

VACUUM TUBE HISTORY

**Vacuum Tube Millionaire
Elmer Tiling Cunningham**

**Presented by:
James Cross**



James Cross

JAMES CROSS' BIO

- **Owner of Vacuum Tubes, Inc for the past 28 years.**
- **Past President of the Tube Collectors Association (TCA).**
- **Author of "The Complete Western Electric Vacuum Tube Library" and "The Complete Jackson Model 648 Tube Tester Manual."**
- **Tube collector for 40 plus years.**
- **Recipient of the the Schrader and Stokes Awards from the TCA for collecting and documentation.**

THE PRINTED WORD HAS BEEN UNKIND ELMER TILING CUNNINGHAM, APPARENTLY.....

- **“Great vacuum tube inventor”**
- **“Must have had dirt on RCA”**
- **“Vacuum tube pirate”**
- **“Most successful bootlegger”**

The truth is more complicated....

Note that much of the pre-1920 information on Elmer's business dealings was presented by Eric Wenaas in an article titled “The Vacuum Tube Tangle” in the AWA Review, Volume 25.

ELMER T. CUNNINGHAM

- **This publicity photo was taken in 1931 when Mr. Cunningham's was made the head of RCA's Radiatron Division.**
- **Elmer was camera shy and there are not very many photos of him. This is one of the few photos of him that appeared in print, and this is how most of us know him.**



EARLY LIFE OF ELMER

- **This is the house where Elmer was born and lived in during his youth at 2413 Sutter Ave, San Francisco. It is no longer standing.**
- **Elmer was born in San Francisco, California on September 1, 1889.**
- **He was the eldest child of John F. Cunningham and Fanny Tiling.**
- **He had one sister, Ruth Cunningham (b 1892) and one brother Harold G. Cunningham (b 1893).**
- **He lived there with his parents, his siblings, and his Aunt Ann Tiling.**



ELMER'S FAMILY

- **His father was a first generation Irish immigrant, who came to the US with his parents at the age of 4. He ran the J F Cunningham company in San Francisco, which shipped in goods from exotic pacific islands.**
- **His mother Fanny was “born at sea”. She was the daughter of Heinrich Tiling, a Latvian doctor in the Russian Army who wrote a book on Siberian botony.**
- **Aunt Anne was a teacher in San Francisco.**



ELMER T. CUNNINGHAM

- **Elmer grew up in a close, middle class family.**
- **He is pictured here (ca 1896) with his brother Harold and sister Ruth.**
- **Bottom Left – Harold**
- **Bottom Right – Ruth**
- **Back Center – Elmer**

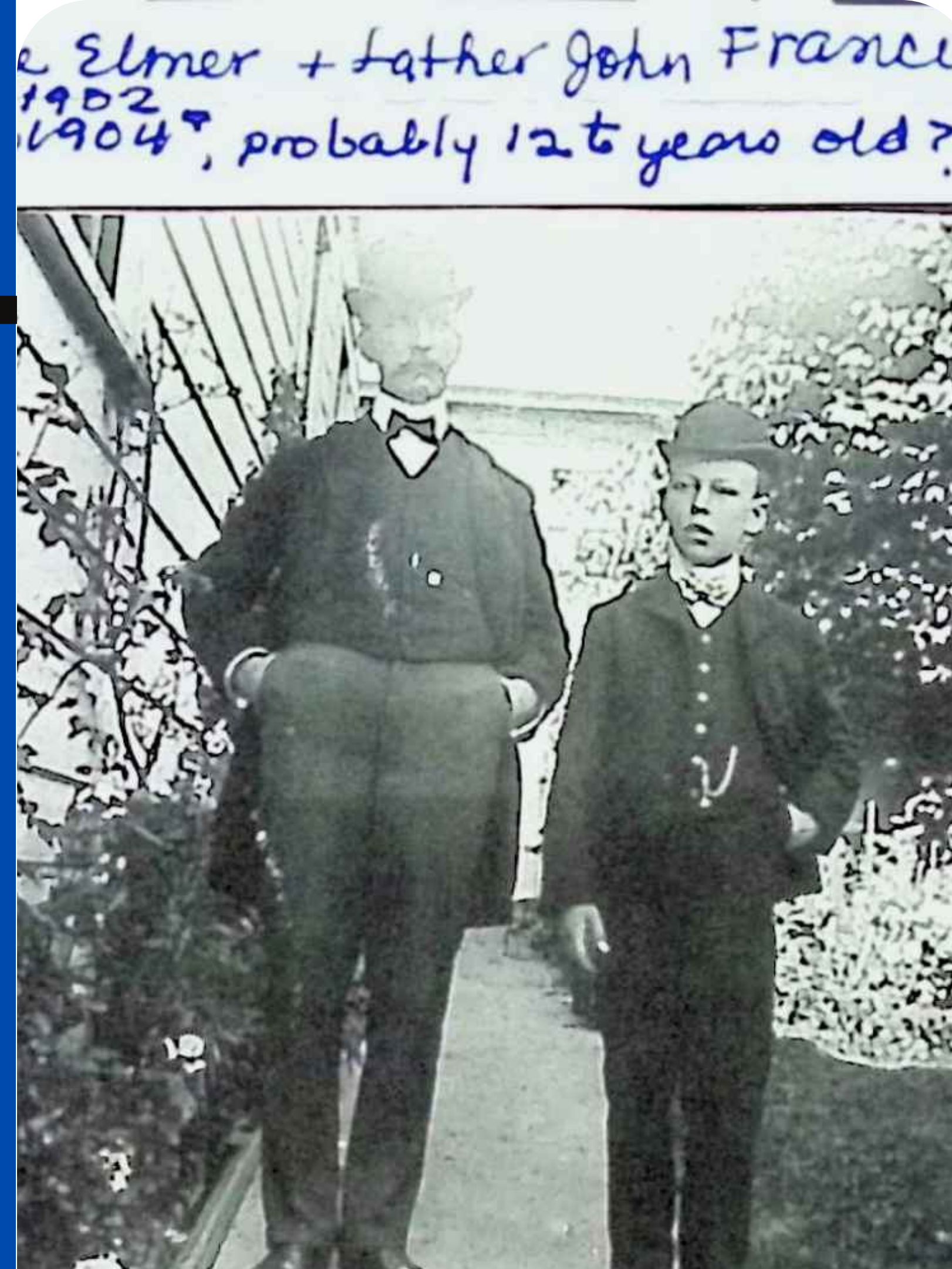


CHRISTMAS AT THE CUNNINGHAM'S CA 1897



1904 ELMER WITH FATHER, JOHN F. CUNNINGHAM

- John F Cunningham was a entrepreneur.
- This is a picture of Elmer and his father while Elmer was a young treenager.
- John taught Elmer about business and entrpreneurship ; lessons Elmer built on with a passion.



1906 SAN FRANCISCO EARTHQUAKE

- In 1906 San Francisco suffered a great earthquake and fire that destroyed a large portion of the city.
- The girl's school was destroyed and this resulted in the girls and boys schools being combined at Lowell High School.
- The Physics teacher from the girl's school taught Elmer and inspired his interest in electronics.

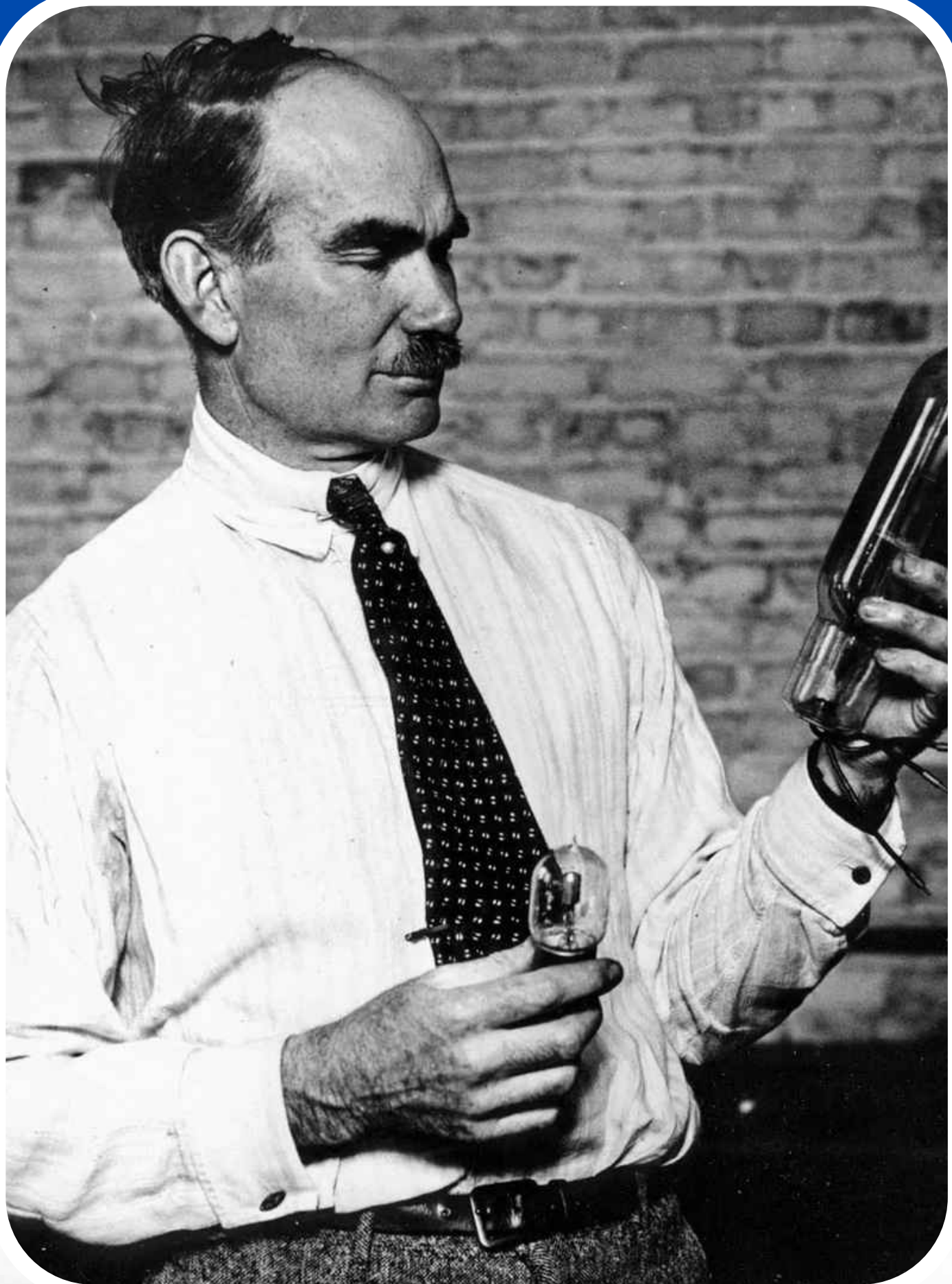


1906 ELMER CUNNINGHAM



- **Elmer's High School Photo.**
- **He attend Lowell High School and graduated in December of 1906.**
- **His Graduation was delayed by the 1906 Great San Francisco Earthquake.**
- **He briefly attended UC Berkley, but dropped out after one semester.**

1906 LEE DEFOREST

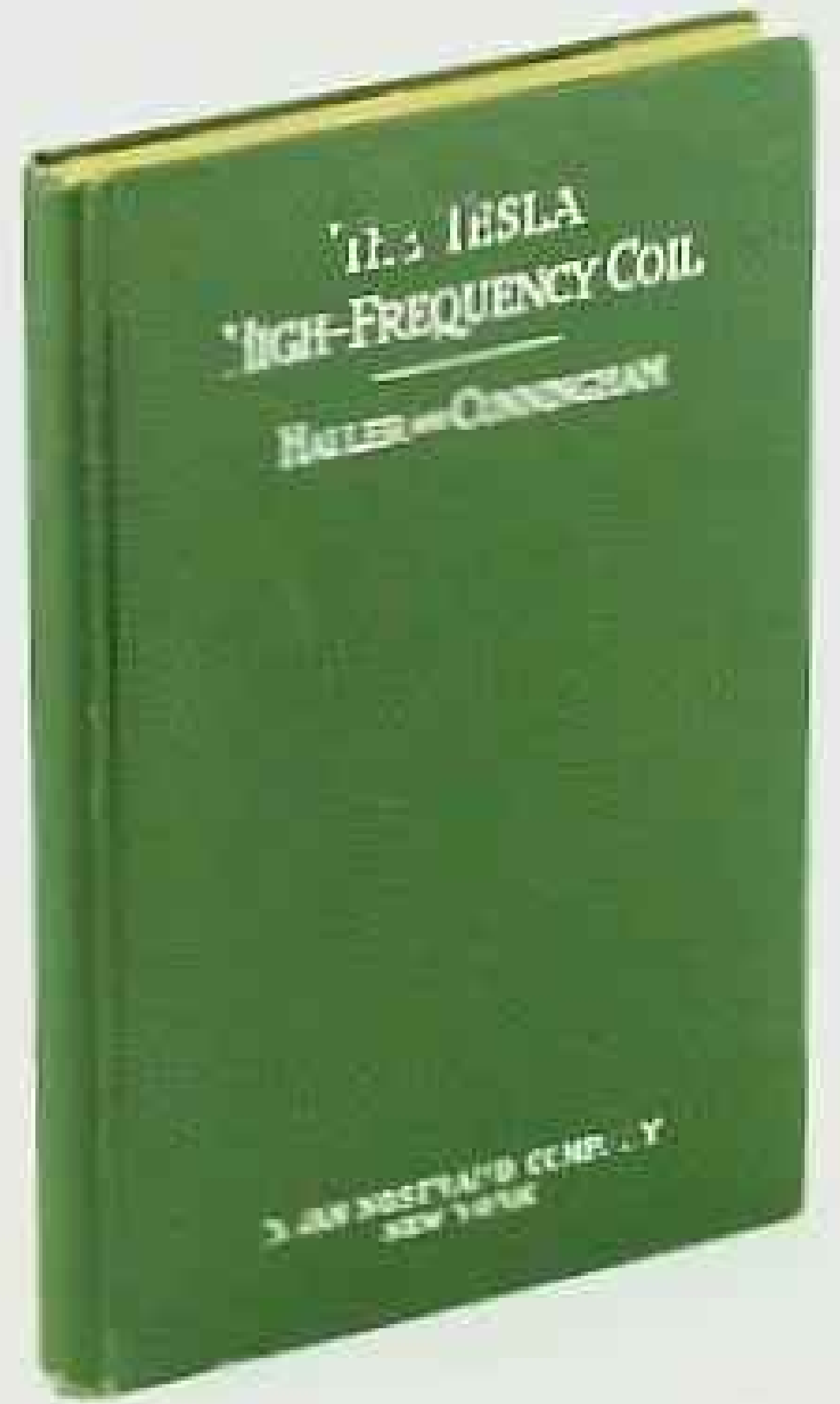


Lee deForest invented the three-element "Audion" (triode) vacuum tube in 1906.

It was the first practical device capable of amplifying weak electrical signals.

1910 THE TESLA HIGH FREQUENCY COIL

- **Written in 1910 by George Haller and Elmer Cunningham.**
- **Cunningham wrote the construction chapters and Haller wrote the technical chapter.**

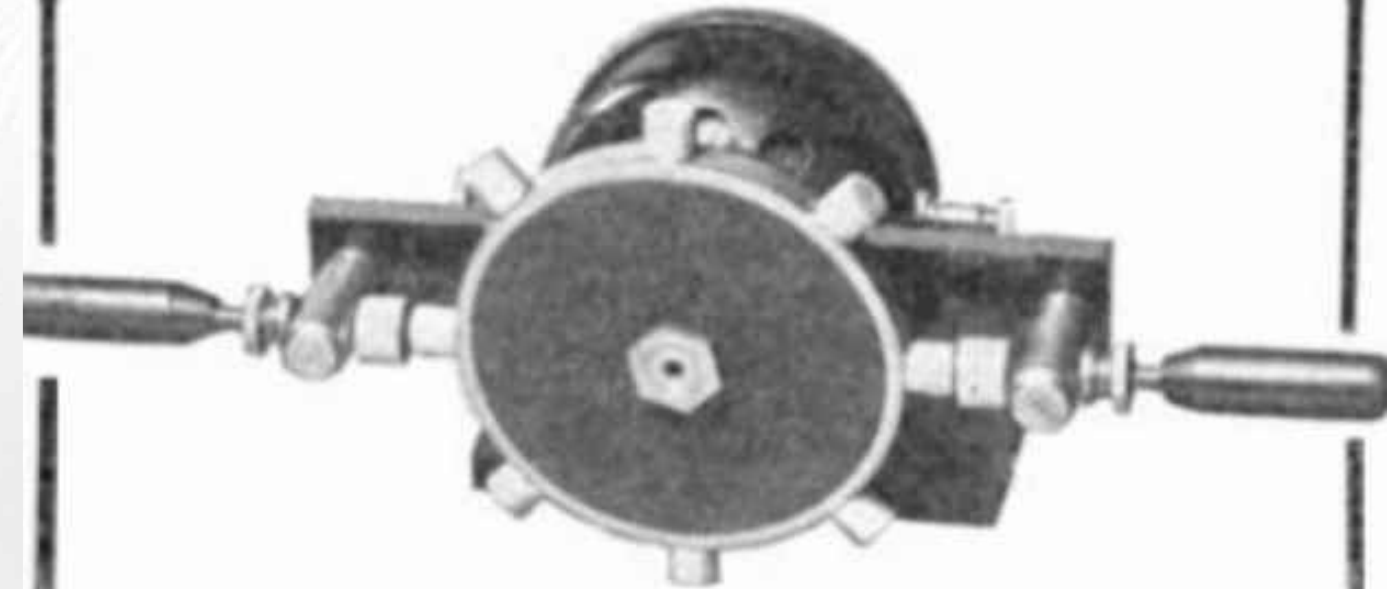


1911 HALLER-CUNNINGHAM ELECTRIC COMPANY

- The Haller-Cunningham Electric Company was a pioneering San Francisco-based radio and wireless equipment manufacturer established in the 1911 by inventor George F. Haller and entrepreneur Elmer T. Cunningham.
- It was largely financed by George Haller's father.
- Cunningham left early, as he sold his interest back to George's father in September 1912.

ROTARY SPARK GAP

Will Increase Sending Distance Nearly
100 Per Cent. Gives High Musical
Note Easily Distinguished from Static
and Interfering Stations.



Disc 4 inches in diameter. Renewable Zinc Gaps. Mounted on fibre base so as to be screwed directly to table.

Can be used on stations up to one Kilowatt.

No. 1. Guaranteed to emit high musical note and to be free from heating, arcing and other faults.

With motor to operate on 110 volts A. C.

or D. C.\$10.00

With motor to operate on 4 dry cells.... 7.00

HALLER-CUNNINGHAM ELECTRIC CO.

428 Market Street,

San Francisco, Calif.

1912 TO 1918

SHELTON ELECTRIC COMPANY - LICK BUILDING

- While Haller-Cunningham lasted as a company until 1919, Elmer left to work for the Shelton Electric Company in 1912.
- Shelton was a national company that sold devices with electronic motors, like dental drills, vibrating massagers, and motors to electrify windup phonograph turntables.
- By 1915, Elmer has risen to be the sales manager of the San Francisco office.

The Shelton Motor Increases Machine and Record Sales



Retail Price, \$17.50

The Shelton Electric Motor will enable you to sell an "electrified" machine to every prospect who enters your store. It can be used equally as well on a \$25 machine as on a \$200 machine. It also increases record sales by stimulating the customer's interest in music and creates a new enthusiasm in his machine.

The Shelton Electric Motor is simply placed against the turntable, and does not require even the turning of a screw. It does not interfere with the spring motor in any way, but, on the contrary, *saves* the spring. Either motor may be used as desired. Made for any lighting circuit. Instantly attached and is not affected by fluctuation of current.

Patents protected by our own and allied interests. Injunction and accounting will be asked for against any manufacturer or dealer making or selling an infringing motor.

Write to-day to nearest office for dealer discounts and special proposition.

SHELTON ELECTRIC CO.

NEW YORK—30 East 42nd Street
CHICAGO—30 East Randolph Street
BOSTON—101 Tremont Street
SAN FRANCISCO—62 Post Street

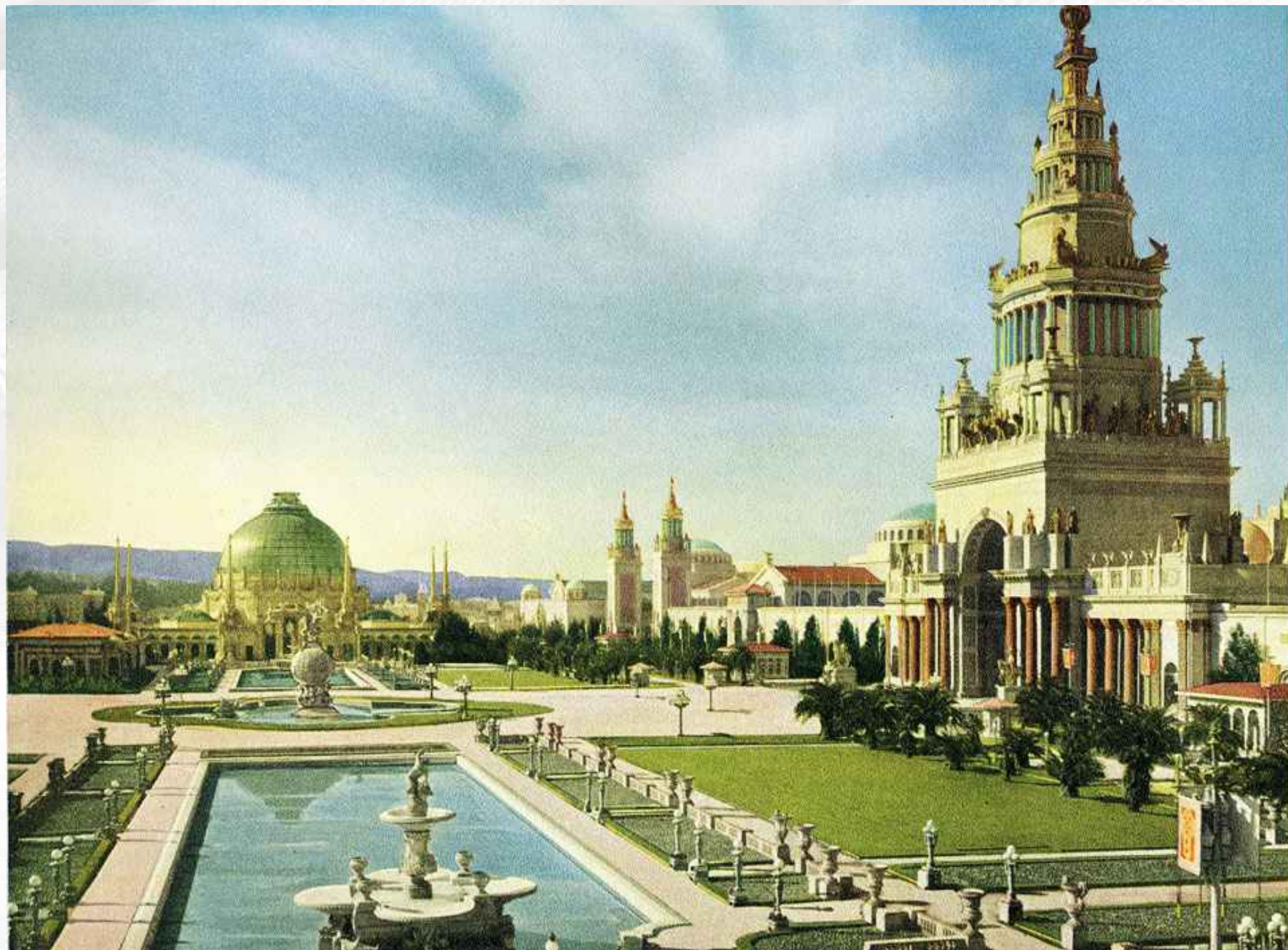


THE 2ND LICK BUILDING CA 1926



1915-1916 PANAMA-PACIFIC INTERNATIONAL EXPOSITION, SAN FRANCISCO

Elmer manned the Shelton Electric Co. Booth



Panama Pacific International Exposition San Francisco.
January 1915.
Court of the Universe.
ars/H. C. Tibbitts Collection

1915 PANAMA PACIFIC DENTAL CONGRESS BROCHURE

SHELTON ELECT COMPANY - LICK BUILDING

List of Exhibitors and their Representatives

THE DENTAL MANUFACTURING CO., LTD.,
London, W., England—George Chalk and
A. H. Parry.

THE C. V. MOSBY CO., Medical Publish-
ers, St. Louis, Mo.—C. V. Mosby.

THE HARVARD CO., Canton, Ohio—E. L.
Monnot.

ELECTRO DENTAL MANUFACTURING CO.,

THE SHELTON ELECTRIC CO., Shelton
Portable Dental Engine, Lick Bldg., San
Francisco—E. T. Cunningham.

ELI LILLY & CO., Indianapolis, Ind.—
R. R. Zane and Dr. W. D. Hacker.

THE DENVER CHEMICAL MANUFACTUR-
ING CO., New York, N. Y.—Edward S.
Sharpless, M. D.

AUGUST 1915

THE BIRTH OF THE AUDIOTRON TUBE

- **While working at the PPIE, Elmer saw the deForest representatives having difficulties with the tubes at the deForest booth.**
- **These representatives, Elman Myers and Otis Moorhead left deForest's company early in 1915, and approached a glassblower in San Francisco named Hyde. Both Myers and Moorhead later claimed they individually invented the tube that came to be called the Cunningham Audiotron.**

AUGUST 1915

THE BIRTH OF THE AUDIOTRON TUBE

- **Elmer entered the scene in mid 1915, and made a non-exclusive agreement with the glassblower Hyde to make tubes for him.**
- **Moorhead went to form his own tube company and Myer returned to work for deForest**
- **Elmer registered “The Audio Tron Sales Company” in August of 1915. Haller-Cunningham was one of his distributors.**
- **The first magazine ads appeared in October 1915 and the ads give the address as room 315 Lick Building. This was Elmer’s side hustle while at Shelton.**

1916 AUDIOTRON ADVERTISEMENT

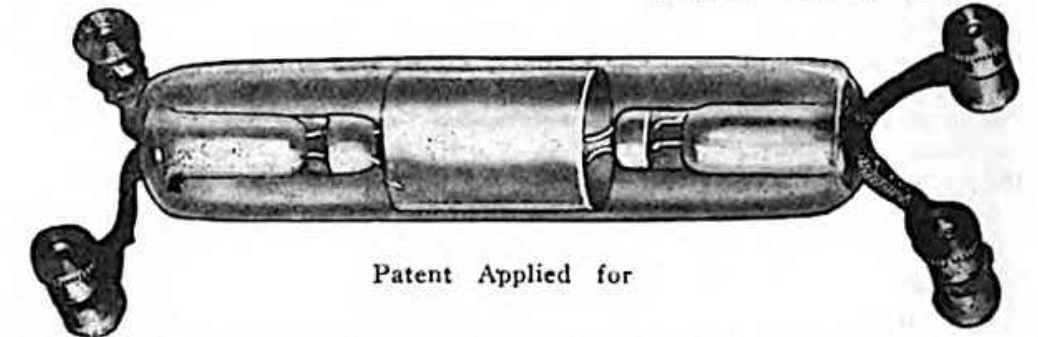
- June 1916 ad showing the form of the tube.
- Gives the address as the Lick building.
- This ad appeared after de Forest sued Cunningham, Moorhead, and Myers for infringement.
- The courts were unsure the tubular tube was infringing, and required posting a bond while the case was decided.
- Elmer posted his bond in order to keep selling tubes and no injunction was issued. None of the others, including deForest, posted bonds.

NO INJUNCTION ISSUED

AGAINST

The Genuine **AUDIOTRON**

(Registry Applied for)



Patent Applied for

The AudioTron has smashed all records—Seattle copies OUI in daytime with one tube. Your receiving range will be more than doubled if you equip your set with the genuine AudioTron—not imitations.

The internal action or mode of operation, not the mechanical structure, determines the quality and sensitiveness. The AudioTron differs from all other bulb or tubular detectors since it utilizes the variations, produced by the impressed grid potentials, in a pure electron flow from negative incandescent tungsten to a cold positive plate. *Its operation, in no way, utilizes a sensitive gaseous medium.*

The genuine electron operated AudioTron is not a “so-called AudioTron” Radiotron, or other form of tubular audion. The genuine AudioTron is so marked and bears our test tag. Don't be misled. We offer \$100 cash for proof that this company has been enjoined.

NEW PRICES

Double Filament AudioTron Tube, \$6.50

Single Filament AudioTron Tube, 5.50

including full instructions for using and operating

Terms: Cash—Transportation Prepaid—Satisfaction Guaranteed

Write Your Own Guaranty

Any genuine AudioTron not received in good condition—not proving sensitive—not giving satisfaction—not being as represented—will be replaced.

When ordering state whether AudioTron is to be used as a detector of damped waves, as an amplifier, or as an oscillator for undamped wave reception.

Special Offer—Expires July 10, 1916

With every double filament AudioTron ordered before July 10, 1916, at \$6.50, transportation prepaid, we will include, free of charge, one regular AudioTron Fixed Condenser especially designed for use in the grid circuit of our tube. Don't delay.

Dealers: Write for “New Trade Proposition,” “Profit Sharing Plan” and “The Patent Situation.” We have a winner for you. Are you with us?

AudioTron Sales Company

315 Lick Building,

SAN FRANCISCO, CALIF.

ELMER HIRES

WILLIAM KENNEDY WHITE

- **On being sued by deForest, Elmer hired patent attorney William Kennedy White.**
- **William K White was one of the most prominent electronics patent attorneys on the West Coast. He was a partner in White, Probst, & Evans.**
- **He must have believed Cunningham was in a good position against deForest, as he accepted Audio Tron stock as a retainer and a promise of one-third net profits.**



NOVEMBER 11, 1916

ELMER GETS MARRIED

- Elmer married Alice Maude Pinnins (nee Anderson) in San Francisco on November 11, 1916.
- Alice was an immigrant to the United States from Ireland via Canada.
- She had been previously married in Ireland, and brought a 9-year-old daughter, Muriel, into the marriage.
- Elmer legally adopted Muriel.

MARRIAGE LICENSE 46934.

State of California, }
City and County of San Francisco) ss.

THESE PRESENTS are to authorize and license any Justice of the Supreme Court, Justice of the District Court of Appeals, Judge of the Superior Court, Judge of the Police Court, Justice of the Peace, Priest or Minister of the Gospel of any denomination to solemnize within said County the Marriage of ELMER TILING CUNNINGHAM, white aged 27 years and past resident of City and County of San Francisco, State of California and ALICE MAUDE PINNINS, white aged 26 years and past resident of City and County of San Francisco, State of Calif., said parties being of sufficient age to be capable of contracting marriage as appears by affidavit of record in my office.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the seal of the Superior Court of the State of California in and for the City and County of San Francisco, this 10th day of November 1916.

(Seal)

H. I. MULCREVY, County Clerk and ex-officio
Clerk of said Superior Court.
By G. L. MUNSON, Deputy.

State of California }
City and County of San Francisco) ss.

THIS CERTIFIES THAT

ELMER TILING CUNNINGHAM and ALICE MAUDE PINNINS
the parties in the above license were joined in marriage by me on the 11th day of November A. D. 1916 in said City and County and State that ROBERT E. McCALL a resident of said City and County of San Francisco, State of California and ____ a resident of said City and County of San Francisco, State of California were present as witnesses of said ceremony.

Name MRS. ROBERT E. McCALL No. 2459 Larkin Street.
Witnesses
Name ROBERT E. McCALL No. 2459 Larkin Street.

IN WITNESS WHEREOF, I have hereunto set my hand this Eleventh day of November A. D. 1916.

JOHN HUNT, Judge of the Superior Court of the City and County of San Francisco, State of California.

Recorded at the request of John Hunt.
Nov. 13, 1916.
No. Q. 5050.

Ed. J. Schaefer
County Recorder.
Paul R. Mendenhall

1917-1919

THE UNITED STATES ENTERS WWI



- **Cunningham kept selling his Audiotron tubes as a side hustle to his job at Shelton until the sale of tubes was banned shortly after the US entered WWI in April 1917.**
- **He remained at Shelton for the duration.**
- **While he was unable to sell tubes, he founded Remler in 1918 as a parts maker/distributor.**
- **Elmer began again to sell Audiotron tubes when the sales ban was lifted in April 1919 and he resumed national advertising.**
- **Elmer settled the suit with deForest in November 1919 for \$2500 plus a licensing agreement to pay an 80 cent royalty on each tube sold.**

1919 RADIO CORPORATION OF AMERICA

- **The Radio Corporation of America (RCA) was formed on October 17, 1919.**
- **Through a bunch of patent cross-licensing, RCA consolidated key radio assets from GE, Westinghouse, AT&T, and the American Marconi Company.**
- **RCA was simply formed as a distributor, not a manufacturer.**
- **RCA merchandised tubes and radios made by GE and Westinghouse.**



APRIL 1920 RCA SUES ELMER CUNNINGHAN

- **Elmer went to New York to negotiate with RCA.**
- **RCA's legal team informed Elmer that his deForest license was invalid.**
- **Elmer returned to California and confronted deForest.**
- **He returned to RCA telling RCA he would make tubes under deForest's personal license.**



THE RCA SETTLEMENT

- **RCA was not absolutely sure of their patent position, and it would have been devastating to lose in court this early in the tube game.**
- **Elmer had actually never made tubes himself and did not want to build a tube factory. He was happy to sell tubes made by someone else.**
- **So they entered into a couple of agreements to resolve the suit. First, Elmer would have some 90 days to sell his remaining stock of Audiotrons.**

THE RCA SETTLEMENT

- **Second, Elmer would become a distributor for RCA, he would get the most favorable distributor pricing, his own branding on the tubes, and he had the right to pick and choose from the lots.**
- **RCA got a large new distribution network.**
- **Elmer poured money into advertising, and he also reported west coast bootleggers to RCA's legal team.**
- **The arrangement was a “win” for both sides.**

LATE 1922 - ELMER SELLS REMLER



Elmer T. Cunningham.

- This is a picture taken in 1922 of Elmer holding some Remler parts.
- “Remler” is Elmer backwards plus an “R” for radio.
- While Remler was founded in 1918, the tube business really took off, so Remler was sold in late 1922.
- Remler operated in San Francisco as a maker of a wide range of products until 1988.

CUNNINGHAM TUBE SALES SOAR

- The name of the company was changed to E.T. Cunningham Inc.
- For example, Cunningham sold more than one million tubes in 1923, accounting for one third of RCA's total sales.
- The check below would account for between 100,000 and 200,000 tubes.

THIS CHECK IS IN FULL PAYMENT OF FOLLOWING ITEMS

DATE	DESCRIPTION	AMOUNT
	New York Draft	
	for	
	Radio Corporation	
	of America-	
	New York City	
	EXACTLY TOTAL	
	LESS DISCOUNT	
	NET	245577.50

HEAD OFFICE
SAN FRANCISCO

E. T. CUNNINGHAM, INC. ✓

No. 465

SAN FRANCISCO, CALIF. July 30, 1925

PAY TO THE
ORDER OF UNITED BANK & TRUST COMPANY \$ 245577.50

EXACTLY TWO HUNDRED FORTY FIVE THOUSAND FIVE HUNDRED SEVENTY SEVEN DOLLARS AND FIFTY CENTS

TO MAIN BANKING OFFICE
UNITED BANK AND TRUST COMPANY
OF CALIFORNIA
COMMERCIAL TRUST
SAN FRANCISCO, CALIF.

SAVINGS
11-34
12

E. T. Cunningham
President

**... AND WHILE RIDING THE PEAK OF
BUSINESS SUCCESS IN 1925 ...**

ELMER DISCOVERS HIS WIFE IS HAVING AN AFFAIR WITH HIS ATTORNEY

- **Sometime in 1925, Elmer discovered that Alice was having an affair with his attorney, William K. White.**
- **This created an unforeseen problem. Elmer had given stock in his company to both his attorney and his wife. If he divorced, he would no longer have control of his own company.**

ELMER DISCOVERS HIS WIFE IS HAVING AN AFFAIR WITH HIS ATTORNEY

- **His solution was to go to RCA and ask RCA to buy a controlling interest in E T Cunningham Inc.**
- **The divorce was filed December 8, 1925 and final December 8, 1926.**
- **Alice married William K. White on December 9, 1926.**

1926 RCA BUYS 55% OF E.T. CUNNINGHAM INC.



1926 RCA BUY 55% OF E. T. CUNNINGHAM INC.

- **RCA purchased 55% of the stock on February 1, 1926, keeping Elmer as president. No one wanted to kill the golden goose.**
- **Everyone was making money, so it was in everyone's interest to keep Elmer in charge.**
- **The agreement allowed Cunningham shareholders to require RCA to buy their shares on one basis up until May 31, 1929 and at another basis thereafter.**
- **Elmer moved to New York to be closer to RCA after the transfer.**

1926 ELMER WITH MOTHER - FANNY

- **Family was important to Elmer.**
- **He took care of his sister Ruth prior to her death.**
- **He took care of his brother, Harry.**
- **He loved and took care of his parents even building them a home.**



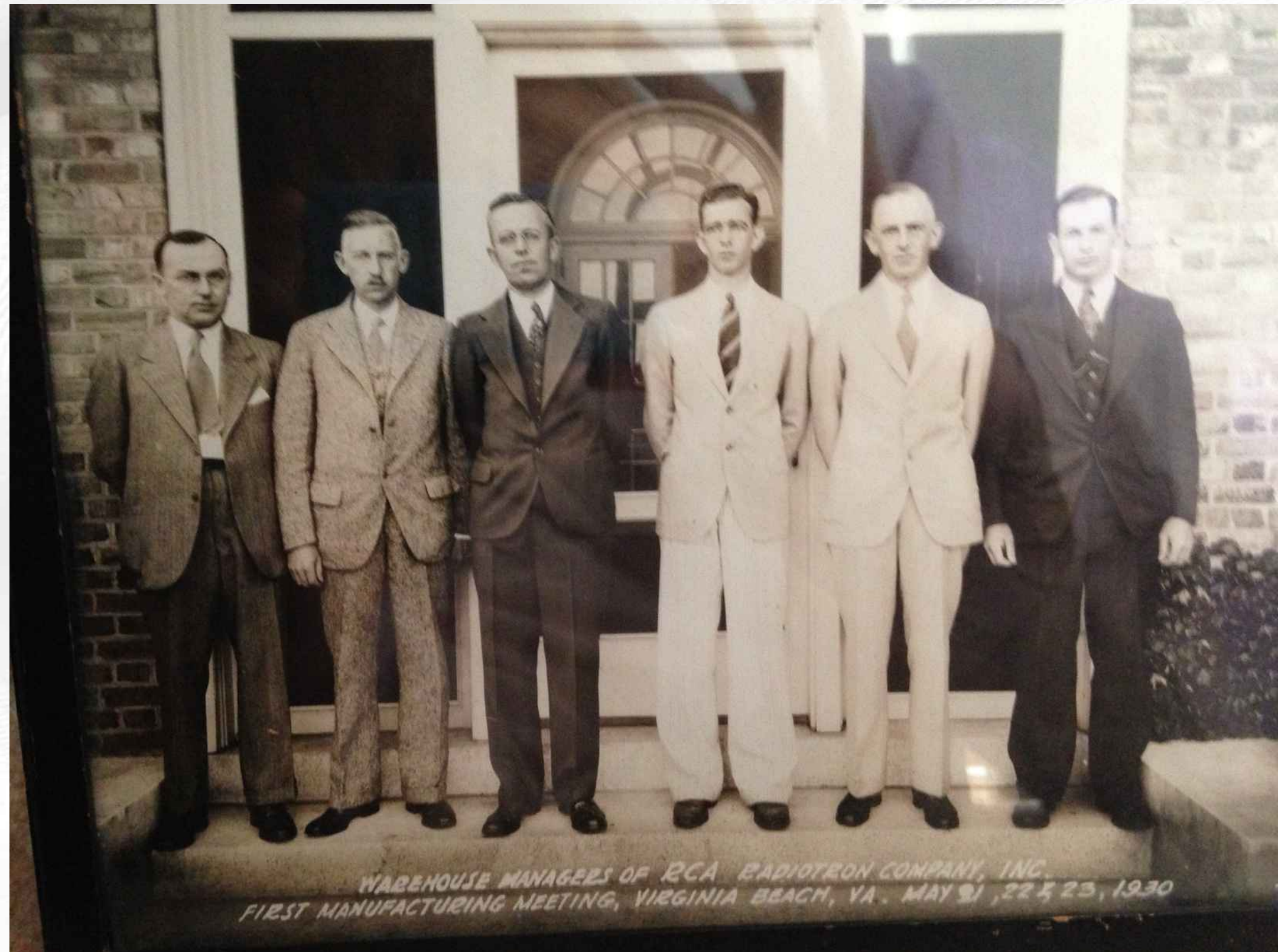
ELMER GIVES TO HIS FAMILY

- **Elmer had homes built next to each other in San Francisco for his parents and Ruth and her husband.**
- **Both are still standing today.**



1930 BROTHER HAROLD

- Elmer always looked out for his family.
- He got his brother Harold a position as a RCA warehouse manager.
- Elmer also got summer jobs at RCA for Harold's daughter.



ANOTHER TRAGEDY - SISTER RUTH DIES IN 1928

- **His beloved Ruth died suddenly.**
- **There was some amount of fighting between Elmer and Ruth's husband about her burial.**
- **Elmer spared no expense and built a huge mausoleum for the Cunningham family.**
- **Ruth was the first interred.**

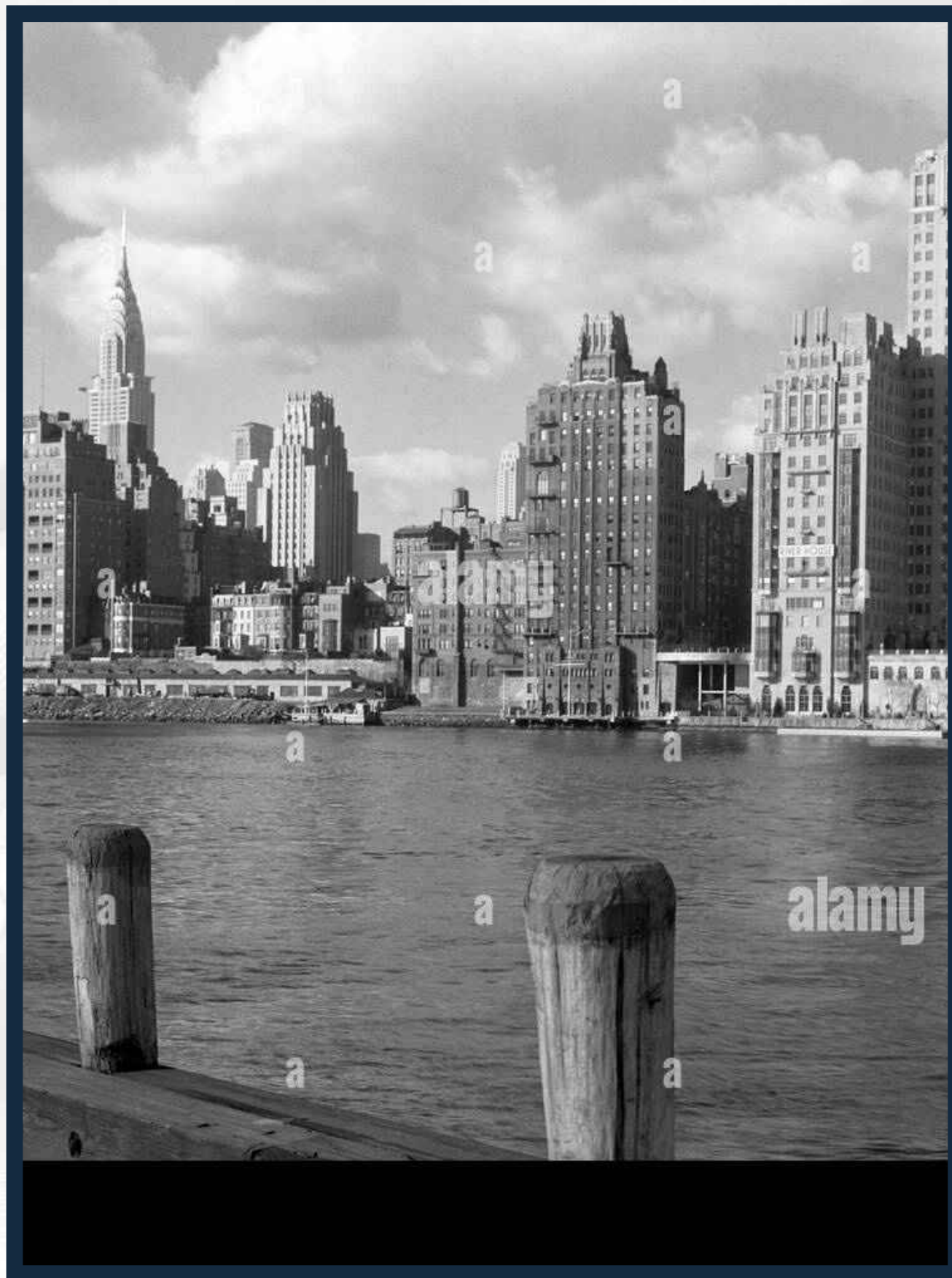


RUTH

CUNNINGHAM MAUSOLEUM

- **Erected at Cypress Lawn Cemetery, Colma, CA.**
- **Built of imported Italian marble.**
- **Elmer's entire close family is interred here, including his parents, his brother Harold and wife, and Elmer and his second wife Margaret.**





New York 1930's

Elmer In New York City

- **RCA was forced to form the Radiotron Division in 1929 to make tubes due to an antitrust action.**
- **RCA completed the purchase of E. T. Cunningham Inc. in 1930.**
- **Elmer was then appointed to be the president of the Radiotron division.**
- **E. T. Cunningham Inc. was formally dissolved as a corporation in 1934.**
- **The Radiotron Division was folded into the RCA Victor Division, and Elmer remained president of the combined entity until he retired in 1937.**
- **Elmer disliked city life and longed to return to California.**

Elmer New York City

1933



Margaret McCutcheon

- **In 1933 while living in New York, Elmer met his soon to be second wife, Margaret Campbell McCutcheon.**
- **She was born in 1884.**
- **She was a New York Socialite from a wealthy Missouri family.**
- **Elmer and Margaret Married in 1934.**
- **They never had any children together.**

MARGARET AND ELMER ca 1935



PORTRAITS PAINTED BY FRANK SALISBURY

ELMER'S BUSINESS ACTIVITIES AFTER RCA



- **After leaving RCA, Elmer became the head of the National Association of Manufacturers.**
- **In the 1940s, he spent time testifying before various congressional committees about proposed laws effecting business and labor relations.**

1938 - 1965

RETIREMENT AND MOVED BACK TO CALIFORNIA



- **Upon retiring, Elmer moved back to Monterey , California with Margaret.**
- **They built a mansion on the Monterey peninsula they called “ELMARGE”, a contraction of Elmer & Margaret**
- **It was a little over 8,000 square feet.**
- **It is located at 1450 Manor Road and sat on 6.5 acres.**
- **He enjoyed golf, and was a member of the exclusive Del Monty Country Club as well as Pebble Beach.**
- **He loved playing bridge with officers from the nearby Presidio at Monterey.**
- **He loved his pets.**

ELMARGE 1960

- Margaret decorated the mansion in the French Provincial style and filled it with important early American antiques.
- A major part of the collection was auctioned off by Sothebys as the “Mrs. E. T. Cunningham Collection” in 1959.
- The large format portraits were donated to the Museum of California at Oakland in 1962.



ELMARGE

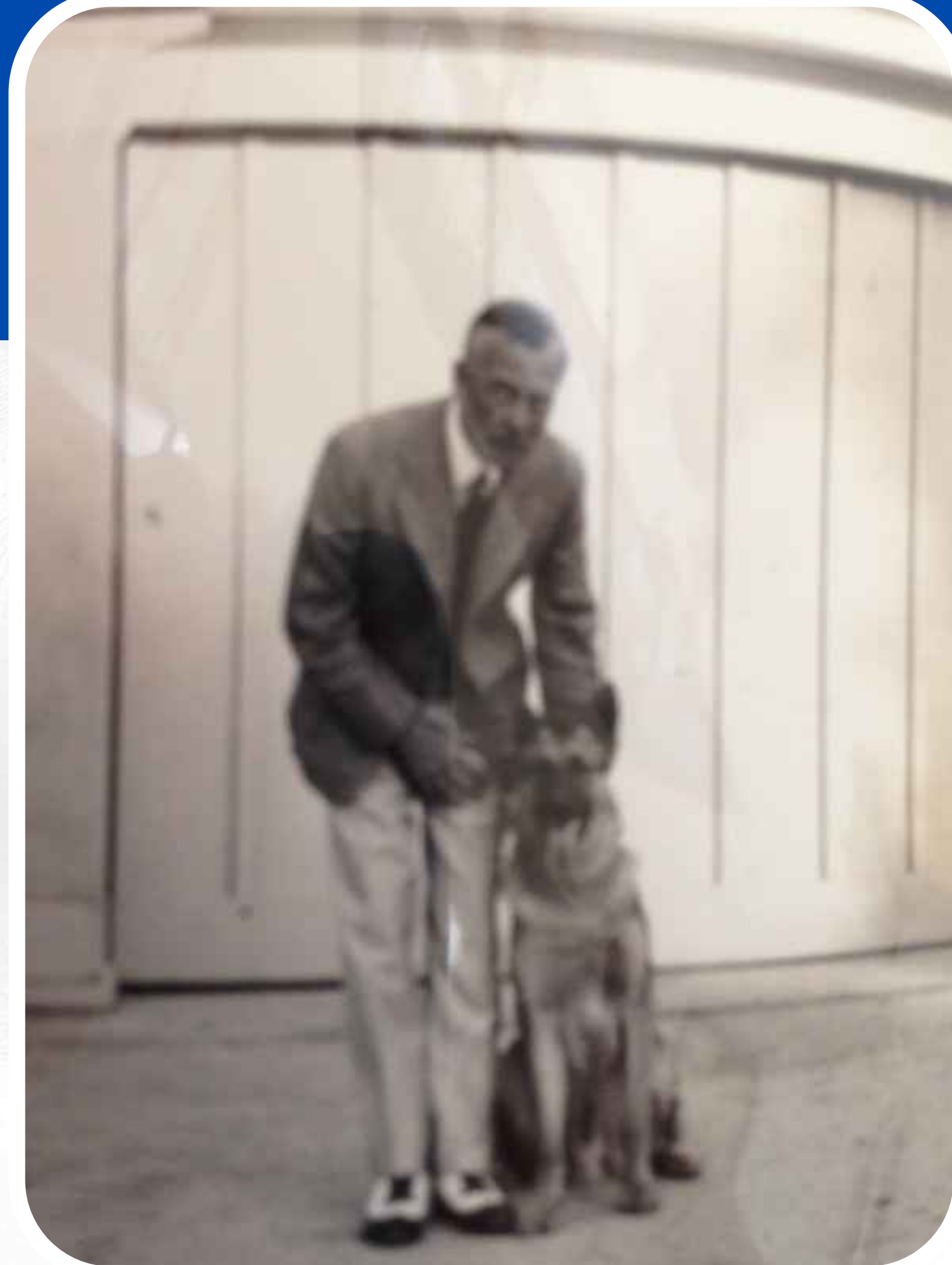
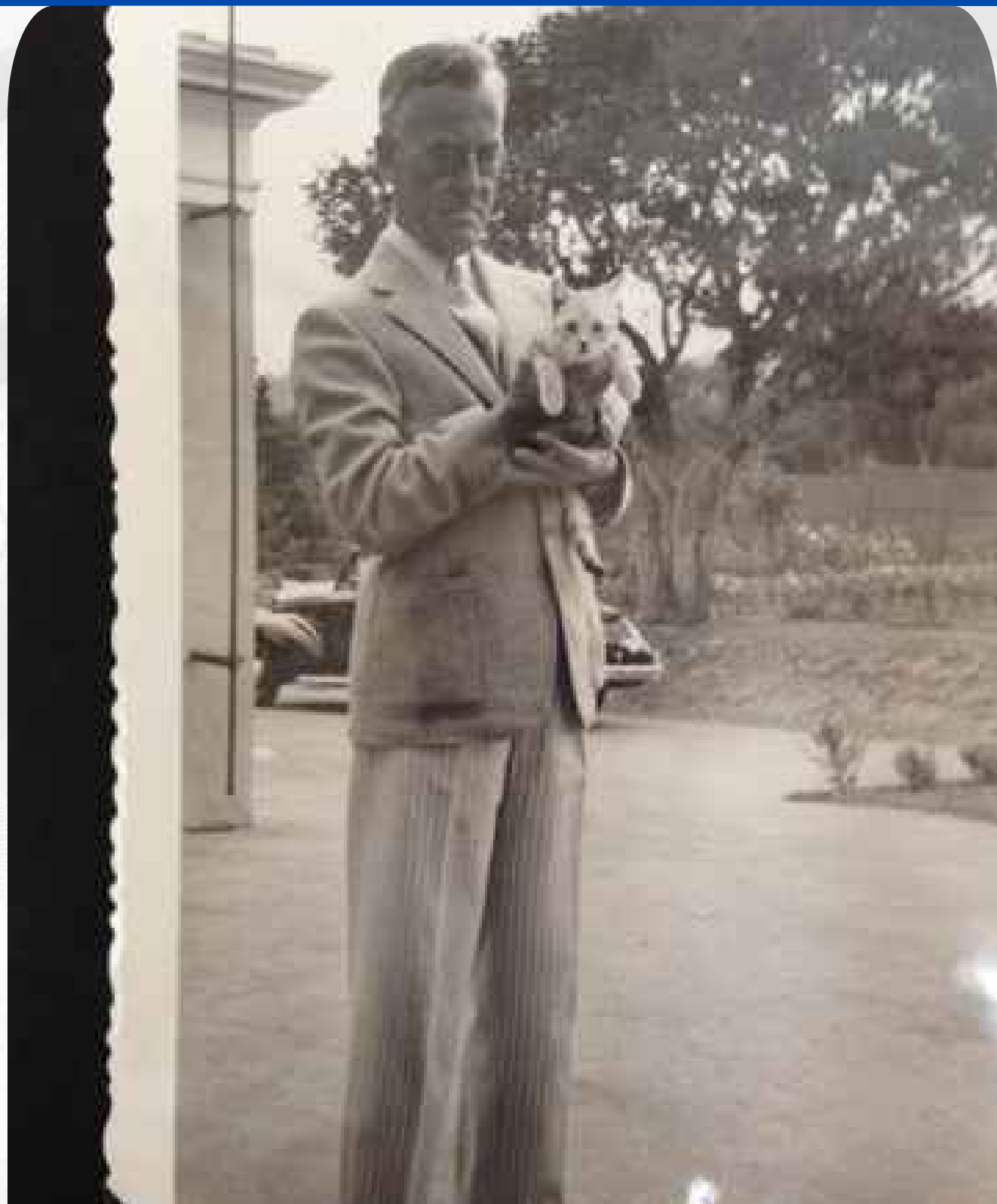
1938 - 1965

RETIREMENT AND GOLF



1938 - 1965

RETIREMENT AND PETS



JUNE 14, 1965

ELMER TILING CUNNINGHAM

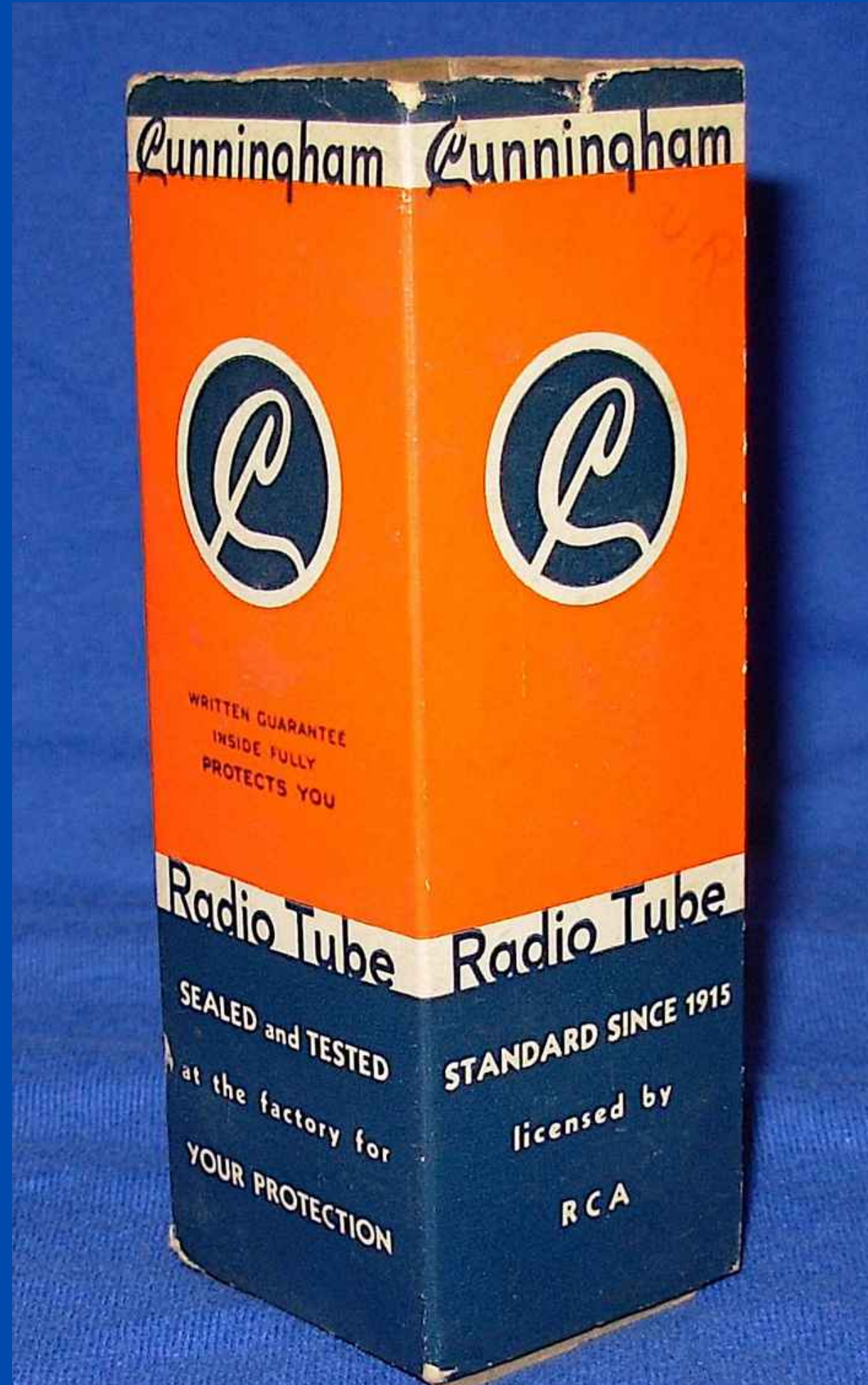


- **Elmer Died on June 14, 1965.**
- **Margaret died in 1966.**
- **By this time he had successfully faded into obscurity.**
- **There was no national notice; only a local obituary and newspaper notices for probate.**

CUNNINGHAM AND RCA BRANDING 1925 TO 1930



CUNNINGHAM BRANDING IN 1930



CUNNINGHAM AND RCA BRANDING 1931 TO 1935

- **Cunningham Radiotron branding 1931 to 1935.**
- **“Cunningham” was dropped in 1936.**



- The Cunningham brand was revived briefly as a separate brand after WWII.
- This particular tube and box are from 1949.



- **RCA maintained the Cunningham trademark until they stopped selling tubes.**
- **The Cunningham “Script C” trademark with and without the word Cunningham appeared on RCA inner box flaps of larger tubes.**
- **This is a box pattern from 1970.**



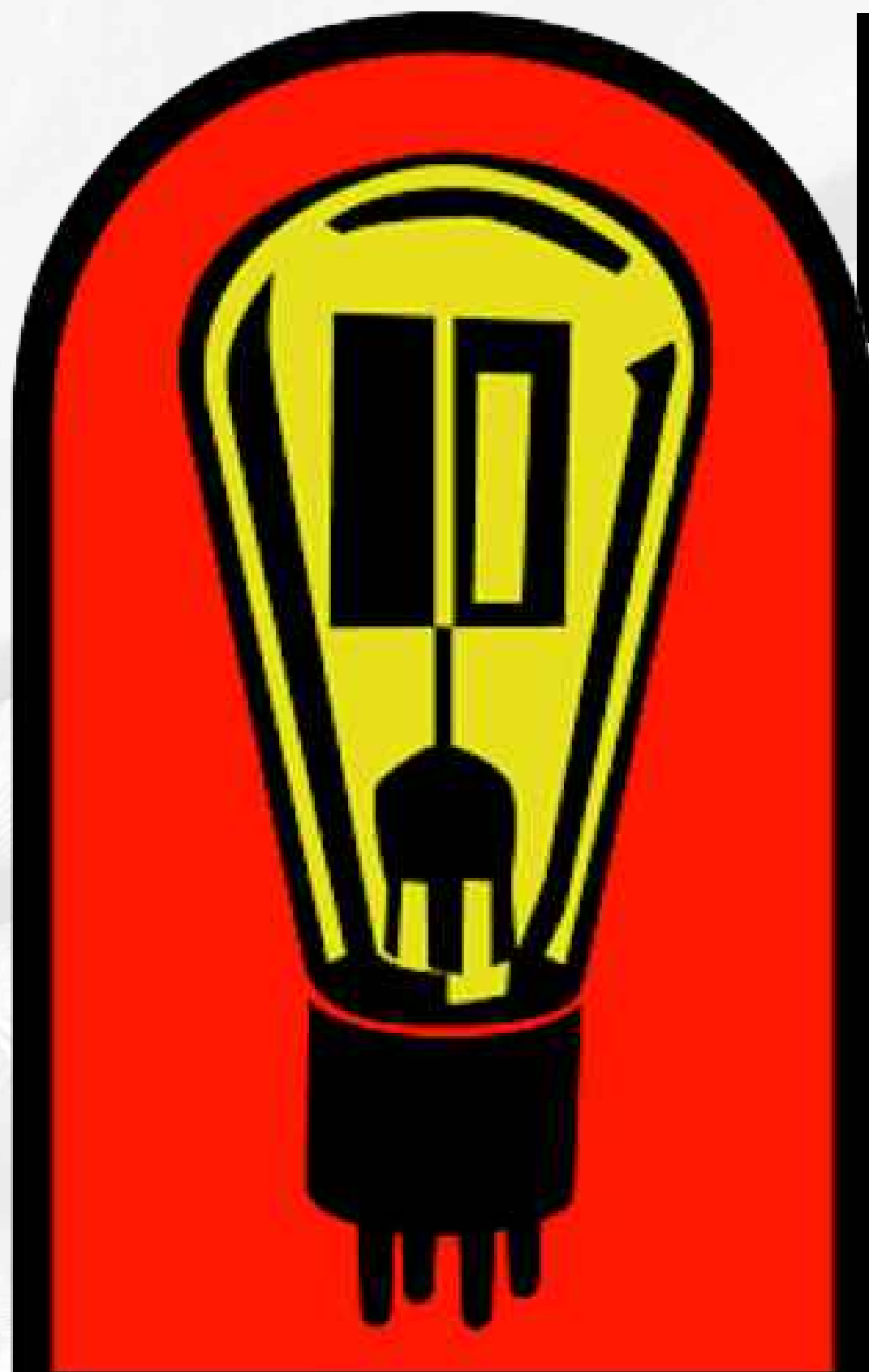
I REACHED OUT TO MURIEL'S DAUGHTER

- **I reached out to Muriel's daughter while researching Elmer. As you might remember, Muriel was the daughter of Elmer's first wife, whom Elmer adopted. So, this person was Elmer's adoptive granddaughter.**
- **Although she was 33 years old when Elmer had died, she had never met him.**
- **While the family thought of the affair between Alice and William White as a scandal, Alice only ever had bad things to say about Elmer. Alice and Muriel were totally estranged from Elmer, almost from the time of the divorce.**

ELMER... TRUTH VS. FICTION

- **“Great vacuum tube inventor” – No, he was simply an entrepreneur.**
- **“Must have had dirt on RCA” – No. RCA entered into an agreement because they were unsure of their patent position and they got the benefit of new distributors.**
- **“Vacuum tube pirate”, “Most successful bootlegger” – Both Elmer and his attorney thought his position was defensible, so I do not consider him a true bootlegger. Indeed, he advertised and sold tubes VERY publicly.**
- **Elmer certainly made millions of dollars in the vacuum tube trade, but it was as a distributor; not as a manufacturer. Elmer’s brand had a lasting impact in the Radio Industry. Even today, in the public mind, Cunningham tubes are separate and distinct from RCA. Even though we all know it is not true.**

THANK YOU
JAMES CROSS



**VACUUM
TUBES** INC.

VACUUM TUBES, INC.



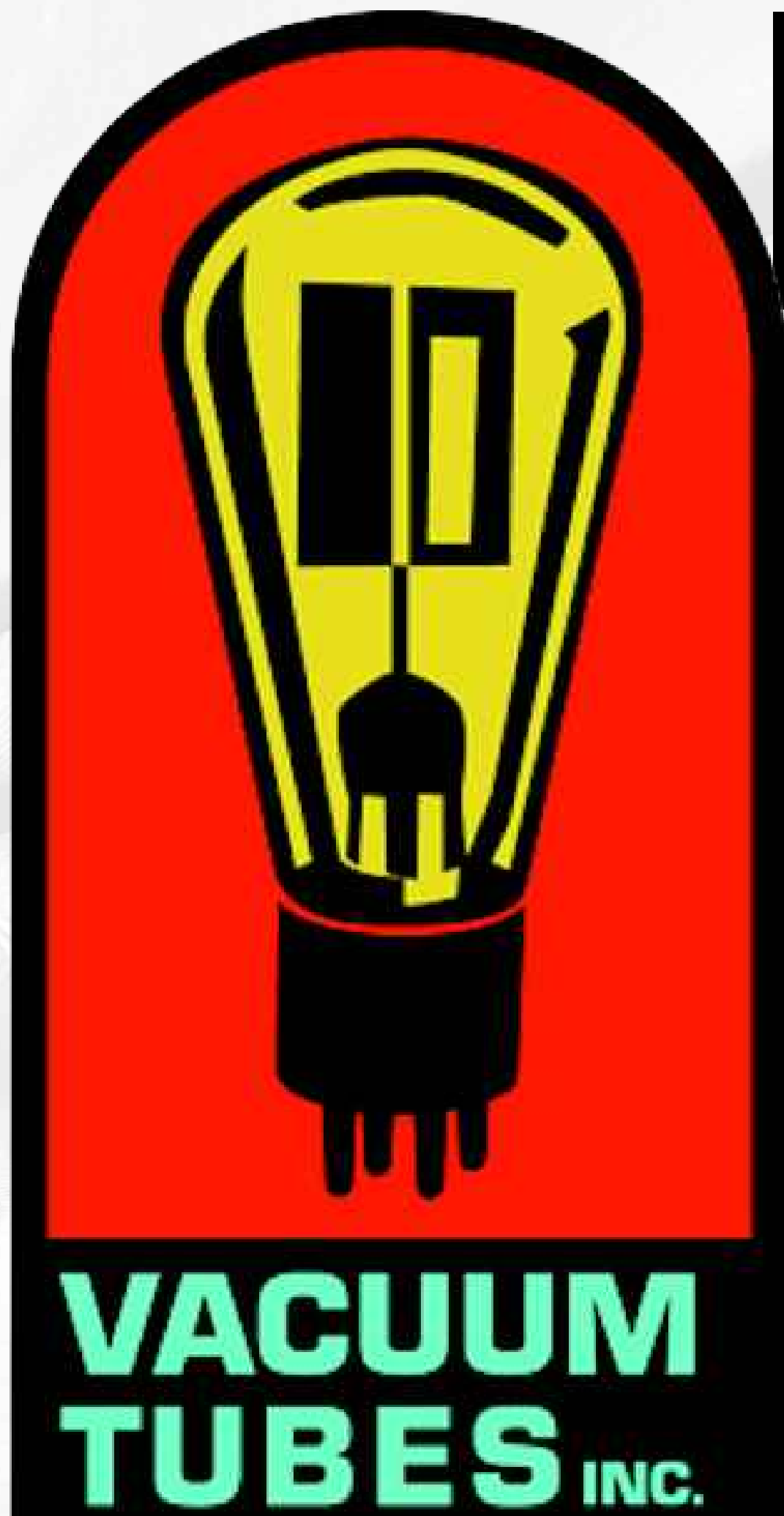
www.vacuumtubesinc.com



407-481-9994



**5603 Commerce Drive, #6
Orlando, FL 32839**



VACUUM TUBES, INC.

- We Buy Vacuum Tubes
- We Sell Vacuum Tubes
- We Sell Tubes Testers
- We Sell Capacitors
- We Sell Tube Sockets
- New Old Stock Tubes.
- We do Not Sell Russian or Chinese tubes.
- We Ship All Over the World.



**Scan QR
Code for
Website**

QUESTIONS?

**Vacuum Tube Millionaire
Elmer Tiling Cunningham**

**Presented by:
James Cross**