The Rise and Fall of Allen B. Du Mont

Part I. The Rise

The late 1940s and early 1950s saw many Americans bring new televisions into their homes bearing the names of the familiar radio companies they knew from before the war. Then, a new name, DuMont, became associated with television. That association matched the company slogan, "The First with the Finest in Television." The public knew that to be the "Finest" television meant one with the largest possible screen, the best performance, and the most attractive cabinet. When viewers watched their new television, the best programs were on the DuMont Television Network. Around your town neon signs and other advertising was blazoned with the name DuMont. As the television boom continued, something changed and the name DuMont, just as quickly, began to fade away. All of this happened under the direction of one man, Allen B. Du Mont (see Fig. 1).

[Editor's note: Part I of this story is in this issue, Part II will be in a future issue.]
[Note: Allen Du Mont spelled his name with a space, but the company name, DuMont, is spelled without a space.]

Young Allen Du Mont

The families of people who become famous or successful often tell childhood stories revealing some clues that point to that person's future in life. The family of Allen Balcom Du Mont was no different. Their story of how a young child who would break apart his toy drum to "find out where the noise came from" must possess the inquisitive mind of a great inventor.[1] Allen B. Du Mont was born in Brooklyn, N.Y. in 1901. His father, a salesman for a large watch company, soon moved his family to Montclair, NJ. When he was 11 years old, Allen and his two brothers contracted polio. While his brothers recovered quickly, Allen did not, and he would remain bedridden

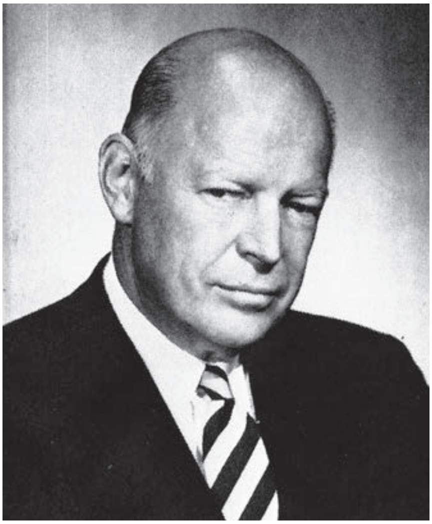


Fig. 1 Portrait of Allen Balcom Du Mont. (*Proceedings of the Radio Club of America*, Oct. 1977, p. 3)

for several months. To help his son pass the time, Allen's father bought him a crystal radio. This fascinated Allen and triggered something in that inquisitive mind. When he recovered, he was left with a limp and an interest in radio and electronics. He would have both for the rest of his life. Soon the family moved to Montclair, NJ, where young Allen continued to demonstrate his ability with radio equipment. He received a ham radio license, W2AYR, at age 14, and built his own receiver and transmitter. Although he was partially disabled, Allen excelled in sports, swimming in particular. After high school, he studied engineering at Rensselaer Polytechnic Institute. During this period Du Mont trained to become a ship's radio operator and during school breaks would sign on with commercial ships cruising the East Coast.[2]

Du Mont at Westinghouse

Upon graduation in 1924, Du Mont entered the workforce during the radio broadcasting boom. He took a full-time position as a production engineer for the Westinghouse Electric Company at their lamp factory in Bloomfield, NJ (see Fig. 2). Although the factory produced millions of incandescent lamps, Du Mont's expertise was needed to increase the production of vacuum tubes for radio. The Westinghouse company had been producing radio-related products in their East Pittsburgh factory. Westinghouse management saw that meeting the demands of the booming radio business would take away from

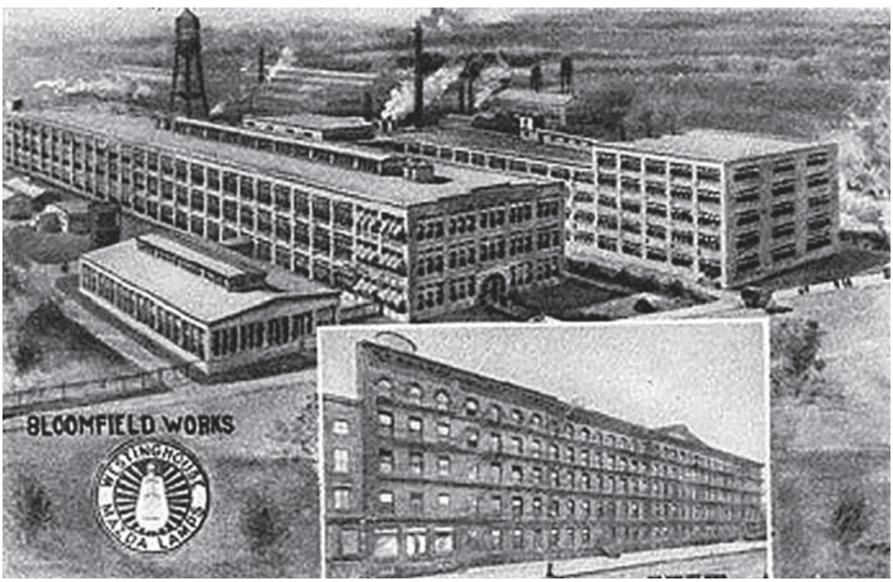


Fig. 2 The Westinghouse Bloomfield, NJ, Lamp Works where Du Mont's first job was to increase production of radio tubes. "Where Westinghouse Mazda lamps are made." (Westinghouse postcard, author's collection)

their core electrical business; therefore, radio had to be moved to their other facilities. Broadcast radio receiver production was moved to the Westinghouse East Springfield, MA, factory and the radio vacuum tubes were produced in the New Jersey Lamp Works. Tube production was far below demand when the new young engineer was assigned to increase production.

Coincidently, a few years earlier, at the Westinghouse East Pittsburgh factory, another young engineer was assigned to increase production of the earlier WD 11 vacuum tubes. He later became famous for his work in television. Vladimir K. Zworykin was the young engineer tasked with changing the production of the WD 11 tube from a handmade, one-at-a-time product to one produced in batches of a few dozen. Although Zworykin, at one point, thought he would be fired after a mislabeled hydrogen tank blew up his lab, he found that management was still happy with his work and asked him to take on larger projects. When he asked if those projects could involve television, the answer was no. That time was still in the future.[3]

Du Mont was very successful in increasing tube production of the model 200 detector triodes and 201 amplifier triodes. As the technology improved, other types of tubes were introduced such as AC filament types, screen grid tubes, transmitter tubes, and more. Over a few years, production went from 500 per day to 50,000 per day. There were several innovations that Du Mont brought to the manufacture of tubes. Some of the innovations included replacing a system of testing tubes at a maximum of 2,000 per day with hand testing. He developed an automatic system with the ability to test 30,000 tubes per day so that workers could continually load in tubes (see Fig. 3).[4] His tube production equipment also could pump a large group of tubes to vacuum in 20 seconds.[5] He once told friends that ten Westinghouse patents were the result of his work. Although company policy at the time prevented the individual from receiving a patent, the company did present him a $500 bonus and the 1927 Westinghouse First Award for the most outstanding accomplishment of any Westinghouse employee.[6] Du Mont was getting noticed in the radio business.

Du Mont leaves Westinghouse for the De Forest Radio Company.

Lee De Forest controlled the De Forest Radio Telephone and Telegraph Company until August 1923, when he sold the company for $1,000.000 to its new president, Theodore Luce, and other Detroit capitalists. De Forest retained a minority stock position and became a consultant. The company was renamed De Forest Radio Company on September 27, 1924, and company brochures dating to 1925 indicated that the company continued to operate in Jersey City, New Jersey.

De Forest wrote in *Father of Radio* that company employee James W. Garside induced Du Mont to forsake Westinghouse to become the company's Chief Engineer in 1928. A vacant factory in Passaic, NJ, was leased and new equipment was ordered so that 30,000 tubes a day could be produced (see Fig. 4).

Fig. 3 Workers load tubes in an automatic tube tester capable of testing 30,000 radio tubes per day. "Here is a view of the high speed tube tester, an almost-human machine which has a capacity of 30,000 tubes a day." *(Radio Engineering*, Apr. 1927, p. 677)

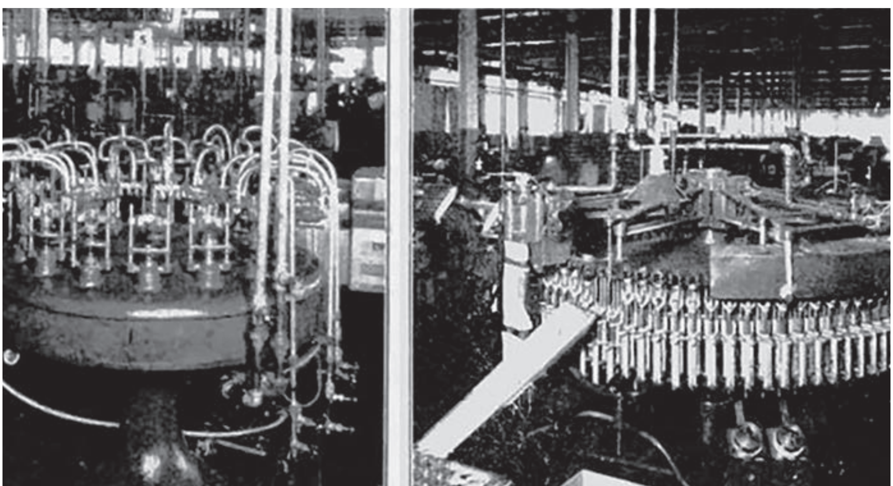
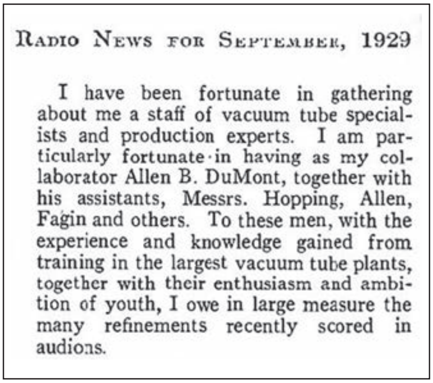


Fig. 4 At a rate of 2,000 per hour, tubes are sealed (left) and bases installed (right). (*Radio Engineering*, Apr. 1930, p. 31)



Radio News for September, 1929

I have been fortunate in gathering about me a staff of vacuum tube specialists and production experts. I am particularly fortunate in having as my collaborator Allen B. DuMont, together with his assistants, Messrs. Hopping, Allen, Fagin and others. To these men, with the experience and knowledge gained from training in the largest vacuum tube plants, together with their enthusiasm and ambition of youth, I owe in large measure the many refinements recently scored in audions.

Fig. 5 In this clip from *Radio News*, Lee De Forest praises Du Mont and his team for their work on vacuum tube production. (*Radio News*, Sept. 1929, p. 282)

Brochures then gave company addresses in both Jersey City and Passaic. De Forest acknowledged the fine work of Du Mont and his crew of young engineers (see Fig. 5).

DuMont also greatly expanded the line of tubes being offered and published a catalog showing about 30 different tubes, including Audions for receiving and transmitting as well as photocells (see Fig. 6). His responsibilities expanded to include the production of radios and related products. Du Mont's successes helped him develop a warm friendship with De Forest (see Fig. 7).

Du Mont and Mechanical Television

Du Mont published a statement in *Radio News*, in July 1930 that the De Forest Radio Company had taken over Jenkins Television Corporation.[7] By this time, he was Chief Engineer and Vice President of Research and took stock of the Jenkins equipment. C. Francis Jenkins and some investors started a television production facility and built an experimental television transmitter in Passaic, NJ (see Fig. 8), while Jenkins continued his research work in Washington, DC. Over the years, Jenkins made steady improvements in mechanical television but never found a path to a commercial TV system. Now elderly, in poor health, and running out of funds, Jenkins lost control to the investors, who took over the Passaic, NJ, plant, and Jenkins hoped to continue research in Washington. That never came to pass because Jenkins died on June 6, 1934, at age 66.

It is not clear how the usually cash-strapped De Forest Company managed to

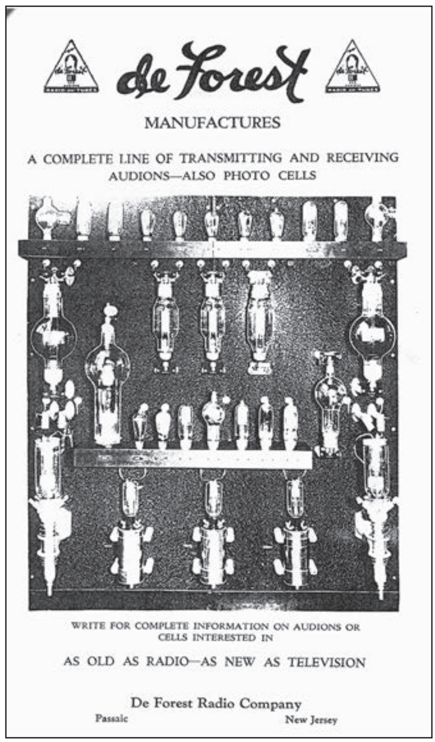


Fig. 6 Cover page of De Forest Radio Company *Audion Catalog*. (Author's collection)

Fig. 7 Du Mont (right) shows a new Audion to De Forest (left). "Dr. de Forest and the young Du Mont in de Forest's tube factory at Passaic, New Jersey." (*Proceedings of the Radio Club of America*, Oct. 1977, p. 4)

Fig. 8 Advertisement of Jenkins Television Corp. for living room television: JD-30 radio and television receiver and R-400 projector radiovisor. (*Television News*, Jan.–Feb. 1932, p. 445)

acquire Jenkins. The transaction was likely a stock swap.[8] It is unfortunate for the Jenkins stockholders that, believing their Jenkins stock to be worthless, they exchanged it for stock in the De Forest Radio Company, which was only months away from becoming worthless as well. But for now, at about 30 years old, Allen Du Mont had become a leader in television research.

Any engineer familiar with mechanical television of the mid-1920s would have been surprised that work with the Nipkow disc was still ongoing. However, when Du Mont saw the equipment and progress that Jenkins had made, he was encouraged to investigate the possibility that a commercial TV product could gain public acceptance (see Fig. 9). There were several companies, such as Western Television, utilizing the work of Ulises Sanabria and Hollis Baird of Shortwave and Television Company in Boston, which was selling televisors and receivers. Along with Jenkins and others, they also maintained regular broadcast schedules. The improvements in mechanical television included resolution improvements by increasing the line rate to 60 and even 120 lines. It also included interlacing lines from double to triple and even quadruple to reduce flicker. Television broadcasting was also assigned more bandwidth and moved to a frequency just above the AM radio band.[9]

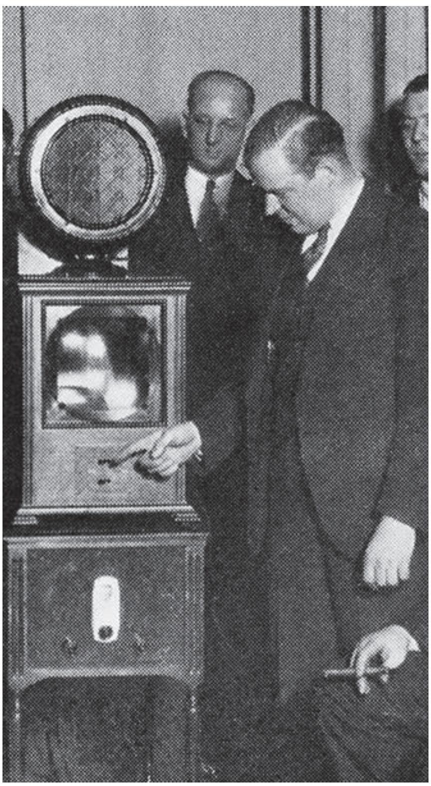


Fig. 9 Allen Du Mont demonstrating a Jenkins scanning drum televisor. (*Television News*, Nov.–Dec. 1931, p. 383)

Du Mont began to investigate what he had "inherited" from the Jenkins company. He found two different cameras in use. The first camera type was the typical flying spot scanner. Light from a bright lamp was passed through a Nipkow disc and focused through a lens at the subject in a darkened room. The flying spot was reflected off the subject and received by a photocell. The second type of camera, for bright outdoor use, received the bright scene focused through a lens onto a Nipkow disc. The scanned light was then picked up by a photocell and sent to amplifiers in the base of the camera stand. The base also contained a motor drive for the operator to move the heavy camera unit. A unique feature was a separate spiral on the disc that provided a monitor for the camera

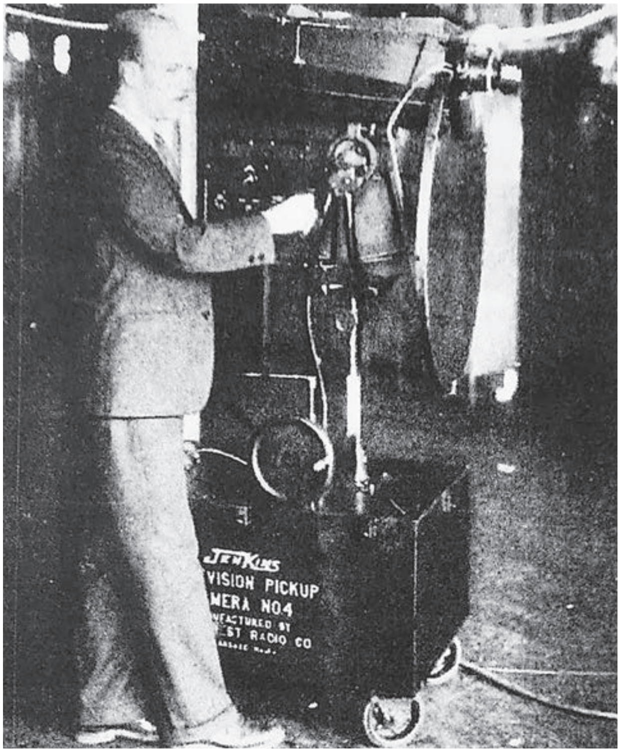


Fig. 10 Jenkins flying spot television camera on a self-propelled base. "Self-propelled television camera for interior or outdoor pickup purposes." (*Electronics*, Aug. 1931, p. 69)

operator (see Fig. 10). In the televisors, the neon television lamp had evolved from the usual single plate lamp to a Jenkins tube with four neon plates for use in a 60-line quadruple interlaced receiver using a scanning drum, which alternated the neon plates between four sets of holes in a rotating drum. The viewer would look through a magnifier to see the image (see Fig. 11). This design quickly became outdated with the introduction of a new type of neon tube, called a crater tube. This tube did not use a lighted plate. Instead, it produced an intense point of light at the center of a cylinder. This was used along with another new development, the lens disc, a Nipkow disc that had a spiral of lenses built into the disc instead of a spiral of holes. By projecting a point of light from the crater tube through the disc and onto the back of a plate of frosted glass, the image could be viewed on the front of the glass. This was the first time a home televisor was not viewed by a single viewer looking through a porthole. Instead, it could be viewed by several people seated comfortably in front of the small screen

Fig. 11 Neon televisor tubes. Left: standard tube. Center: two 4-segment tubes. Right: crater tube. (Early Television Foundation website and author's collection)

(see Fig. 12).[10] The De Forest Company also took over the test broadcasts from the Jenkins transmitter. They were transmitting test programs with simultaneous broadcasting of sight and sound. This was an innovation that made home reception less complicated. After all of these advances were brought together and many demonstrations were made, the general public was not impressed. The test broadcasts did not demonstrate programs of any acceptable entertainment value. The smaller companies discounted their products, and the only buyers were some home tinkerers. In addition, the financial problems caused by the depression reduced the number of investors making risky investments. Based on television field tests by RCA and General Electric, David Sarnoff

Fig. 12 Jenkins model R-400 televisor with lens disc and crater tube. (Early Television Foundation website: https://www.earlytelevision.org/jenkins.html)

concluded that there was no commercial future for mechanical TV. Also, most of the RCA-licensed radio manufacturers had no reason to put much effort into TV research. The results of RCA's research were being published, and licensed companies had full access.

Allen Du Mont soon came to the same conclusion about the Jenkins equipment but he was still convinced that a commercial television system was possible. The use of an improved cathode ray tube would provide the answer needed to build an all-electronic television system. So, like Vladimir Zworykin, only several years later, Allen Du Mont received permission to pursue research on electronic television. Du Mont got the same negative response from the De Forest Company. Although he was disappointed, Du Mont continued his work and soon took his family on a vacation to Bermuda. Unfortunately, upon his return, he found that the De Forest Radio Company had collapsed, only several months after taking over the Jenkins company. As had happened to many whose careers were linked with De Forest, Du Mont was out of a job. Despite the end of the De Forest Radio Company, Du Mont and De Forest remained lifelong friends. They were often photographed together, and De Forest worked as a consultant at DuMont Labs for some time in his later years.

Du Mont Starts Out on His Own

With his position at De Forest Radio Company ended, Du Mont concluded the time had come to make a decision. He believed that the only path to commercial television included the cathode ray tube, and he saw the status of television in 1931 as follows:

- There was a public demand for television to replace radio.
- Television would have to be all electronic, using a cathode ray tube.
- A great amount of work was needed to develop a commercial television CRT.
- Once the CRT was ready, the control circuits could readily be built.
- Allen B. Du Mont could start a small company and build a television.

Quoting Allen Du Mont, "The road ahead seemed to clear. Develop the tube, develop the circuits to control the tube, and—presto—we would have television. I invested $500 and a very good friend (Henry R. Crowley) put in $500. This was the initial working capital for DuMont Laboratories. We hired three good men, and a fourth man worked part-time. One was a glass blower, and two were technicians. Our place of business was the basement of my house in Upper Montclair (NJ)."[11] The house and basement are shown in Fig. 13.

Du Mont would soon learn that it would take the work of many companies, several years, and millions of dollars to reach "presto." But Du Mont was off to a start: some used equipment was brought into the shop, and CRTs were being built from almost nothing. Somedays the entire staff would go rock hunting in Northwest, NJ, bringing back rocks to grind up to start formulating phosphors for cathode ray tube screens. A brother-in-law of Du Mont's wife, Al Steadman, was a chemist, and he joined the team where he helped develop filaments and cathodes.[12] Du Mont took outside work to support his family and the company. He provided consulting services, sometimes as an expert witness. He wrote magazine articles on television topics under his own name. He worked as a consulting engineer for Globe Television and Phone Company.[13] At the Globe company, it appeared that he was connected to the design of their lens disc television, as it had a close resemblance to the Jenkins model. [14] An article in *Television News* announced that cathode ray tubes were being made available to experimenters. These tubes had been designed and built by DuMont and sold by Globe.[15] In another article, "What the Cathode Ray Tube Means to Television," Du Mont, now listed as Chief Engineer of Globe, wrote that although the mechanical TV with a lens disc is a great improvement, the cathode ray tube would be needed to get television

Fig. 13 Du Mont's home. Top left: rear view of former Du Mont home with present-day view of basement entrance. Top right: basement bench memorial. Bottom: the same bench in Du Mont's early lab days circa 1932. (Early Television Foundation website: https://www.earlytelevision.org/jenkins.html)

performance to a higher standard acceptable to the public.[16]

In his basement laboratory, Du Mont got back to work building cathode ray tubes. He had another use in mind for his tubes. At the time, the method available to electronics engineers to measure and analyze electrical currents was by using an oscillograph. Before the cathode ray tube, some of these devices used a string attached to a circuit, causing it to vibrate by the incoming signal. Light was projected onto the string which produced a shadow on a screen. This image on the screen exposed moving strips of photographic film which was fed through an automatic film developer. The final film, a negative, displayed the pattern of the electrical signal for the operator to analyze. A similar device used a mirror galvanometer to reflect the light source and expose the film.

Fig. 14 Unopened DuMont Laboratories CRT crated for shipping circa late 1930s. (Author's collection of early CRTs)

Anyone working in electronics today using a modern oscilloscope would be amazed to see the effort required to obtain a poor representation of the electrical current. Du Mont and others recognized that the cathode ray tubes had the potential to become a precise measuring device. Building and selling oscillographs with improved DuMont cathode ray tubes could become a business capable of carrying the company on a path to television. The CRT business had a slow start with revenues of $70 the first year (sold two cathode ray tubes), $1,850 the second year, and $18,000 the third.[17] A typical cathode ray tube sold in its original crate is shown in Fig. 14. As the business started to grow, more funding was needed. Du Mont borrowed against insurance policies, mortgaged property, and borrowed from his friends and family. Over the first four years of business, he invested a total of another $41,000 in his company.[18]

To begin, Du Mont researched the status of cathode ray tube development in the United States and abroad. It was well known that the cathode ray tube was a crude, expensive, and short-lived laboratory device. The cathode ray tube's earliest ancestor was the Crookes tube invented by Sir William Crookes in 1878. In 1897 Karl Ferdinand Braun invented the Braun tube. As shown in Fig. 15 (top), this tube has one side with a phosphor-painted screen that was illuminated by the cathode ray beam. As more was learned about the action of the cathode rays, in particular, from the experiments of J. J. Thompson, more elaborate tubes were developed. The tube shown in Fig. 15 (center), is a later Braun tube with deflection plates added to move the beam. The tube in Fig. 15 (bottom), is referred to as a Wehnelt tube. It includes improvements made by Arthur Wehnelt. He found that heated cathodes produced more cathode rays with less high voltage. He also added a cylinder that focused the beam. The "Wehnelt cylinder" was the start of these designs using several cylinders for controlling, focusing, and accelerating the beam. This tube also had four plates; one pair mounted vertically and one pair mounted horizontally. With the proper voltages applied the spot could be positioned anywhere on the fluorescent screen. All of these elements combined to position and shape the beam before it hit the screen. In the early days of work in his basement laboratory, Du Mont built tubes of this type for experimental use (see Fig. 16).

Cathode ray tubes of these types were the basis of the first proposal to build an electronic television system using cathode ray tubes to both create and display a television image. This plan was first proposed by the Scottish electrical engineer A. Archibald Campbell-Swinton in a presentation in 1908 and expanded on in 1911 (see Fig. 17). One cathode ray tube used the light from a subject to create an electronic image, and that signal was sent to a second tube which displayed an image. This plan was never put into practice, but the concept of an all-electronic television system was proposed and discussed in scientific circles.[19]

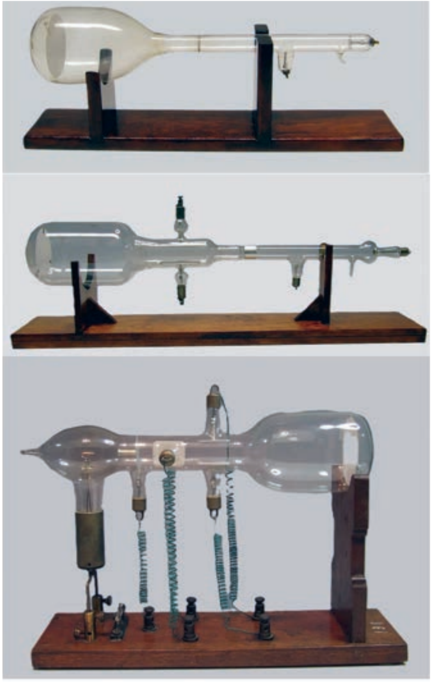


Fig. 15 Early cathode ray tube evolution. Top: early Braun tube. Center: later Braun tube with deflection plates. Bottom: later Braun tube with heated filament, known as a Wehnelt tube. (Author's compilation of photos from the Cathode Ray Tube website, www.CRTsite.com)

Great strides were made towards using the cathode ray tube as a display for use as an electrical measuring device or as a television display by Baron Manfred von Ardenne, working in Germany (see Fig. 18). At the Berlin Radio Show in 1931, von Ardenne displayed a working closed circuit television system using two CRTs. The first cathode ray tube was configured as the light source for a flying spot camera. Light is passed through a transparency slide and picked up by a photocell. This signal was then sent by wire to the second cathode ray tube, configured as in an oscilloscope, where the image was displayed. Von Ardenne related the details of his recent work in an article in *Television News*, May–June 1932.[20]

The basement lab had become too small, so Du Mont rented space on Valley Road in Upper Montclair, NJ, in a storefront that had been a hat shop (see Fig. 19). In 1932, Du Mont had made some early cathode ray tubes for experimental purposes. He published a paper in the proceedings of the Institute of Radio Engineers (IRE), telling of his progress to that time and the further advances needed to use the cathode ray tube in television.[21] He made a study of different shaped cylinders and their ability to focus the beam passing through to be a sharp dot on the screen and the relation of the applied voltages to the best focus. He also investigated methods to modulate the beam so that an image can be produced on the screen. He concluded that applying a negative bias voltage to one element could create a control grid that would take the dot from cutoff to full brightness with a minimum change in voltage. He also found that a second element could act to vary the focus without being affected by the control grid. In addition, a third element was added to accelerate the beam. Now the electron gun began to take shape.[22] Du Mont's

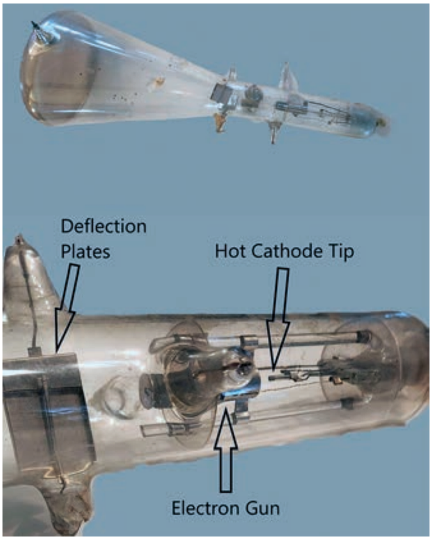


Fig. 16 This 1932 experimental CRT, attributed to DuMont Laboratories, is labeled to show the deflection plates, hot cathode tip and electron gun. (Author's collection of early CRTs)

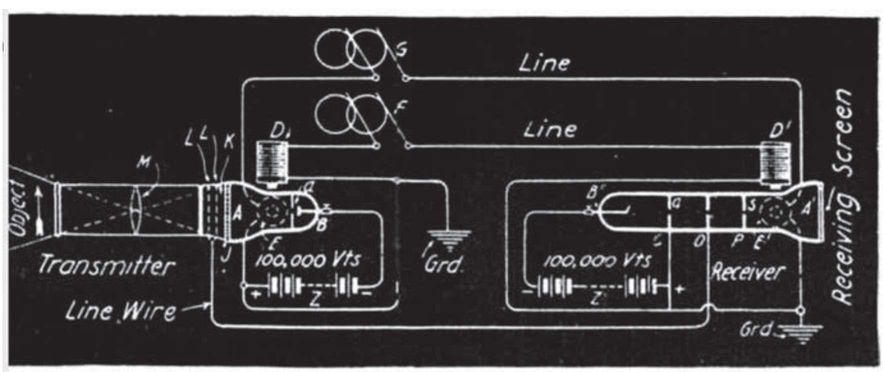


Fig. 17 A. Archibald Campbell-Swinton's proposal for an all-electronic television system, 1908. (*All About Television*, Summer 1927, p. 66)

cathode ray tube is shown in Fig. 20 with an inside anode silver coat in the funnel-shaped portion. A potential in the range of 3,000 to 5,000 volts was applied to obtain an intense bright spot.

The cathode ray tubes of von Ardenne were improved to the point where they would soon be commercially useable. The article listed improvements in frequency response, smaller spot size, and the use of shielding to reduce oscillations visible in the screen background. By 1936, his cathode ray tubes were ready for television receivers placed around Berlin and a clever camera system was set up to transmit images of outdoor events. On the top of a television truck, a film camera would record the event. The exposed film passed through the roof of the truck directly into an automatic film processing system, and the developed film was then scanned, frame by frame, by a flying spot scanner. The picture signal was then combined with the audio and sent to the transmitter. This is how the 1936 Olympic Games were televised around Berlin.

The DuMont Oscillograph Business

In the mid-1920s, Allen Du Mont had an early experience with cathode ray tubes when he was working at Westinghouse.

Fig. 18 Early CRT by Manfred von Ardenne. (Author's collection of early CRTs)

Fig. 19 Second location of the DuMont Laboratories factory, a former hat shop on Valley Road in Upper Montclair, NJ. "Later Du Mont occupied two small stores at 532 Valley Road, Upper Montclair. With 1500 square feet of floor space and 20 employees, he was off to a good start." (*Radio Age*, May 1989, p. 2)

Fig. 20 Early DuMont Laboratories CRT used in experiments described in an article written by Allen Du Mont. (*Proceedings of the IRE,* Dec. 1932, p. 1875)

A researcher, working with a German tube, likely a von Ardenne sample, had accidentally burned out the filament. He asked Du Mont to repair the tube. He did and thus became the first CRT rebuilder in the country.[23] In 1932, Du Mont made advances on his cathode ray tubes. When the design was ready for producing his first CRT-based oscillograph intended for sale, he found that their small operation, although expanded into additional storefronts on Valley Road, was not going to be capable of producing the electrical assembly.

Back in his time at De Forest Radio, Du Mont had hired Fred M. Link to build the television transmitters. After De Forest, Link started his own successful company, where he became known as the "Father of two-way Communication." Du Mont contracted Link to build his early line of oscillographs (see Fig. 21).

Du Mont also knew that his customers would have to be educated to recognize the benefits of having an oscillograph in their labs. They instituted a program of demonstrating their products at schools, companies, and universities so that new engineers and technicians would take their knowledge of oscillographs with them. The DuMont Laboratories had many publications that were given away to these new engineers and technicians (see Fig. 22). As other companies began to use the term oscilloscope, DuMont Labs maintained the name oscillograph. Also, as the uses of cathode ray tubes increased and also became used in television, the term CRT came into popular use.

Thomas T. Goldsmith Joins DuMont

Thomas T. Goldsmith was born in Greenville, SC, in 1910. He attended Furman University and after receiving his degree, started to work on a Ph.D. at Cornell University. It was during this period that he became acquainted with cathode ray tubes and oscillographs. When he needed a CRT repaired and wanted a new tube with a higher vacuum than was available, he first came into contact with Allen Du Mont and his early basement operation. Sometime later, as he was completing the work for his Ph.D., Goldsmith was in New Jersey.

He was traveling with his professor, who suggested they stop and visit Du Mont. At this time, in 1936, Du Mont had already moved out of the basement of his home to a storefront, a former hat shop, at 542 Valley Road in Upper Montclair. During this visit, Du Mont remarked that Goldsmith knew a lot about CRTs, so Du Mont asked him when could he start working for DuMont Labs. Knowing his studies would be completed soon, he replied that he could start November 1. Goldsmith asked what his title would be and Du Mont replied "Whatever you want." Goldsmith decided to start his career as Director of Research. Neither man knew that Goldsmith would keep that title for 40 years. On that day, Thomas T. Goldsmith (see Fig. 23) not only became employee number 14 of Allen B. DuMont Laboratories Inc., but he also started a lifelong friendship with Allen Du Mont.[24]

When Du Mont's daughter, Yvonne Du Mont Stelle, was asked to describe her father, she simply replied, "My father was an engineer."[25] People would also note that Allen Du Mont, the entrepreneur,

Fig. 21 Early DuMont Laboratories oscillographs built by Link Radio for the Allen DuMont Labs in the 1933–1935 period. (*Proceedings of the Radio Club of America*, Oct. 1977, p. 5)

was often described as an introvert and being of a quiet and retiring nature, while Goldsmith, as can be seen in his many interviews, was an extrovert. When both attended meetings or presentations, Goldsmith often took the lead.

Another important engineer, Samuel Christaldi, joined DuMont Labs in October 1938. He joined the company as Chief Engineer. When asked why he chose DuMont after graduating from Rensselaer Polytechnic Institute, where he learned about Du Mont as an alumnus, he said it was because of Du Mont himself, a man he described as having ambition with integrity, a straight shooter, and an employer interested in his employees. He was employee number 29.

The Magic Eye Tube and the Pickle Factory

Du Mont's research into CRTs led him to make several interesting inventions. One of these was a device that became known as the magic eye tube or simply, a tuning eye tube. It became a familiar device on higher-end console and table radios in the late 1930s and 1940s. Through the glass face of the small tube, a pie-shaped plate could be seen. When in use, the plate would have a green glow with a visual gap (like a piece of pie was

Fig. 22 Sample of the many DuMont Laboratories publications, both catalogs and instructional. (Author's collection)

missing) on its small screen. As the radio was tuned, the gap would shrink to a minimum telling the operator they had reached the optimum tuning of the incoming radio signal and were getting the best reception. But these eye tubes were not on the market as a DuMont product, but rather as an RCA product.

David Sarnoff and Allen Du Mont were long-time acquaintances going back to their early days as radio operators (see Fig. 24). When Du Mont demonstrated the little CRT, Sarnoff was impressed and offered to purchase the patent for RCA. The purchase price, just under $20,000, was determined by the fact that Sarnoff had a spending limit of $20,000 without first getting approval from the RCA Board of Directors.[26] This deal was agreeable to Du Mont, as he knew just what to do with this money. The company could then move out of the storefronts in Upper Montclair as he used the funds to purchase a former pickle works at 2 Main Avenue in Passaic, NJ (see Fig. 25).[27] In a building with three usable floors of 30,000 square feet, there was space for proper engineering and research departments in the basement, CRT production on the first floor, and television and oscillograph manufacturing on the second floor.

This facility allowed Du Mont to hire more employees, expand production of CRTs, and produce new oscillographs. Catalogs from the 1940s show as many as a dozen different oscillograph models, for different applications and levels of performance. Du Mont continued to provide technical information for engineers and technicians and researched additional

Fig. 23 Portrait of Thomas T. Goldsmith, Director of Research, Allen B. DuMont Laboratories, from 1936. (*Radio Age*, June 1989, p. 1)

Fig. 24 Friends Allen Du Mont (left) and his friend David Sarnoff (right), president of RCA, both wireless operators in their early days, are shown as they were in 1944. (*The Raster*, Jan. 1945, Du Mont collection, Smithsonian Institution)

applications for his products. Although the DuMont Labs oscillograph business was successful, it wasn't able to support the television research.

DuMont Status Report on the CRT for Television

The 1930s CRTs that DuMont and other companies could build were not ready for television use. The available tubes could only be advertised as intended for experimental use. Some tubes were cold-cathode and some used small amounts of gas in the tube to aid in focusing. Du Mont set a list of goals for an acceptable television CRT. He published this list in the March 1933 issue of *Radio Engineering*:

1. They should reproduce with fidelity, the observed wave,
2. The threshold effect should be at a minimum,
3. They should give a brilliant spot on the fluorescent screen,
4. The spot should be regular in shape over the entire screen,
5. It should be possible to focus the spot to any desired size,
6. Maximum sensitivity is desirable,
7. There should be a minimum current across the deflection plates, and
8. The trace should not blur at high frequencies.[28]

Du Mont also recognized that the cost and life expectancy of the tube was critical if people were going to be able to afford a television and he also realized that the three-inch and five-inch tubes would not produce an acceptable picture for home use. He also disliked the idea

Fig. 25 The DuMont Laboratories' new factory at 2 Main Ave., Passaic, a former pickle works, purchased with funds from sale of the "Magic Eye Tube" patent. (*Radio Age*, Feb. 2010, p. 5)

of viewing a vertically mounted CRT by watching a reflection from a mirror in the TV lid. So he set his goal for television: a television needed a direct view tube with a minimum picture of 8 by 10 inches.

CRT Research Picks Up

Cold cathode tubes were quickly eliminated, as heated cathodes ran at lower voltages and the beams were easier to control. In his work, Goldsmith concluded that having any gas in the tube caused the blurring at high frequencies, so all tubes would be of high vacuum. Tests were made to find the best-shaped elements to produce the best-focused spot. Tests were made of minerals to produce the best color fluorescence to match the use of the tube. Green was chosen as the best for use in an oscillograph, blue when the screen is to be photographed, and a compound mixed to produce white for television.

Du Mont and Goldsmith developed what they referred to as a post-deflection intensifier band. This ring of a conductor was applied as one or more bands around the glass tube in the area between the deflection plates and the screen. By applying a high voltage to these bands as well as the screen, the beam was accelerated to the screen producing a much brighter spot. They further developed a focusing electrode in the electron gun and a ratio of high voltage values to best focus the spot on the screen. They also improved the control grid element to turn the beam on and off and all the intensities in between.

To attain the cost-effectiveness he desired, the filament and cathode were improved to last thousands of hours. To produce a large screen with a flat face would require a thick heavy glass to prevent implosion. By using a spherical shape, Du Mont was able to use thinner glass taking advantage of the strength of the shape, like that of an egg. This meant that the curve of the outer edges would have a distorted area, so they used a 14-inch tube to get a 12.5-inch diagonal image. These factors plus the expected economies of scale with higher production got Du Mont the tube he needed for television. Magazines of the day described the tube as the "Big Bertha" of cathode ray tubes (see Fig. 26).

Before Du Mont or von Ardenne could produce a television receiver, a device to produce a test image had to be created. The answer was a flying spot scanner, similar to the Campbell-Swinton proposal, in which the flying spot was the dot scanning the face of a cathode ray tube. Von Ardenne's scanner was shown and described in an article in *Television News* (see Fig. 27). In an interview, Thomas Goldsmith describes the early flying spot scanner built in the DuMont Lab. It was built from two DuMont oscillographs, with oscillograph #1 acting as a still image camera. The CRT in the first oscillograph was specially constructed with an image (a profile of Abraham Lincoln) scratched into the phosphor face. With a steady focused beam turned on, and vertical and horizontal deflection applied, the image on the screen is scanned. This image (showing the profile of Lincoln) was received by a photocell collecting the light coming from the CRT screen on oscillograph

#1. At oscillograph #2, the same vertical and horizontal deflection is applied to move the beam in synchronization with #1. This picture signal from #1 is now applied to the control grid to modulate the brightness of the focused beam of #2 and the image from # 1 is now also visible on #2. The DuMont staff used this system to create a test signal (as they never developed a camera tube) to understand what would be needed to create a viable television receiver. Later, DuMont Labs built their own TV cameras using Iconoscopes purchased from RCA.[29]

Du Mont's European Tour

To be clear, neither Du Mont nor any of his associates ever claimed that Du Mont invented television. After Du Mont passed away, his colleagues did credit him as "the man responsible for television." This claim could be equally applied to many people. Television is not an invention that resulted from any single person's "ah ha" moment. It would take advances by many people to make television happen and Du Mont's work started with improving the CRT for television.

It was well known that European companies were working on television and in some areas were more advanced than U.S. companies. England and Germany were already broadcasting in 1936. Du Mont, to get a jumpstart on building a complete receiver, made a trip to Europe to learn about the progress of work there. He visited Germany, France, and England. In England, he visited the Ferranti and Cossor companies. At Cossor, an old established electrical manufacturer, he was impressed with their television receivers. The company claimed to have sold the first electronic television to a hotel in England in 1936. Du Mont purchased a few Cossor TVs and shipped them back to the lab.

Back at home, it was clear that the race against RCA and other manufacturers to

Builds Giant Television Tube

Allen B. DuMont examines the giant cathode-ray television tube he has developed. Tube has a diameter of 13½ inches.

DESCRIBED as the "Big Bertha" of cathode ray tubes, a new television tube developed by Allen B. DuMont, of Montclair, N. J., has a diameter of 13½ inches. The largest tubes heretofore available for oscillograph work have been of a 9-inch diameter.

The new television tube is distinguished by its rounded sides, which provide the necessary added strength to withstand the atmospheric pressure on the highly evacuated glass bulb of the tube.

Fig. 26 Allen Du Mont with "Big Bertha," a 14-inch CRT for television he has developed. The largest tubes heretofore available for oscillograph work have been of a 9-inch diameter. The new television tube is distinguished by its rounded sides, which provide the necessary added strength to withstand the atmospheric pressure on the highly evacuated glass bulb of the tube. (*Modern Mechanics*, Apr. 1938) produce a television for sale was getting tight. When the shipment arrived at the DuMont Lab, the Cossor units were "dissected" and used as a model to construct the first DuMont receiver. From there, it was a process of reverse engineering to replace the British valves with American vacuum tubes and configure the circuit for a DuMont television CRT. The result is the DuMont 180; the two chassis can be compared in Fig. 28. A production line was set up and DuMont TVs made their way down the line for sale in 1938 (see Fig. 29).

The Transmitter

Allen Du Mont had lived through the beginning of the radio broadcasting era. At that time, a radio manufacturer knew that he couldn't sell radios if there was nothing to hear, so many created their own broadcasting stations. Du Mont saw the situation to be the same in the early days of television. He would need to broadcast television content, not only for equipment testing but also to give the early TV enthusiasts something to watch. DuMont Laboratories applied for an experimental license and was assigned W2XVT. Fred Link was again contracted to build this and other transmitters.[30] A 50-watt transmitter was built and installed in the basement of the Passaic factory (see Fig. 30). From a makeshift studio, DuMont timeshared a single channel on which there would be a test pattern and an occasional movie. Soon, another experimental license, W2XWV,

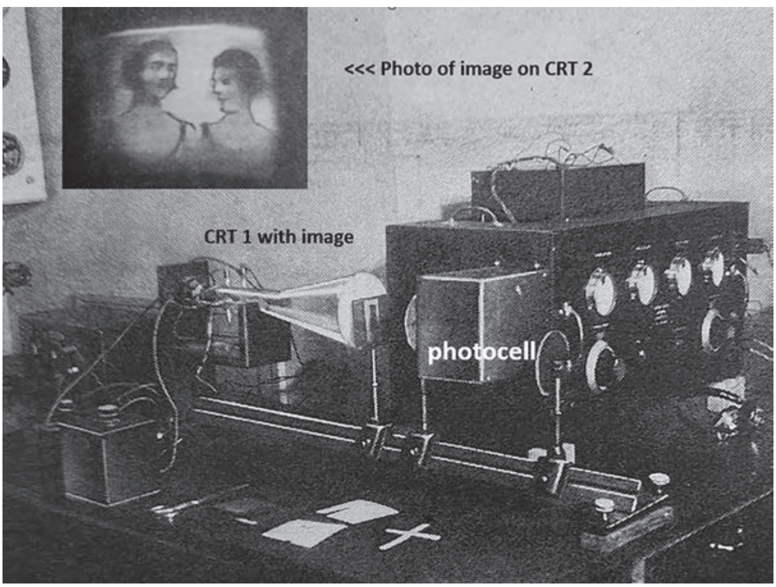


Fig. 27 Actual flying spot scanner of Manfred von Ardenne similar to DuMont Laboratories' test pattern generator. CRT 1 scans the transparent image and the light is picked up by the photocell. The signal is sent to CRT 2 which displays the image. The inset is the actual unretouched image from the transparency. (*Television News*, May–June 1932, p. 90)

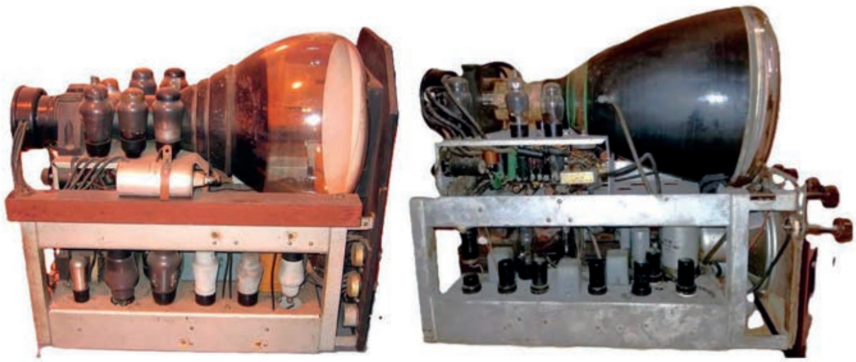


Fig 28 Comparison of the British Cossor TV chassis (left) and DuMont Laboratories model 180 chassis (right). (Early Television Foundation website: https://www.earlytelevision.org/jenkins.html, and author)

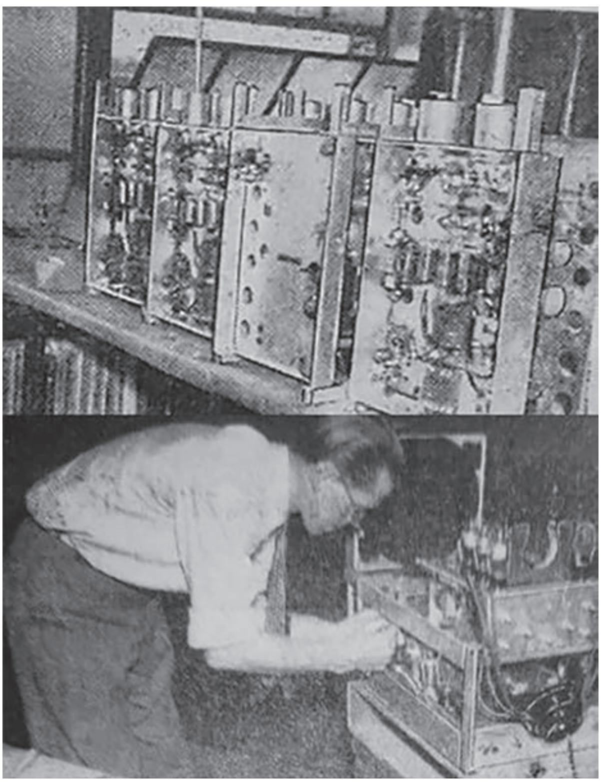


Fig. 29 Final assembly of DuMont Laboratories model 180 TV. Top: television chassis that have been prepared. Bottom: television being assembled. (*Radio and Television*, May 1939, p. 7)

was granted for DuMont's New York office. This would later be assigned the call letters WABD (initials for Allen B. Du Mont). This station would become the flagship of the DuMont Television Network. With a limited staff, the day-time factory staff would also take turns working a second shift as the night-time broadcasting staff.[31]

Paramount Pictures Invests

The Allen B. DuMont Laboratories Inc. grew at a fast pace every year and that took money. In the depression years of the 1930s that was a tough job. In the business of trying to create television, where so many had failed, the chance of getting bank or investor funding was near zero. In addition, the laboratories did not have a lucrative enough business to fund the work on their own. When Du Mont prepared to build and sell televisions, he saw that they would have to start a new business. For people to buy televisions there would have to be something to watch.

This meant having to broadcast more than a test pattern. For Du Mont and Goldsmith, two talented engineers, the logical answer seemed simple. If they had the expertise to produce the hardware for television, they should affiliate with someone with expertise in providing the entertainment content for television.

In 1937, Paramount Pictures made the first investment in Allen B. DuMont

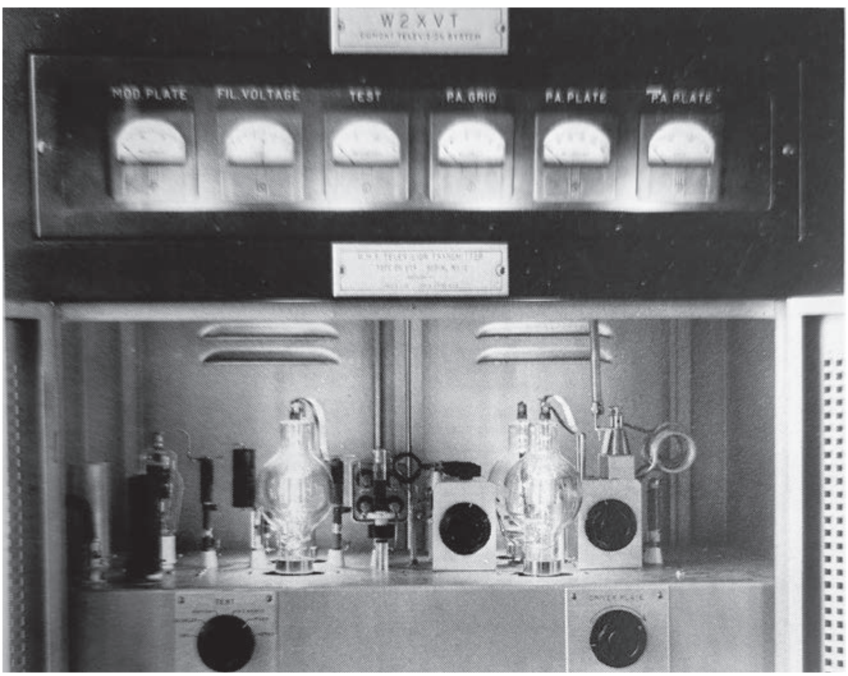


Fig. 30 W2XVT 50 watt experimental TV transmitter final amplifier stage at the Passaic factory. (*Proceedings of the Radio Club of America,* Mar. 1978, p. 22)

Laboratories with a purchase of stock totaling $56,000. This made Paramount the sole owner of a new Class B stock, which also allowed Paramount to elect the secretary and treasurer of the company. Du Mont and some others controlled all of the Class A stock. For the time being this solved the problem of getting the DuMont Television Network started. Spaces for the new transmitter and new studios were arranged at 515 Madison Avenue, New York.

Setting TV Standards

As television was making its way from the laboratory to field tests under experimental licenses, there were no transmission standards. When David Sarnoff at RCA decided to abandon mechanical television, RCA began extensive testing to find what would be required for television standards that were not only acceptable for eager customers but could also be manufactured and marketed at a reasonable price. Test broadcasts from the Empire State Building were made, the results were analyzed, changes were made, and further tests were planned. During the mid-1930s, rapid progress was being made. Zworykin's Kinescope was in use as well as the iconoscope camera tube. Field testing was now all electronic. In 1936 several test receivers, model RR359, were built in both 9-inch and 12-inch versions with the CRT facing upward into a mirror in the lid. They were placed in the homes of RCA engineers, who would report on the reception of the test broadcasts. David Sarnoff had been spending huge amounts of money and was under pressure to get television commercialized to start getting some return on RCA's investment. Upon completion of the 1936 field tests, RCA planned to move ahead with a 441-line, 30-frame-per-second standard. In 1939, the standards were still not finalized and Sarnoff believed that if RCA began producing receivers and started broadcasting at the 1939 World's Fair, the FCC would be pressured to approve the standard. However, the FCC did not want to allow sales of equipment that could become obsolete quickly, so the chairman of the FCC, James Lawrence Fly, was forced to act and did not give Sarnoff approval.

Other companies, including DuMont, did not agree with the 441-line standard, believing a much higher line rate would be better for the viewer, particularly as the screen sizes were expected to grow larger. DuMont recommended that television receivers should be built that allowed the owner to turn a switch for different line ratings. In this way, advances in broadcasting would not make a television of a certain design obsolete. DuMont had proposed 525 lines with a 15-frame-per-second rate. Philco recommended 605 lines with a 24-frame-per-second rate. Zenith and CBS preferred waiting for more field tests to determine the best format.[32]

The RMA, the Radio Manufacturers Association, had been formed in 1924 to give the companies that built radios the opportunity to have a voice in setting standards and advising government regulators on the technical needs of radio. Their work ranged from recommending broadcast standards down to standardizing the dimensions of connectors and the color codes printed on components. The RMA was also the place where new vacuum tubes had their numbers assigned and their specifications registered. In 1950, to reflect their work in television, the name was changed to RTMA, Radio & Television Manufacturers Association.

Unfortunately, they were unable to agree on a set of standards for television broadcasting. One member, RCA, and many other members who were license holders of RCA, were pushing hard for the 441-line RCA standard. It was when RCA started to move ahead with the 441-line standard that the FCC chairman, James Fly, called a halt that brought about the creation of the National Television Standards Committee (NTSC). Representatives of various companies, including Thomas Goldsmith from DuMont, served on subcommittees, and in 1941 standards were adopted. The compromise was the 525-line standard that survived until the TV standard went digital in 2009.

Later, Allen Du Mont and other companies saw the need for another organization, and in 1944, the Television Broadcasters Association was formed with Du Mont as the president. In this way all of the interested parties would have an equal voice in recommending standards and regulations.[33]

First Television Receiver on the Market

The June 15, 1938 issue of *Broadcasting Magazine* carried the announcement that the DuMont company had two television receiver models available for sale to the public. They were both classified as direct-view sets, not viewed via a mirror in the lid. The larger 14-inch console with an audio section was priced at $650, and a smaller 12-inch model without an audio section was priced at $425. In 2024 dollars this would be $14,550 and $9,550 respectively. Both sets were on showroom display but had to be ordered with a 5–6 week delivery date (see Fig. 31). In the same article, DuMont engineers announced that the company started work on an experimental TV broadcast station and they planned to broadcast television programming on a scheduled basis.[34] Another article, in the same issue, announced that the Radio Manufacturers Association television committee had held meetings in hopes of forming technical standards for television broadcasting which would be submitted to the FCC. However, they soon announced that no

Fig. 31 DuMont Laboratories model 180 table top with 8-inch by 10-inch screen, regarded as first U.S.-manufactured TV on the market in 1938. (Early Television Foundation website)

agreement was reached, leaving the public concerned that in 1938, an expensive television could quickly become obsolete.[35]

The War Years

In the 1930s, the United States prepared for war in Europe. Allen Du Mont had some ideas he thought would help the U.S. military defend the country. His ideas sounded like a description of radar. He thought that radio could be used to detect enemy ships and planes. He made arrangements through his military friends to present his ideas to the staff at Fort Monmouth. He returned and told his staff that the idea was well received, but Du Mont was told he should not apply for a patent or make the idea public in any way, as secrecy was so important.[36] He also presented an idea to detect an infrared signal from the heat radiated by ships and planes. RCA and Vladimir Zworykin were working on similar devices for infrared detection with no positive results.[37]

Soon Du Mont, Goldsmith, and the laboratories would be involved with the radar work being done at the MIT Radiation Lab. The DuMont capabilities with oscillographs filled a need for radar displays. The ability of the CRT face to display the outgoing radar pulse on screen and the reflected radar pulse coming in afterward could determine the range of the object. By knowing the time base on the display and measuring the difference between the leading edges of the two pulses on the display, which traveled at the speed of light, the distance to an object could be calculated. Radar systems quickly evolved and so did DuMont's displays. Special CRTs were built, many with two and even five independent electron gun and deflection assemblies.

As the United States entered the war, DuMont Laboratories was involved in building displays for radar and other communications equipment. During the war years, the company was working at full capacity to provide radar components, mortar fire locators, electronic timers for Loran C equipment, and general-purpose and militarized oscillographs. Also, during this time, specialized oscillographs and other equipment were provided to the Manhattan Project, Oak Ridge Laboratories, Los Alamos Laboratories, Sandia Corporation, and others.[38] A government representative, Donald Lippincott, met with Du Mont and Goldsmith to explain that many companies were offering their services to the government at no charge, Du Mont had to explain that with the shutdown, too much of their income was lost and they could not survive without some income from the government. Goldsmith has reported that DuMont Labs received about $5 million over that period.[39] This work included sharing their CRT designs with other manufacturers to meet wartime requirements. Goldsmith was chairman of the Cathode Ray Tube Committee of the Radio Manufacturers Association (now the EIA) to standardize the CRTs and display equipment so direct replacement for military equipment could come from any supplier.[40]

Postwar Television Takes Off

After the war, the electronic communication industry was preparing for the expected rapid growth of television.

Allen B. DuMont Laboratories' technical staff was well prepared and perhaps one of the finest ever assembled by a company of this size. It produced very effectively, a tribute to the leadership and inspiration provided by Allen Du Mont.[41] Every division was ready to go to work.

- The Receiver Division: concentrated on the design of high-quality 12-, 15-, and 20-inch receivers.
- The Transmitter Division: refined the pre-war studio equipment, added image orthicon cameras, film chains, and high-power VHF transmitters, and started to develop UHF transmitters.
- The Tube Division: responsible for the design of new larger-screen electromagnetic deflection CRTs for television.
- The Instrument Division: resumed the production of oscillographs to satisfy industry demand that was delayed by the war effort.
- The Broadcast Division: The original short hours of experimental broadcasting from Passaic would end and the new station WABD (for Allen B. Du Mont) would go on the air. Affiliated stations would be added to offset the cost of programming. Many other divisions would work to support these major efforts.
- Research Division: as Du Mont realized the importance of research, he encouraged Goldsmith's and Christaldi's research in television as well as other products.[42]

Allen Du Mont enjoyed his work and the progress of his company. He would take a daily walk through the plants and confer with his employees. He would then go back to the modest office he had kept for some years. When his wife told him he needed to upgrade his humble office with battered furniture to one more fitting his position, he declined. He retorted, "You know, ever since we got successful, all the young fellows in the plant want big, fancy offices. I figure leaving mine this way saves me a lot of arguments" (see Fig. 32).[43] He also had better ways to spend the money.

Tom Goldsmith was happy with his position as Director of Research, noting that the company had grown from the time of his hiring, just a decade earlier as employee number 14, to a staff, he recalled in later years, that would reach 6,000.[44]

All of this growth did not come without a cost. Sales in 1946 exceeded $2 million, but that still resulted in an operating loss of $1.5 million.[45] Wall Street investors now saw television in a new light. The company could now raise money, as they did with Paramount, but this would again have DuMont Labs standing on unfamiliar ground. The television industry was going to grow very fast. If DuMont Labs could not fund fast growth, it would be left behind. The flagship station, WABD, went on the air as "New York's Window on the World," and the race to become the DuMont Television Network was on (see Fig. 33).

End of Part I

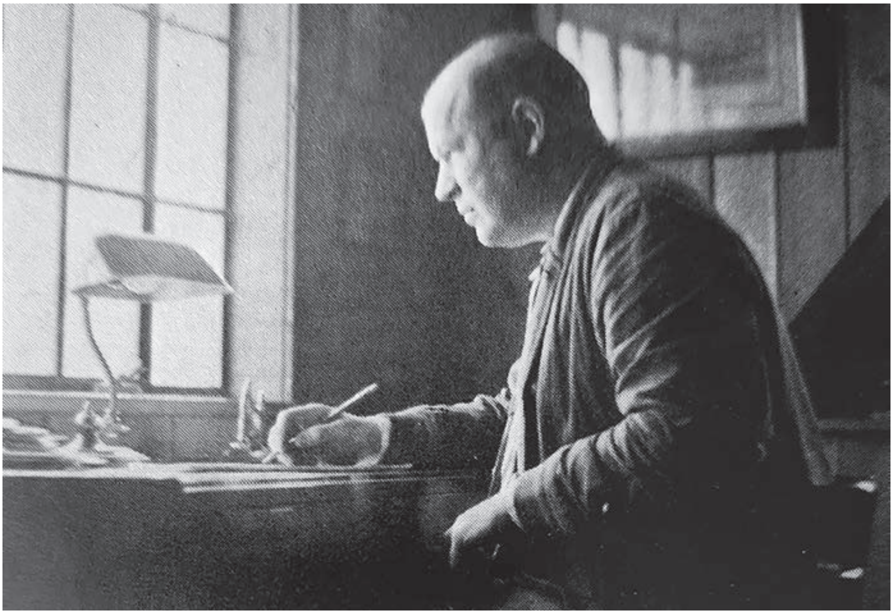


Fig. 32 Allen B. Du Mont at his humble office and desk, happy in his work. (*Proceedings of the Radio Club of America,* Mar. 1978, p. 20

Fig 33 Screen shot of WABD, the DuMont Laboratories flagship station, which signs on the air as "New York's Window on the World." (Author)

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About the Author

Author **Mike Molnar** was honored to be presented with the Radio Club of America's 2024 Ralph Batcher Memorial Award for the preservation of the history of radio and electronic communication. Also in 2024, Mike was chosen to give the historical presentation at the IEEE milestone ceremony marking Hazeltine's invention of the Neutrodyne Circuit at the Stevens Institute of Technology. With all of this, Mike also celebrated 40 years of running his company, Diagnostic Services Inc., building nuclear medicine equipment for veterinary specialists. He seems to be running it a bit slower each year.

Mike and his understanding wife, Pam, also have enjoyed showing the collection of historical radio, TV, and other artifacts to new visitors. A few rare items from the collection have gone on the road with the IEEE traveling display, presently at the National Museum of Industrial History. Also in 2025, Mike will be continuing to edit the newsletter for the Early Television Foundation.

Author Mike Molnar (right) and his assistant Lila can read the clock on the wall. It's time to stop writing and relax while we watch some TV.