A Short History of Canadian Television and Technology

The primary purpose of this research is to document some early history of how television evolved in Canada and also some advancements in television technology over the decades. In this story, the term "early television" references either the first mechanical televisions or the growth of television after WWII, depending on the context. Some of what is written here was actually experienced by the author over the decades.

The Short History

The invention of the television was the work of many people in the 19th century and early 20th century. Television stations were operational in the United States before any Canadian stations went on the air. The first experimental station with no regular programming began on January 13, 1928. General Electric programs were transmitted from station W2XB in Schenectady, New York, using a 24-line mechanical scanning system.[1] It would be safe to assume that any television station from this era would have been using a mechanical scanning system, since standards had not yet evolved.

In Canada, the first television station, VE9EC, was an experimental one based in Montreal, Quebec.[2] It broadcast between October 9, 1931, and 1935, showing neon red and black pictures. The station was owned by La Presse and radio station CKAC. VE9EC used a mechanical scanning system that broadcast 60 to 150 lines on a frequency of 41 MHz.[3] Broadcasts were witnessed by over 100,000 people who lined up to view images at the Ogilvy Department Store on Ste. Catherine Street in Montreal. Ogilvy's of the present day is shown in Fig. 1. Over time, new electronic scanning systems were able to deliver more scan lines (i.e., 441 lines) thus improving resolution tremendously.[4]

The 1940s and 1950s were a critical period for television development with the adoption of the first broadcasting standard. The 525-line National

Fig. 1. Ogilvy's department store of today. (Wikipedia By Jeangagnon - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=36663809)

Television System Committee (NTSC) standard was developed in 1941, but it had no provision for color nor would it begin volume production until after WWII ended.[5] In 1953, a second NTSC standard was adopted, which defined a new standard for color television broadcasting and was also compatible with the existing population of black-and-white receivers. NTSC was the first widely adopted broadcast system and remained dominant until 1997, when it started to be replaced with different digital standards such as the Advanced Television Systems Committee (ATSC) and others.

By the late 1940s, Canadians who lived in close proximity to U.S. border cities could watch American shows and programming where available. In order to promote the sale of TV receivers, the transmitters and the programming had to be there first. Merchants who sold televisions in Canada had to import them from the United States since there was no TV manufacturing in Canada around this time.

The first television manufactured by a major company in Canada was in 1948. However, there is debate if this was by Canadian Westinghouse in Hamilton, Ontario,[6] or by Canadian General Electric.[7]

In a September 1949 issue of *Billboard*, it was announced that Canadian Fairbanks Morse and Canadian Marconi would start to build radios and TVs for Emerson Electric for sale in the Canadian marketplace.[8] It was to be on a royalty basis as evidenced in a separate announcement. This was also the beginning of TV manufacturing for Canadian Marconi. The company also built the TV Model 100, shown in Fig. 2, which bears an identical appearance to the American General Electric Model 10T5 of 1949, shown in Fig. 3.

Another early Canadian television set was the Viking Console, shown in Fig. 4, which made its debut in 1952. The stylish set was sold by the Eaton's department store chain and manufactured by Electrohome in Kitchener, Ontario, as a private label TV. Viking was Eaton's house brand.[9] There was also the Rogers-Majestic brand of television produced by Phillips Electronics Canada. RCA opened a television production plant in Prescott, Ontario, in 1953.

Many other companies, too numerous to mention here, also got into TV manufacturing.

Television set production and acceptance was a great boom to the Canadian television industry. In 1951, there were

Fig. 2. Canadian Marconi TV Model 100. (Author's collection)

Fig. 3. American General Electric TV Model 10T5. (eBay)

Fig. 4. Viking Console TV. The set's production signaled the arrival of television in the average Canadian home. (https://www.historymuseum.ca/cmc/exhibitions/hist/tv/tv01eng.html)

more than 90,000 sets in Canada, and by 1953 this increased to over 300,000.

On September 8, 1952, the Canadian Broadcasting Corporation (CBC) made its historic television debut in Montreal as station CBFT.[10] However, Canadians with TVs had already been tuning into American border TV stations since the late 1940s. The CBC had set a target of September 1951 for the Canadian debut of television, but equipment shortages caused by the Korean War pushed the date back to 1952. Canadian Marconi designed and manufactured their own TV designs in 1951.[11]

By late 1965, the Canadian Marconi Company (CMC) decided to discontinue manufacturing home radios and televisions sets. This decision was announced in the *Vancouver Sun* on December 29, 1965.[12] CMC stated that it would discontinue manufacturing these consumer products by the end of January 1966, although it would be mid-1966 before the company was completely out of the consumer market. It also stated that an organization would remain in place for an unspecified period to honor all warranties and supply a full backup of parts. The records of the company stated that the consumer division was shut down because of increased competition,[13] which was primarily from Japan. To replace this business, the company planned to focus on divisions that specialized in higher-margin electronic products, such as commercial marine and land communication equipment, defense communications equipment, and aviation electronics.

Canadian Marconi had been broadcasting television programs using the

letters CFCF-TV since January 20, 1961, shortly after it received its first license for a private television station in 1960. The Canadian government had refused numerous applications from CMC for a television license during the 22 years from the company's first application submitted in 1938, to 1960, when a license was finally granted. Marconi's station CFCF-TV continued broadcasting regular programs until 1972, when Canadian Marconi was required to sell its broadcasting assets because of a change in the requirements that would reduce foreign ownership of these assets. CMC had received licenses for broadcast stations CFCF-AM, CFCF-FM, CFCF-CX short wave, and CFCF-TV before 1968, when *The Broadcasting Act of 1968* was passed by the Canadian Parliament. This act established a policy that the Canadian broadcasting system must be owned and controlled by Canadians.[14] It directed the Canadian Radio-television and Telecommunications Commission (CRTC) to implement this policy.

Unfortunately, the English Electric Company, Ltd., of London had purchased controlling interest in the Canadian Marconi Company circa August 5, 1953, long before this act was passed.[15] As a result of this legislation, Marconi began to look for potential buyers in 1970. Marconi had been ordered to sell its broadcasting assets by June 30, 1972, to meet federal requirements that restricted foreign companies from owning more than a 20% interest in Canadian broadcasting outlets.[16] There were five entities that bid on the broadcasting rights, and Multiple Access, a national computer service company based in Toronto, was the winning bidder. Thus ended Canadian Marconi's broadcast activities in Canada, although broadcast stations under the CFCF letters continue there to this day.

Advancements in Technology Over the Decades

Television design and technology changed immensely over the decades. These changes can be categorized into the groups shown below. These are arranged alphabetically.

Antennas

Many TVs in urban areas used rabbit ear antennas to receive signals for the reception of local TV stations. These rabbit ears consisted of two telescoping arms arranged as a V. For optimum reception, the arms were lengthened for the low VHF channels (2–6) and shortened for the high VHF channels (7–13). Sometimes the rabbit ears would have to be rotated for maximum signal reception. Ghosting was also a problem in those days. First, the primary signal from the transmitter would be received. If any of the signal was reflected from, say, a tall building or even an aircraft in flight, the reflected signal would arrive a moment later and had the effect of casting ghosts on whatever was being received. Some folks even made their own indoor antennas using tinfoil.

As the distance from the transmitter to the receiver increased, rabbit ears could no longer do the job. Cable TV had not yet arrived. Homeowners had no choice but to erect outdoor antennas.

These were affixed to a tubular mast and supported with guy wires attached to the base of the roof. The outdoor antenna could assume several configurations. In Hamilton, Ontario, two antennas were required to receive Canadian and U.S. programming. One antenna would consist of a low VHF Yagi, as typically shown in Fig. 5, which was pointed to Buffalo, NY, in order to receive channel 2 (NBC), channel 4 (CBS), and channel 7 (ABC). A VHF folded dipole with a reflector element was pointed towards Toronto to receive channel 6 (CBC) and channel 9 (CTV). Both antennas were connected to the TV set with 300 ohm twin lead and terminated on a ceramic, double pole, double throw knife switch which was affixed to the back of the TV. The two poles of the switch were connected to the antenna terminals of the TV. This arrangement meant that the viewer had to change the position of the switch depending on whether a low or high VHF channel was to be received, or to use an antenna pointed at the TV station. Since channel 7 was in the high band, and channel 6 was in the low band, it was a compromise of antenna resonance and direction. This was the typical antenna configuration for Hamilton and surrounding vicinity.

For viewers who did not want to fuss with flipping a knife switch when changing from low to high VHF channels, an all-purpose VHF/UHF antenna could be erected on a rotor. This had one slight disadvantage. If the desired station was a large azimuth angle away from the current position, the viewer would dial in the new position on the rotor control box, then wait for the very slow rotor to swing the antenna to the new position. The rotor only moved about one rotation per minute! At installation time, the rotor control would have to be "calibrated" by first receiving all stations within the antenna's range, then marking the face of the rotor control box with the station numbers. Rotors could also be prone to icing during winter conditions. Back in the 1950s and 1960s, it was very easy to tell which houses had a TV and which ones didn't.

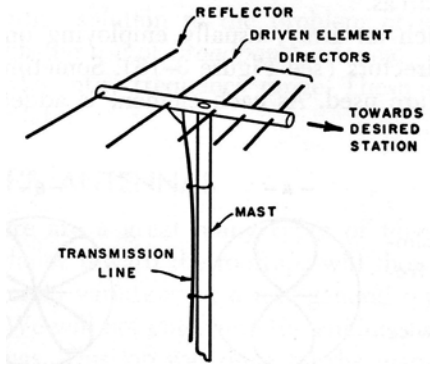

Fig. 5. Low band VHF Yagi antenna for channels 2–6. The gain of a Yagi antenna was needed to reduce snow in the picture if the TV was a long distance from the transmitter antenna. It also aided in reducing ghosts. (Public domain)

In September 1952, small-scale cable TV was being evaluated in Toronto and Montreal. Eventually, these early tests would create a whole new industry. As cable subscriptions grew, rooftop antennas started disappearing one by one. There is now a multitude of ways to receive television content, with fiber cable and satellite reception dominating the landscape. A segment of the population has opted to "cut the cable" and receive

their programming via high-definition, combination antennas, supplemented by the internet's streaming content sources such as Netflix or CNBC. There is still a viable market for satellite dishes in rural areas where the stations are out of range and the dwellings are spaced too far apart for the affordable installation and operation of cable TV.

Cabinets

Early television cabinets could be very ornate and were available in many types. Walnut and mahogany were two popular kinds of woods used in the fabrication of cabinets. Some sets could be purchased in a particular furniture style such as French Provincial. Some TVs came with a built-in radio and phonograph. But what was one to do if the television wore out before the radio and the phonograph?

As more televisions were sold in the 1950s, the most notable change was cabinet styling and the increase of the picture tube size to 21 inches, as evidenced in Canadian Marconi Models 168K23 and 169K23, shown in Fig. 6. For the technical person, perhaps the man of the house, hand wiring, tube count, servicing ease, and sound and picture quality were emphasized.

Cabinet styles could be as simple as a cube-shaped box sitting on peg legs or elaborate floor consoles. Black plastic soon displaced wood as the cabinet material of choice.

Cathode Ray Tubes

Cathode ray tube (CRT) sizes grew from 5 inches in the late 1940s to 43 inches in the 1990s. As the CRT size grew, it became imperative to protect the CRT

Fig. 6. Canadian Marconi 1950s Citation series TVs. The Citation Models 168K23 and 169K23 were two attractive styles and two great sets. The sets were hand-wired with 20 tubes and 2 diodes, and featured a swing-out chassis with a full power transformer. Staticlear sound and bright sharp pictures were possible even in remote areas. The warm walnut finish on the cabinets was hand rubbed for added loveliness. (Author)

from inadvertent damage by the user. To prevent an accidental implosion of the CRT, a tinted safety glass, akin to that of an automotive windshield, was placed in front of the CRT. Later on, the safety glass became an integral part of the CRT, thus eliminating the need for the occasional cleaning of the stand-alone safety glass. This also helped to reduce the cost of the television. It was this author's personal experience to have witnessed the sudden crazing of the entire safety glass on the family's television. When it happened, it sounded like a gunshot. This may have been caused by the cabinet applying stresses on the safety glass but it was nice to know that it stayed in one piece. CRTs frequently became gassy and had to be replaced. Depending on usage, one could get at least 10 years of life from the CRT. Eventually, CRT makers made the tubes last even longer; a typical 1999 36-inch RCA lasted 20 years.

During the era of CRT televisions, there were numerous shops across the country which would rejuvenate worn out CRTs. These shops became fewer and fewer and all closed their doors once LCD flat-screen TVs became the norm. CRTs could also be rebuilt, but these shops also closed their doors and the rebuilding machines were discarded.

Near the end of the CRT era, Sony offered flat-screen CRTs in their Vega series of televisions, but this was too little too late. Just around the corner was the debut of the high resolution flat-screen TV which made the CRT and projection televisions obsolete. Flat screens can display 720 lines (standard definition) or 1080 lines (high definition) and the largest models can be fabricated to be up to 108 inches diagonally. For a while, 3D television looked promising but it was discontinued in 2017 due to low consumer demand. The 4K standard (a.k.a. Ultra-High Definition) is capable of displaying 2,160 lines in progressive scanning mode. When the transition from CRT to flat screen occurred, the aspect ratio also changed from 4:3 for a CRT to 16:9 for flat-screen TVs.

In 2019, the 8K QLED standard made its appearance. (Q means Quantum.) Not much will be televised in 8K initially and the viewer will need a 50 Mbps internet link to stream it in all its glory. While human eyes are not rated in pixels, an approximation of what we can see is 40 megapixels, where 8K is 33 megapixels resolution. But our eyes don't see everything in equal resolution. The high resolution is only a small circle in the middle of our vision, which would be about 7 megapixels. So while high resolution would allow us to get bigger TV sets, it would make lower resolutions look smoother. Anything above 8K is effectively better than our eyes can see. For this type of TV, the 8K standard will make the most sense for screen sizes of 65 inches and up.

Circuit Design and Vacuum Tubes

Early televisions used an intermediate frequency (IF) of 21.25 MHz for audio and 25.75 MHz for video. This design was problematic if the viewer lived in the vicinity of an amateur radio station that operated in the 15 meter band (21.000 to 21.450 MHz). The fundamental signal could interact with the television's

IF stages and could cause interference even though the amateur was operating legally. Alternately, third order harmonics from 7 MHz transmissions could cause television interference for the same reason. If the problem could not be rectified technically, it was usually best for the operator to cease operations so as to maintain a good relationship with the neighbor. The extent of interference to television IF is not known, but it is believed to be the exception rather than the rule. Later on, this ceased to be a problem when televisions were designed with a 41.25 MHz IF for the sound and 45.75 MHz IF for the video.

In an effort to reduce cost, transformerless TV designs found their way into the marketplace. This had the effect of launching new families of standard vacuum tubes whose filaments ran on what some might call "odd voltages." Types 2FH5, 4AU6, and 10DR7 are just three examples of tubes that could be found in the series filament string in a transformerless TV. In a transformerless radio with five tubes, it's very easy to find a tube with an open filament. It must have been very challenging when a service technician was confronted with a transformerless TV having perhaps 20 tubes whose filaments were wired in series.

Nuvistor tubes, designed by RCA in 1959, were widely used throughout the 1960s in television sets beginning with RCA's "New Vista" line of color sets in 1961.[17] Nuvistors were very small metal tubes, usually triodes, that offered a low noise figure at ultra-high frequencies. A typical nuvistor is shown in Fig. 7.

In 1960 the General Electric Company combined multiple common tube types into "fat" tubes—as many as four in a single glass envelope, all heated by a common filament. The idea was to reduce the amount of power required to heat the tubes and the space they required on the chassis, as well as the costs of multiple sockets. In truth, they were designed almost completely for the color TV market. This was the apex of TV design using vacuum tubes.

Fig. 7. Nuvistor. These were miniature metal tubes that had usage for the receiving front end stages. RCA announced the first Nuvistor triode tube, the 7586, in 1959. It was intended to be a competitor to the transistor. Height: 0.8 inches, diameter: 0.435 inches. (Bob Kastz, https://wtfamps.com/2018/05/16/the-nuvistor-and-bob-katzs-audio-blender-via-inner-fidelity/)

By the 1970s, hybrid designs started appearing. The receiver portion of the television would be composed of solid-state circuits while the vertical and horizontal circuitry still retained vacuum tubes. As semiconductors improved, televisions became totally solid-state except for the CRT. Controls started to disappear, replaced with pushbuttons and on-screen menus.

When TVs were 100% vacuum tube, it took nearly 30 seconds for the tube filaments to come up to operating temperature after the set was powered up. In fact, this was the norm for all vacuum tube equipment. When TVs first went solid-state, the only tube left with a filament was, of course, the picture tube. To reduce the warm-up time of the CRT filament, manufacturers designed a "standby" mode whereby a reduced filament voltage was applied to the CRT when the set was powered off. This reduced the warm-up time to less than 10 seconds, and increased the CRT life by reducing thermal transients.

Color Broadcasting

Probably the biggest innovation in TV technology was the introduction of color broadcasting in the early 1950s. The initial proposal by CBS for a color TV standard was incompatible with the existing base of black-and-white TVs; regardless, the FCC approved this standard in 1950. A short while later, a compatible standard was developed by RCA whereby the black-and-white sets simply ignored the luminance and chrominance information found in the color signal, and the FCC changed their approval to the compatible system in 1953.

Color TV was introduced in Canada on September 1, 1966. Canada was the third country in the world to get color TV, after the United States in 1953 and Japan in the early 1960s. High prices for color televisions and the scarcity of color programming greatly slowed its acceptance in the marketplace. It was not until the mid-1960s that color sets started selling in large numbers in the United States, due in part to the color transition of 1965 in which the major networks announced that over half of all network prime time programming would be broadcast in color that autumn. The first all-color prime time season came just one year later.

On August 31, 2011, Canadian local over-the-air television stations in certain areas stopped broadcasting in analog and started broadcasting digital signals.[18] (The United States had previously converted on June 12, 2009.) The switch to digital affected television viewers who receive local, over-the-air TV stations using an outdoor antenna or "rabbit ears." These viewers needed either a digital converter box, such as shown in Fig. 8, or a television with a digital tuner. In the alternative, they could receive their TV services from a cable, satellite, or other service providers. If they decided to purchase a digital converter box, they could purchase one with the analog pass-through feature. This feature enabled the viewing of both digital and analog signals which may be important for viewers that receive both types of signals.

Fig. 8. Digital TV converter box. This was a short-lived product as TVs were quickly bought new with only the digital tuners. (By Jeffrey Beall - own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=4973347)

Controls

Most early monochrome (black-and-white) TV sets had the following controls: volume, channel selector, fine tuning, brightness, contrast, horizontal hold, and vertical hold. These were all accessible to the viewer.

It was not uncommon to frequently readjust the horizontal or vertical hold controls to either keep the picture from breaking up or rolling respectively. The vertical hold control was usually nested with the set's front or side panel controls while the horizontal hold might be at the back of the set. When channels were changed, it might require that the fine tuning control be adjusted. As better circuitry were included in TV designs, the fine tuning, vertical hold, and horizontal hold controls became obsolete.

Costs

In the era of vacuum tubes, all equipment had to be handcrafted. Robotic assembly of circuit boards had yet to be invented. As a result, televisions were very expensive in the 1950s and 1960s when compared with the average factory wage of the era. For example, a 21-inch Simpson Sears Silvertone television cost C$295 in 1955. To a factory worker making a wage of a dollar an hour, it took 295 hours of labor to pay for the set. Had manufacturing techniques and technology not changed, that very same TV would cost C$2,728 in 2017 when inflation was factored in. Compare that to today's TV cost versus wages and it can be seen that it only takes 20 to 40 hours of labor to pay for a medium-sized flat-screen TV in 2017. These prices continue to come down as large-scale integration became common.

Until the arrival of flat-screen TVs, several significant developments helped to drive down manufacturing costs. First came the introduction of printed circuit boards. Tube sockets could be soldered directly to the board, thus eliminating the need to wire filament strings. The introduction of Compactron and Novar tubes reduced the tube count. Solid-state was probably the biggest factor in driving down cost, as well as the use of plastic cabinets to replace wood.

Programming

In the beginning, television broadcasts were not 24/7 because there was not enough programming and viewership to fill the available time. Most stations signed off at midnight and didn't resume operations until morning. Stations usually broadcast the "Indian-head" test pattern of Fig. 9 so that technicians could make transmitter adjustments. After checks were completed, the station would stop transmitting until the usual 6 a.m. start of programming.

The Indian-head test pattern is a black-and-white television test pattern that was introduced in 1939 by RCA of Harrison, New Jersey.[19] It was also used in Canada following the Canadian national anthem sign-off in the late evening.

During the late 1950s, the test pattern was seen less frequently, because there were fewer sign-offs, on fewer stations, and for shorter periods in the morning, since new and improved TV broadcast equipment required less adjusting. In later years, the test pattern was transmitted for as little as a minute after studio sign-off while the transmitter engineer logged required FCC/Industry Canada transmitter readings, and then turned off the power. Towards the end of the Indian-head TV era, around the late 1970s, there was no nightly test pattern on some stations, when automatic logging and remote

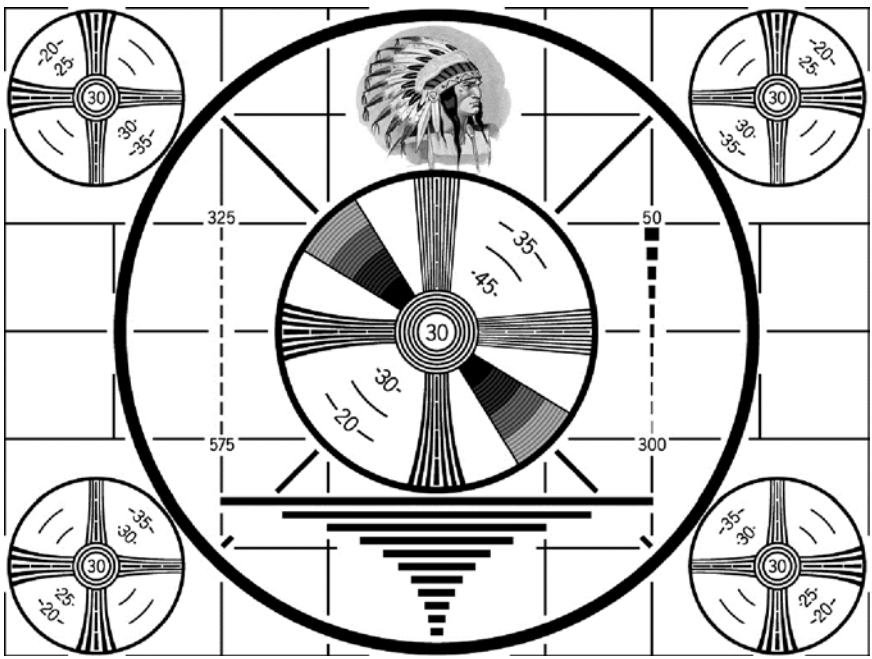

Fig. 9. This is the Indian-head test pattern transmitted by a station when regular programming was finished for the day. This enabled the station engineer to perform any required adjustments to the transmitter. (Public domain)

transmitter controls allowed shutdown of power immediately after the formal sign-off.

After an immediate transmitter power off, in lieu of the Indian-head test pattern and its sine wave tone, a TV viewer heard a loud audio hiss and saw "snow" on the TV screen. When U.S. broadcasters transitioned to color television, the SMPTE color bars of Fig. 10 superseded the black-and-white Indian-head test pattern image.

In general, the programming of the 1950s and 60s could be slotted into three groups. News and game shows were featured in the morning; soap operas in the afternoon, and primetime programs in the evening hours between 8 and 11 p.m. Westerns, police dramas, and variety shows made for popular viewing during prime time.

Program listings were published in *TV Guide,* whose first issue was released on April 3, 1953, in the United States.[20] Prior to that time, listings were published in local viewing areas. As an example, Lee Wagner (1910–1993), who was the circulation director of Macfadden Publications in New York City, printed a New York City area listings magazine in 1948 called *The TeleVision Guide*. In Canada, *TV Guide* originated as a domestic version of the American *TV Guide* before being spun off into a separate print publication that was published from 1977 to 2006, at which point it ceased publishing and its content was migrated to a website.

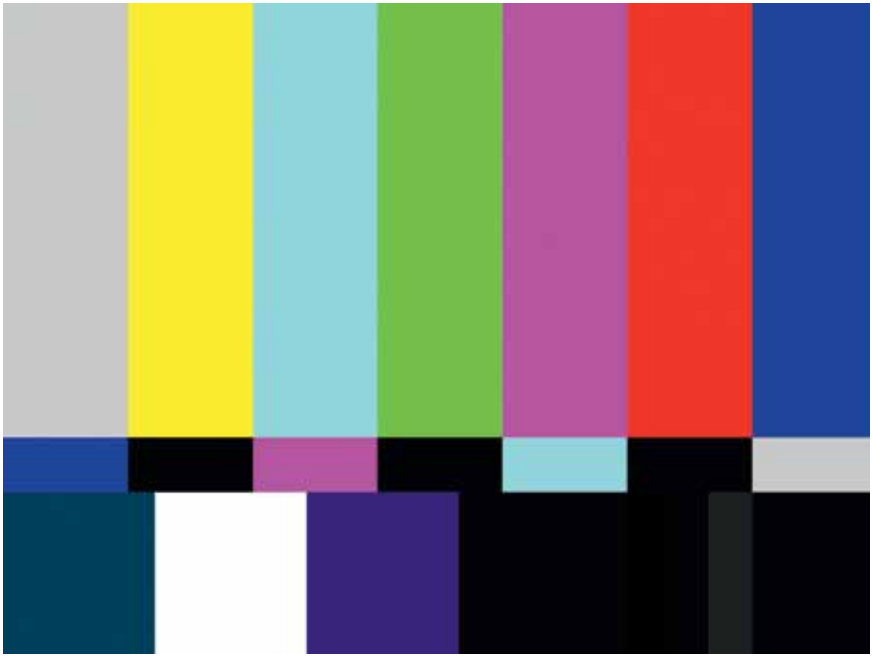

Fig. 10. The SMPTE test pattern replaced the Indian-head pattern as color television took over from black-and-white. (Public domain)

The first Canadian stations came on the air in September 1952. These were CBFT in Montreal and CBLT in Toronto. In Canada, television developed differently than in the United States. There were two major reasons for this. First and foremost was the fact that Canada has two national languages, namely English and French. It was therefore necessary to develop both French and English broadcasting networks and programming to service the French-Canadian marketplace which was mainly situated in the Province of Quebec. The second reason was the influence of American programming. It was much easier to obtain the rights to air American shows rather than develop programming of Canadian content.

Many early television programs were live because a cost-effective video recorder had not yet been developed. The first commercial video recorder, the Ampex VRX-1000 shown in Fig. 11, did not make its debut until 1956. Because of its $50,000 price at the time, the recorder could only be afforded by the television networks and the largest individual stations.[21]

Whatever happened to channel 1? During the era of experimental TV, channel 1 was assigned to 44–50 MHz, which was located at the lower end of the VHF band. In 1940, the FCC reassigned 42–50 MHz to the FM broadcast band, and Channel 1 was reassigned to 50–56 MHz. In the spring of 1946, after FM was moved to 88–108 MHz, Channel 1 was reassigned to 44–50 MHz. Channel 1 was abandoned on June 14, 1948.[22] The vacancy was reallocated to fixed and mobile services. More on this can be found in the story titled "History of FM Radio: 1940s to 1960s" in *AWA Review* Volume 34, 2021.[23]

Scanning Systems

In the United States, mechanical scanning methods were used in the earliest television systems in the 1920s and 1930s. They broadcast in the 2–3 MHz band until the FCC created allotments in the 40 MHz band. The vacated spectrum was then reassigned as the police band. One mechanical TV system used 48-line images. Next came 60-line images. All mechanical television was considered to be "experimental." It should be pointed out that the entertainment value of mechanical transmissions was non-existent, and broadcasts were rare and limited in length. By 1935, low definition electromechanical television broadcasting had ceased in the United

Fig. 11. Ampex VRX-1000 videotape recorder. This was very expensive and could only be afforded by the television networks and the largest individual stations. (Wikipedia photo by Karl Baron from Lund, Sweden)

States except for a handful of stations run by public universities that continued operating up to 1939. The Federal Communications Commission (FCC) saw television as being in a continual flux of development with no consistent technical standards, hence all such stations in the United States were granted only experimental and non-commercial licenses. This hampered television's economic development. Obsolescence was "easy" to handle in those days because TV set sales to the public did not begin (in earnest) until the post-war period. The various experimental standards affected only a small number of laboratory sets and a small number of "field" test sets (perhaps in the low hundreds). In Canada, it would have been a similar situation for the elite few who could even afford to buy a set to receive experimental American broadcasts.

All-electronic scanning television, first demonstrated in September 1927 in San Francisco by Philo Farnsworth, and then publicly by Farnsworth at the Franklin Institute in Philadelphia in 1934, was rapidly overtaking mechanical television. Farnsworth's system was first used for broadcasting in 1936, starting at 400 lines to more than 600 lines with fast field scan rates. RCA demonstrated/transmitted all-electronic TV in 1933.[24] In 1939, RCA paid Farnsworth $1 million for his patents, after ten years of litigation. RCA also demonstrated all-electronic television at the 1939 World's Fair in New York City. The last mechanical television broadcasts ended in 1939 at stations run by a handful of public universities in the United States.

Field tests in Los Angeles on various electronic scanning systems began in 1936. By 1938, the United States adopted RCA's 441-line system. RCA had also evaluated 240- and 343-line electronic scanning before settling on 441 lines. The system was publicly launched by NBC during the New York World's Fair. Because Canadian television came after United States television, Canadians did not have to go through the phase of experimental, mechanical televisions. The 525-line NTSC standard replaced the 441-line standard on July 1, 1941, and opened up the door to the mass production of televisions after WWII in both Canada and the United States.

Servicing

Early televisions had tube counts around 20 to 22. With that many tubes, the mean time to failure decreased so tubes had to be replaced occasionally. The stages most prone to tube failure were the low voltage rectifier and the horizontal output stage. When the television failed, the viewer would typically call up their favorite TV repair shop and place a service call. A technician would then show up at the front door with a tube caddy, such as shown in Fig. 12 and Fig. 13. This was a wooden case with two clamshell-type storage areas in the top third of the case. These clamshells would be stocked with the most popular types of tubes. At the bottom of the caddy, there was space for tools or additional tubes.

Based on experience and symptom recognition, the technician would substitute the most likely failed tube. The tube substitution method was the most

foolproof one, especially when dealing with a tube in the receiver's RF stages. If the technician did not have a tube to substitute, it meant a trip back to the shop. For faults that could not be repaired in the viewer's home, the technician pulled the chassis out of the cabinet in order to bring it back to the shop for a bench repair. That meant the household would be without a set until the chassis was repaired.

Fig. 12. Typical tube caddy ready to carry to the jobsite. They came in several sizes. (Author)

Often, a television owner would become very concerned if the sound was good but there was no light being emitted from the picture tube. Many folks thought that the picture tube went defective. A good technician would assure the owner that the picture tube was the very last one to go.

Just like Saturday morning car mechanics, the TV world also had do-it-yourself folks (DIY) who tackled TV repair. They would look at a symptom chart which would tell them the most likely tubes to check. The suspect tubes would then be taken to a drugstore that was equipped with a tube tester. The tubes would then be tested, and if one

Fig. 13. Tube caddy interior. The bottom part would be filled with tools, and the two parts on the side that fold out would be filled with tubes. A second tube caddy may also be brought along if more tubes were needed. (Author)

was found to be bad, the customer could purchase a new tube from the stock of tubes stored inside the tester. Rumor has it that the drugstore emission type tube testers were biased to show many tubes as being weak or bad when in fact they were perfectly good. However, this has not been corroborated anywhere. With the advent of solid-state TV design came the mass disappearance of TV repair technicians, TV repair shops, drug store tube testers, and do-it-yourselfers.

Sound

Pre-1941 TVs used amplitude modulated sound. The NTSC standard of 1941 directed that TV sound be frequency modulated. Initially, sets were designed to receive FM monaural signals having a maximum deviation of +/- 25 kHz, unlike the FM broadcast band where permissible signal deviation is +/- 75 kHz.

Multichannel television sound, better known as MTS, is the method of encoding three additional channels of audio into an NTSC-format audio carrier. It was adopted by the FCC as the United States standard for stereo television transmission in 1984. Sporadic network transmission of stereo audio began on NBC on July 26, 1984, with The Tonight Show starring Johnny Carson—although at the time, only the network's New York City flagship station, WNBC, had stereo broadcast capability.[25] Regular stereo transmission of programs began in 1985. Canada soon followed suit.

In older TVs, there was sufficient space to install proper permanent magnet speakers in the cabinet. In many of the new flat-screen TVs there is insufficient depth to facilitate proper, inboard speakers. As a result, the audio can sound somewhat "tinny" since the internal speakers are just too small. To address this problem, the viewer must hook up an external audio amplifier and quality speakers in order to achieve good audio fidelity.

Tuners

Early electro-mechanical tuners in televisions consisted of ganged wafer switches which had contacts that were used to select different taps on a coil, thus tuning the receiver to different stations. A wafer type tuner is shown in Fig. 14. Over time, the contacts would become intermittent and the tuner knob would have to be jiggled until the station was tuned in. In really bad cases, a wedge of paper placed behind the knob would stabilize reception. A TV repairman would clean the contacts of oxidation using a product called tuner cleaner, developed specifically for this task, such as shown in Fig. 15. It was therefore not surprising that early televisions only had a life expectancy of perhaps ten years before a seriously intermittent tuner caused the set to be scrapped. Shortly after the wafer type tuner was used, the turret-style tuner was developed specifically for TV usage, such as shown in Fig. 16. Since this also had contacts, it was also subject to the same intermittent contact problems, but in general was more reliable. However all the frequency-determining components were located on the turret strips and assembly time was reduced. In the 1980s, tuners became all electronic. Gone was the clunk, clunk,

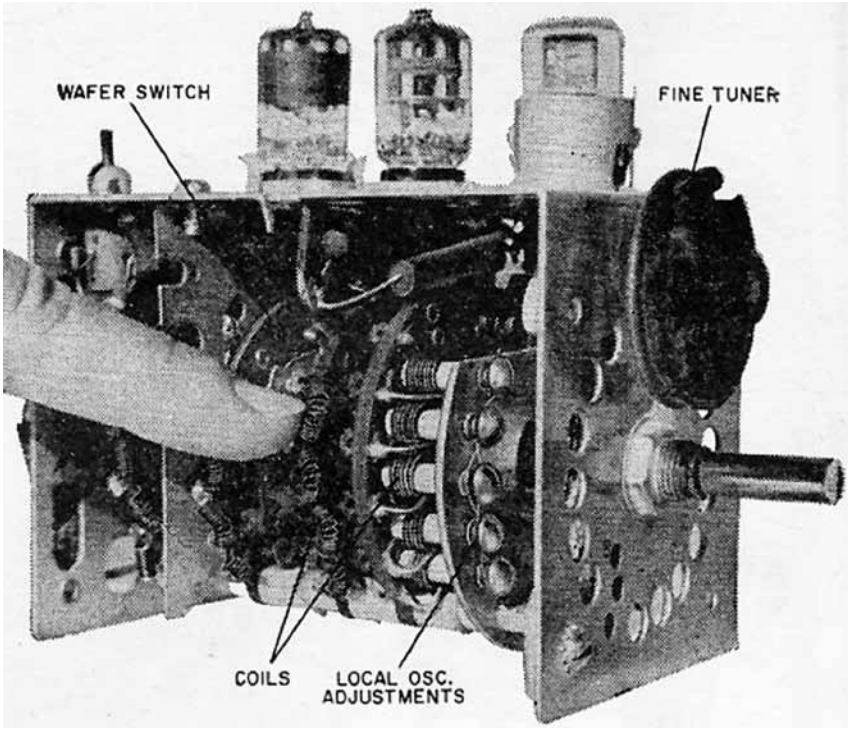

Fig. 14. Wafer type TV tuner. This is similar to a band switch in many multi-band receivers. The wafer type tuner was eventually replaced with the more reliable turret style. The tuner consisted of the RF amplifier(s) and oscillator/mixer stages. The resulting IF signal was fed into the IF amplifier stages on the chassis. (https://www.rfcafe.com/references/popular-electronics/taming-tv-tuner-popular-electronics-march-1967.htm)

clunk sound of the switch-wafer and turret tuner. Also gone was the need for the ubiquitous tuner cleaner to clean TV tuners, but the product has remained, to clean intermittent contacts of all kinds! Advanced formulations were made and renamed contact cleaner.

When UHF television came into being, the FCC allocated channels 14 to 83. The All-Channels Act was passed by the United States Congress in 1961, which allowed the Federal Communications Commission to require that all television set manufacturers must include UHF tuners, so that new UHF band TV stations could be received by the public.[26] This was a problem at the time since the major TV networks were well-established on VHF, while many local-only stations on UHF were struggling for survival. Canadian TV production and programming followed suit.

In 1983, the FCC removed channels 58 through 83 from UHF TV and reassigned them to land mobile radio systems. Television production in Canada made the necessary changes to conform with the U.S. allocations.

Fig. 15. Tuner cleaner, developed to clean TV tuner contacts. Many companies sold such a product, this is a new improved variety. (Author)

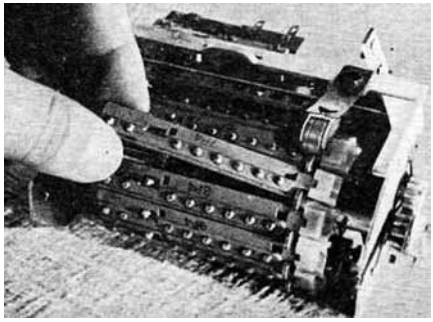

Fig. 16. Turret style TV tuner. This was a new design for TV receivers and was more reliable but still had reliability problems. (https://www.rfcafe.com/references/popular-electronics/taming-tv-tuner-popular-electronics-march-1967.htm)

Canadian Television Production Today

Founded in 1907, Electrohome was Canada's largest manufacturer of TVs from 1949 to 1984. From 1984 to 1999, Electrohome-branded TVs were produced under license by Mitsubishi Electric, and from 1999 to 2007 by Jutan (distributed by Canadian distributor Citizen Electronics). The company underwent an orderly wind-up in late 2008. In February 2010, the Electrohome brand was acquired by Bluetronics Group, a division of Circus World Displays Limited.

All TVs now sold in Canada come from the Far East.

It is hoped that this article gives the reader a glimpse into Canadian television history.

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About the Author

Jerry Proc, VE3FAB, a resident of Etobicoke, Ontario, has been a licensed amateur radio operator since 1964 and also holds an Advanced Amateur Radio Operator's Certificate. His interest in electronics was sparked at a very young age, and during the 1960s Jerry developed a fascination with military radio gear. In 1970, he graduated with a diploma in Electronics Engineering Technology from the Radio College of Canada. Later, he obtained an Advanced Networking Certificate through Continuing Education Studies program at Humber College, Etobicoke, Ontario. Jerry has served in both a technical and managerial capacity in the mainframe computer and data communications field since 1970 and is currently retired from Bell Canada where he was employed as a network support specialist.

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