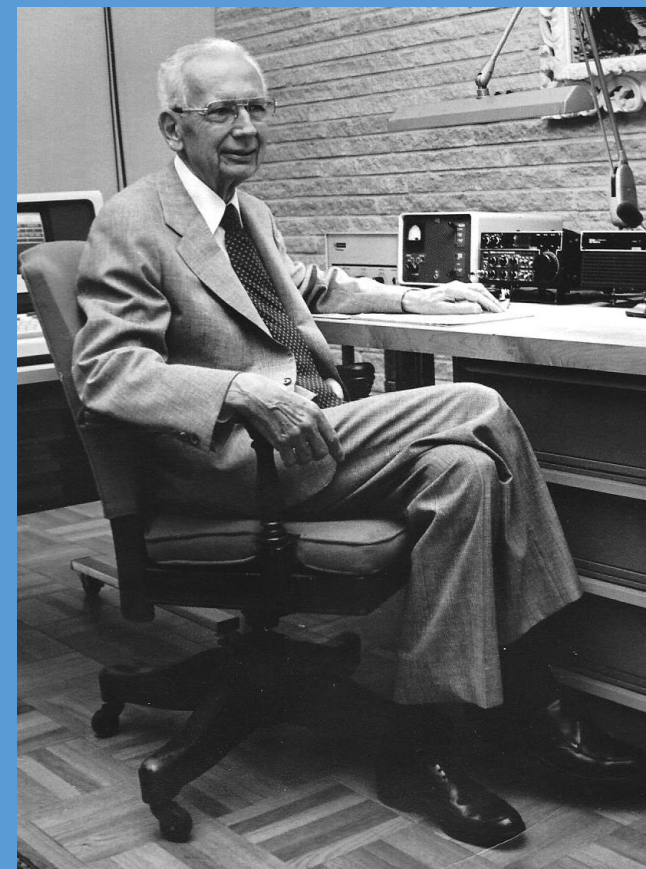




A PERSONAL RETROSPECTIVE OF ARTHUR COLLINS

Michael M. Collins



Introduction: The following article is based on a Power Point presentation I gave in Dayton, Ohio, May 20, 2016, to the Collins Collectors Association.

I chose to present my father as an historical figure by placing him in a time line of innovation and invention in physics and electronics that both influenced him in his early years and to which he later contributed.

In the judgment of others, he was an empirical inventor within the realm of electronics comparable to Marconi or to Bill Gates and Steve Jobs among contemporary luminaries.¹

Under his leadership, basic research at Collins Radio produced systems and products at the leading edge of innovation in radio communication, antenna design and radio wave propagation, avionics, and the marriage of computers with telecommunication.

1. Stearns, B., 2002. *Arthur Collins: Radio Wizard*; Barnes, M. Interview in *A Culture of Innovation*. A.A. Collins Legacy Association. 2014.



Frictional electrical machine (18th Cent.) Museum of History of Science, Florence ITALY



J. B. Jenkins' replica of AAC's 1925 MacMillan transmitter.

Craftsmanship in scientific apparatus: Respect for the **elegance of Structure and Order in Nature**. AAC was born during, and influenced by, a **second renaissance in experimental physics**.

Historical Perspective: If you leave the Pitti Palace, and cross over the Ponte Vecchio bridge in Florence Italy you need only to walk a short way to the Museum of the History of Science. Here you will find a wonderful collection of scientific apparatus, even including one of Galileo's original telescopes. These are machines of inquiry beautifully made of brass, wood, and glass. Their design and craftsmanship show a respect for the complexity and order in nature.

Every amateur radio operator knows that poorly made machines don't work well. Scientists have always been skilled tinkers.

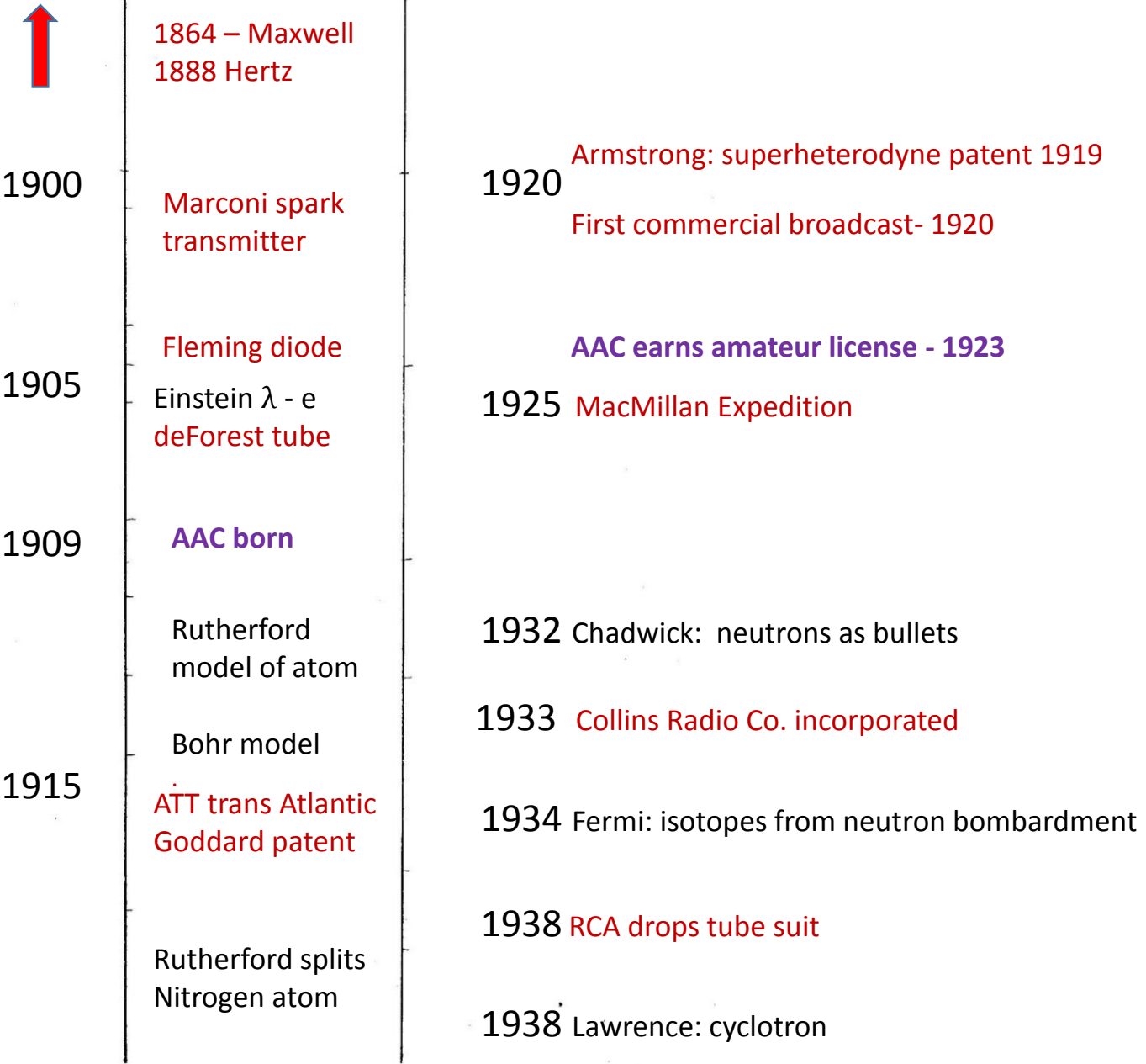
On the left is a 400 year old static electricity machine, sponsored by the Medici court, and used as entertainment - a kind of parlor trick at social gatherings - but also a tool of research during off hours.

Art Collins' MacMillan Expedition transmitter, on the right, also reflects the same reverence for good design and construction, which later became a hallmark of Collins Radio.

TIMELINE: AA Collins was born during the birth of the New Physics, when the nature of matter was revealed - an exciting time of **synergy between theory and experimentation**.

Radio wave propagation was in the *experimental* phase. The **physics of radio** fascinated AAC.

— *the gateway of the atom, we are in a world our senses cannot experience. There is a new architecture – which we cannot know: we can only try to picture it by analogy, a new act of imagination.*
—Jacob Bronowski, 1973, *The Ascent of Man*.



It is always important to place an historical figure into a time-line.

The early 20th Century was the age of the New Physics when a synergy developed between the theorist and the experimental physicist. Theory drove experimental design; early results led to modifying the theory, establishing a creative cycle.

The work being done then on the nature of the atom, and research in Radio Science were endpoints in a continuum, with the electron literally flowing between them.

Atomic physics was in the news, and must have inspired a young Art Collins. Early radio oscillators, modulation schemes, and wave propagation were inherently empirical topics.

Art Collins quickly exhausted published radio theory and began a career as a disciplined experimenter, but with a working knowledge of theory.

The MacMillan Expedition set was an early triumph (see The Collins Story video "*Steps To The Moon*").

In the chart notice first the long gap between Maxwell's equations on electromagnetism, and the first spark gap transmitter experiments by Hertz. Another long gap exists until Marconi built his primitive transmitters.

The mathematics of electronics preceded by several decades the expression of theory in practice as generators, motors, or oscillators producing radio waves.

It's fascinating to see that the jump from the spark transmitter to tube oscillators occurred just before Dad was born, and that the super heterodyne receiver was invented when he was only 10; in four more years he had his amateur license.

He was lucky to have access to the latest vacuum tubes; most of his friends were using crystal sets and spark gap transmitters. This early radio work was being done just when some of the most fundamental discoveries in physics were made concerning the structure of the atom. Rutherford's 'solar system model' (electrons as planets) was soon supplanted by Bohr's model of orbital shells separated by quantum gaps in energy states.

All this must have been very exciting to the curious mind of Art Collins.

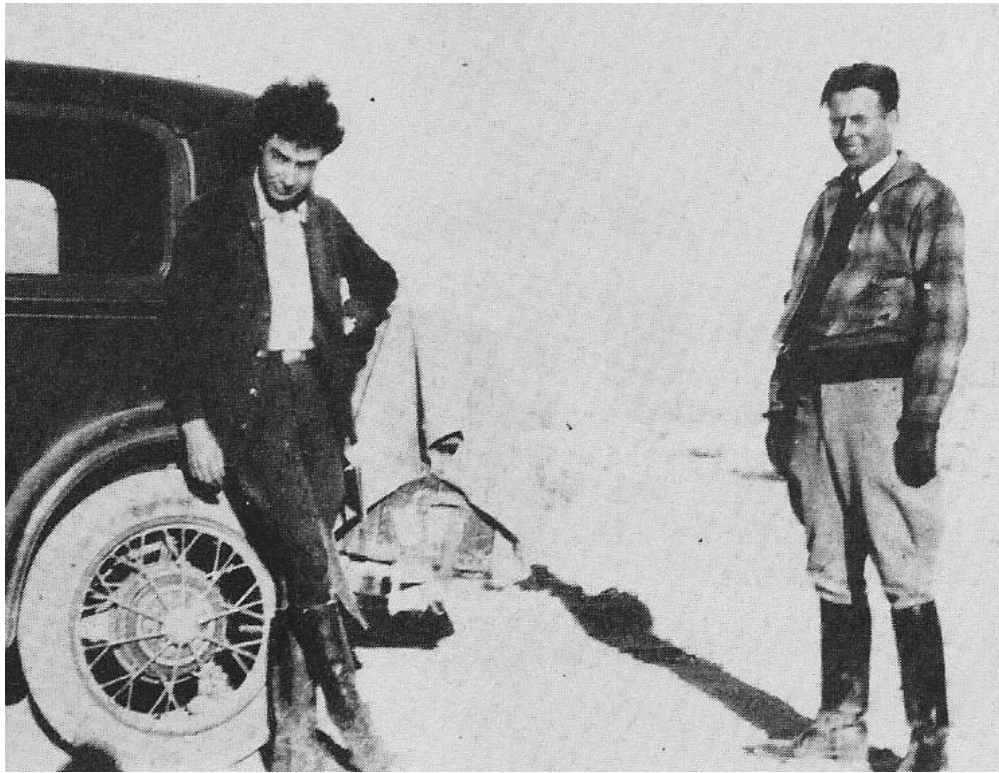
One could also argue that the early success of Collins Radio owed much to Goddard, and his vacuum tube patent, which broke the RCA monopoly following Art Collins' discussions with Goddard.

That's a long story told in detail in Ben Stearns' book *Radio Wizard*.

"When we step through the gateway of the atom, we are in a world which our senses cannot experience. There's a new architecture there; a way that things are put together which we cannot know."

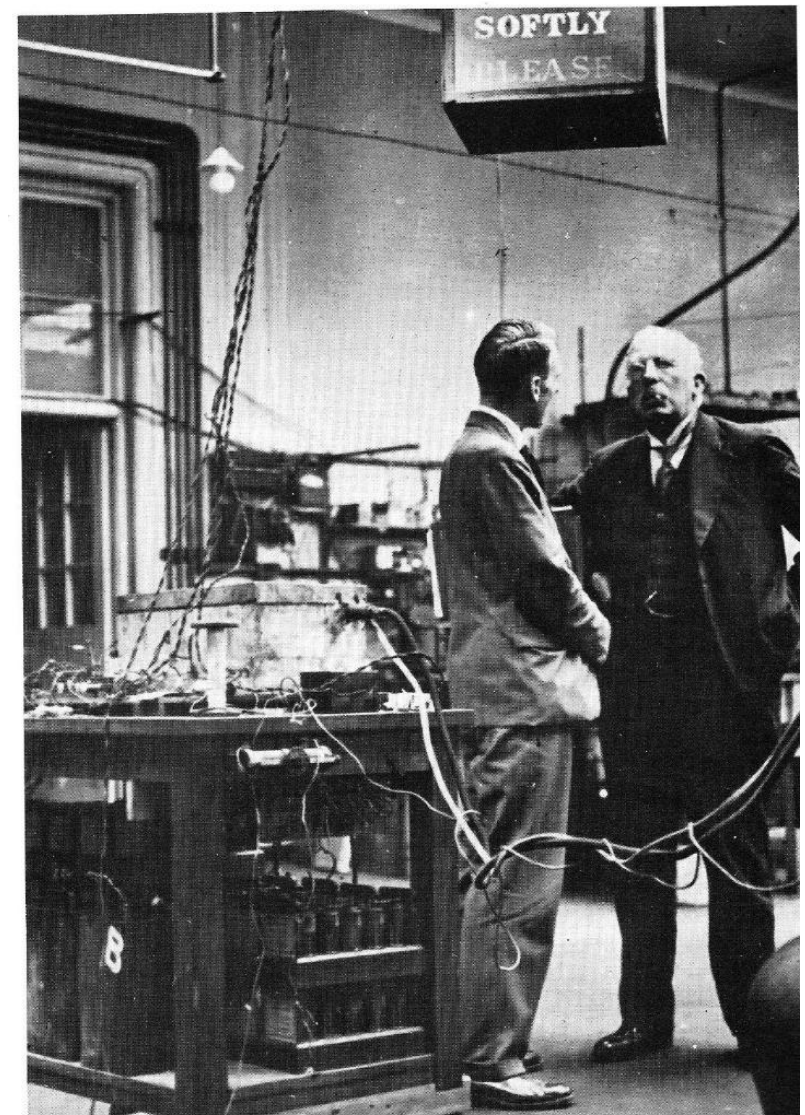
—Jacob Bronowski, 1973, *The Ascent of Man*.

The quote from Jacob Bronowski reminds us that our brains evolved to perceive and interpret a material-based/cause and effect reality. Quantum jumps and the wave/particle duality challenge our imagination as does the transformation from electron flux to propagating radio waves and back again to electron oscillation at the receiving antenna.

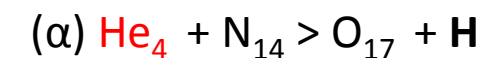


Their stances tell a story: **Robert Oppenheimer** the theoretical physicist; **Ernest Lawrence** the take-charge experimentalist – Berkeley CA *circa* 1940.

The synergy of theory and experiment. AAC lived in both worlds.



Ernest Rutherford – the premier experimentalist; wonderful, hand-made apparatus in cluttered under-funded Cavendish Labs, Oxford, 1910



Here are some human figures that illustrate my remarks.

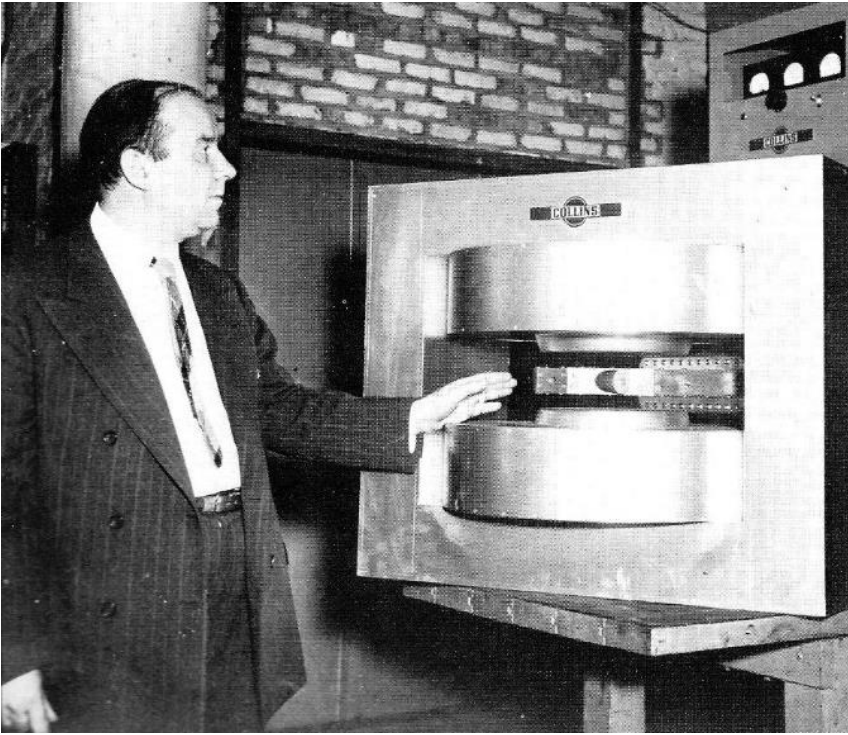
The casual slouch of Oppenheimer typifies a theorist, somewhat disconnected from his surroundings. With his alert posture, Lawrence is obviously an experimentalist.

Art Collins would later meet Lawrence when Lawrence's graduate student and Dad's boyhood friend Winfield Salisbury introduced the two in a project that led to Collins Radio building cyclotrons for Argon and Brookhaven research Labs.

On the right is Ernest Rutherford. With only modest funding from Oxford his famous Cavendish Lab was relegated to the basement.

His motto was: "Build it carefully, but make the apparatus as simple as possible, yet still able to do the job".

Rutherford used radium as a natural source of alpha particles (essentially helium [He] atoms), and studied their nature in a vacuum chamber with a 'scintillation' screen. He found more H atoms being produced than could be accounted for in the radioactive source material. He realized he had 'split' the nitrogen atom, present in small amounts in the partial vacuum, producing a different element, the oxygen isotope O17.

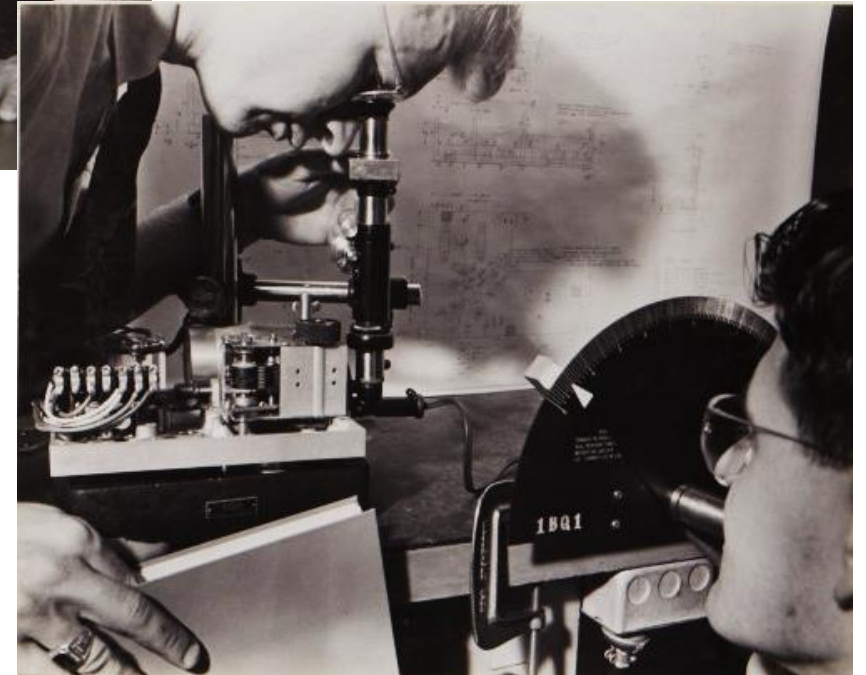


AAC & Frank Davis with pre-war Autotune

The Autotune demanded extraordinary precision in mechanical engineering

Winfield Salisbury and model of Collins cyclotron

Salisbury was a link between Collins Radio and Ernest Lawrence at Berkeley Labs. Both Radio Science and Atomic Physics demanded precision apparatus.



Here is a photo of Winfield Salisbury with a Collins cyclotron.

To finish up my point that physics and electronics share a heritage of precise mechanical apparatus, notice on the right the technician checking the exacting tolerances of an Autotune® module.

How to sum up a comparison of Arthur Collins with historic figures?

Thomas Edison is probably the paragon example of an early entrepreneur.

Edison became famous as an applied engineer - using basic electro-mechanical principles to design and build practical devices for the consumer market.

Arthur Collins lived in both the theoretical and experimental worlds of electronics.

He is today recognized (by too few - see the AACLA video documentary "*A Culture of Innovation*") both for his genius in innovative concepts, and also for designing and building complex devices serving society's needs.

His intellect was more similar to Rutherford (Oxford) or Ernest Lawrence (U.C. Berkeley cyclotron), but his accomplishments contributed to the common good in the manner of Edison.



AAC inspects soy bean crop,
properly attired in suit & tie.



a bulletin of
THE COLLINS FARMS COMPANY

More Bushels from Fewer Acres

The kind of agriculture which has been introduced into the American scene by M. H. Collins cannot be called "chain farming" nor "machine farming" nor "corporation farming." These terms are either inadequate or misleading. We, who have been brought up to regard farming as a tradition — as a mode of living — have no neat phrase in our minds which conveys the picture. The Collins Farms Company employs power machinery in all its field operations. It farms large areas under unified management. It uses its size and reputation as an institution.

Issued at Cedar Rapids
August 15, 1930



Collins Farms — a collective based
on latest farm equipment, farming
techniques and hybrid seed corn.

M.H. Collins was also an innovator & entrepreneur
Collins Farms nourished the sprouting Collins Radio Co.

Family History: And now a quantum leap, from cyclotrons to soy beans.

My grandfather Merle Hunter Collins was also an innovator who formed Collins Farms as a collective of small farms, each sharing the latest farm machinery, planting hybrid seed corn, and using modern practices such as contour plowing and crop rotation.

He was initially quite successful but Collins Farms fell victim to the Depression.

MH then became the de facto CFO of Collins Radio.



MH's home, Cedar Rapids, IA. Built with limestone blocks quarried in Stone City. The attic ham shack faced the back yard.



Faith Andrews Collins
Mrs. M.H.



Merle Hunter Collins, at work at
Collins Radio *circa* 1940

This is the boyhood home of Art Collins, built with limestone from Stone City, the attic ham radio shack was in back, with antenna wires to beautiful oaks that you can still see there today.

Unusual for a woman at that time, Faith had a college degree from Rockford College.



**Collins Family Home in Cedar Rapids, circa 1980.
Addition with Redwood Siding built about 1954.**

Original house in background at right.

My uncle Jack Van Dyke painted the *fresco* mural in the entry way.



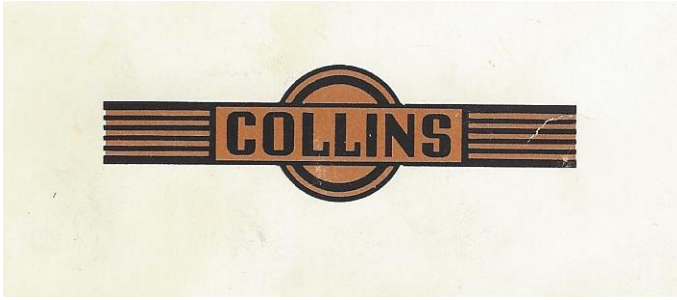
The original Collins home was a two story house, with the single story addition added in about 1954, using redwood siding.

Notice the fall color reflected in the picture window.

My uncle painted this mural of the house.



Peg Van Dyke – late 1920s



Peg Collins designed this early logo

AAC and Peg married in 1930. 2 children, Susan and Michael.

Peg Collins was a well-known artist, recognized for her expressive portraits and humorous “mural art”. She and her brother Jack Van Dyke were both students of Grant Wood, famous for “American Gothic”.



Margaret “Peg” Van Dyke Collins 1954

My mother is rarely mentioned in stories about my Dad. She was a very talented artist, a student of Grant Wood (*American Gothic*), and a member of the Thomas Hart Benton school of mural art.

She also designed this early Collins logo.

“Pin Ball Game” Small town Iowa.

Peg Collins was a member of the Thomas Hart Benton School of 1930s ‘regionalist’ or ‘mural art’.

Much is happening in a small space.

Note exaggerated depth perspective, casual intrusion of man’s legs.

Faces tell the story of how the game is going.

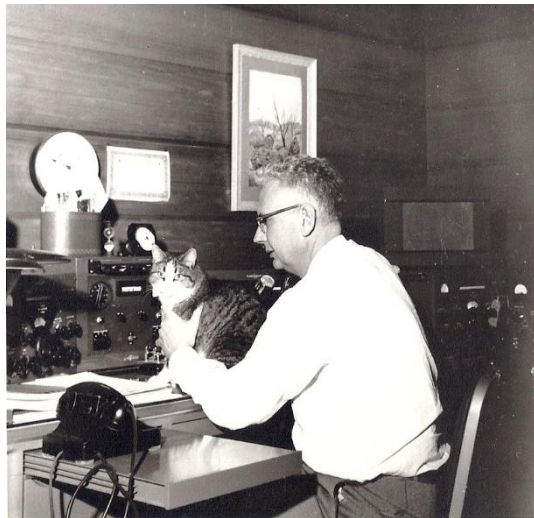




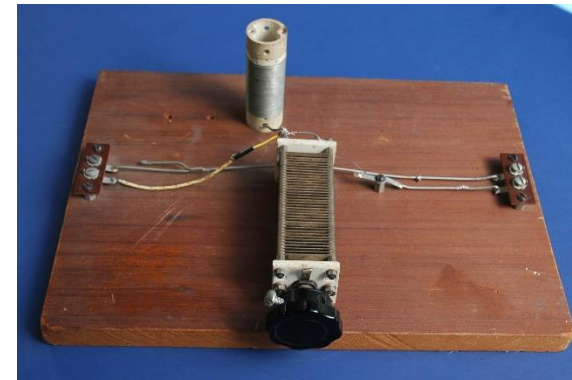
Goddard and early tube display



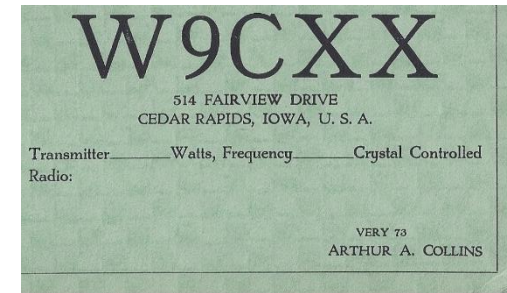
Rocky Mt. Rig 9ZZA mobile



AAC and Katy Lou in Cedar Rapids ham shack about 1956.
Pet tree frog (not shown) chirped in synch with Dad's CW



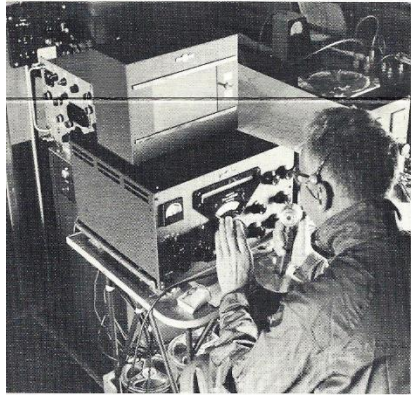
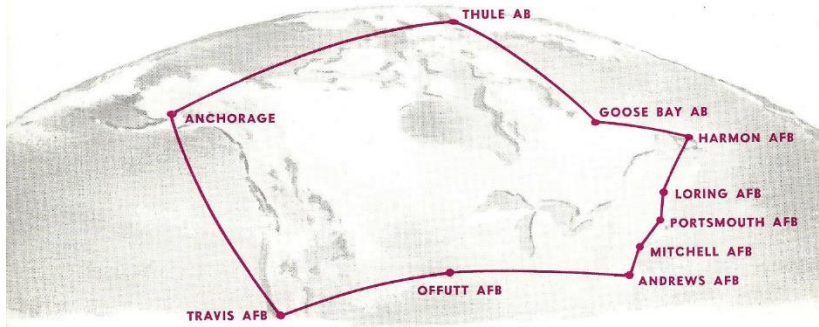
"Crystal set", build by
AAC & MMC 1954



Attic era QSL card

Shown above: a display in AAC's office of Goddard's and other early tube designs; the panel truck used in the Navy-sponsored cross country trip to study radio wave skip and propagation; and Dad in his ham radio station at home.

WØCXX/M



This card confirms your contact with WØCXX/M, aboard a United States Air Force Strategic Air Command C-97 during a recent trip in the North Pole region. Amateurs aboard the aircraft were Maj. Gen. F. H. "Butch" Griswold, KØDWC; Lt. P. J. "Phil" Ferrell, W7PUG; Leo Meyerson, WØGFQ, and Art Collins, WØCXX. Col. Jack Bestic, chief of SAC communication/electronics, also assisted in the operation. Some 1200 contacts were made on the KWS-1/75A-4 SSB station during the 10,000 mile trip. In addition to contacts with a ham SSB net in the U. S. and with 24 other countries on all continents, the station established direct inter-polar sideband contact with Little America and Ross Island stations of the Navy's Operation Deepfreeze. The inter-polar contact covered 11,000 miles each way and involved two auroral zones, one in summer and one in winter condition. Thanks for the QSO.

Amateur radio _____ Your _____ kc

SSB signals were S _____ during our QSO at

_____ GMT, _____ 1956, QTH _____

aboard USAF, Strategic Air Command C-97 in flight in the North Pole region.

Equipment: Collins 75A-4 receiver and KWS-1 transmitter, 25 ft. fixed wire antenna, 60 cycle standard equipment was operated from 400 cycle 115 volt supply available in the aircraft. A noise-cancelling microphone permitted VOX operation.

A. A. "ART" COLLINS, WØCXX
201 34th St., S. E.
Cedar Rapids, Iowa



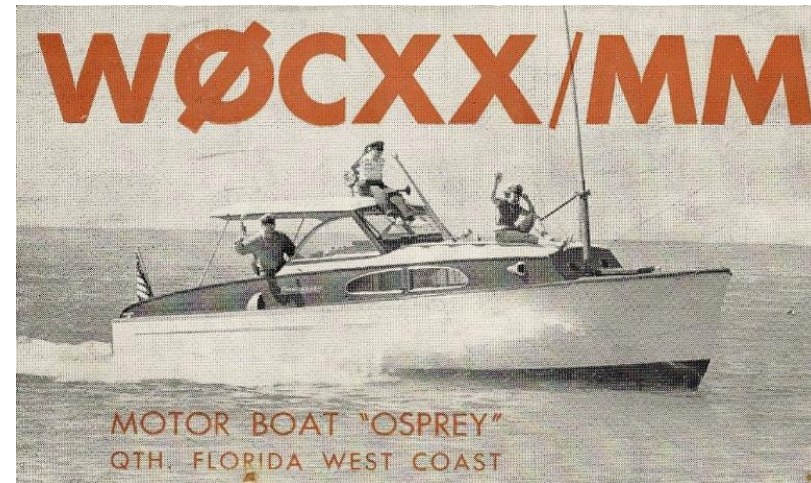
SSB
Polar
Demo
Flight

1956

QSL
Keepsakes



Willie
Butch
Art



AAC
Mike
Susan

1956

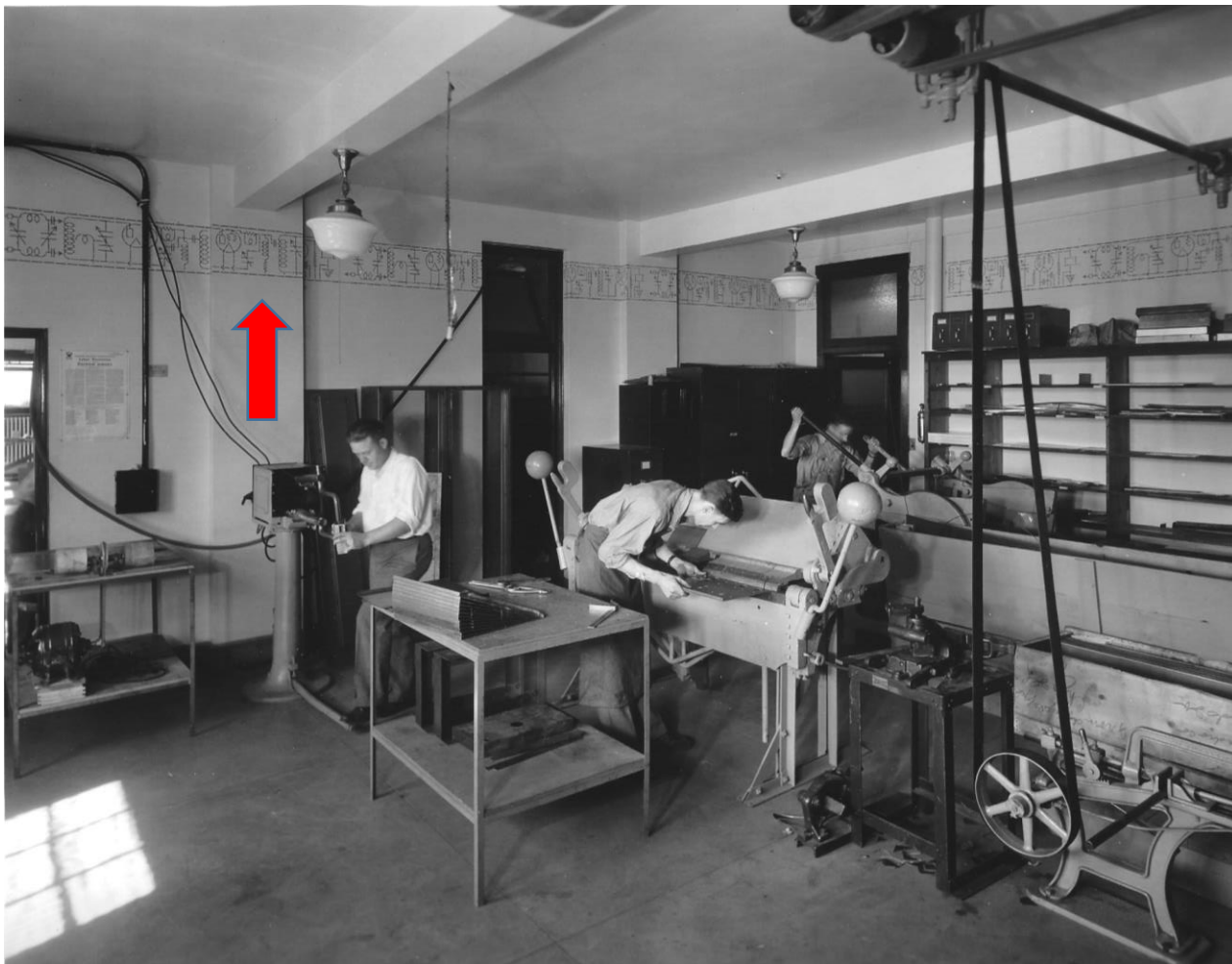
Young people today don't understand the edge of fear that was an undercurrent during the Cold War.

For nuclear deterrence to work, both the US and the Soviets had to demonstrate a credible weapon system, but also assure the other side that a central authority had full command.

Before Single Side Band (SSB, a superior modulation technique perfected by Collins Radio) communicating with the bomber fleet was often unreliable, which could threaten the credibility and stability of nuclear deterrence.

SSB was more than a technology breakthrough; it literally helped keep the peace.

See **Collins Radio and The SAC HF SSB Demonstration Flights** in the "Stories Section" of this web site.



Ted Saxon (l) and John “Slim” Dayhoff (rt). Note schematic wall art and non-OSHA drive belts. Dayhoff became head of Fabrication in Cedar Rapids

“All work spaces are to be kept neat and clean” – AAC, 1948 memo

12-Series Transmitter production
1930s 1st Ave. Cedar Rapids



Keeping your work place clean was always important.

It's a family tradition that his offspring have inherited to only a limited degree!



AAC at
controls of
twin Beech



AAC with first B-18 twin Beechcraft



Vern Ritger, AAC, Gen. Doolittle, Max Burrell

Airplanes & AAC



SSB circumpolar demo flight SAC C-97



Art's first plane ... a Rearwin Sportster

Dad got his pilot's license about 1930 and flew until he got bifocals!

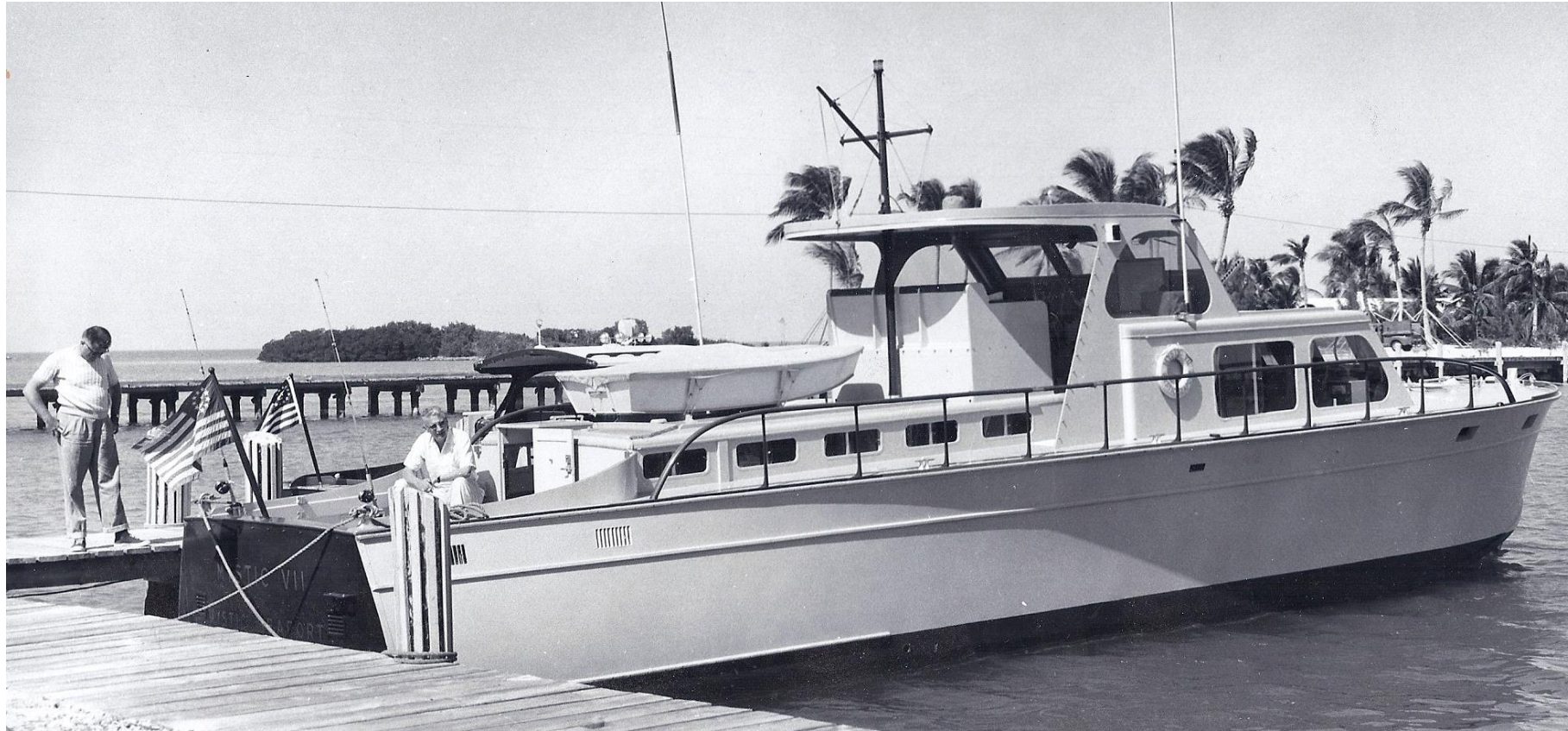
Certainly, the Horizontal Situation Indicator and later flight directors owe a lot to his experiences with primitive instruments in the 1930s.

He blamed his time in open cockpit aircraft as the cause of hearing loss.

His personal plane in the mid-1950s was a Beech Bonanza with the V tail. We flew this plane to visit friends in New Mexico, whom he had met earlier through Goddard.

The head company pilot in the 1960s campaigned for a corporate jet, but the boss said the short Cedar Rapids to Dallas hop didn't justify the extra expense. The Gulfstream turboprops were fine airplanes.

Boats were AAC's only "escape mechanism" for relaxation



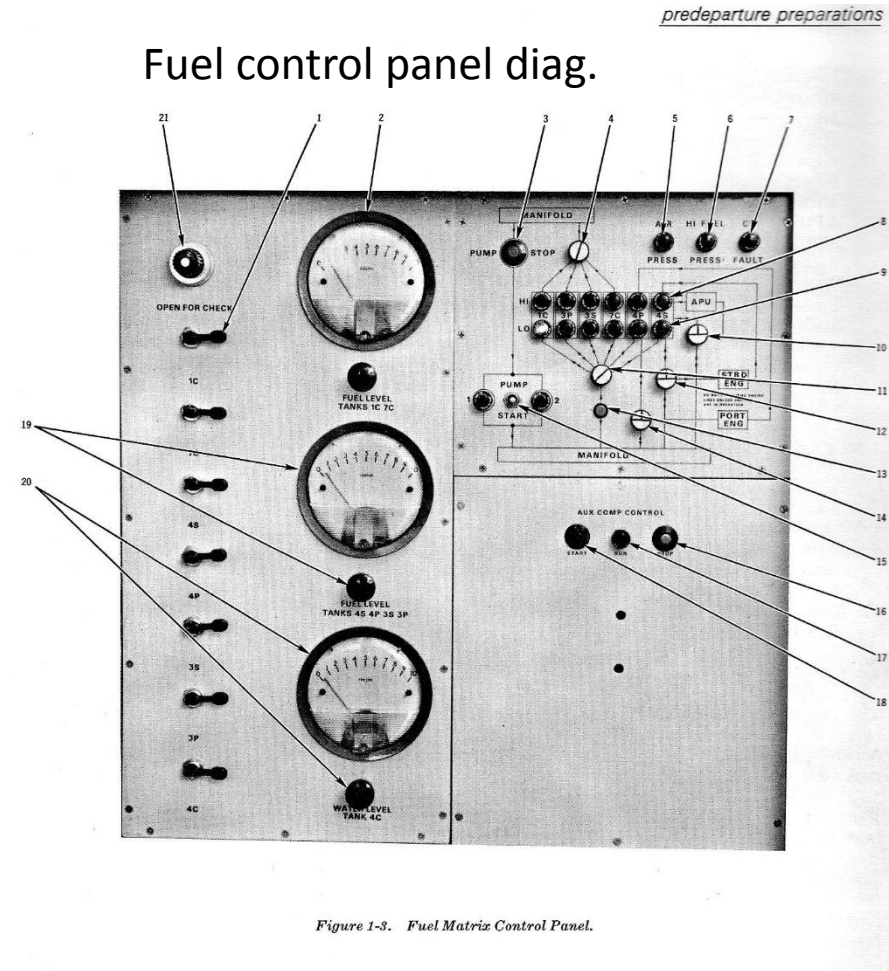
Collins pilot Bill Stevens and AAC inspect newly purchased 56 ft. Huckins , based on WWII PT boat design. Later named Osprey II. Sarasota, Fla. 1956

Boats: Boats gave Dad a degree of solace and relaxation. He didn't like the small compartments common on the larger cabin boats.

He and Frank Dyer sawed out, and tossed overboard, underway, a non-essential bulkhead on the Huckins!



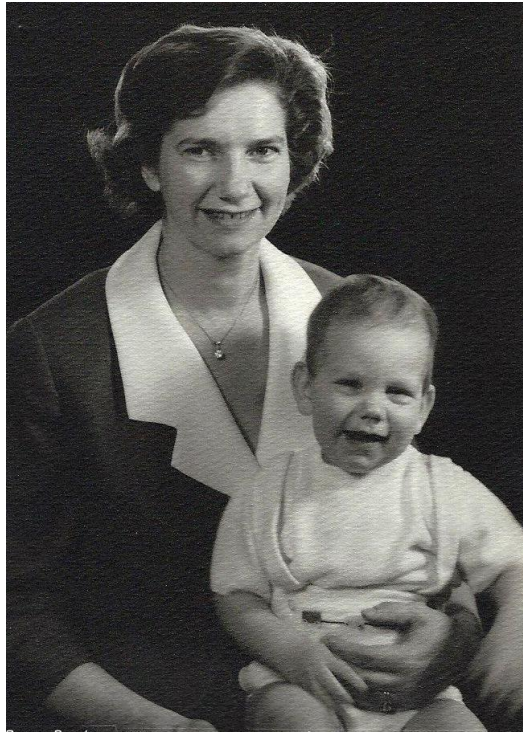
Custom-built fiberglass 70 ft. Peregrine. Hull designed by Alex Lippisch. Dual GM 12V71, ex PT boat V-drives. Conference room interior. 1969



AAC stayed aboard in Newport Beech CA. Detail from Operator's manual. Comm/Nav: 618-Ts, VOR, ADF, Decca radar. Proposed marine radio line never came into production.

The Peregrine was an impressive project, involving a tow tank in Cedar Rapids to test hull design, supervised by Alex Lippisch.

At the time this was the largest fiberglass boat, built in Costa Mesa, California.



Mary Margaret
and Alan, *circa*
1965



Mary and AAC in Dallas, *circa* 1982

AAC married Mary Margaret Meis in 1957. Two sons, Alan and David

Peg Collins died suddenly and unexpectedly of a stroke in 1955 at age 46.

Dad remarried to Mary Margaret Meis in 1957.

Mary was a caring wife to Dad and a patient stepmother to me and my sister. She was more outgoing than the reclusive Art Collins, and was quite active in hospital projects, and various museums.

This is one of my favorite pictures of Dad, happy and relaxed with his loose tie, and of course holding a Chesterfield.



Collins gear ages better than we do. MMC (above) tunes ART-13 USS JFK 1970; Loney Duncan enjoys this picture (up rt.) during video taping 2013. ART-13 aboard *FiFi* B-29 (rt). Excellence in mechanical engineering.



I was surprised to find old Collins gear from the 40s and 50s still in service in the Navy in the 1960s.

I think the ART-13 HF transmitter on the carrier JFK was used as an on-board set.

Loni Duncan enjoyed this picture, as he was a great fan of the ART-13. They were used on C-54s at NAS Pensacola.

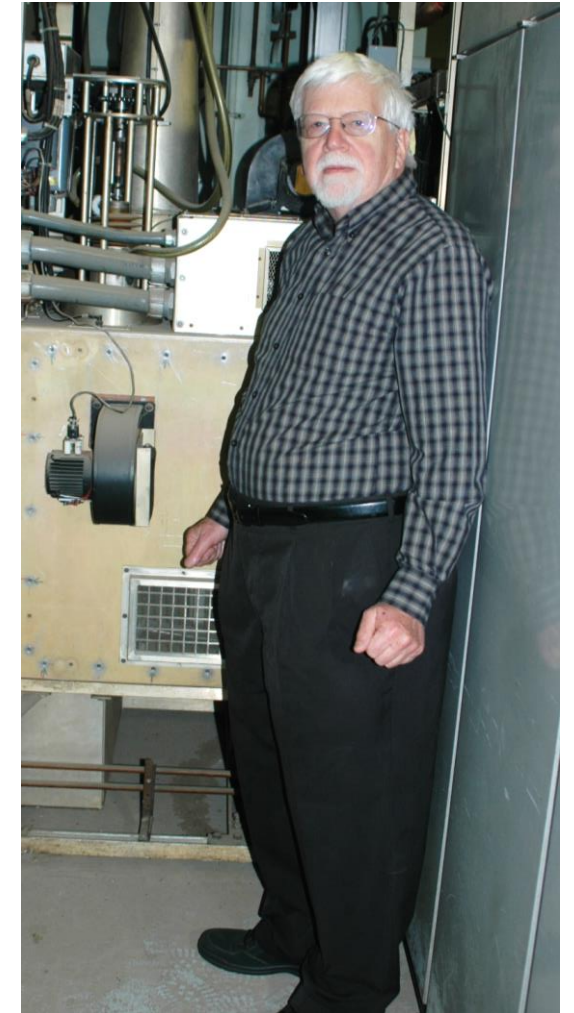


Smallest and largest Collins Radios
Jim Stitzinger and MMC



821-A 250KW transmitter for VOA, Delano, Calif.

Precise mechanical tuning on a
massive scale. AWA, CCA,
AACLA Joint Rescue 2015 saved
this historic equipment



“Are you sure this damned
thing is turned off?”



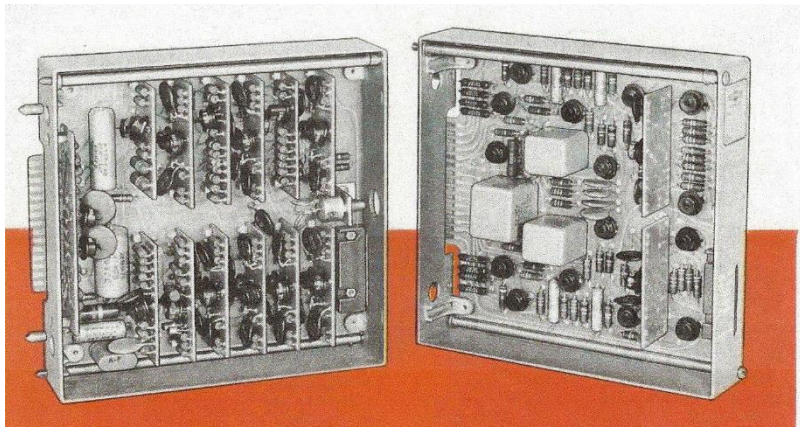
Collins Radio built many large installations, such as microwave relay stations, Apollo tracking stations, and the Voice of America 821A high power transmitter. This version has computer-controlled tuning and stands today as a very impressive accomplishment.

The little device Jim Stitzinger gave me to hold is, by comparison, the smallest Collins Radio transmitter, a miniature space suit beacon used in Apollo.

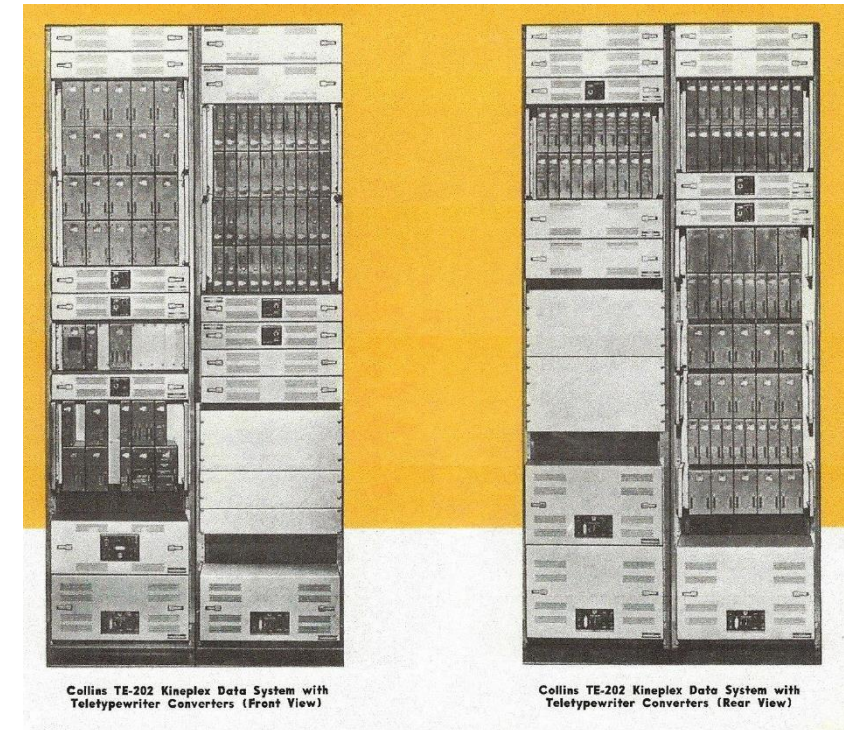
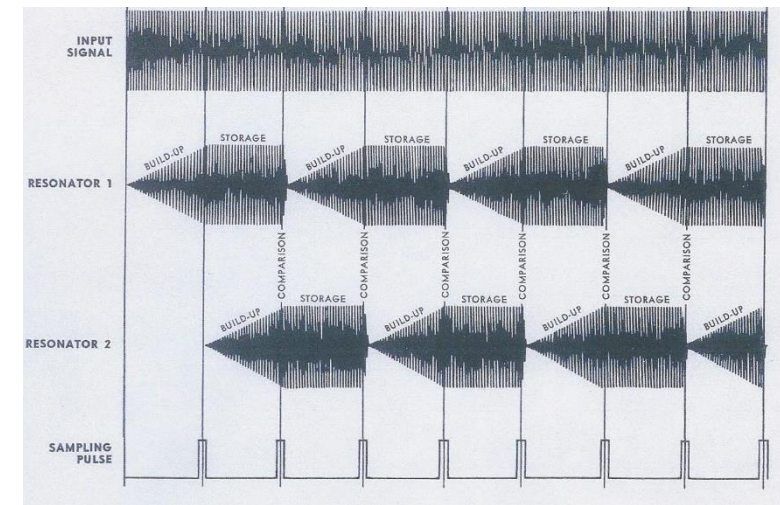
Kineplex used pulse code modulation and predicted wave detection for **long-distance telecommunication** in mid 1950s.

World's first practical **Modem**.

Transmitter/Receiver pulse synchronization and frequency control were essential elements. The first use of the **mechanical filter** was in the frequency control circuitry.



Kineplex was the forerunner of the Collins standard **planar design of modular 'ATR' boxes** mounted in racks. Used in microwave, avionics and C-System computers. **By contrast, ham sets were handmade gems.**



The importance of the **Kineplex** system is not widely appreciated today. (See the '*The Internet Connection*' video.) It was important for what it did, for how it did it, and for how it was made. It was a key innovation: one of the very first high-speed, long distance telecommunication systems, and one that set Collins Radio on a new course.

It was a binary code system. A vibrating reed generated a precise audio tone, which was used to generate pulses, carried in channels separated by Quadrature Phase Shift Modulation(based on the symmetrical phases of the sine wave).

With synchronization and timing circuits the receiver reproduced exactly the transmitted train of pulses. So the Signal to Noise ratio was very good.

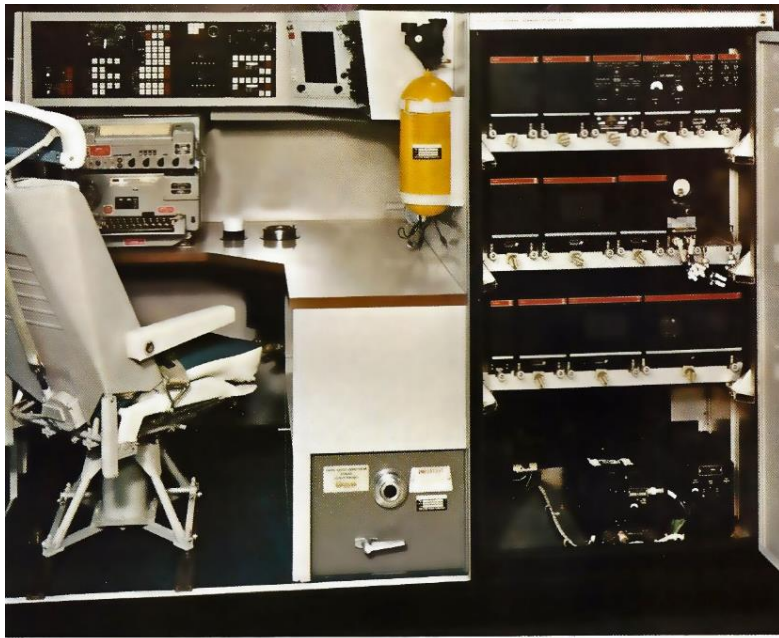
The first use of the mechanical filter was in circuits that corrected for frequency drift due to Doppler Effect, multipath, or shifts in the ionosphere. The world's first successful modems were also a part of Kineplex, and interfaced with several kinds of peripheral equipment, using microwave, phone lines, or HF as carriers. All this was in the mid-1950s.

Kineplex carried 40X the data traffic of the then-current Bell System teletype on the same bandwidth. Up to that time a company needing to transfer large amounts of data over a distance had to use the slow teletype or ship it as bulk!

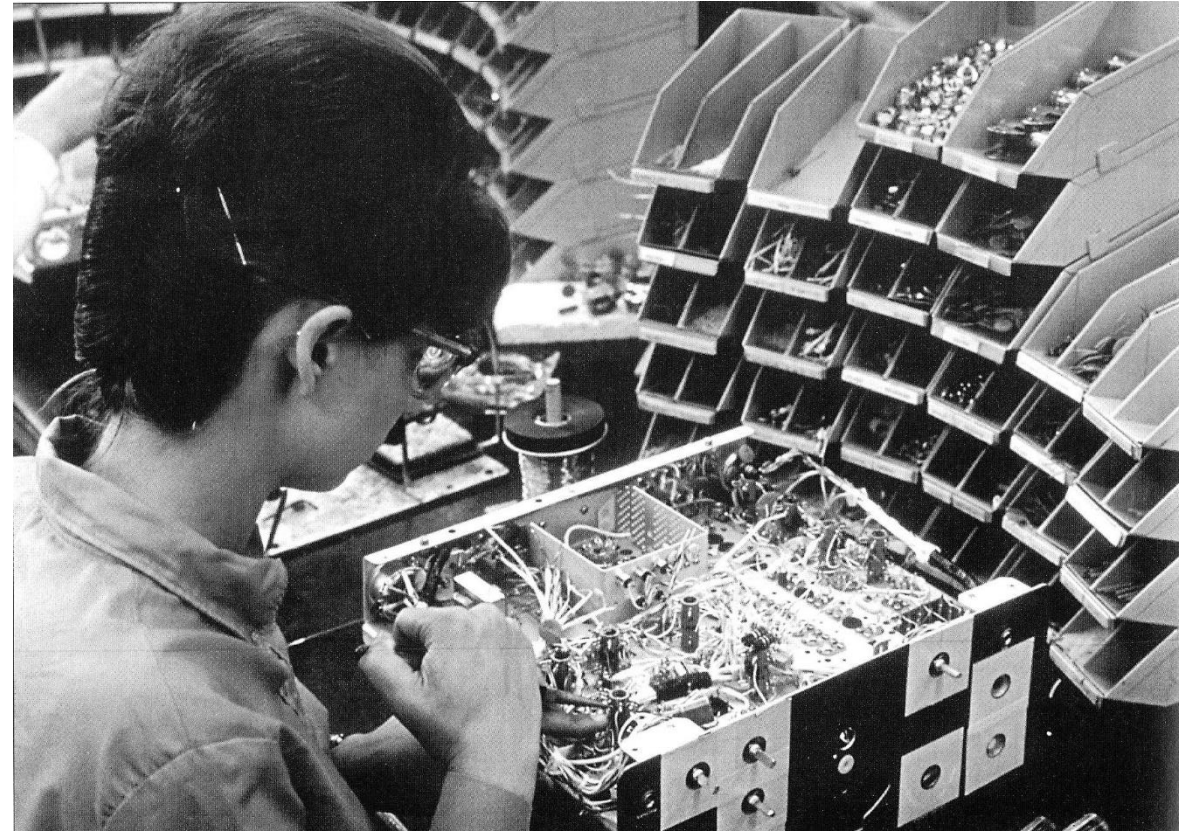
Newport Beach, Dallas and Cedar Rapids were linked in an early network, and AAC predicted in 1957 that computers soon would be used to control routing and switching functions.

Kineplex was manufactured in a unique way. It used a modular and planar design. Small circuit cards, manufactured by Collins, were mounted in standard modular boxes, which were mounted in standard racks.

Kineplex also allowed very effective encryption, which was a key part of classified derivative systems: DEWLINE (Distant Early Warning) and NTDS (Naval Tactical Data System) projects.



1969 Airborne Command & Control station. Multilayer boards / rack-mounted modular ATR boxes, micro-processor control. Automated manufacture. **State of the art electronics.**



KWM-2 production. Hand built to highest standards, using discrete components, a **magnificent anachronism** compared to other product lines.

Collins was a pioneer in Planar Design & Process Engineering

The early circuit boards of Kineplex led, in the 1960s, to very sophisticated, multilayer boards mounting Collins micro-electronics, inside standard ATR boxes, in standard racks.

Much of the manufacturing was automated.

Modular design allowed a customer to expand a system by simply adding boxes, and maintenance was made easier because a faulty box could be quickly swapped for a replacement.

Compare this to the hand assembly of discrete components in the KWM-2.

It is no slight to see Collins amateur radio line as a magnificent anachronism.

Making the video documentary : *A Culture of Innovation*. September 2013



Roschan Sharma (l) with Lawrence Robinson (rt)

Hired in 1952 by Mel Doelz, Roshan Sharma solved the equations for the precise dimensions of mechanical filter discs. Retired in 1984.



Rod Blocksom hits “go” switch for ART-13 Autotune while Tom Ackerman and crew record the action.

Legacy. The legacy of Art Collins is hard to compare to entrepreneurs in this age of highly specialized digital technology in the consumer market.

If self-restraint and modesty in the public eye were a test he would win hands down. In terms of the extraordinary diversity of disciplines he mastered he would have few peers among current luminaries.

At no point in this rainbow of invention was there anything like "Facebook" - this was a time when the guys in white shirts and narrow ties actually built stuff!

Michael M. Collins PhD
July 2026