspiration that culminated, after a year's preparation, in a march to the superintendent's office, bold new plan in hand.

First 'new' class

Those first 30 students were tough and hard to get through to. The break came when Joe gave a handheld, two-meter amateur radio rig to one of the ringleaders, a fella called "Little Eddie." Joe called him over and said, "Eddie, someone in this box wants to know you." Eddie replied, "%*&$@%!." But when Eddie took the rig, he was overwhelmed, shocked with the recognition that some adult did indeed take the time to speak to him, and cordially at that, over the air. Eddie and the class were hooked.

Happy P.S.: Recently, Joe had a visit from "Little Eddie." Wearing a new three-piece suit and carrying a beeper, "Little Eddie" thanked Joe for straightening him out. He's now a licensed electrician and doing well.

Most of the radio equipment at the school belongs to Joe or has been donated. Code practice is held daily, and by Thanksgiving time the kids are all up to at least 5 wpm, fast enough to begin studying spelling and grammar via Morse code. Nobody told them that code is tough, so they just go ahead and learn it. Feminists take note, the girls are better at learning code than the boys!

Honors

Joe and his 22 Crew have been honored with the Marconi Award of the Veteran Wireless Operators Association and by the Radio Club of America, which has awarded the Radio Club of JHS #22 a Grant-in-

(continued on page 53)

1993 Communications Symposium, 84th Anniversary Dinner and Awards Presentation

By Jane Bryant and Don Bishop, Proceedings co-editors

Members and guests came to the New York Athletic Club building near Central Park in New York for the Radio Club of America's Communications Symposium, 84th Anniversary Dinner and Awards Presentation on Nov. 19, 1993.

Raymond C. Trott (F) and Don Bishop (LF) organized the symposium. Mr. Trott served as moderator, introducing presentations by four members. About 50 members and guests were in the audience for the afternoon session, which began at 2:30.

John S. Powell (F), a sergeant with the University of California Police and past president of the Association of Public-Safety Communications Officials - International, spoke to the audience about "APCO 25 - The Next Generation of Public Safety Radio Equipment."

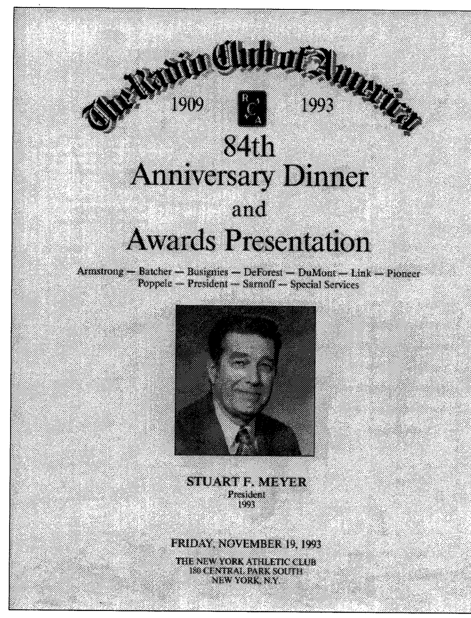
Dr. John S. Belrose (M), the director of radio sciences at the Communications Research Centre in Ottawa, Ontario, Canada, delivered a paper titled "Fessenden & the Birth of Radio Communications." He played a recording of a communication received from a voice-modulated spark-gap transmitter that he built to demonstrate how Fessenden's early radiotelephone transmissions might have sounded.

Dr. Ulrich L. Rohde (F), president of Compact Software, Paterson, NJ, spoke about "Key Components of Modern Radio Systems" and showed diagrams of up-to-date radio designs.

Dr. Don Erickson (M), a former TV broadcaster and college professor who now is engaged in consulting and writing, gave a talk titled "TeleDOME — A New Kind of Broadcast Studio." His paper about the Teledome appears in this issue.

About 275 members and guests gathered at the athletic club building by 5:30 p.m. for the reception, which was followed by the dinner and awards presentation organized by banquet committee chairman Mal Gurian (F), committee member and banquet coordinator Connie Conte (F), and committee members Edward F. Weingart (F) and Fred M. Link (LF).

Mr. Trott served as master of ceremonies for the awards presentation.



Francis H. Shepard, Jr. (LF), as secretary emeritus, reported the results of the election for directors and officers. With respect to officers, the vice president is elected, and the following year becomes executive vice president, and then president. Mr. Shepard reported the election of Gaetano J. Amoscato (F) as vice president, the automatic succession of John W. Morrisey, P.E. (LF) to executive vice president, and the automatic succession of Mal Gurian (F) to president.

Other officers elected for one year include Joseph S. Rosenbloom, Esq. (F), vice president/counsel; Eric D. Stoll, Ph.D., P.E. (LF), treasurer; and Gilbert R. Houck (F), secretary.

The following members were elected to two-year terms on the board of directors beginning in 1994: George J. Apfel (LF), John E. Brennan (F), Vivian A. Carr (F), William E. Endres (F), Robert C. Gunther (S), Emmet B. Kitchen (F) and Kenneth M. Miller (LF).

Several members were presented with honors and awards, including Mr. Bishop, the President's Award; Mr. Trott, the Spe-

cial Services Award; Hugh G.J. Aitken, Ph.D. (F), the Ralph Batcher Memorial Award; Jerry S. Stover, P.E. (F), the Fred M. Link Award; Andrew F. Inglis (F), the Allen B. DuMont Citation; Robert L. Everett, Ph.D. (F), the Jack Poppele Broadcast Award; and Ben Tongue (F), the Sarnoff Citation.

Following the awards presentation, Jack A. Shaw, chairman and CEO of Hughes Network Systems, delivered the keynote speech, "Communications — America's Next Frontier." He said that regulatory, technological, competitive and economic issues constitute the critical factors driving the growth of the wireless industry. "All [of these issues] will play a role in making [wireless] communications the new frontier for America," he said. The text of Mr. Shaw's speech appears in this issue.

After the keynote speech, Mr. Meyer was given a Presidential Recognition plaque in appreciation of his service to the Club as its president for 1993.

Mr. Link then presented Fellow certificates to members present at the banquet who were elevated to the membership grade of Fellow in 1993. These members include Hugh M. Archer, Dearborn, MI; George M.W. Badger, Portola Valley, CA; Mark B. Baretella, M.D., Kalamazoo, MI; Maryanne Micchelli-Conte, Nutley, NJ; Donald C. Cox, Ph.D., Tinton Falls, NJ;

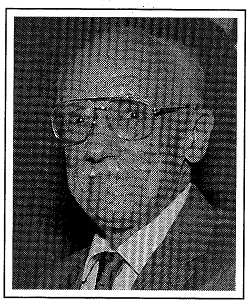
William F. Denk, Devon, PA; James A. Douglas, Gaithersburg, MD; and Linda H. Ford, Greensboro, NC.

Additional members elevated to Fellow include Lawrence J. Gabriel, Boca Raton, FL; Robert W. Galvin, Barrington, IL; Edward J. Gordon, Stillwater, MN; Michael C. Gurka, Cape Coral, FL; Ronald J. Jakubowski, Solon, OH; Stanley F. Kaisel, Ph.D., Portola Valley, CA; James A. Lang, P.E., Los Altos, CA; Maxine Carter-Lome, West Orange, NJ; and Thomas F. McNulty, Baltimore.

Also named as Fellows are Raymond Minichiello, P.E., Bedford, NH; Ake S. Persson, Cary, NC; John S. Powell, Berkeley, CA; Willard K. Shaw, Vista, CA; Eugene R. Smar, P.E., Rockville, MD; Carl G. Smedal, Fort Lauderdale, FL; Wilbert F. Snyder, Boulder, CO; and Wee R. Wical, Kane' Ohe, HI.

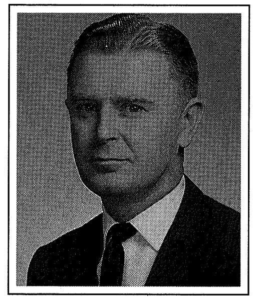
On behalf of all of the newly elevated Fellows, John S. Powell delivered the Response for Fellows. "Not only should we be worried about getting people interested in RF or radio, we need to be concerned about the entire fields of math and science," Powell said, speaking of the need to help young people get the most out of their education. The text of Mr. Powell's speech appears in this issue.

Honors and Awards – 1993



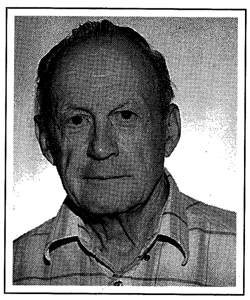
SARNOFF CITATION
BEN TONGUE

Awarded in recognition of significant contributions to the advancement of electronic communications.



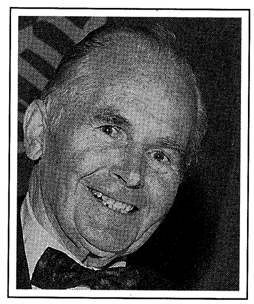
RALPH BATCHER MEMORIAL AWARD
HUGH G.J. AITKEN, PH.D.

Awarded in recognition of work in preserving the history of radio and electronic communications.



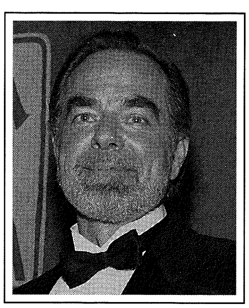
ALLEN B. DuMONT CITATION
ANDREW F. INGLIS

Awarded for leadership in the design of television equipment.



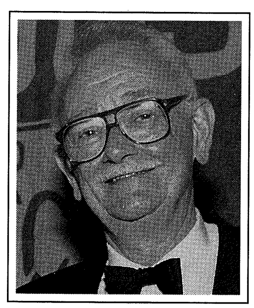
FRED M. LINK AWARD
JERRY S. STOVER, P.E.

Awarded for significant contributions to the development and advancement of land-mobile communication.



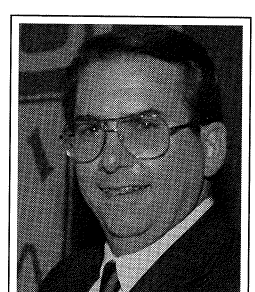
JACK POPPELE BROADCAST AWARD
ROBERT L. EVERETT, PH.D.

Awarded in recognition of long-term contributions to the improvement of international broadcasting.



SPECIAL SERVICES AWARD
RAYMOND C. TROTT, P.E.

Awarded for outstanding contributions to the success of The Radio Club of America



PRESIDENT'S AWARD
DON BISHOP

Awarded in recognition of his contributions to the success of The Radio Club of America.

Communications — America's Next Frontier

By Jack A. Shaw

Good evening and thank you. I am particularly honored to be a part of your 84th Anniversary Awards Presentation. The Radio Club of America is a unique organization, and as members you certainly have ample reason to be proud of your heritage. In my particular case, I am celebrating my 30th year in the field of telecommunications, commencing with the launch and subsequent explosion of Syncom I, the world's first synchronous communications satellite. Some of the most enjoyable times that I have had in my life have centered around remembering the past 30 years with some of my colleagues, and trying to understand and appreciate the significant advances that have been made in this most enjoyable industry.

I am very thankful that I have had the opportunity to participate in bringing voice, video and data to countries and people all over this planet where those services did not exist and where hopefully they have contributed to a better life. You know we all have this insatiable appetite to talk just a little bit more today than we did yesterday; to send volumes and volumes of data to each other; and to watch every sporting and news event that has ever taken place, anywhere in the world, and at any time. This appetite, this insatiable appetite for communicating with each other, is, in my opinion, the reason that communications is America's next frontier. I challenge you to find an opportunity, any opportunity, that is greater than that which is facing us in the field of communications. We are all so fortunate to be here today, in this time and space, and to be a part of this revolution in how we communicate with each other. If there was any doubt that communications, and wireless communications in particular, is our next great frontier, the events of the past months have eliminated those for good.

This is the text of the keynote speech delivered during the Nov. 19, 1993, Radio Club of America 84th Anniversary Dinner and Awards Presentation.

Daily changes

Today, wireless communications is the most dynamic, the most challenging, and the most rewarding field in the world. Change happens on a daily basis. New alliances and mergers have changed the way we see our industry, and will soon change the way we see ourselves.

If there was any doubt that communications, and wireless communications in particular, is our next great frontier, the events of the past months have eliminated those for good.

Bell Atlantic and TCI. AT&T and McCaw. US West and Time Warner. MCI and British Telecom. Motorola/Nextel/Cencall, NTT/Nextel. The list goes on and on. All are examples of the new direction our industry is heading, and these are only the most visible examples. When John Sculley, a leading figure in the computer industry and an innovator in personal computing, leaves a multibillion-dollar company for a relatively small company in wireless data, it sends a strong message: "Wires are yucky; wireless is where it's at."

But it's one thing to pronounce the arrival of wireless communications as the new frontier and quite another thing to demonstrate, in clear terms, why this is so. To give you that clear demonstration, I'll try to focus on four key issues that affect the industry: technological, regulatory, competitive and economic. I'll give you a comparison of how these factors have shaped another leading industry of today — the transportation industry. And, I'll give you my views of how these same factors will affect the future of the wireless communications industry.

Look at the improvements in automobile technology and how they have shaped the products we use today. Air conditioning, airbags, anti-lock braking systems, fuel efficient powerplants — all have changed the way we view the cars we buy and drive. Today, few people would buy a car without airbags and anti-lock brakes, and it's hard to find a new car without air conditioning as a standard feature. The creation of the minivan — a recent innovation — addressed the needs of a new generation of car buyers and built the base for the success — some would say the survival — of Chrysler.

New communications technologies

Likewise, new communications technologies that are in their infant stages today will become the standard of tomorrow. Digital cellular, digital specialized mobile radio, cellular packet data, high-definition television (HDTV), in-home multimedia, wireless local loop technologies, direct broadcast television — all will drive continued expansion, growth, and opportunities for the wireless industry. Within these areas, some technologies will rise above the others. Take digital cellular, for example. Today there are three directly competing technologies: time-division multiple-access (TDMA), code-division multiple access (CDMA) and global system for mobile communications (GSM). Each offers benefits. Each has supporters. Each has markets. And the arrival of digital specialized mobile radio (SMR) with "cellular-like" services and personal communications services-based (PCS) based services may change the equation completely. While it's too early to say which technology (or technologies) will dominate, it's certain that this diversity will deliver our ultimate objective: giving consumers the best wireless service at the lowest price.

Regulatory

In the area of regulatory factors, it's helpful to see how regulation — and deregulation — have shaped another leading industry, transportation, and how regulation will shape tomorrow's leading industry, communications. In transportation, new regulations in the 1940s and 1950s enabled trucking companies to compete with railroads, creating greater flexibility for producers of goods and delivering more options at lower prices to consumers. The result was the creation of a multibillion-dollar industry employing hundreds of thousands of people. In the 1970s, deregulation of the airline industry led to lower ticket prices, more flight options and a huge increase in consumer demand.

Likewise, the deregulation of telecommunications has led to unparalleled growth in new services, and the regulations that formed the ground rules of the wireless business over the past decade are changing in ways that will lead to more services, more consumer options and faster industry growth.

Look at today's duopoly structure in the cellular industry. It was ideal for creating the kind of stable environment that an infant industry needed to grow. Now, with the market for wireless communications being well-established, regulators are opening up more spectrum for new services. PCS will expand the base of wireless users dramatically, delivering voice, data and even video. And digital SMR will offer yet another alternative to today's cellular services.

Internationally, deregulation — otherwise known as privatization — is helping developing countries to leapfrog into the 21st century. Fixed wireless networks are bringing advanced telecommunications to people and nations that have never before had access to reliable dial tone. In China, the former Soviet Union and Latin America, new economies, opportunities and freedoms will be enhanced by the ability to communicate with anyone, anytime, anywhere.

On a recent visit to a number of republics within the former Soviet Union, including the subrepublic of Tatarstan, it became abundantly clear to me that companies such as the one I represent have enormous opportunities and, I might add, maybe obligations, to bring modern communications services to these people who so desperately need them. During the Cold War, restrictive governments controlled communications and attempted to censor what people were told or what they were allowed to see. Now these same people need to become part of the industrial world and to attract investment, and to do that, they need hotels, transportation, airports and, yes, more than anything else, they need to be able to communicate. Wireless networks are a fast, economical technology that can provide this service, and deregulation makes wireless a practical alternative to more traditional solutions. In both Chengdu, a city in the Peoples Republic of China, and Tatarstan, a subrepublic of Russia, Hughes is currently installing the very latest in wireless technology.

It is ironic that developing nations will be the first beneficiaries of some of the most state-of-the-art equipment available today, and that it will assist them in communicating among themselves and with other nations in the world.

Another area of regulation that has become increasingly important is industry standards — whether government regulated or industry regulated. The creation and acceptance of unified standards will determine how quickly and how effectively wireless communications are deployed. In HDTV, digital cellular, PCS and wireless data, as the industry continues to grow, the ability to set and support consistent standards will be vital to its success and growth.

Competition

The third key factor, competition, is perhaps the most powerful. Look at how competition shaped the auto industry. At its outset, cars were made by dozens of small companies — each with limited resources and correspondingly limited product lines. The consolidation of auto manufacturers into the "Big Three" created the efficiencies to deliver high-quality, low-priced products — resulting in America's adoption of the car as a cultural icon. In the past two decades, the ability of foreign manufacturers to produce highly efficient, high-quality, low-cost vehicles forced American manufacturers to change dramatically — resulting in a stronger American industry and a new perspective on what consumers demand.

In the communications industry, we are in a period of simultaneous consolidation and expansion. The pending merger of AT&T and McCaw promises to combine two of the strongest companies in their respective industries, creating a single entity with the ability to deliver wireless calls seamlessly from end to end. The pending merger of Bell Atlantic and TCI promises to combine two companies with very different — but uniquely compatible — technologies and perspectives, creating an entity that can switch video and data services over high-capacity cable systems. And in the case of my own organization, the combination of a leader in satellite communications with the world's largest automaker hopefully will result first in integrated cellular mobile telephones, and ultimately lead to a range of services such as vehicle location, remote diagnostics, and even in-car video on demand.

But the competitive landscape cannot be viewed only from an American perspective. We live in a global economy, and the field of competition will not only be in New York, Dallas, Chicago and Los Angeles. It will also be in Mexico City, Caracas, Bangkok, Chengdu, Tartarstan and Moscow. Those companies with a global view and a willingness to take risks will win in these and other places. And we must remember — our overseas competitors in Europe and Asia are aggressively pursuing these markets. To succeed as an American industry, we must be willing to look, travel and work beyond our borders. I submit to you that the 1990s' customer is better educated, is more aggressive, is more demanding, has more options and demands better service than at any time in our history. The customer is truly "king" and whatever else they wish to be. They most surely fit the role of the famous 800-pound gorilla who gets whatever he wants, and we as providers of telecommunications products and services had better understand this fact and tailor our offerings to fit their needs.

Economics

The final factor affecting the future of the American telecommunications industry is economics. As the move from rails to roads was driven by the economic needs of the country, and the move from large "gas guzzlers" to fuel-efficient vehicles was driven by the economic realities of gasoline prices, so will the economics of telecommunications drive the products and services of the future.

The economics of providing cellular service are driving the move to digital. With higher capacity, carriers can provide equal or better services for less. The economics of fixed wireless are driving the telecommunications of developing countries. With the ability to install and turn on a fixed wireless network at one-third to one-half of the cost of a traditional land-line network and in one-third of the time, countries that could not afford basic telephony are now able to deploy advanced systems that help bring their economies into the 20th and 21st centuries. The long-heralded "home office" movement will gain further impetus from our ability — in the near future — to conduct video conferences from our homes. The appetite of consumers, worldwide, for high-quality entertainment services — delivered on their *schedule — will drive the growth of interactive media, direct broadcast television and a host of other services. And finally, the need for consumers to get low-cost "dial tone" anytime and anywhere, will drive the growth of personal communications.*

So there you have it. The four critical issues driving the growth of telecommunications, and especially wireless communications. Regulatory, technological, competitive, and economic. All will play a role in

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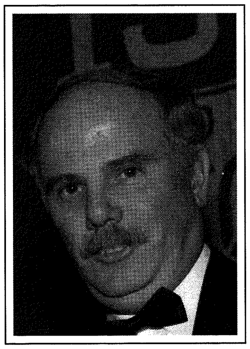


Response for Fellows

By John S. Powell

Mr. President, officers and directors, fellows, members and guests, it is indeed an honor to be selected to respond for this year's newly elected fellows.

I want to take this opportunity to follow up on a theme briefly addressed in last year's response by my friend Roger Block. Roger said, "The ranks of people interested in RF continues to decline . . . we seem to be a dying breed." He continued, "It should be a top goal of all club members to continue to interest young people in radio."

If this fine institution is to continue to welcome fellows of the quality that is expected, something must be done to insure that our brightest and most capable young people receive the attention and direction they need.

Unfortunately, if one looks at the state of our education systems, the work ethic (or lack thereof) of many of our young people, and the overall state of American society, it is a wonder that we are doing as well as we are. Not only should we be worried about getting people interested in RF or radio, we need to be concerned about the entire fields of math and science .

If this fine institution is to continue to welcome fellows of the quality that is expected, something must be done to insure that our brightest and most capable young people receive the attention and direction they need. No longer can we expect government or any other organization to carry the load.

There is hope and there is a way but only if each of us is willing to do our part. To that end, I want to issue each of you a series of personal challenges.

Being born and raised on a farm in California's great Central Valley near Fresno, I certainly was not offered the high-tech environment that is available to many of today's young people. But I had parents and a family that cared.

Now to the first and most important challenge; if it is not met, the others may not be possible. Most of you are parents, grandparents, aunts or uncles. *The challenge is to take an interest in the young children in each family*. Make sure they get the attention, the love, and the quality family life that will ensure their success in later years, no matter what profession they choose.

I attended a three-room grammar school that was not rich, but that had a wealth of support from the community. Every parent was involved with the school board, the PTA, or with sports programs. They made sure that the school had both the equipment and the qualified educators to address the many interests of young children. Fortunately for me, that included a very good basic science program. This is the second challenge: *Take an active role with your local schools whether or not have children attending.* Many schools yearn for tutors to assist not only the draggers, but also the gifted. Can you be of help?

My high school placed an emphasis on "college prep." The curriculum was well-rounded without the host of "side shows" we see in some of today's schools that, if nothing else, simply do not allow the time to become well-grounded in the basics. It was also a safe and disciplined campus where teachers and administrators were respected. This is the third challenge: *Ensure that your local school districts offer quality programs taught by qualified instructors.*

▲ *Twenty-five members were elected to the membership grade of Fellow in 1993. Sixteen of those members posed to have their photograph taken at the Anniversary Dinner and Awards Presentation at the New York Athletic Club in New York, Nov. 19, 1993. First row, l-r: Thomas F. McNulty, James A. Lang, P.E., Linda H. Ford, Maryanne Micchelli-Conte, Edward J. Gordon, Lawrence J. Gabriel and George M.W. Badger. Second row, l-r: Lee R. Wical, Willard K. Shaw, Raymond Minichiello, P.E., Wilbert F. Snyder, Maxine Carter-Lome, Carl G. Smedal, Mark B. Barettella, M.D., John S. Powell and Ronald J. Jakubowski.*

Promote the programs and curriculum that are needed for a good basic and well-rounded education.

Outside of school, there are a number of organizations that build character and respect. With a father who was scoutmaster for over 60 years, there is no doubt where my interests were directed.

Programs such as scouting, 4-H and others improve social skills and provide a good foundation for learning and for life. More importantly, they build leaders from those with the skills and the interest. How many of today's leaders in government and industry were Eagle scouts? You might be surprised at the answer. *The fourth challenge then is to be involved in civic groups that actively support young people.* Better yet, be the adult leader of such a group where you can serve as a role model.

I had the opportunity in high school to study algebra and chemistry under a new and vibrant graduate from the University of California at Berkeley, undoubtedly one of the best public institutions of higher education in the world. He was a great promoter of Cal, and why not, having studied under the tutelage of the great Professor Joel Hildebrand and a chemistry department with more than a half-dozen Nobel laureates as active faculty members. In the early 1970s, budding engineers on the West Coast went to either Cal or Stanford. With a little prodding, I think I chose wisely. I note for those of you from the West Coast that tomorrow (Nov. 20, 1993) will be the 98th playing of the "Big Game" that will determine who the real powerhouse is in Northern California for the next year. One could not graduate from such a fine institution in those years without a true awareness of the big picture and the pressing issues of the day.

I came away from Cal with the best education I could ask for, as well as a keen awareness of the cultural and ethnic diversity that is the reality of America today.

Now, my Alma Mater is facing deep financial cuts with direct impact on programs and on the quality of its faculty. While it continues to grow and modernize its plant at an amazing pace (with one of the largest alumni bases in the country, it is now a public institution that receives more than half of its income from private gifts), it nonetheless needs more support, both public and private. That is the final challenge: *Love and support the institutions of higher learning that gave each of you the education that makes you what you are today.*

During these preceding minutes, I have not mentioned three of the most influential people in my choice of careers. Two were an electrician and a broadcast engineer I met during my childhood. The third I met while at Cal — Art McDole is a fellow of the Radio Club and probably the most responsible for me being where I am today. All three were or are active amateur radio operators willing to share their lives and their knowledge with energetic and inquisitive young people.

In her article titled "Inspiring the Youth" in the May 1993 *Proceedings*, Carole Perry perhaps summed it up best: "In an age where there are lots of negative forces competing for the time and minds of young people, I really believe that all responsible adults have an obligation to do what they can to help keep the kids on the right path towards becoming productive members of society and good citizens."

You see, these are not challenges at all; they are really opportunities and they are obligations. I have no doubt that some day in the future some man or woman will have the privilege of standing where I am tonight because someone in this audience answered those challenges and took the opportunity to help today's youth.

John Powell, whose amateur radio station call sign is WB6SDS, received his B.S.E.E. from the University of California, Berkeley, in 1973. He has been employed by the University of California Police Department for 21 years, the past 16 years as a sergeant. He has served as UC's statewide communications coordinator for 20 years. John is the immediate past president of the Association of Public-Safety Communications Officials - International (APCO). He has been a member of the APCO Project 25 Steering Committee since 1989, serving as co-chairman in 1992-93. John has been a member of the Radio Club since 1989. He is a member of the Communications Committee of the International Association of Chiefs of Police and a member of the IEEE.

Communications – America's Next Frontier

(continued from page 35)

making communications the "new frontier" for America. Just as these factors drove the transportation industry over the past 50 years, they will drive communications over the next 50 years. The only difference will be the speed and intensity with which these factors drive our industry. All four issues involve risk on the part of the players in this industry. Fortunately, I represent a company that is not risk-adverse, but rather prone to move out briskly and accept the fact that the aggressive companies may make mistakes, but slow ponderous companies will most surely lose. We're in for a wild and exciting ride.

Predictions

It would not be fair for me to display this view without giving my own perspective on where we are going and what will be most important as we move ahead. So, like any good prognosticator, let me give you my predictions. And, as with any respectable handicapper, you are welcome to point out my errors after the race — I'll be pleased to meet with all of you 50 years hence at your 134th Anniversary Dinner. My calendar is open.

First, in my opinion, services, not products, will drive the industry. The tools that deliver those services still be a vital component, but it is a continued flow of new and enhanced services that people have and will continue to demand.

Second, technology and the industry itself will continue to get more complex. This growing complexity will demand greater agility from everyone — service-providers, regulators and manufacturers.

Third, the domestic market will require — and produce — more competition. What we are seeing today in the mergers, new players and new technologies is only the first stage of an increasing level of competition.

Fourth, and finally, the international market will require more cooperation and fairness. The rules of the Cold War world have changed forever. The success of our industry and of the economies around the world will demand greater mutual understanding, a merging of interests and objectives and a willingness to let the best ideas, technologies and services compete on a level playing field.

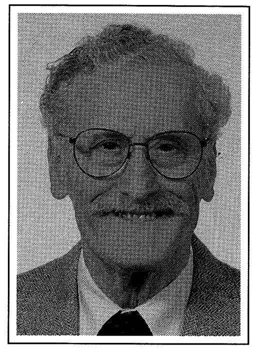
You know I am so proud and so enthusiastic about being a part of this industry. The opportunities appear limitless. The technology is fun. The people are great. The applications are a challenge. The marketplace in America is the greatest of anywhere in the world. All the nations in the world are our potential customers, and we always have the opportunity of making this planet a better place to live by bringing people together through better communications. What more could one ask for? Communications is truly America's next frontier, and we as a group of people are most fortunate to be a part of it.

Thank you and have a really great holiday season.

Jack A. Shaw (M) is chairman and chief executive officer of Hughes Network Systems Inc., Germantown, MD, a subsidiary of GM Hughes Electronics.

The Untold Pearl Harbor Radar Story

By Pat West



Ever wonder what happened to the radar set that detected the Japanese aircraft before the raid on Pearl Harbor?

This article reveals the fate of that SCR-270 radar set; informs you of some of the radar development background; and includes a couple of World War II stories illustrating radar use during that great war.

The SCR-270 was a radio-echo detection and direction-finding system for locating aircraft. It operated by transmitting a short-duration pulse of high frequency radio waves, which would be reflected or re-radiated by any metallic or conducting surface within the field of the directive transmitting antenna; therefore, one or more aircraft within the antenna field appeared as a source of reflected radio waves.

Rotating the antenna, which also served as the receiving antenna, provided a means for determining the azimuth or direction of aircraft. The system measured the time it took a blip or reflected return from the target to appear on a cathode ray tube indicator to give the distance or range to the detected aircraft.

The maximum range of the radar was about 250 miles up to 50,000 feet under all atmospheric conditions including rain, mist, smoke or fog, and during daylight or darkness. The azimuth and range data supplied by the set permitted the plotting of the location of detected aircraft on maps.

Design of the SCR-270 was initiated by the Army Signal Corps in 1936, and Westinghouse was given the production contract in 1940.

There were two versions of the radar design. The SCR-270 was the portable version, and the SCR-271 was the fixed station version. Westinghouse built 454 portable units and 334 fixed station units. The first SCR-270 radar was shipped on May 24, 1940. During the course of production, many changes were made to improve the radar performance.

The earliest version of the portable radar was the SCR-270B, which was the Pearl Harbor version. The SCR-270D represented the most improved version.

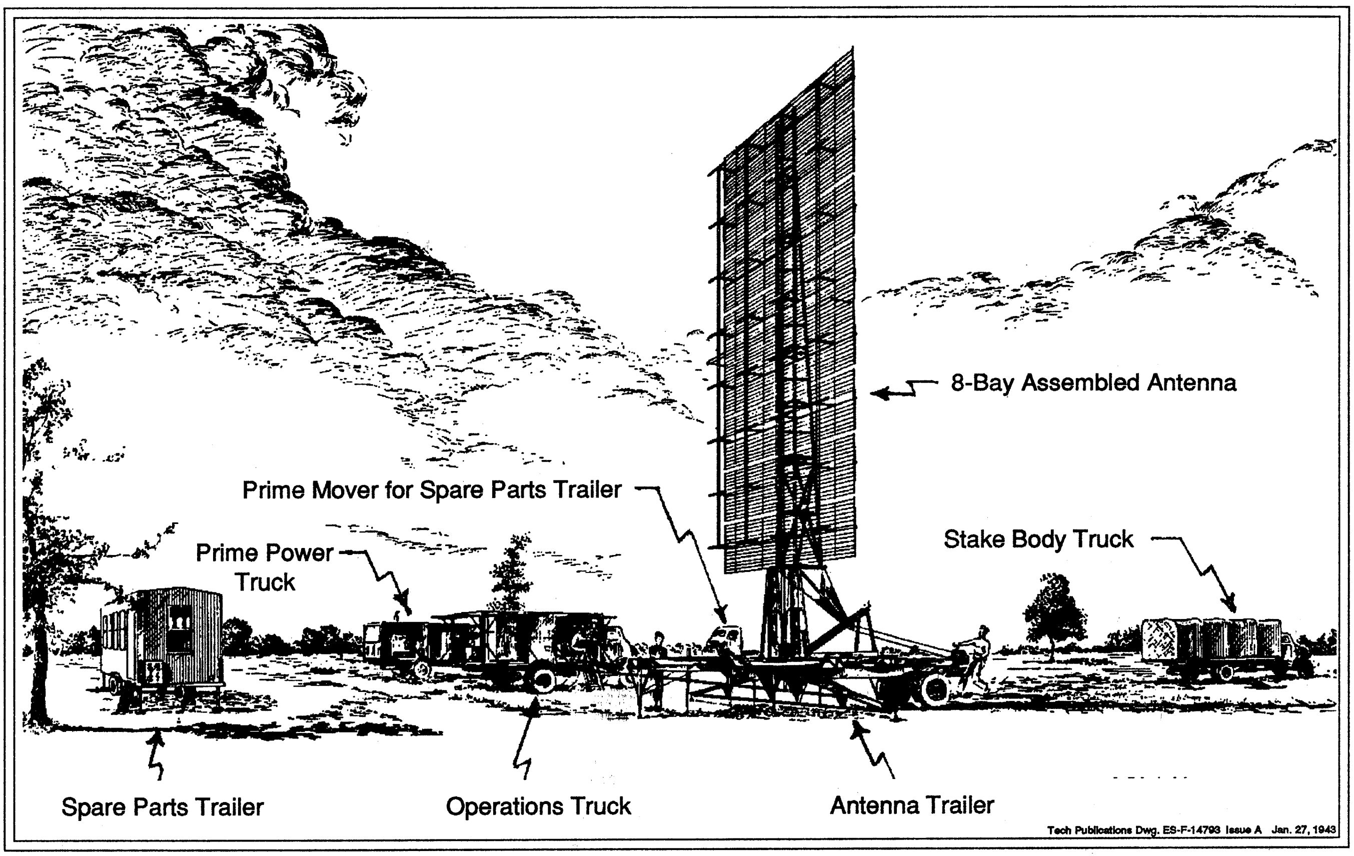
A significant difference between the two radars was in the antenna system. The

The irony of this story is that the only radar that reported the Japanese raid on Pearl Harbor ended up protecting Japan from possible air attack from the Soviet Union!

SCR-270B antenna elements were supported by a wood structure, whereas the SCR-270D structure was metal.

Antenna design in the late 30s was more black art than theory. Westinghouse had a final assembly building on Sandy Hook near Fort Monmouth, New Jersey. The antenna trailers and electronics were shipped from Baltimore, and a field test crew on Sandy Hook assembled the total set, and got it tuned up and running. There was no antenna range, so the test crew manually aimed the antenna at a large natural gas storage tank on the Brooklyn shore. One man would climb the antenna tower, and another would sit at the cathode ray tube indicator.

The man on the tower would bang away at the antenna elements, making them either shorter or longer, as the man on the indicator watched the indicator. The indicator operator would yell *up* or *down* as the



The SCR-270D radar on site (Signal Corps illustration). Facilities for operating personnel are not shown.

signal on the indicator varied.

When a maximum return from the gas storage tank was achieved, the test crew's job was done. The Army would then send in a crew to take the set away. Westinghouse Engineering in Baltimore worried as to what they could use as a test target if Brooklyn ever took their gas tank down!

A major task in setting up a radar system in the field consisted of mounting the antenna elements from the stake body truck on to the antenna mount trailer and running communications, power and control cables between vehicles. It generally took several hours to set up a station at a site.

Other vehicles were required to transport the station crew of about 100, which included radar and communications operators, maintenance people and other support personnel. Also, vehicles were required to transport communications equipment, cooking equipment and tents. A convoy usually consisted of 10 or 15 vehicles.

Fred Suffield and other radar engineers are fully convinced that an SCR-270 radar with its broad pulse, 104 MHz to 112 MHz frequency and "A" scope, with the possible addition of some newer receiver electronics, would detect any so-called "stealth" aircraft flying today.

Fred further says that, in fact, the stealth secrecy seems overdone. If you go to any advanced country and collect a group of physicists, mathematicians, chemists and electronics types, and give them a target of low radar reflectivity design, then they will all come up with about the same thing. They all work with the laws of physics, and the military has not been able to classify them yet!

In September 1941, tests of the SCR-270 radar at Pearl Harbor were so successful that Major General Short wired Washington that there was no possibility of a surprise attack on Pearl Harbor.

Just after 7 a.m. on Dec. 7, 1941, Corporal Joseph Lockard detected a large group of planes approaching the harbor. Upon contacting his superior, Lockard was told to ignore the reading. It was thought that the sighting was an expected incoming flight of B-17 bombers. Minutes later, Japanese planes descended on Pearl Harbor.

What happened to the radar that spotted the Japanese at Pearl Harbor? The writer has uncovered the facts resulting in the following untold Pearl Harbor radar story.

Colonel Richard H. Saurer, retired since 1974, was a captain and electronics officer of the 39th Air Division Defense during the 1950s. About 1956, there was ongoing activity to replace old radars with updated and improved ones.

The SCR-270 was an excellent radar for detection and tracking, but had no target altitude determining capability. Its accuracy was also not adequate for interceptor control.

As Colonel Saurer relates it, the officer in charge of Site 18, while reviewing the maintenance records for the SCR-270 being dismantled at that site, discovered that it was the same radar that Corporal Lockard used to detect the Japanese at Pearl Harbor.

The SCR-270B had been relocated from near Kaena Point, Oahu, Hawaii, to Wakkanai, Japan. The site was situated at the northern tip of Hokkaido Island. The site commander thought that such a historical piece of equipment should be placed in a museum. Therefore, he advised 5th Air Force but they said: "*Junk it.*"

Accordingly, the old historical radar was turned over to Air Force salvage, and the electronic components probably ended up on a scrap heap. Dick Saurer believes that, since there had been ~so much political controversy on this particular radar, the Air Force was anxious to get rid of it; in other words, sweep it under the rug!

The irony of this story is that the only radar that reported the Japanese raid on Pearl Harbor ended up protecting Japan from possible air attack from the Soviet Union!

Since 1981, the Historical Electronics Museum in Baltimore, Maryland, has been searching for an SCR-270 radar to add to its collection. If the old radar at Site 18 in Japan had been preserved, the museum would have had its radar! The museum volunteers have literally combed the face of the earth, with their search even leading them to China.

Historical Electronics Museum

For the past 10 years, the Historical Electronics Museum had been searching for an SCR-270 radar to add to its collection. The museum volunteers have literally combed the face of the earth, with their search even leading them to China.

Finally, in the spring of 1990, word came that two antenna trailers had been found at the University of Saskatchewan in Saskatoon, Canada. Originally used in atmospheric physics studies, one of the trailers and masts was then being used as a support base for a modern radar antenna in continuing studies of the aurora borealis or "northern lights."

The university's physics department graciously agreed to donate the antennas to the museum, and the difficult job of transportation of the 30-foot trailers began. Finally, on July 20, 1990, the trucks arrived at the museum with the antenna trailers.

During the course of 1991, the museum's staff and volunteers worked to restore one of the antennas to its working condition by Dec. 7, in time for the 50th anniversary of the Pearl Harbor attack. All of the restoration done on the SCR-270 trailer and antenna were to original specifications.

SCR-270 radar

The SCR-270 radar was one of the most significant of all historical U.S. Army Signal Corps developments. Development of this long-range, early-warning radar began in 1936 at Fort Monmouth, New Jersey, and Westinghouse received the production contract in 1940.

In September 1941, tests of the SCR-270 radar at Pearl Harbor were so successful that Major General Short wired Washington that there was no possibility of a surprise attack on Pearl Harbor.

Just after 7 a.m. on Dec. 7, 1941, Corporal Joseph Lockard detected a large group of planes approaching the harbor. Upon contacting his superior, Lockard was told to ignore the reading. It was thought that the sighting was an expected incoming flight of B-17 bombers. Minutes later, Japanese planes descended on Pearl Harbor.

Partially because of this incident, radar gained popular support. The SCR-270 provided a strong defensive tool throughout the rest of the war.

Westinghouse in World War II

Westinghouse was given the production contract for the SCR-270 in 1940. From 1940 to 1943, the Radio Division in Baltimore built 454 SCR-270s (mobile unit) and 334 SCR-271s (fixed unit) plus 142 sets of major components on contracts amounting to $38,863,931.59. Each SCR-270 unit cost $55,000; each SCR-271 cost $35,000. The first model was shipped on May 24, 1940. This marked the entry of the Radio Division into the field of radar.

To accommodate these plans for manufacture, Westinghouse constructed a plant at Lansdowne near Baltimore with more than 37,000 square feet of space. Production of the antenna trailers was subcontracted to Couse, a company in new Jersey.

Museum

The Historical Electronics Museum's address is P.O. Box 746, M.S. 4015, Baltimore, MD 21203; tel. 410-765-3803.

—From a museum brochure

An SCR-270 operator adjusts the oscilloscope controls while viewing the CRT through a glare shield.

Frederick G. Suffield, one of the Baltimore Westinghouse engineers at the time when this plant produced the SCR-270, told me recently that the current goal of the museum is to completely reconstruct an SCR-270. The only parts they have are a rusty water cooler, one receiver borrowed from the Smithsonian and one indicator that was a basket case before they rebuilt it. They are building a transmitter, power supply, and modulator from scratch.

In the spring of 1990, two antenna trailers were located at the University of Saskatchewan in Saskatoon, Canada. The physics department at that school graciously agreed to donate the antennas to the museum.

During 1991, the museum and volunteers worked to partially restore one of the big antennas to its working condition by Dec. 7, 1991, in time for the 50th anniversary commemoration of the Pearl Harbor attack.

In 1942, I studied the SCR-270 radar at the Signal Corps, Fort Monmouth, New Jersey, Radar School. I met Corporal Lockard at Fort Monmouth, where he was in the Officer Candidate School; however, his lips had been sealed by the government and he had nothing to say about his Pearl Harbor experience.

During 1942, I also taught the SCR-270 field installation and operation, in the Sarasota, Florida area. In Florida, we would proceed with a convoy of vehicles to a designated training area where we would set up the radar and operate it for several days giving our aircraft position reports to a control center where they would be plotted with those from other radars on a large horizontal plotting table, containing a map of that portion of Florida.

One late night my radar crew started reporting a large target to the control center. The target was approaching land from about 50 miles out in the gulf. The target was identified as hostile, and fighters were about to be committed when it was discovered that the target was moving at a rate of only about 30 miles per hour.

We at the radar site as well as those at the center

Missing pieces sought

Anyone who knows of any of the missing pieces of the radar that might be made available to the Westinghouse museum is asked to contact the museum at P.O. Box 746, M.S. 4015, Baltimore, MD 21203; tel. 410-765-3803.

The missing pieces include:

MC-298-A antenna position control
MC-391-A antenna PPI control
BC-349 frequency meter
BC-758-A keying unit
BC-403-D, -E or -F oscilloscope
PE-74 power unit
BC-404-C receiver
BC-785-A transmitter
RA-60-A rectifier
RU-4-A water cooling equipment
IE-20-A set of test equipment
TE-80-A set of tool equipment
MC-394 set of transmission equipment

were very embarrassed to discover that we had been tracking a cloud!

I had many unique experiences with radar during World War II, but a most interesting one occurred in France. We were a standby control center located near the city of Lyon. At that time, I was serving as communications officer for the center.

We used two control centers for our operation. One was active, and the second was usually on stand-by, but still plotted all targets. When a move was made, the stand-by unit would move forward and become the active center.

For several nights at about 10 p.m., an aircraft was plotted, flying from the direction of Stuttgart, Germany, toward Spain. About 4 a.m. each morning, another aircraft was plotted, flying in the opposite direction.

An intercept of the Stuttgart-to-Spain flight was planned. A British-built nightfighter called a Beaufighter was directed to the target. An intercept was accomplished, the aircraft was identified as hostile, and it was shot down.

Those who first visited the crash site stated that the aircraft was loaded with advertisements for German movies; however, all others were quickly banned from visiting the site, and we never found out what the aircraft contents were all about. Very strange!

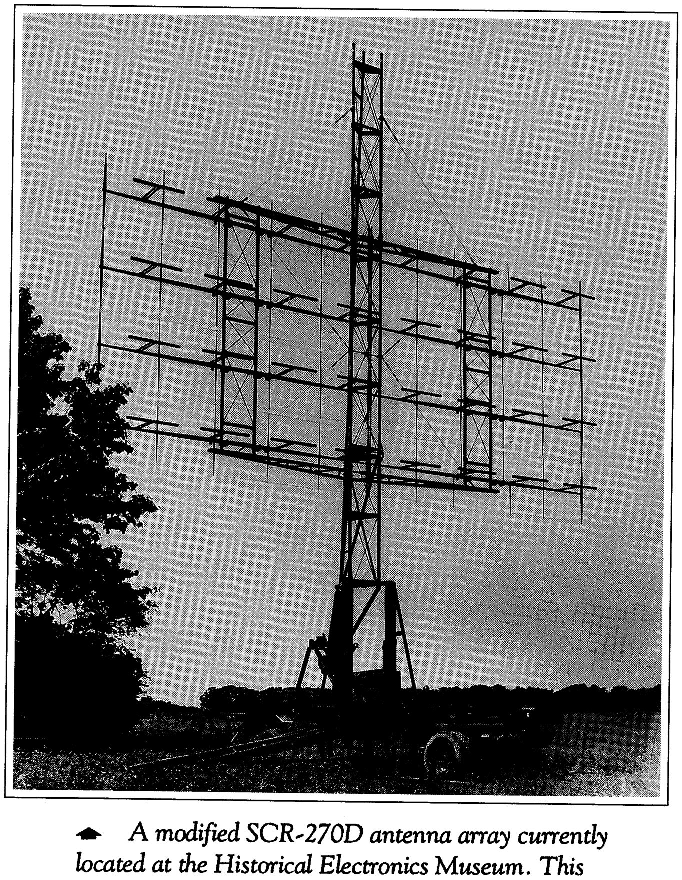
The official report stated that valuable documents and material were recovered from the wreckage. The interception was considered to be a significant Allied victory because it frustrated the enemy's attempt to use Spain as one of his last remaining sources of intelligence of the outside world.

The Germans were assembling B-17s from those that were shot down and were flying them on night bombing missions. It was customary for a night fighter pilot to obtain a visual observation before shooting down an aircraft identified by the control center as hostile. The pilot would not fire when he identified the aircraft as friendly; however, a German crew in a B-17 could then shoot down our night fighter.

I remember the incident when we discovered what was happening. Late at night, I was monitoring the radio frequencies we used and overheard the conversations between the controller and the involved aircraft.

The controller vectored the night fighter toward a hostile aircraft. The pilot identified the plane as a B-17 and was turning away, when I heard him shout: "My God, they are shooting at us! They got my radar man but he is alive! We are going down! I will stay with the airplane!"

The controller advised him many times to jump, but he stayed with his comrade and died in the resulting crash. Our future tactics were changed so that a visual identification was not required before shooting down a



A modified SCR-270D antenna array currently located at the Historical Electronics Museum. This array has four bays, each containing eight dipoles.

The SCR-270D antenna array had eight bays, each containing four dipoles.

Teaching radar

I recall an event from teaching the radar: The antenna transmission line entered the operating vehicle near the entry door. I would gather the students near the transmission line and explain that one could get a serious burn or could even be killed if the line were touched.

To illustrate, the radar was turned on, and I would take a lead pencil, hold it carefully, and draw about a 6-inch arc from one of the two transmission lines. It was a great safety demonstration!

—Pat West

plane identified by the control center as hostile.

Unfortunately, the full story about radar involvement in World War II, including the significant role of the SCR-270, has never been told, as the contributions of radar were sidelined by the events of the use of nuclear bombs at Hiroshima and Nagasaki. Radar played a major role in Europe by the detection and tracking of targets which resulted in the destruction of enemy aircraft and direct support of troops on the ground.

The 64th Fighter Wing, commanded by General Glenn O. Barcus, was under 12th Tactical Air Command in the Ninth Air Force. In January 1945, Colonel Nelson P. Jackson took over command of the wing when General Barcus assumed command of the 12th TAC. Control Center 2, with which I was involved in Nancy, France, primarily supported General Patch's 7th Army. Control Center 2 used the radio call sign BAGGAGE.

Aircraft controlled by BAGGAGE included those from the 27th, 50th, 84th, 324th and 358th Bomb Groups, and the 417th Night Fighter Squadron. Principal aircraft involved during that phase of the war were the P38, P51, P47, P61 (Black Widow) and the British built Beaufighter.

Some accomplishments during early 1945 include the following, which represent single-day records from January through April, 1945:

- 19 aircraft destroyed in the air.
- 157 aircraft destroyed on the ground.
- 40 locomotives.
- 654 railroad cars.
- 23 tanks.
- 15 armored vehicles.
- More than 1,000 motor transport.
- 125 horse-drawn vehicles.
- five bridges.
- 12 barges.
- 442 buildings.

(continued on page 47)

SCR-270-D RADIO SET PERFORMANCE AND CHARACTERISTICS

(Source: SCR-270-B Radio Set Technical Manual, Sept. 22, 1942)

Maximum Detetion Range	250 Miles
Maximum Detection Altitude	50,000 Feet
Range Accuracy	± 4 Miles*
Azimuth Accuracy	± 2 Degrees
Operating Frequency	104-112 Mhz
Antenna	Directive Array **
Peak Power Output	100Kw
Pulse Width	15-40 Microsecond
Pulse Repetition Rate	621 CPS
Antenna Rotation	Up to 1 RPM Maximum
Transmitter Tubes	2 Triodes***
Receiver	Superheterodyne
Transmit/Receive Device	Spark Gap

* = Range accuracy without calibration of range dial.
** = Consisting of dipoles, 8 high and 4 wide.
*** = Consisting of a push-pull, self excited oscillator, using a tuned grid, tuned cathode circuit.

Fort Shafter, T.H.
Territory of Hawaii

Personally appeared before me, the undersigned, as authority for administering oaths of this nature, one Grover C. White Jr., s-396182, 2nd Lieut., Signal Corps, Signal Company, Aircraft Warning, Hawaii who after being duly sworn according to law deposes and sayeth:

1. At the request of the Control Officer and Naval Liaison Officer the AWS agreed to operate its detectors beyond the daily period of two hours before until one hour after dawn. The first schedule required operation of all staitons from 4 a.m. to 6 p.m. This schedule was modified to the hours of 4 a.m. to 6 p.m. A temporary schedule was next devised which required all stations to operate from 4 a.m. to 11 a.m. and to have "staggered" operation, i.e., 3 stations from 11 a.m. to 1 p.m., the remaining 3 stations from 1 p.m. to 4 p.m. On Saturday, December 6, 1941, I contacted the Control Officer to request authority to have all stations operate from 4 a.m. to 7 a.m. only on Sunday, December 7, 1941; this was agreed to by the Control officer.

2. Staff Sergeant Stanley J. Wishas, SCAWH, acting RDF Officer, reports that he saw nothing that could be construed as suspicious in the information received by the AWS Information Center from 4 a.m. to 7 a.m. Sunday, December 7, 1941. This is verified by Lt. Kermit A. Tyler, Air Corps, who was the only officer in the Information Center from 4 a.m. to 7 a.m.

3. At approximately 7:20 a.m. a report was received from a Detector station at Opana that a large number of planes was approaching Oahu on a course North 3 degrees East at a distance of appproximately 132 miles. This information was immediately transmitted by the switchboard operator, Pfc. Joseph McDonald to Lt. Tyler, who talked to Opana about the flight. The statement of Pfc. Joseph McDonald, SCAWH, the switchboard operator is attached.

4. The Navy Liaison Officer's position within the Information Center was not manned when I reached the Information Center at about 8:20 a.m. This position was manned shortly thereafter by Technical Sergeant Merle E. Stouffer, SCAWH, who remained on the position until approximately 4:30 p.m. when the position was taken over by Naval Officers.

Further the deponent sayeth not.

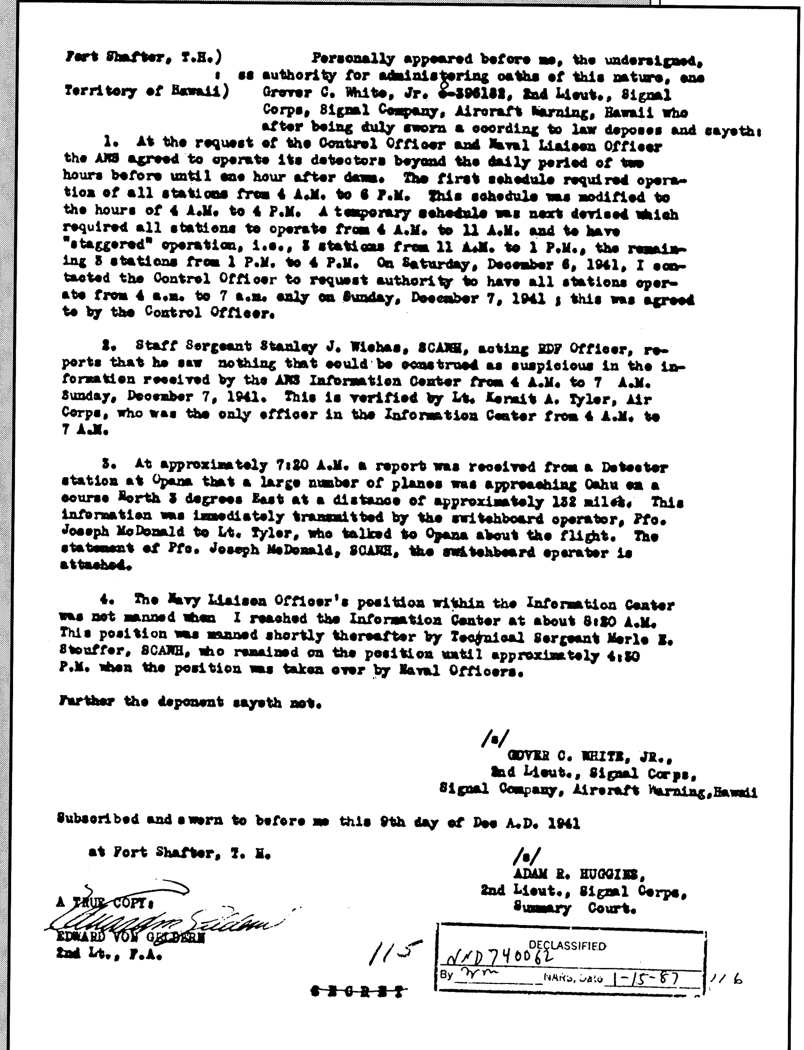
Signed, Grover C. White Jr.
2nd Lieut., Signal Corps, Signal Company, Aircraft Warning, Hawaii.

Subscribed and sworn to before me this 9th day of Dec A.D. 1941 at Fort Shafter, T.H.

Signed, Adam R. Huggins, 2nd Lieut., Signal Corps, Summary Court.

A true copy:
Signed, Edward Von Gelder, 2nd Lieut., F.A.

Declassified 1-15-87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GOVER C. WHITE, JR.,
2nd Lieut., Signal Corps,
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Subscribed and sworn to before me this 9th day of Dec A.D. 1941

at Fort Shafter, T. H.

/s/
ADAM R. HUGGINS,
2nd Lieut., Signal Corps,
Summary Court.

A TRUE COPY:
EDWARD VON GELDERN
2nd Lt., F.A.

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DECLASSIFIED
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By [illegible] NARS, Date 1-15-87

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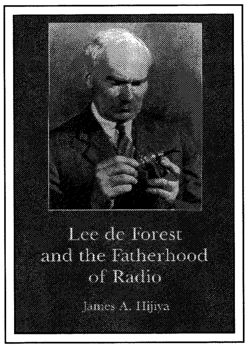


Book Review

Lee de Forest and the Fatherhood of Radio

Reviewed by Don Bishop

Lee de Forest and the Fatherhood of Radio focuses on the American inventor's "spiritual quest" for immortality, which intertwines with his lifelong pursuit of *fame*.

According to the author, James A. Hijiya, it was through enduring fame that de Forest expected to achieve immortality. Although he spurned the conventional notions of an immortal soul, he wanted to avoid the "spiritual death of living without purpose" through a fame that would keep his memory alive forever.

The title echoes that of de Forest's own *Father of Radio: The Autobiography of Lee de Forest*, published in 1950. In the autobiography, de Forest gives himself much credit for the development of radio communications and broadcasting.

...Hijiya finds de Forest's pursuit of fame to be a demonstration of his will, strength and endurance.

Furthermore, the title is apt because part of Hijiya's book evaluates the strength de Forest's claim that he was the father of radio. He finds the claim weak for a several reasons: For one, the accuracy of de Forest's theoretical explanations of his radio-related inventions and the extent to which he may have used other people's ideas as though they were his own are debatable. For another, his results as a manufacturer of radio apparatus and as a broadcaster were limited.

Although some historians may find de Forest's claim of credit for certain inventions and subsequent developments to be weak, Hijiya finds de Forest's pursuit of fame to be a demonstration of his will, strength and endurance.

De Forest chronicled his school experiences, romantic quests and lack of friends in his diaries, and Hijiya covers them, often using excerpts of de Forest's own words.

De Forest married and divorced three times before finding a lasting union with a wife who remained devoted to him until his death. He never had the son he wanted who would carry on his name, but he loved his three daughters. (He had a son who lived only two days.)

Because the invention that gave Forest's the most fame is the *audion*, the author includes much information about that invention and the controversy about its place in history in relation to similar inventions and de Forest's development.

Hijiya makes an interesting distinction between *invention* and *discovery*, crediting de Forest with the audion's invention (meaning the creation of a working device) and others with its discovery (meaning the accurate explanation of how it works and its further development).

The audion patented by de Forest was an improved radio detector. As a most basic definition, a radio detector converts a radio signal into a visible or audible indication so the information it carries can be understood. The audion not only converted radio signals but amplified the resulting audio energy so operators could hear even weak signals over their headphones.

The later version of the audion was called a triode electron tube or vacuum tube. "Triode" refers to the use of three electrodes.

The early audion's glass envelope was not fully evacuated. Residual ionized gas sustained the current flow. "Audion," Hijiya recounts from the record, means "audible ions," which the author interprets as showing that de Forest meant to use gas ionization to hear wireless signals.

In contrast, electron emission sustains current flow in modern vacuum tubes. It was engineers at AT&T and General Electric who, at about the same time in 1912, realized the need to evacuate the tube thoroughly to make the audion powerful and durable enough to be widely used as an amplifier. De Forest had clung to the notion that residual gas was necessary.

De Forest sold patent rights for the audion to AT&T, and never realized as much profit from the invention as he later thought he should have.

Hijiya recounts that De Forest also patented an invention called Phonofilm for recording sound on film for motion pictures. For a time, the movie studios resisted talkies in favor of silent films, delaying the production of talkies. Later, one studio chose an inferior method called Vitaphone that used a phonograph record synchronized with a film, and another used a sound-on-film method called Movietone that was devised by a former de Forest collaborator.

With nearly all his money gone and no market for his Phonofilm, de Forest was left with a patent to denote his achievement, but no fame.

The inventor came close to making millions. Had he developed his audion instead of selling the patent rights to AT&T, he might have earned more from the invention.

Had the federal government not shut down his New York broadcasting station in 1920, he might have reaped substantial rewards from the station when the broadcasting business boomed later that decade.

And had he guarded his sound on film development more carefully and captured the public's imagination with his early talkies, Phonofilm might have won him his fortune.

During the latter half of his life, de Forest continued to pursue fame. Hijiya describes some of his later inventions, none of which gained much attention and no marketing success. De Forest wrote numerous letters to publications and appeared on broadcast programs. He used his autobiography as a vehicle for promoting his place in history, although only 2,500 copies had been distributed during the two years following its publication.

Hijiya's book helps to clarify why de Forest's name did not reach the highest ranks of inventors in the public mind, despite his determination from an early age to make it so. In addition, we are given a look at de Forest's personality and at the people who helped to shape his life.

Lee de Forest and the Fatherhood of Radio by James A. Hijiya is published by Lehigh University Press, 440 Forsgate Drive, Cranbury, NJ 08512; telephone 609-655-4770; fax 609-6558366; ISBN 0-934223-23-8, $32.50.

Don Bishop (LF) is co-editor of the Proceedings.

The Untold Pearl Harbor Story
(continued from page 45)

In addition to these, there were hundreds of close air support missions, which represented about 60 percent of all missions. Additionally, many lost aircraft were guided safely to home airfields.

The infantry loved us because our fighter-bombers bailed them out on many an occasion. Our unit developed a significant number of the tactics for close air support that are used even today and probably were used in the Gulf War, and the SCR-270 radar was the backbone of our system.

On Dec. 7, 1991, 50 years after the SCR-270 radar provided an unheeded 53-minute warning of the Japanese Pearl Harbor attack, the individuals who designed, developed and operated the first U.S. military radar during wartime, reminisced at a recent ceremony held at the Historical Electronics Museum. They gathered to recognize the historic role of radar in detecting the attack.

C.P. "Pat" West, P.E., (M) a graduate of Purdue University, West Lafayette, Indiana, is a retired Boeing Engineer of nearly 35 years. Much of his activity at Boeing was spent in the Command, Control and Communications area. He was in the Signal Corps during World War II, and spent three years in Africa and Europe.

He was involved in radar and communications during nine campaigns and five beachhead landings while chasing the Axis armies through eight countries and over 2,500 land miles. He exited the service as a captain in 1946.

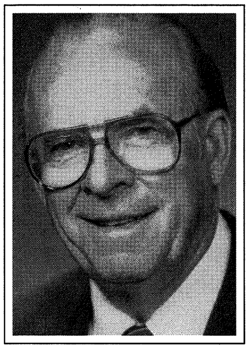
The majority of his writing during Boeing years was technical. As an amateur radio enthusiast of 56 years, he has published several articles in amateur radio publications.

He is a registered professional engineer and a life senior member of the IEEE and, he has held most of the IEEE management positions in the Seattle area. He is also an associate fellow of AIAA.

He holds the Amateur Extra class license and remains active in that great hobby with the station call W7EA. He is also an avid trout fisherman and swings a wicked but very inaccurate golf club.

Has been married for 46 years to the same gal, and they have two sons. Currently, he is writing memoirs and has completed 50 articles such as "The Untold Pearl Harbor Radar Story."

Silent Keys



R. James Evans (F)

R. James Evans, 78, of East Lansing, MI, died Oct. 29, 1993 of congestive heart failure and coronary artery disease. He had served as president of the Association of Public-Safety Communications Officials - International (APCO). He also was a life member of APCO and served as president of its Michigan chapter.

He joined the Michigan State Police in 1938, retiring in 1972 as chief of communications. He then became program manager of communications with the Criminal Justice Program in the Michgan governor's office.

He retired from state service in 1976 and established a communications consulting firm, Evans & Evans Associates, from which he retired in 1993. He was responsible for implementing many 9-1-1 centers throughout the United States.

Evans was born in Owosso, MI, and lived in the Lansing area since 1952 after moving there from Paw Paw, MI. He was a member of All Saints Episcopal Church and attended Notre Dame Unviersity. He was a 32nd degree Mason and a Shriner, and he was past master of the Paw Paw-Lawton Lodge of Masons.

He leaves his wife, Mabel; three children, Carol Evans Cox Verboon of Hanford, CA; the Rev. William Evans of Alexandria, VA; and Janet Sue Evans Strait of Grand Rapids, MI; and five grandchildren, Kimberli S. Cox, Fresno, CA; Robert James Cox, Fairfax, VA; Katherine and Sara Elizabeth Evans, Alexandria, VA; and Nathan Strait, Grand Rapids, MI.

Funeral services were held Nov. 2, 1993, in East Lansing. Memorial contributions may be made to the American Heart Association.

— *APCO Bulletin and family members*

Jorman I. Koski (F)

On Dec. 4, 1993, the land mobile industry lost one of its genuine pioneers.

On that date, Joe Koski passed away in Fort Worth, TX, during his 77th year. Joe, a product of Finnish parents, was born, raised and graduated from high school in Brooklyn, NY. He began his communications career in New York City, building transmitters for international broadcasting.

He came to Fort Worth with the Civil Aviation Administration and ended up with the fledgling Communications Division of that city. Returning to the city after service as an electronics instructor for the U.S. Navy during World War II, he became assistant superintendent of communications.

At an age when most people are concentrating on their careers, Joe entered Texas Christian University. While there, he won a number of writing awards and earned his B.A. degree.

He was made superintendent of communications for Fort Worth and, under his guidance and inspiration, many innovations in mobile radio were conceived and created. Among them were the first rear fender-mounted, ruggedized motorcycle two-way radio; modular plug-in dispatching console equipment; and high-powered transmitters. Production lines were set up, and when other duties didn't interfere, employees of the Communications Division assembled equipment under Joe's tutoring.

Joe was the Associated Public-Safety Communications Officers' (APCO) frequency coordinator for Texas during public safety two-way radio's explosive growth in the 1950s. He later served as national president of APCO.

In his civic life, Joe was a Mason and an amateur radio operator (W5KSX and ex-W2JRZ). He was president of the Kilocycle Club, a promoter of Finnish-American associations and active in the City of Fort Worth's retirees' organizations. An excellent musician, he was "Band Dad" for Fort Worth's Amon Carter-Riverside High School.

He is survived by his wife, Josephine; two sons, Jorman of Albuquerque, NM; and Wayne of Fort Worth; and several grandchildren.

Joe, you were a class act, and we sorely miss you.

— *Charles M. White (F)*

Lloyd D. Colvin (M)

Lloyd D. Colvin, W6KG, 78 years old, died Dec. 14, 1993, in Istanbul. He was born April 24, 1915, in Spokane, WA. His wife of 55 years and DXpedition partner, Iris Colvin (M), W6QL, survives him.

At the time of his death, both Lloyd and Iris had received permission to operate from Turkey. Lloyd did not operate, but Iris did, briefly, as TA1/W6QL. Lloyd suffered an apparent stroke, was hospitalized, and died shortly thereafter.

Lloyd Colvin first was licensed as a radio amateur in 1929, and his early interest in radio led to an Army career in the Signal Corps. He served 30 years, retiring as a lieutenant colonel in 1961.

In the 1950s and '60s, he was a general contractor and president of Drake buildings, building houses, apartments and hospitals in the San Francisco Bay area.

In 1965, the Colvins began traveling the world, and in the nearly three decades that followed, they visited 223 countries, operating from half of them. Their reputations as ambassadors preceded the, enabling them to obtain permission to operate when most others couldn't (although a few stone walls stood, in countries such as Burma and Bhutan). The American Radio Relay League board of directors recognized the Colvin's contributions to international goodwill by naming them Amateur Radio Ambassadors of the Decade 1980-1990.

The Colvin's last major trip was to Southeast Asia in 1992.

Over the years, the Colvins made more than a million contacts and had more than a half-million QSLs on file.

In addition to his wife Iris, Lloyd Colvin leaves a daughter, Joy Gilcrease, and two granddaughters, Justine and Vanessa Gilcrease.

There was no public service, and his remains were to be scattered at sea.

— *ARRL Letter*

Grants-In-Aid Fund Donation

Mary McCormick, left, and Dan Lowndes, right, receive their winners' plaques from Steve Aldinger. Lowndes' time for the course was 17:32 with a pace of 5.65. McCormick crossed the finish line in 27:49 with an 8.97 pace. There were 117 entrants.

Celwave has donated $1,600 to the Radio Club of America Grants-In-Aid Fund. The money represents proceeds from entry fees paid by competitors in the Third Annual International Wireless Communications Expo 5K Fun Run/1 Mile Walk in Las Vegas on April 14, 1994.

Steve Aldinger (F) presented a check for the donation to President Emeritus Fred M. Link on April 15 at a breakfast sponsored by the Southwest section of the Club.

Electronics Wizard No 'Pending Patentor'

By Julie A. Carson

Looking for someone to develop that one electronic gadget, thingamabob or doohickey that will make your contrivance work just right?

Look no further than Frank Shepard, a member of the Kiwanis Club of Summit, NJ, whose inventive work placed him in the Radio Club of America (RCA) nearly 60 years ago.

Founded in 1909, the RCA is comprised of about 1,200 executives, engineers and amateurs in the radio field. Frank fondly remembers joining the club in 1935.

"At first, I just sat and listened in awe..."

"At first, I just sat and listened in awe at the accomplishments and knowledge of the other members of the club," he says, including radio engineer William Finch and electrical engineer Barrett Hazeltine, both experts in their specialties. "It's people like that whom you get to meet and talk to that are such an inspiration."

Frank also has gained acclaim in radio, largely through his work as a consultant. Among his patent achievements:

- He conducted basic research into hearing aids, patenting to Zenith one with "nonlinearity that would bridge the gap (present in the ear) if you had nerve deafness because of the harmonics of the intermodulation piece."
- He developed new circuitry for weather information-gathering equipment. "The Weather Bureau (later known as the [U.S.] National Weather Service) used to send balloons to the upper atmosphere," Frank explains. "They'd measure winds and radio the signals back to earth. My circuit made the equipment more reliable and able to send more signals (such as) temperature, height and humidity."

He developed a splicer for film. "DuPont had developed a new movie film, and there wasn't any glue that would stick it together after splicing and editing without affecting the grain quality of the film," he says. "I made a high-frequency radio oscillator to heat the film rapidly enough that it wouldn't affect its quality."

That just skims the surface. Frank has more than 125 patents, and his work ranges from amplifiers and small radios to high-speed printers, hydraulic gun controls and electric signs.

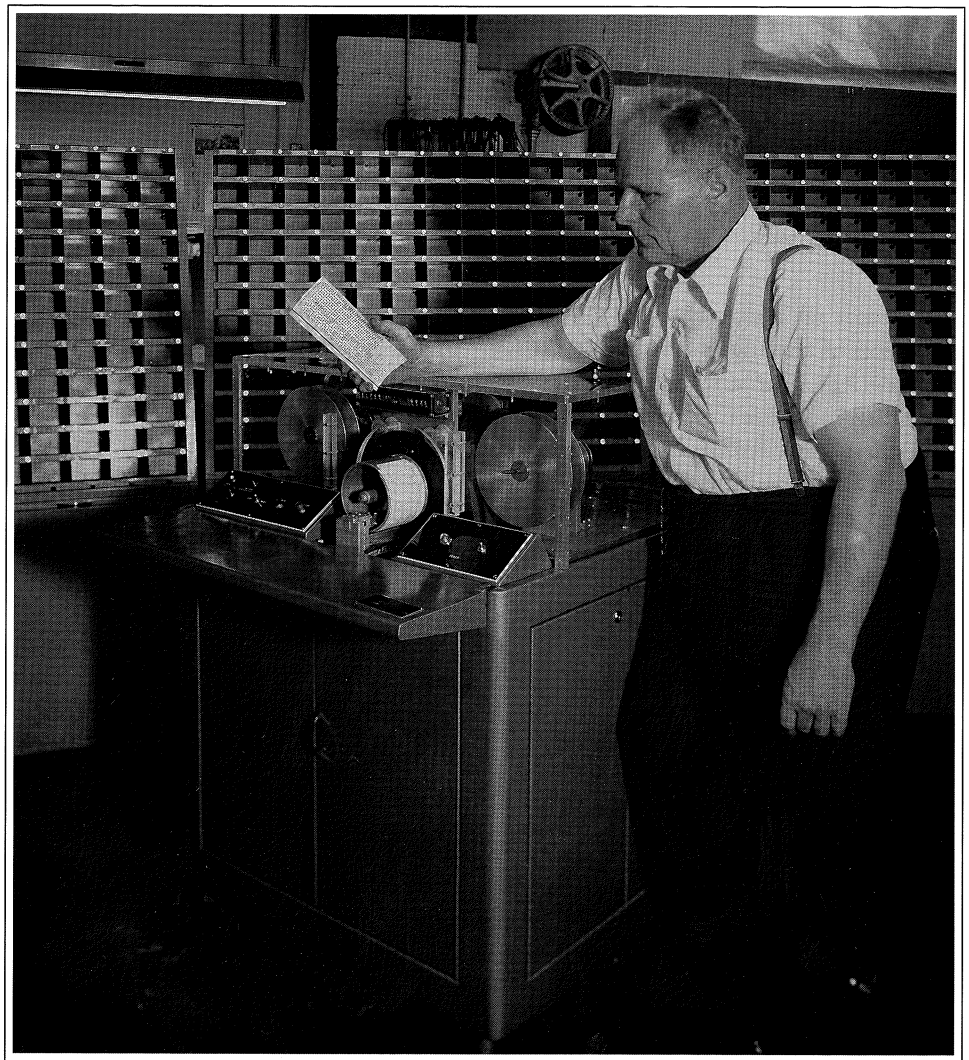
Frank explains the patenting process. "If my idea solves one of (a company's) problems, I'll assign the title of the patent to that company, but my name is listed as the original owner of the patent. Then, I have the right to sell the patent to companies in fields not in competition with the company I did the original work for."

A life member of the RCA, Frank has filled many offices in the club, including director, secretary, president, and (currently) secretary emeritus. He serves on the club's election committee, which entails annually reviewing 500 to 600 applications for membership into the group. The club presented Frank with the Armstrong Medal for outstanding contributions to radio art and science in 1993.

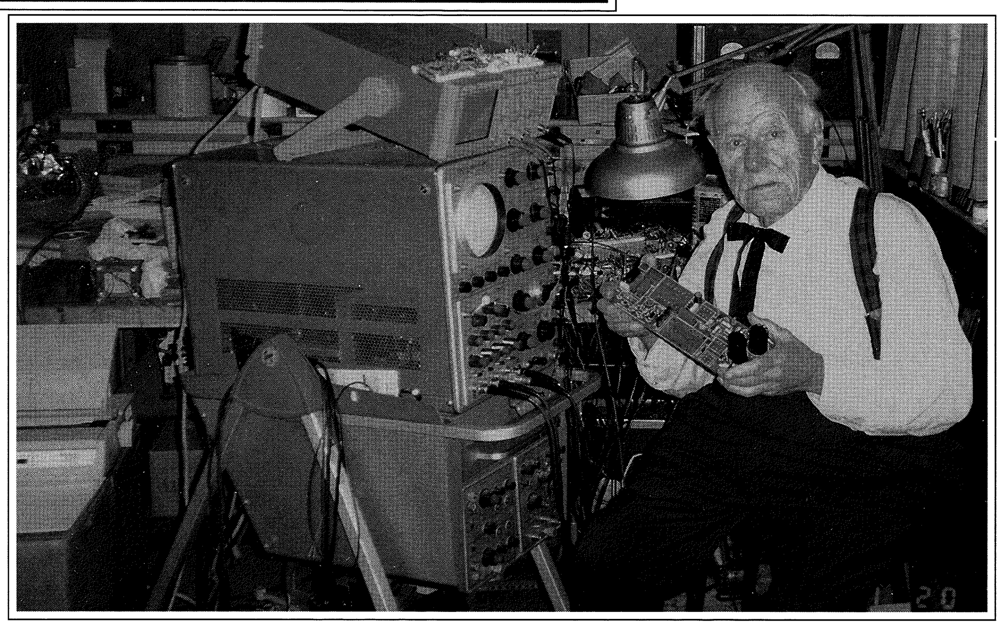
At age 88, Frank continues to do consulting work and spends much of his time in his laboratory.

"Right now, I'm working on (developing) electronic controls that will help drive or operate elevators or automobiles," Frank says. Odds are, his current efforts will result in yet another patented invention.

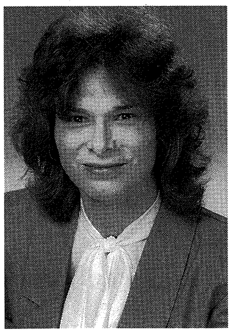
—Kiwanis Club of Summit, NJ



In 1961, Shepard prepared a printout for Sperry's NAVDAC computer for the first inertially navigated Polaris submarine, including electronics and printer, and delivered the first system of a series within 10 weeks from the initial conference.



Shepard at work in his laboratory in Summit, NJ, in January 1994.



The Teacher: John D. Ryder (1907-1993)

By Rikki T. Lee (M)

This is not an obituary; rather, it is the celebration of the life and works of an important teacher. Last summer, the radio and electronics industries lost one of their brightest lights: John Ryder, Ph.D. When he passed away on July 28 at age 86, he left behind family, friends and students — plus an enormous library of books and articles that future generations will read and discover the genius of the teacher.

Jack was a superb educator, but most of all a great humanitarian

Professionally, his life accomplishments are too large in number and importance to be included in this brief and somewhat late remembrance. However, an appreciation of the size and scope of Ryder's achievements cannot be gained otherwise.

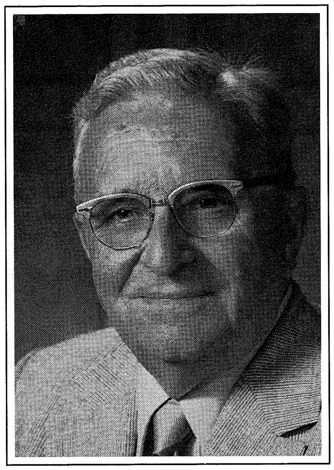
- Experience: director of electronic research at Bailey Meter Co. (1931-41); professor and assistant director of engineering experimental station at Iowa State University-Ames (1941-49); head of Electrical Engineering Department,

University of Illinois-Urbana (1949-54); Dean of the College of Engineering (1954-68) and professor of electronic engineering (1968-72) at Michigan State University-East Lansing; and professor of electronic engineering, University of Florida-Gainesville (from 1972).

- Other engineering educational accomplishments worldwide: adviser of Guindy College and Poona College (1961-63); established engineering school at University of the Ryukyus in Okinawa, Japan; served as external examiner for the first graduating classes in engineering at the University of Nigeria in Nsukka (1967); Vice-Chief of Party for the USAID Higher Education Project in Rio de Janeiro (1966-68); and visits to other engineering schools in Long Kong, New Zealand, Australia and Japan.
- Member of the Radio Club of America since 1983 and a Fellow since 1984. Also, he was a Fellow of AMS, a Fellow of IEEE and past president of the IRE (Institute of Radio Engineers, which merged with the American Institute of Electrical Engineers into the IEEE; he was a Fellow of both organizations). He was also a Rotarian.
- Michigan State University named its new engineering facility the John D. Ryder Building.
- Amateur radio licenses since 1924: 8DQZ, W8DQZ, W0VDE, W9VDE and K4IHX.
- Assisted in the birth of IEEE and member of the first board of directors. In 1974 he was the IEEE's executive vice president. First editor of the IEEE, launched *Spectrum* in 1963. While with the IEEE, he was chairman of the History Committee, the Centennial Task Force and the Friends of the Center for the History of Electrical Engineering.
- His many awards: Distinguished Alumnus, Ohio State University (1957); Man of the Year, National Electronics Conference (1970); Distinguished Alumnus, Iowa State University (1974); Paul Harris Fellow, Ocala Rotary Club (Rotarian of the Year, 1985); and Radio Club of America's Ralph Batcher Award (1987). His numerous IEEE awards include: the Haraden Pratt Award, Outstanding Electrical Educator, Education Society Achievement Award, Centennial Medal, and "Key to the Future." He was

also a member in the *Spectrum* Electrical Engineering Centennial Hall of fame, and an Education Society Achievement Award.

- Ryder owned 25 patents in temperature measurement and control, motor control and analog computation: High-Speed Self-Balancing Potentiometer (1938), Control of Wound Shading Pole Motors (1942), Electrical Calculator (1943), Network Analyzer Generator (with W.B. Boast, 1952), etc.



- Eight technical textbooks: *Networks Lines and Fields* (2nd edition, 1955), *Fundamentals of Radio* (1958, co-author), *Electronic Engineering Principles* (3rd edition, 1961), *Engineering Electronics* (2nd edition, 1967), *Introduction to Circuit Analysis* (1973), *Electronic Circuits and Systems* (with C.M. Thomson, 1976), *Electronic Fundamentals and Applications* (5th edition, 1976) and *Engineers and Electrons* (with D.G. Fink, 1984). He also contributed to the 1974 *Encyclopedia Brittanica* "Electrical and Electronics Engineering" section.
- About 50 technical papers, including: "Tube Control of D-C Motors (*Electronics*, April 1936), "The Renaissance in Electrical Education" (*Electrical Engineering*, 1951), "An Experiment in Reduction of Physics Content" (*Journal of Engineering Education*, 1958) and "How the Students Spoke" (*Radio Club of America Yearbook*, 1985).

On a more personal side, Ryder is survived by his wife of nearly 60 years (Sylvia), his son, daughter and four grandchildren.

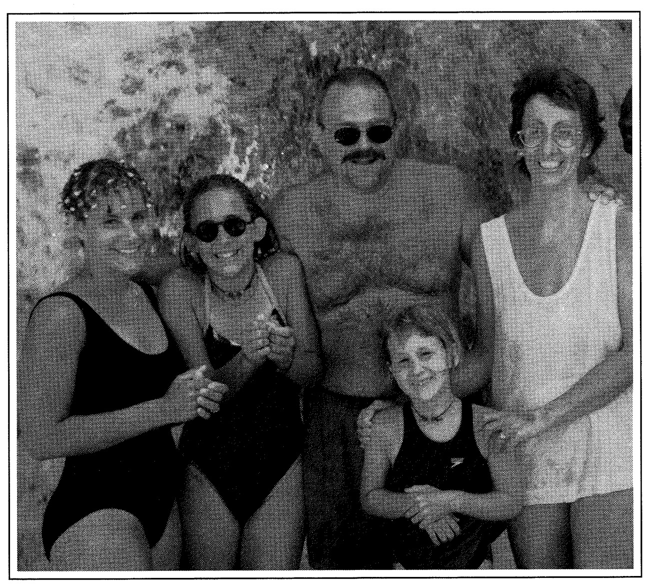
We cannot leave this tribute of John Ryder without mentioning his influence his many students. As a student at Case Institute of Applied Sciences, Al Gross first met Ryder in 1937. "He was my mentor and lifelong friend," Gross said. "It was his encouragement and guidance that gave me the incentive to pursue and develop my patents in two-way radio and paging. With personal wireless growing as it is, Jack Ryder had a guiding hand in its creation.

"Jack was a superb educator but most of all a great humanitarian. I had the honor and pleasure to bring into the Radio Club of America a man of his character. I miss him."

Joe Fairclough...

(continued from page 28)

Aid for the past four years. The Crew has also received attention from Senator Goldwater and from Mayor Koch of New York. Joe, in recognition of the work he is doing, was invited to the Reagan inauguration. In 1984, he was named Teacher of the Year by the American Radio Relay League.



The Fairclough family on holiday: Joe WB2JKJ, wife Juanita and daughters Jessica, KB2DLX, Johanna and Justine.

Joe's wife, Juanita; and daughters Jessica, 16, KB2DLX; Johanna, 12; and Justine, 6, are enthusiastic supporters of Joe's productive program. It all doesn't leave much time for anything other than school, but he does enjoy rebuilding cars and drag racing. Can it be that drag racing is calming after a week with 180 seventh and eighth graders!

WB2JKJ and the 22 Crew maintain schedules with other schools and with individual amateurs around the country. In the morning from 7 to 8:30, the class talks locally to classes in other schools about current events, the Big Apple, the weather and other topics. The rest of the day they may be found (when not learning code or English via code) on 21.395 MHz as the control station of the Classroom Net, which involves classes around the country. The 22 Crew can be contracted on the air between their regular schedules. It would be great if each of you readers checked in with the "Core of the Big Apple," radio station WB2JKJ, on 21.395MHz. Congratulate them and Joe.

John G. Troster (M) lives in Atherton, CA. His amateur radio station call sign is W6ISQ. Reprinted from Worldradio.

The Radio Club of America, Inc.

Founded 1909, New York, U.S.A.

WORLD'S OLDEST RADIO COMMUNICATION SOCIETY

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Date:____________________

TO: THE EXECUTIVE COMMITTEE

I hereby apply for membership in THE RADIO CLUB OF AMERICA, INC. and agree, if elected, that I will be governed by the Club's Constitution and By-Laws as long as I continue to be a Member.

____
Signature

Full Name:____
(FAMILY NAME) (GIVEN NAME) (INITIAL) (CURRENT AMATEUR CALL)

Home Address: ____
(STREET) (CITY) (STATE) (ZIP CODE)

Business Address:____
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Telephones: Home (____)______________, Business (____)_________________ Ext. ____________

Birthplace ____________________________________Date of Birth: ____________________________

Education and memberships in other clubs and societies: ____________________________________

____

____

In what particular branch of the Communications Art are you most interested? ____________________________

Present occupation: ____

In what year did you become interested in electronic communications?____________________________

Previous experience (indicate approximate dates): ______________________________________

____

____

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Please list the names of two or more members to whom you are personally known and who will sponsor you. A letter of recommendation must be submitted by one of the sponsors, and entered on the reverse side, before submission to the membership chairman.

Sponsors

____

Mail this application to the Membership Chairman, Mrs. Vivian Carr, at 645 Hoey Avenue, Long Branch, NJ 07740, with $25.00 entrance fee, plus $40 for three year's dues, in U.S. funds. made payable to The Radio Club of America, Inc.

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